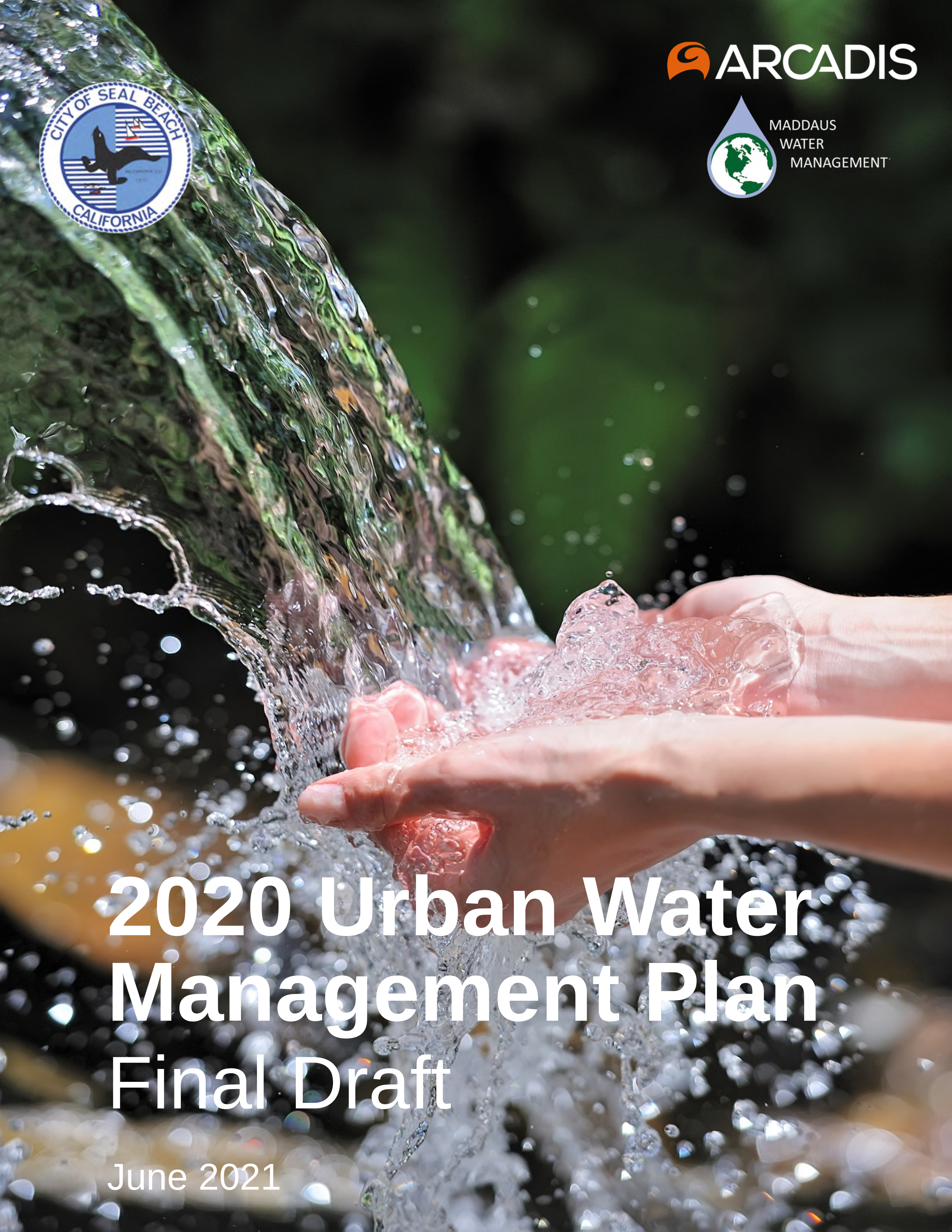


CITY OF SEAL BEACH
CALIFORNIA

ARCADIS

MADDAUS
WATER
MANAGEMENT

2020 Urban Water Management Plan

Final Draft

June 2021

2020 URBAN WATER MANAGEMENT PLAN

Sarina Sriboonlue, P.E.
Project Manager

Prepared for:

City of Seal Beach
211 8th Street
Seal Beach, California 90740

Prepared by:

Arcadis U.S., Inc.
320 Commerce
Suite 200
Irvine
California 92602
Tel 714 730 9052
Fax 714 730 9345

Our Ref:

30055240

Date:

June 2021

CONTENTS

TABLES

FIGURES

APPENDICES

ACRONYMS AND ABBREVIATIONS

%	Percent
20x2020	20% water use reduction in GPCD by year 2020
ADU	Accessory Dwelling Unit
Act	Urban Water Management Planning Act of 1983
AF	Acre-Feet
AFY	Acre-Feet per Year
AWWA	American Water Works Association
BEA	Basin Equity Assessment
Biops	Biological Opinions
BMP	Best Management Practice
BPP	Basin Production Percentage
CDR	Center for Demographic Research at California State University Fullerton
CEC	Constituents of Emerging Concern
CEE	Consortium for Energy Efficiency
cfs	Cubic Feet per Second
CII	Commercial/Industrial/Institutional
City	City of Seal Beach
CPTP	Coastal Pumping Transfer Program
CRA	Colorado River Aqueduct
CUP	Conjunctive Use Program
CVP	Central Valley Project
CY	Calendar Year
DAC	Disadvantaged Communities
DCP	Delta Conveyance Project
DDW	California State Division of Drinking Water
Delta	Sacramento-San Joaquin River Delta
DRA	Drought Risk Assessment
DMM	Demand Management Measure
DOF	Department of Finance
DVL	Diamond Valley Lake
DWR	Department of Water Resources
ESA	Endangered Species Act
FIRO	Forecast Informed Reservoir Operations
FY	Fiscal Year
GAP	Green Acres Project
GHG	Greenhouse Gas
GPCD	Gallons per Capita per Day
gpf	Gallons per Flush

GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
GWRS	Groundwater Replenishment System
GWRSFE	Groundwater Replenishment System Final Expansion
H_2O_2	Hydrogen Peroxide
HECW	High Efficiency Clothes Washer
HEN	High Efficiency Nozzle
HET	High Efficiency Toilet
IPR	Indirect Potable Reuse
IRP	Integrated Water Resources Plan
JADU	Junior Accessory Dwelling Unit
kWh	Kilowatt-Hour
LRP	Local Resources Program
LTFP	Long-Term Facilities Plan
MAF	Million Acre-Feet
MCL	Maximum Contaminant Level
MET	Metropolitan Water District of Southern California
MF	Microfiltration
MG	Million Gallon
MGD	Million Gallons per Day
MHI	Median Household Income
MNWD	Moulton Niguel Water District
MTBE	Methyl Tertiary Butyl Ether
MWDOC	Municipal Water District of Orange County
MWELO	Model Water Use Efficiency Landscape Ordinance
NDMA	N-nitrosodimethylamine
NRW	Non-Revenue Water
OC	Orange County
OC Basin	Orange County Groundwater Basin
OC San	Orange County Sanitation District
OCWD	Orange County Water District
ORP	On-Site Retrofit Program
PFAS	Per- and polyfluoroalkyl substances
PFOA	perfluorooctanoic acid
PFOS	perfluorooctane sulfanate
Poseidon	Poseidon Resources LLC
PPCP	Pharmaceuticals and Personal Care Product
PPT	parts per trillion
PSA	Public Service Announcement
QWEL	Qualified Water Efficient Landscaper

RA	Replenishment Assessment
RHNA	Regional Housing Needs Assessment
RO	Reverse Osmosis
RUWMP	Regional Urban Water Management Plan
SBx7-7	Senate Bill 7 as part of the Seventh Extraordinary Session
SCAB	South Coast Air Basin
SCAG	Southern California Association of Governments
SCWD	South Coast Water District
SDP	Seawater Desalination Program
sf	Square Feet
SMWD	Santa Margarita Water District
SOC	South Orange County
STEAM	Science Technology Engineering Arts and Mathematics
SWP	State Water Project
SWRCB	California State Water Resources Control Board
TAF	Thousand Acre-Feet
TDS	Total Dissolved Solids
USBR	United States Bureau of Reclamation
UV	Ultraviolet
UWMP	Urban Water Management Plan
UWMP Act	Urban Water Management Planning Act of 1983
VOC	Volatile Organic Compound
Water Code	California Water Code
WBIC	Weather-Based Irrigation Controller
WF-21	Water Factory 21
WSAP	Water Supply Allocation Plan
WSCP	Water Shortage Contingency Plan
WSIP	Water Savings Incentive Program
WUO	Water Use Objective

EXECUTIVE SUMMARY

INTRODUCTION AND UWMP OVERVIEW

The City of Seal Beach (City) prepared this 2020 Urban Water Management Plan (UWMP or Plan) to submit to the California Department of Water Resources (DWR) to satisfy the UWMP Act of 1983 (Act or UWMP Act) and subsequent California Water Code (Water Code) requirements. The City is a retail water supplier that provides water to its residents and other customers using the imported potable water supply obtained from its regional wholesaler, Municipal Water District of Orange County (MWDOC) and local groundwater from the Orange County Groundwater Basin (OC Basin), which is managed by the Orange County Water District (OCWD).

UWMPs are comprehensive documents that present an evaluation of a water supplier's reliability over a long-term horizon, typically 20-25 years. This 2020 UWMP provides an assessment of the present and future water supply sources and demands within the City's service area. It updates various 2015 UWMP items related to: water resource needs, water use efficiency, assessment of water reliability, and strategies to mitigate water shortage conditions. The 2020 UWMP adds a 2020 Water Shortage Contingency Plan (WSCP) to help the City effectively respond to potential water shortages. This 2020 UWMP contains all elements needed to comply with new requirements of the Act as amended since 2015.

UWMP PREPARATION

The City coordinated the preparation of this 2020 UWMP with other key entities including MWDOC (regional wholesale supplier for Orange County), MET (regional wholesaler for Southern California and the direct supplier of imported water to MWDOC), and OCWD (OC Basin manager). The City also coordinated with other entities, which provided valuable data for the analyses prepared in this UWMP, such as the Center for Demographic Research (CDR) at California State University Fullerton for population projections, through MWDOC's assistance.

SYSTEM DESCRIPTION

The City was incorporated in 1915 and later became a charter city in 1964. The City is governed by a five-member City Council.

The City is located along the California coastline in Orange County and is bordered to the north by the City of Los Alamitos, and the unincorporated Rossmoor community; to the east by the Cities of Garden Grove, Westminster, and Huntington Beach; to the south by the Pacific Ocean and City of Huntington Beach; and to the west by the City of Long Beach. The City's Water Division operates four production wells, an active service connection with MET, emergency interconnections with other utilities, two reservoirs with a total storage capacity of seven million gallons (MG), two booster stations, four disinfection sites, approximately 680 hydrants and manages 74.8-mile water mains system with about 5,350 service connections.

Lying in the South Coast Air Basin (SCAB), its climate is characterized by Southern California's "Mediterranean" climate with mild winters, warm summers and moderate rainfall. In terms of land use, the City is mostly developed with a mix of residential, commercial, industrial, and public land. There is a large U.S. Naval Weapons Station within the City along with light industrial and institutional land uses. Recent developments are mainly additions of 30 residential units with a park. Moving forward, the City will continue planning for its Regional Housing Needs Assessment (RHNA) allocation and future planned developments beyond 2020 may include accessory dwelling units (ADUs). The current population of 24,000 is projected to increase by 1.5% over the next 25 years.

WATER USE CHARACTERIZATION

Water use within the City's service area has been relatively stable in the past decade with an annual average of 3,482 AF for potable use. In FY2019-20, the City's water use was 3,273 AF of potable water (groundwater and imported). There is currently no recycled water use within the City's service area. In FY2019-20, the City's water use profile was comprised of 70.4% residential use, 18.4% commercial, industrial, and institutional (CII) use, 0.5% large landscape/irrigation, with non-revenue water (NRW) comprising about 10.6%.

WATER USE PROJECTIONS: 5-YEAR AND 25-YEAR

The City's service area is almost completely built-out and is projected to add minimum land use and small population increase. Water demand is likely to decrease 3.0% over the next 5 years. In the longer term, water demand is projected to increase 4.1% from 2025 through 2045. The projected potable water use for 2045 is 3,306 AF.

This demand projection considers such factors as current and future demographics, future water use efficiency measures, and long-term weather variability.

CONSERVATION TARGET COMPLIANCE

Retail water suppliers are required to comply with the requirements of Water Conservation Act of 2009, also known as SBx7-7 (Senate Bill 7 as part of the Seventh Extraordinary Session), which was signed into law in 2010 and requires the State of California to reduce urban water use by 20% by 2020 from a 2013 baseline.

The retail water suppliers can comply individually or as a region in collaboration with other retail water suppliers, in order to be eligible for water related state grants and loans. The City is part of the Orange County 20x2020 Regional Alliance created in collaboration with MWDOC, its retail member agencies as well as the Cities of Anaheim, Fullerton and Santa Ana. The Alliance was created to assist OC retail agencies in complying with SBx7-7.

The City met its 2020 water use target and is in compliance with SBx7-7; the actual 2020 consumption was 95 gallons per capita per day (GPCD), which is below its 2020 target of 142 GPCD.

WATER SUPPLY CHARACTERIZATION

The City meets its demands with a combination of imported water and local groundwater. The City works together with two primary agencies, MET and MWDOC, to ensure a safe and reliable water supply that will continue to serve the community in periods of drought and shortage. The sources of imported water supplies include water from the Colorado River and the State Water Project (SWP) provided by MET and delivered through MWDOC.

In FY 2019-20, the City relied on 65% groundwater and 35% imported water.

It is projected that by 2045, the water supply portfolio will change to approximately 85% groundwater and 15% imported water. Note that these representations of supply match the projected demand. The City can purchase more MET water through MWDOC, should the need arise.

The City does not own or operate wastewater treatment facilities but owns and operates the wastewater collection system in its service area that sends all wastewater to Orange County Sanitation District (OC San) for treatment and disposal. OCWD's Groundwater Replenishment System (GWRS) produces recycled water for indirect potable reuse (IPR) through the replenishment of the OC Basin. The City benefits from this indirect use of recycled water.

WATER SERVICE RELIABILITY AND DROUGHT RISK ASSESSMENT

Every urban water supplier is required to assess the reliability of their water service to its customers under a normal year, a single dry year, and a drought period lasting five consecutive years. The water service reliability assessment compares projected supply to projected demand for the three hydrological conditions between 2025 and 2045. Factors affecting reliability, such as climate change and regulatory impacts, are accounted for as part of the assessment.

The City depends on a combination of imported and local supplies to meet its water demands and has taken numerous steps to ensure it has adequate supplies. MET's and MWDOC's 2020 UWMPs conclude that they can meet full-service demands of their member agencies through 2045 during normal years, single-dry years, and multiple-dry years. Consequently, the City is projected to meet full-service demands through 2045 for the same scenarios.

The Drought Risk Assessment (DRA) evaluates the City's near-term ability to supply water assuming the City is experiencing a drought over the next five years. Even under the assumption of a drought over the next five years, MET's 2020 UWMP concludes a surplus of water supplies would be available to all of its Member Agencies, including MWDOC and in effect, the City, should the need for additional supplies arise to close any local supply gap. Additionally, the City partakes in various efforts to reduce its reliance on imported water supplies such as increasing the use of local groundwater and indirect recycled water.

WATER SHORTAGE CONTINGENCY PLANNING

Water shortage contingency planning (WSCP) is a strategic planning process that the City engages in to prepare for and respond to water shortages. A water shortage, when water supply available is insufficient to meet the normally expected customer water use at a given point in time, may occur due to a number of reasons, such as water supply quality changes, drought, and catastrophic events (e.g., earthquake). The City's WSCP provides real-time water supply availability assessment and structured steps designed to respond to actual conditions. This level of detailed planning and preparation will help maintain reliable supplies and reduce the impacts of supply interruptions.

The WSCP serves as the operating manual that the City will use to prevent catastrophic service disruptions through proactive, rather than reactive, mitigation of water shortages. The WSCP contains the processes and procedures that will be deployed when shortage conditions arise so that the City's governing body, its staff, and its retail agencies can easily identify and efficiently implement pre-determined steps to mitigate a water shortage to the level appropriate to the degree of water shortfall anticipated.

DEMAND MANAGEMENT MEASURES

The City, along with other retail water agencies in Orange County, recognizes the need to use existing water supplies efficiently. This ethic of efficient use of water has evolved as a result of the development and implementation of water use efficiency programs that make good economic sense and reflect responsible stewardship of the region's water resources. The City participates in regional water savings programs and works closely with MET and MWDOC to promote regional efficiency.

PLAN ADOPTION, SUBMITTAL, AND IMPLEMENTATION

The Water Code requires the UWMP to be adopted by the Supplier's governing body. Before the adoption of the UWMP, the City notified the public and the cities and counties within its service area per the Water Code and held a public hearing to receive input from the public on the UWMP. Post adoption, the City submitted the UWMP to DWR and other key agencies and made the document available for public review no later than 30 days after filing with DWR.

1 INTRODUCTION AND UWMP OVERVIEW

The City of Seal Beach (City) prepared this 2020 Urban Water Management Plan (UWMP or Plan) to submit to the California Department of Water Resources (DWR) to satisfy the UWMP Act of 1983 (Act or UWMP Act) and subsequent California Water Code (Water Code) requirements. The City is a retail water supplier that provides water to its residents and other customers using the imported potable water supply obtained from its regional wholesaler, Municipal Water District of Orange County (MWDOC) and local groundwater from the Orange County Groundwater Basin (OC Basin), which is managed by the Orange County Water District (OCWD). The City, as one of MWDOC's 28 member agencies, prepared this 2020 UWMP in collaboration with MWDOC, Metropolitan Water District of Southern California (MET), OCWD, and other key agencies.

UWMPs are comprehensive documents that present an evaluation of a water supplier's reliability over a long-term (20-25 year) horizon. In response to the changing climatic conditions and regulatory updates since the 2015 UWMP, the City has been proactively managing its water supply and demand. The water loss audit program, water conservation measures and efforts for increased self-reliance in order to reduce dependency on imported water from the Sacramento-San Joaquin Delta (the Delta) are some of the water management efforts that the City is a part of to maintain the reliability of water supply for its service area.

This 2020 UWMP provides an assessment of the present and future water supply sources and demands within the City's service area. It presents an update to the 2015 UWMP on City's water resource needs, water use efficiency programs, water reliability assessment and strategies to mitigate water shortage conditions. It presents a new 2020 Water Shortage Contingency Plan (WSCP) designed to prepare for and respond to water shortages. This 2020 UWMP contains all elements to meet compliance of the new requirements of the Act as amended since 2015.

1.1 Overview of Urban Water Management Plan Requirements

The UWMP Act enacted by California legislature requires every urban water supplier (Supplier) providing water for municipal purposes to more than 3,000 customers or supplying more than 3,000 acre-feet (AF) of water annually to prepare, adopt, and file an UWMP with the DWR every five years in the years ending in zero and five.

For this 2020 UWMP cycle, DWR placed emphasis on achieving improvements for long term reliability and resilience to drought and climate change in California. Legislation related to water supply planning in California has evolved to address these issues, namely Making Conservation a Way of Life [Assembly Bill (AB) 1668 and Senate Bill (SB) 606] and Water Loss Performance Standard SB555. New UWMP requirements in 2020 are a direct result of these new water regulations. Two complementary components were added to the 2020 UWMP. First is the WSCP to assess the Supplier's near term 5-year drought risk assessment (DRA) and provide a structured guide for the Supplier to deal with water shortages. Second is the Annual Water Supply Demand Assessment (WSDA) to assess the current year plus one dry year i.e., short-term demand/supply outlook. Analyses over near- and long-term horizons together will provide a more complete picture of Supplier's reliability and will serve to inform appropriate actions it needs to take to build up capacity over the long term.

The various key new additions in the 2020 UWMP included as a result of the most recent water regulations are:

- **Water Shortage Contingency Plan (WSCP) –** WSCP helps a Supplier to better prepare for drought conditions and provides the steps and water use efficiency measures to be taken in times of water shortage conditions. WSCP now has more prescriptive elements, including an analysis of water supply reliability; the water use efficiency measures for each of the six standard water shortage levels, that correspond to water shortage percentages ranging from 0-10% to greater than 50%; an estimate of potential to close supply gap for each measure; protocols and procedures to communicate identified actions for any current or predicted water shortage conditions; procedures for an annual water supply and demand assessment; monitoring and reporting requirements to determine customer compliance; reevaluation and improvement procedures for evaluating the WSCP.
- **Drought Risk Assessment –** The Suppliers are now required to compare their total water use and supply projections and conduct a reliability assessment of all their sources for a consecutive five-year drought period beginning 2021.
- **Five Consecutive Dry-Year Water Reliability Assessment** - The three-year multiple dry year reliability assessment in previous UWMPs has now been extended from three to five consecutive dry years to include a more comprehensive assessment of the reliability of the water sources to improve preparedness of Suppliers for extended drought conditions.
- **Seismic Risk –** The UWMP now includes a seismic risk assessment of the water supply infrastructure and a plan to mitigate any seismic risks on the water supply assets.
- **Groundwater Supplies Coordination –** The UWMP should be in accordance with the Sustainable Groundwater Management Act of 2014 and consistent with the Groundwater Sustainability Plans, wherever applicable.
- **Lay Description** – To provide a better understanding of the UWMP to the general public, a lay description of the UWMP is included, especially summarizing the Supplier's detailed water service reliability assessment and the planned management steps and actions to mitigate any possible shortage scenarios.

1.2 UWMP Organization

This UWMP is organized into 10 main sections aligned with the DWR Guidebook recommendations. The subsections are customized to tell the City's story of water supply reliability and ways to overcome any water shortages over a planning horizon of the next 25 years.

Section 1 Introduction and UWMP Overview gives an overview of the UWMP fundamentals and briefly describes the new additional requirements passed by the Legislature for 2020 UWMP.

Section 2 UWMP Preparation identifies this UWMP as an individual planning effort of the City, lists the type of year and units of measure used and introduces the coordination and outreach activities conducted by the City to develop this UWMP.

Section 3 System Description gives a background on the City's water system and its climate characteristics, population projection, demographics, socioeconomics, and predominant current and projected land uses of its service area.

Section 4 Water Use Characterization provides historical, current, and projected water use by customer category for the next 25 years within the City's service area and the projection methodology used by MWDOC to develop the 25-year projections**.**

Section 5 Conservation Target Compliance reports the SB X7-7 water use conservation target compliance of the City (individually and as a member of the OC 20x2020 Regional Alliance).

Section 6 Water Supply Characterization describes the current water supply portfolio of the City as well as the planned and potential water supply projects and water exchange and transfer opportunities.

Section 7 Water Service Reliability and Drought Risk Assessment assesses the reliability of the City's water supply service to its customers for a normal year, single dry year, and five consecutive dry years scenarios. This section also includes a DRA of all the supply sources for a consecutive five-year drought period beginning 2021.

Section 8 Water Shortage Contingency Planning is a brief summary of the standalone WSCP document (Appendix H) which provides a structured guide for the City to deal with water shortages, incorporating prescriptive information and standardized action levels, lists the appropriate actions and water use efficiency measures to be taken to ensure water supply reliability in times of water shortage conditions, along with implementation actions in the event of a catastrophic supply interruption.

Section 9 Demand Management Measures provides a comprehensive description of the water conservation programs that the City has implemented, is currently implementing, and plans to implement in order to meet its urban water use reduction targets.

Section 10 Plan Adoption, Submittal, and Implementation provides a record of the process the City followed to adopt and implement its UWMP.

2 UWMP PREPARATION

The City's 2020 UWMP is an individual UWMP for the City to meet the Water Code compliance as a retail water supplier. While the City opted to prepare its own UWMP and meet Water Code compliance individually, the development of this UWMP involved close coordination with its wholesale supplier, MWDOC along with other key entities within the region.

2.1 Individual Planning and Compliance

The City opted to prepare its own UWMP (Table 2-1) and comply with the Water Code individually, while closely coordinating with MWDOC and various key entities as discussed in Section 2.2 to ensure regional integration. The UWMP Checklist was completed to confirm the compliance of this UWMP with the Water Code (Appendix A).

One consistency with MWDOC and the majority of its other retail member agencies is that the City selected to report demands and supplies using fiscal year (FY) basis (Table 2-2).

Table 2-1: Plan Identification

<table>
<tr><th colspan="4">DWR Submittal Table 2-2: Plan Identification</th></tr>
<tr><th>Select Only One</th><th colspan="2">Type of Plan</th><th>Name of RUWMP or Regional Alliance</th></tr>
<tr><td>☑</td><td colspan="3">Individual UWMP</td></tr>
<tr><td></td><td>☐</td><td>Water Supplier is also a member of a RUWMP</td><td></td></tr>
<tr><td></td><td>☑</td><td>Water Supplier is also a member of a Regional Alliance</td><td>Orange County 20x2020 Regional Alliance</td></tr>
<tr><td>☐</td><td colspan="2">Regional Urban Water Management Plan (RUWMP)</td><td></td></tr>
<tr><td colspan="4">NOTES:</td></tr>
</table>

Table 2-2: Supplier Identification

DWR Submittal Table 2-3: Supplier Identification	
Type of Supplier	
☐	Supplier is a wholesaler
☑	Supplier is a retailer
Fiscal or Calendar Year	
☐	UWMP Tables are in calendar years
☑	UWMP Tables are in fiscal years
If using fiscal years provide month and date that the fiscal year begins (mm/dd)	
7/1	
Units of measure used in UWMP (select from drop down)	
Unit	AF
NOTES: The energy intensity data is reported in calendar year consistent with the Greenhouse Gas Protocol.	

2.2 Coordination and Outreach

2.2.1 Integration with Other Planning Efforts

The City, as a retail water supplier, coordinated this UWMP preparation effort with other key entities, including MWDOC (regional wholesale supplier for Orange County), MET (regional wholesaler for Southern California and the direct supplier of imported water to MWDOC), and OCWD (OC Basin manager). The City also developed this Plan in conjunction with other MWDOC-led efforts such as population projection from the Center for Demographic Research at California State University Fullerton (CDR).

Some of the key planning and reporting documents that were used to develop this UWMP are:

- **MWDOC's 2020 UWMP** provides the basis for the projections of the imported supply availability over the next 25 years for the City's service area.
- **MWDOC's 2020 WSCP** provides a water supply availability assessment and structured steps designed to respond to actual conditions that will help maintain reliable supplies and reduce the impacts of supply interruptions.

- **2021 OC Water Demand Forecast for MWDOC and OCWD Technical Memorandum (Demand Forecast TM)** provides the basis for water demand projections for MWDOC's member agencies as well as Anaheim, Fullerton, and Santa Ana.
- **MET's 2020 Draft Integrated Water Resources Plan (IRP)** is a long-term planning document to ensure water supply availability in Southern California and provides a basis for water supply reliability in Orange County.
- **MET's 2020 UWMP** was developed as a part of the 2020 IRP planning process and was used by MWDOC as another basis for the projections of supply capability of the imported water received from MET.
- **MET's 2020 WSCP** provides a water supply assessment and guide for MET's intended actions during water shortage conditions.
- **OCWD's Groundwater Reliability Plan** (to be finalized after July 2021) provides the latest information on groundwater management and supply projection for the OC Basin, the primary source of groundwater for 19 retail water suppliers in OC.
- **OCWD's 2019-20 Engineer's Report** provides information on the groundwater conditions and basin utilization of the OC Basin.
- **OCWD's 2017 Basin 8-1 Alternative** is an alternative to the Groundwater Sustainability Plan (GSP) for the OC Basin and provides significant information related to sustainable management of the basin in the past and hydrogeology of the basin, including groundwater quality and basin characteristics.
- **Local Hazard Mitigation Plan** provides the basis for the seismic risk analysis of the water system facilities.
- **Orange County Local Agency Formation Commission's 2020 Municipal Service Review for MWDOC Report** provides comprehensive review of the municipal services provided by MWDOC.
- **Water Master Plan and Sewer Master Plan** of the City provide information on water infrastructure planning projects and plans to address any required water system improvements.

Statewide Water Planning

In addition to regional coordination with various agencies described above, the City as a MWDOC member agency is currently a part of MET's statewide planning effort to reduce reliance on the water imported from the Delta.

It is the policy of the State of California to reduce reliance on the Delta in meeting California's future water supply needs through a statewide strategy of investing in improved regional supplies, conservation, and water use efficiency. This policy is codified through the Delta Stewardship Council's Delta Plan Policy WR P1 and is measured through Supplier reporting in each Urban Water Management Planning cycle. WR P1 is relevant to water suppliers that plan to participate in multi-year water transfers, conveyance facilities, or new diversions in the Delta.

Through significant local and regional investment in water use efficiency, water recycling, advanced water technologies, local and regional water supply projects, and improved regional coordination of local and regional water supply efforts, the City has demonstrated a reduction in Delta reliance and a subsequent improvement in regional self-reliance. For a detailed description and documentation of the City's consistency with Delta Plan Policy WR P1 see Section 7.4 and Appendix C.

2.2.2 Wholesale and Retail Coordination

The City developed its UWMP in conjunction with MWDOC's 2020 UWMP. The City provided its historical water use and initial water use projections data to MWDOC (Table 2-3). MWDOC facilitated in refining the projections of the City's water demand and the imported supply from MWDOC over the next 25 years.

The City also has been taking part in many regional programs administered by MWDOC to assist retail agencies meet various State compliance, such as the OC Regional Alliance for SB x7-7 compliance, regional water loss program for SB555 compliance, and regional water use efficiency programs. Sections 5 and 9 provide detailed information on these programs.

Table 2-3 Retail: Water Supplier Information Exchange

DWR Submittal Table 2-4 Retail: Water Supplier Information Exchange
The retail Supplier has informed the following wholesale supplier(s) of projected water use in accordance with Water Code Section 10631.
Wholesale Water Supplier Name
Municipal Water District of Orange County
NOTES:

2.2.3 Public Participation

For further coordination with other key agencies and to encourage public participation in the review and update of this Plan, the City held a public hearing and notified key entities and the public per the Water Code requirements. Sections 10.2 and 10.3 describe these efforts in detail.

3 SYSTEM DESCRIPTION

The City was incorporated in 1915 and later became a charter city in 1964. The City is governed by a five-member City Council.

The City is located along the California coastline in Orange County and is bordered to the north by the City of Los Alamitos, and the unincorporated Rossmoor community; to the east by the Cities of Garden Grove, Westminster, and Huntington Beach; to the south by the Pacific Ocean and City of Huntington Beach; and to the west by the City of Long Beach. The City's Water Division operates four production wells, an active service connection with MET, emergency interconnections with other utilities, two reservoirs with a total storage capacity of seven million gallons (MG), two booster stations, four disinfection sites, approximately 680 hydrants and manages 74.8 mile water mains system with about 5,350 service connections.

Lying in the South Coast Air Basin (SCAB), its climate is characterized by Southern California's "Mediterranean" climate with mild winters, warm summers and moderate rainfall. In terms of land use, the City is mostly developed with a mix of residential, commercial, industrial, and public land. There is a large U.S. Naval Weapons Station within the City along with light industrial and institutional land uses. Recent developments are mainly additions of 30 residential units with a park. Moving forward, the City will continue planning for its Regional Housing Needs Assessment (RHNA) allocation and future planned developments beyond 2020 may include accessory dwelling units (ADUs). The current population of 24,000 is projected to increase by only 1.5% over the next 25 years.

3.1 Agency Overview

This section provides information on the formation and history of the City, its organizational structure, history of formation and relationship to MWDOC.

3.1.1 Formation

The City is a predominantly residential community located along the California coastline in Orange County. It was incorporated in 1915 and became a charter city in 1964.

Originally called Bay City, Seal Beach was developed in the early 1900's as a resort destination for residents of the Los Angeles area. Its early growth was accelerated by the construction of the Pacific Electric Railway Trolley, which reached the City in 1906. The railway allowed visitors to reach the City more easily and in greater numbers to enjoy the many hotels, bathhouses and dance halls which were constructed for their recreation. In 1926, oil was discovered in the City, and the oil boom that followed resulted in the development of Seal Beach into the residential community it is today.

3.1.2 City Council

The City is administered under a council-manager form of government and is governed by a five-member City council elected by district serving four-year alternating terms. Current City Council members are:

- Joe Kalmick, Mayor (District One - Old Town & Surfside Colony)

- Mike Varipapa, Mayor Pro Tem (District Three - Hill, Coves, Bridgeport, and Heron Pointe)
- Thomas Moore, Council Member (District Two - Leisure World, College Park West, and Rossmoor Center)
- Schelly Sustarsic, Council Member (District Four - College Park East and Town Center)
- Sandra Massa-Lavitt, Council Member (District Five - Leisure World)

3.1.3 Relationship to MWDOC

The City is one of MWDOC's 28 member agencies purchasing imported water from MWDOC, Orange County's wholesale water supplier and a member agency of MET. The City's location within MWDOC's service is shown on Figure 3-1.

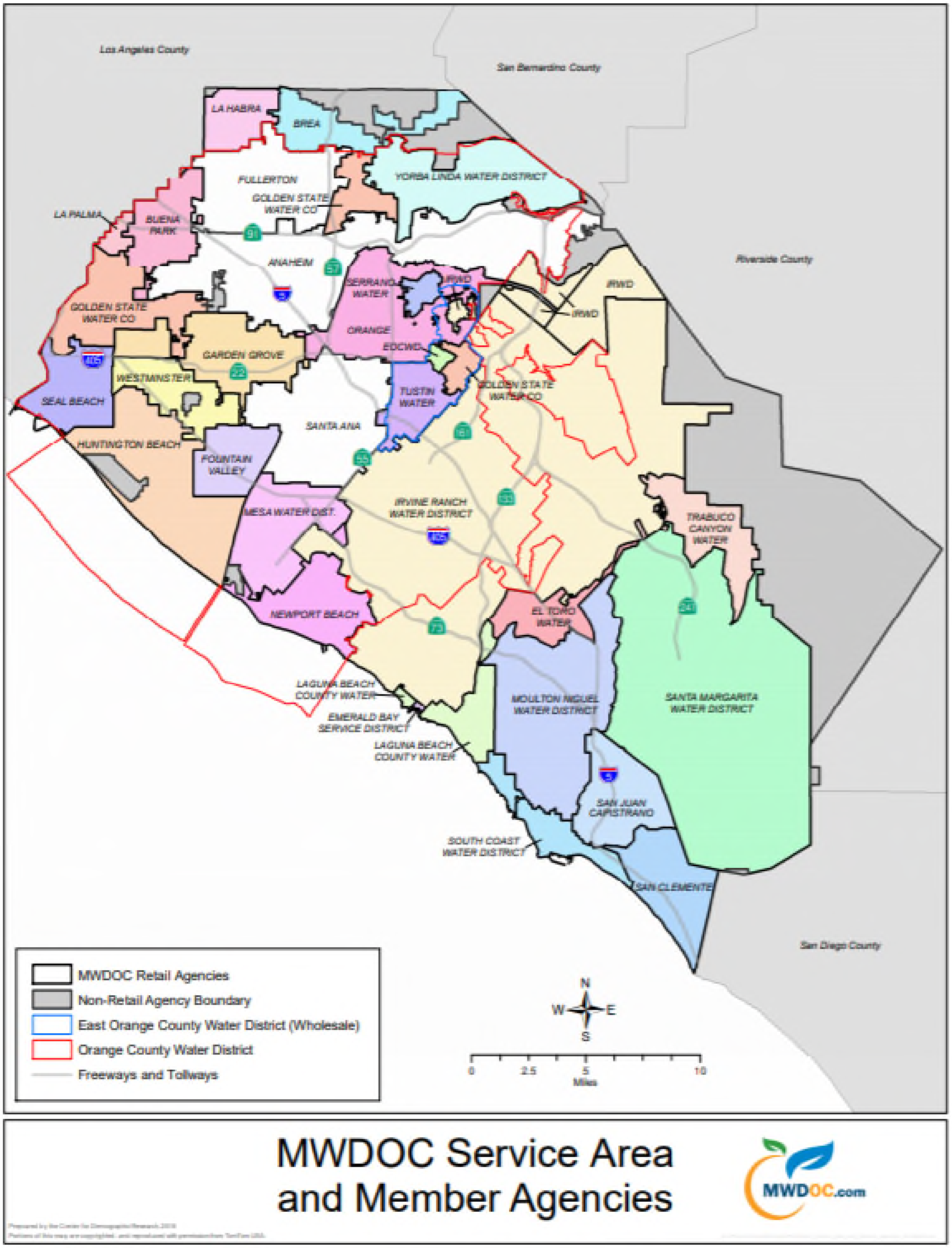


Figure 3-1: Regional Location of City of Seal Beach and Other MWDOC Member Agencies

3.2 Water Service Area and Facilities

3.2.1 Water Service Area

The City is bordered to the north by the City of Los Alamitos, and the unincorporated Rossmoor community; to the east by the Cities of Garden Grove, Westminster, and Huntington Beach; to the south by the Pacific Ocean and City of Huntington Beach; and to the west by the City of Long Beach.

Rossmoor Center, located in the City, is served by an investor-owned water utility, the Golden State Water Company (GSWC). Therefore, this UWMP is limited to those communities receiving water service from the City and covers an aerial extent of approximately 7,135 acres within the City's boundaries. The Leisure World Retirement Community, with 6,808 dwelling units, is served by the City through three master meters. The City maintains the water distribution facilities and the fire hydrants within Leisure World.

The service area is divided into several distinct communities as shown in Figure 3-2 and described below:

- **Old Town**, which is the area south of Pacific Coast Highway (PCH) and Marina Drive, between First Street and Seal Beach Boulevard, was developed in the 1920's. It is the oldest area of the City. High density residential and commercial land uses are prevalent. Large single-family residential lots are found in the Gold Coast District. The City's mile long beach in Old Town is used for surfing and swimming. The Seal Beach Pier, located at the end of Main Street, provides fishing facilities.
- **Bridgeport** is the area west of PCH north of Marina Drive and southeast of the San Gabriel River. It was primarily developed in the 1960's and consists of medium and high density residential land uses. It includes the Seal Beach Trailer Park, and Oakwood Apartments. Old Town and Bridgeport cover 276 acres.
- **Marina Hill** was developed in the 1950's and consists mostly of single-family homes. This area covers 201 acres north of Pacific Coast Highway and west of Seal Beach Boulevard, adjacent to the south edge of the Hellman Ranch property. It is further divided into Marina Hill-North and Marina Hill South, with Bolsa Avenue forming the boundary.
- **Hellman Ranch** Covers 199 acres and is located west of Seal Beach Boulevard and north of Marina Hill. The development includes 100 acres of open space, freshwater wetlands and 70 single-family residential units.
- **The Boeing Facility, Police Facility and City Yard** are located on 107 acres between Hellman Ranch and Westminster Avenue, west of Seal Beach Boulevard. This area is zoned for light industry. The Boeing Facility supports Boeing's commercial aviation program. Engineering and design operations are also conducted from this facility. Development plans for the area include 31 acres of industrial, 19 acres of commercial, and a 120 room hotel on 2 acres.
- **Surfside**, a colony that was incorporated in the 1930's, became a part of Seal Beach in 1969. The area consists of single-family dwelling units located on 10 acres of the south spit of Anaheim Bay. Although a gated community, pedestrian and bicycle access to the beach is available.

- **Leisure World**, completed in 1962, covers the portion of the City between Westminster Avenue and the San Diego Freeway westerly of Seal Beach Boulevard. It is a gated community of 533 acres with 6,608 dwelling units, four club houses, and a nine-hole golf course. Leisure World is a retirement community for seniors 55 years and older. Medical, religious, commercial, and recreational facilities are all provided within the compound limits. The existing population is 8,400.
- **College Park East** is a single-family residential area developed in the late 1960's. It is located on 292 acres between the San Diego Freeway and Lampson Avenue, west of Bolsa Chica Channel in the northeast section of the City.
- **Bixby Old Ranch and Old Ranch Golf Course** are located north of Lampson Avenue and east of Seal Beach Boulevard. Most of Bixby Old Ranch has recently been developed. This area covers 230 acres. The golf course is served through two meters. Irrigation water to the golf course is provided by a private on-site well.
- **College Park West** is a 62-acre small residential community located along San Gabriel River northeast of Leisure World. Water service to College Park West is provided through a metered supply connection from Leisure World.
- **The Seal Beach National Wildlife Refuge** was established in 1972 and preserves 911 acres of salt marsh and upland area in Anaheim Bay. The refuge is located within the boundaries of the U.S. Naval Weapons Station and there is no public access.
- **Sunset Aquatic Park** was acquired by the County in 1962 from the U.S. Navy. It encompasses 67 acres of Anaheim Bay and is the site of a public marina and park.
- **The U.S. Naval Weapons Station** was established in 1944. It covers approximately 5,000 acres of land located between Seal Beach Boulevard and Bolsa Chica Road from the San Diego Freeway to Pacific Coast Highway.

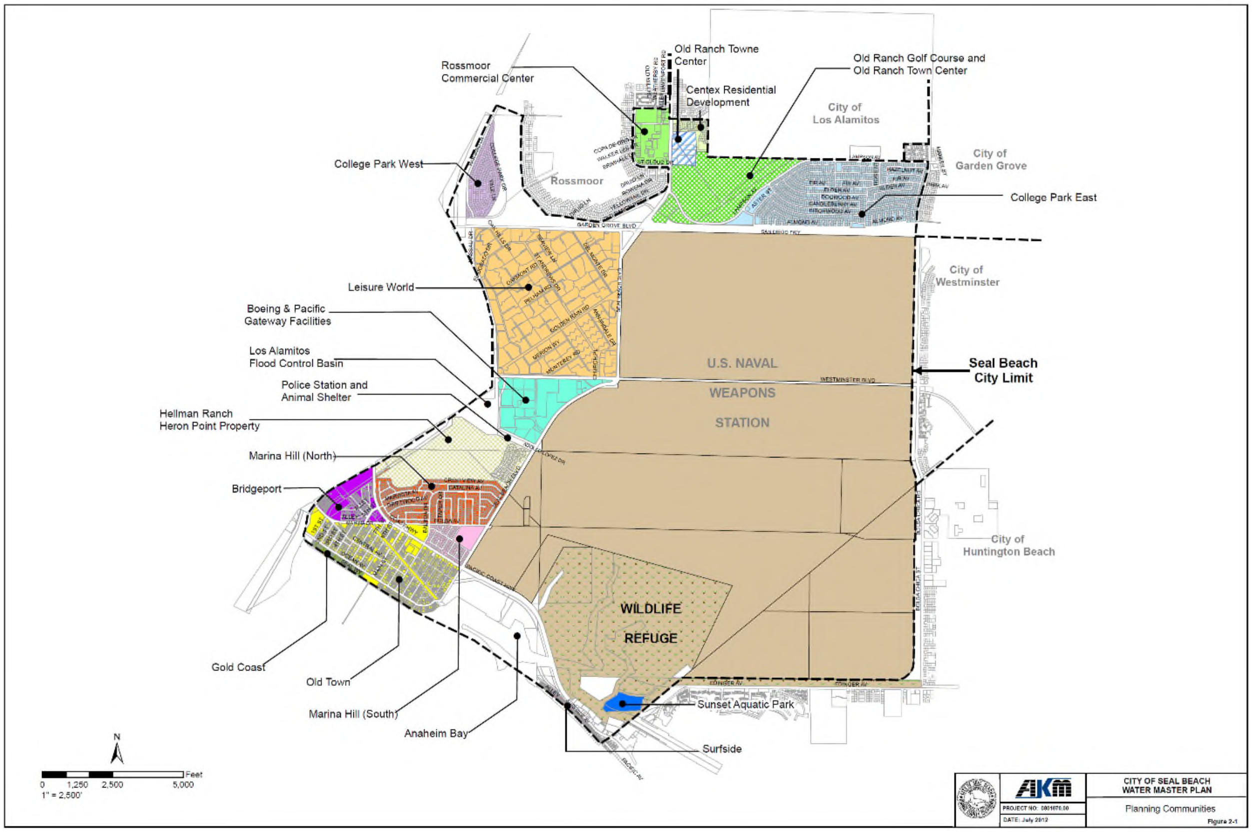


Figure 3-2: City of Seal Beach Water Service Area

3.2.2 Water Facilities

The City's Water Division of the Department of Public Works maintains 74.8 miles of mains, four production wells, two reservoirs with a total storage capacity of seven MG, two booster stations that constantly maintain water at approximately 60 pounds per square inch (psi), four disinfection sites, approximately 680 hydrants, approximately 5,350 service connections, an active service connection with MET and emergency interconnections with the City of Long Beach, the City of Huntington Beach, the City of Westminster, and GSWC,. Figure 3-3 illustrates the City's water supply and distribution system.

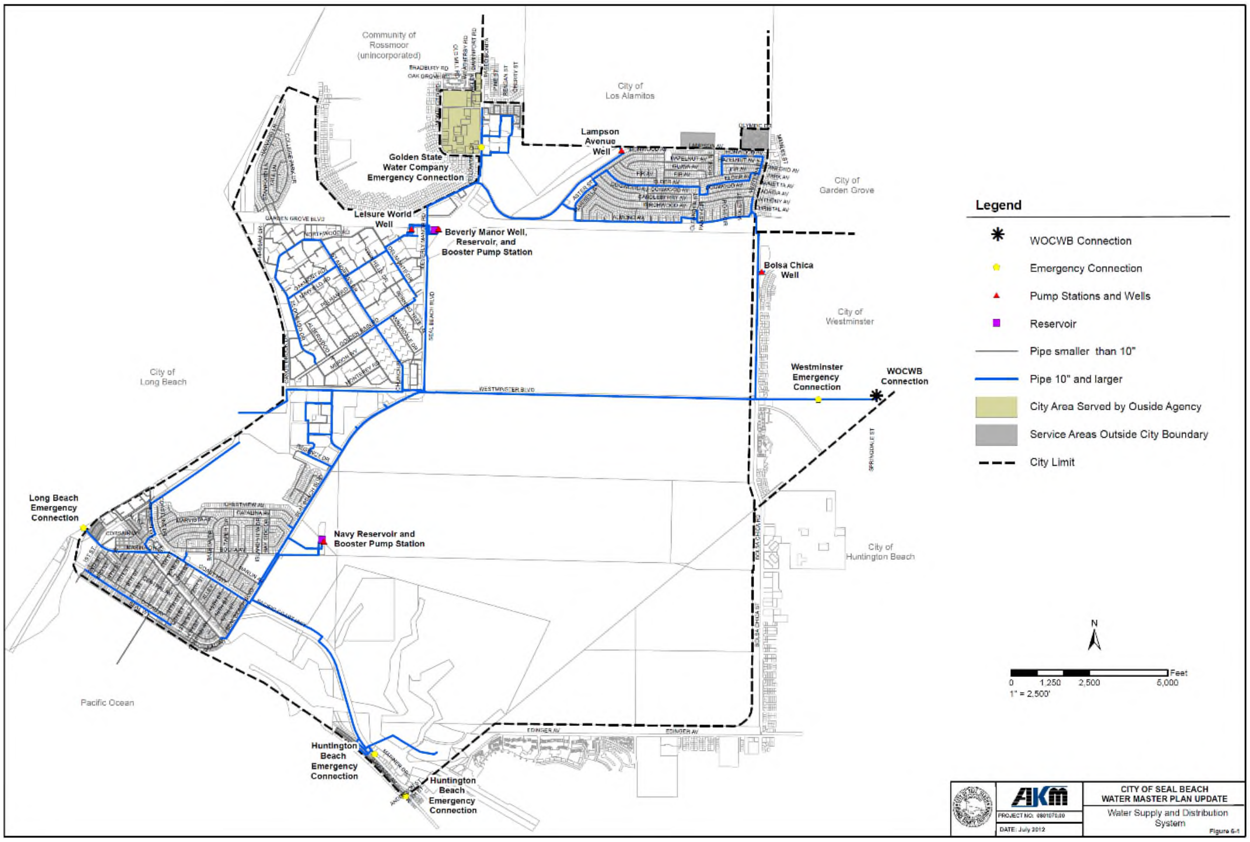


Figure 3-3: City of Seal Beach Distribution System

The system connections and water volume supplied are summarized in Table 3-1.

Table 3-1: Retail Only: Public Water Systems

DWR Submittal Table 2-1 Retail Only: Public Water Systems			
Public Water System Number	Public Water System Name	Number of Municipal Connections 2020	Volume of Water Supplied 2020
CA3010041	City of Seal Beach	5,350	3,273
	TOTAL	5,350	3,273
NOTES:			

3.3 Climate

The City is located within the SCAB that encompasses all of OC, and the urban areas of Los Angeles, San Bernardino, and Riverside counties. The SCAB climate is characterized by Southern California's "Mediterranean" climate: a semi-arid environment with mild winters, warm summers, and moderate rainfall.

Local rainfall has limited impacts on reducing water demand in the City, except for landscape irrigation demand. Water that infiltrates into the soil may enter groundwater supplies depending on the local geography. However, due to the large extent of impervious cover in Southern California, rainfall runoff quickly flows to a system of concrete storm drains and channels that lead directly to the ocean. OCWD is one agency that has successfully captured stormwater along the Santa Ana River and in recharge basins for years and used it as an additional source of supply for groundwater recharge. Based on the 2017 Basin 8-1 Alternative Plan, OCWD captured an average annual stormwater volume of approximately 44,000 AF over the period of ten years, from Water Year 2006-07 to 2015-16; however, this period's rainfall was 17% below the long term average using San Bernardino precipitation data. Based on a longer period (1989-2015) of rainfall and captured stormwater records, the average year water budget of OCWD assumes a stormwater capture volume of 52,000 AF.

MET's water supplies come from the State Water Project (SWP) and the Colorado River Aqueduct (CRA), influenced by climate conditions in northern California and the Colorado River Basin, respectively. The years 2000-2018 have been the driest 19-year period in the history and both regions have been receiving record low precipitation which directly impact water supplies to Southern California. Due to the prolonged drought conditions since 2000, storage within the Colorado River system has declined to half of its reservoir capacity and has been fluctuating at that level (DWR, January 2020).

3.4 Population, Demographics, and Socioeconomics

3.4.1 Service Area Population

According to CDR, the City's service area has a 2020 population of 24,000. The City is almost completely built-out and overall, its population is projected to increase by only 1.5% over the 25-year period from 2020 to 2045. The growth is slightly higher in the first 15 years until 2035 and tapered off from there. Table 3-2 shows the population projections in five-year increments out to 2045 within the City's service area.

Table 3-2: Retail: Population - Current and Projected

DWR Submittal Table 3-1 Retail: Population - Current and Projected						
Population Served	2020	2025	2030	2035	2040	2045
	24,000	24,110	24,527	24,652	24,554	24,357
NOTES: Source - Center for Demographic Research at California State University, Fullerton, 2020						

3.4.2 Demographics and Socioeconomics

As shown in Table 3-3 below, the total number of dwelling units in the City is expected to increase minimally by 0.8% in the next 25 years from 14,064 in 2020 to 14,171 in 2045. Table 3-3 also shows a breakdown of the total dwelling units by type for the 25-year period from 2020 to 2045.

Table 3-3: City of Seal Beach Service Area Dwelling Units by Type

City of Seal Beach Service Area Dwelling Units by Type						
Dwelling Units	2020	2025	2030	2035	2040	2045
Total	**14,064**	**14,079**	**14,132**	**14,155**	**14,160**	**14,171**
Single Family	4,490	4,500	4,550	4,554	4,557	4,567
All Other*	9,574	9,579	9,582	9,601	9,603	9,604
Source: Center for Demographic Research at California State University, Fullerton, 2020 *Includes duplex, triplex, apartment, condo, townhouse, mobile home, etc. Yachts, houseboats, recreational vehicles, vans, etc. are included if is primary place of residence. Does not include group quartered units, cars, railroad box cars, etc.						

In addition to the types and proportions of dwelling units, various socio-economic factors such as age distribution, education levels, general health status, income and poverty levels affect City's water management and planning. Based on the U.S. Census Bureau's QuickFacts, the City has about 39.9% of population of 65 years and over, 12.8% under the age of 18 years and 3.4% under the age of 5 years. 94.9% of the City's population with an age of more than 25 years has a minimum of high school graduate and 49% of this age group has at least a bachelor's degree.

3.4.3 CDR Projection Methodology

The City obtains its services area population and dwelling unit data from MWDOC via CDR. MWDOC contracts with CDR to update the historic population estimates for 2010 to the current year and provide an annual estimate of population served by each of its retail water suppliers within its service area. CDR uses GIS and data from the 2000 and 2010 U.S. Decennial Censuses, State Department of Finance (DOF) population estimates, and the CDR annual population estimates. These annual estimates incorporate annual revisions to the DOF annual population estimates, often for every year back to the most recent Decennial Census. As a result, all previous estimates were set aside and replaced with the most current set of annual estimates. Annexations and boundary changes for water suppliers are incorporated into these annual estimates.

In the summer of 2020, projections by water supplier for population and dwelling units by type were estimated using the 2018 Orange County Projections dataset. Growth for each of the five-year increments was allocated using GIS and a review of the traffic analysis zones (TAZ) with a 2019 aerial photo. The growth was added to the 2020 estimates by water supplier.

3.5 Land Uses

3.5.1 Current Land Uses

The City is mostly developed with a mix of residential, commercial, industrial, and public land. There is a large U.S. Naval Weapons Station within the City along with light industrial and institutional land uses. uses.

Based on the zoning designation collected and aggregated by Southern California Association of Governments (SCAG) around 2018, the current land use within the City's service area can be categorized as follows:

- Single family residential – 7.4%
- Multi-family residential – 7.4%
- Commercial – 2.4%
- Industrial – 1.7%
- Institutional/Governmental – 47.8%
- Agriculture – 0.5%
- Open space and parks – 3.8%
- Other – 26.5% (e.g., Undevelopable or Protected Land, Water, and Vacant)
- No land use designation – 2.4%

Figure 3-4 shows the breakdown by land use within the City.

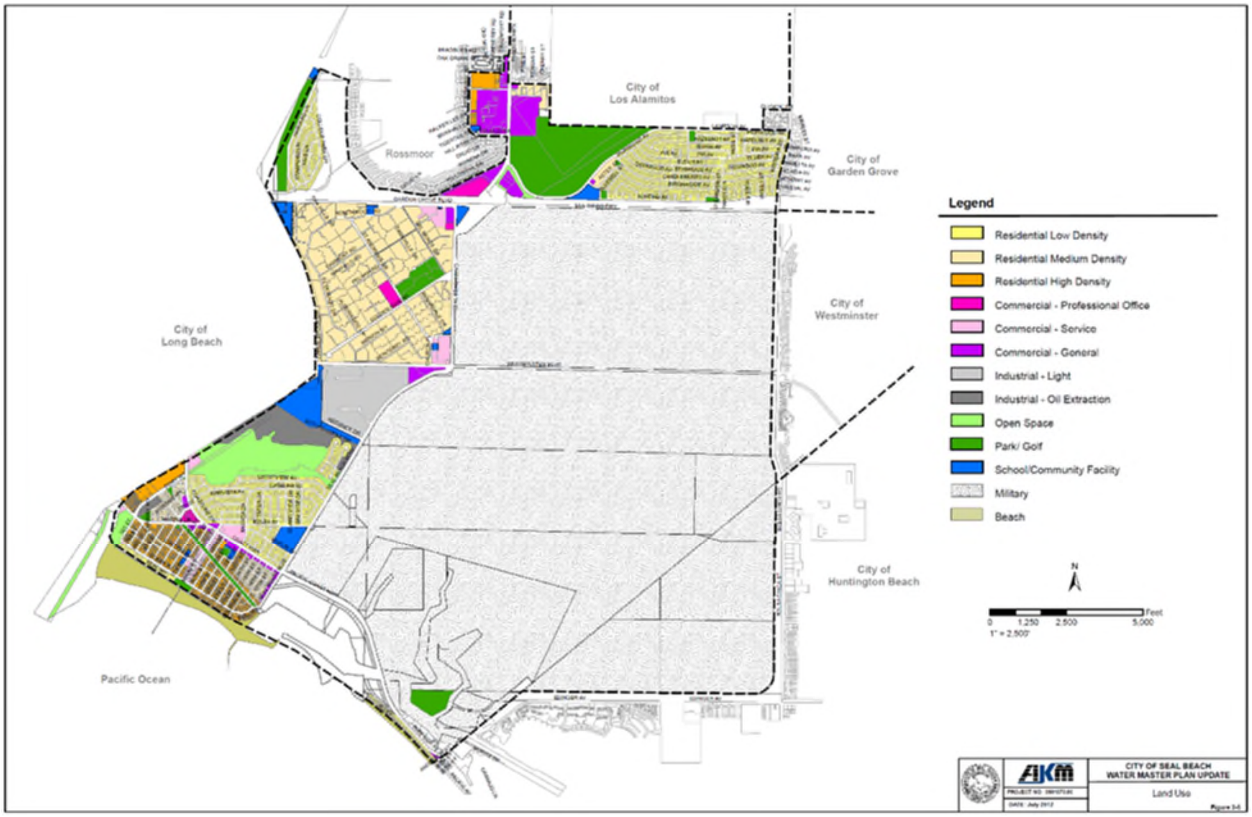


Figure 3-4: City of Seal Beach Land Use

3.5.2 Projected Land Uses

The City is adding 30 residential units with a park in District 1, which will increase the total water demand of the City.

Moving forward, the City will continue planning for its RHNA allocation and new developments may also include ADUs beyond 2020.

State law requires jurisdictions to provide their share of the RHNA allocation and the SCAG determines the housing growth needs by income for local jurisdictions through RHNA. The City’s RHNA allocation for the 2021 - 2029 is 1,243 units. This includes 258 units for very low-income households, 201 units for low-income households, 239 units for moderate-income households, and 545 units for above moderate-income households.

ADUs are separate small dwellings embedded within residential properties. There has been an increase in the construction of ADUs in California in response to the rise in interest to provide affordable housing supply. The Legislature updated the ADU law effective January 1, 2020 to clarify and improve various provisions to promote the development of ADUs. (AB-881, "Accessory dwelling units," and AB-68, "Land use: accessory dwelling units”) These include:

- allowing ADUs and Junior Accessory Dwelling Units (JADUs) to be built concurrently with a single-family dwelling. JADUs max size is 500 sf.

- opening areas where ADUs can be created to include all zoning districts that allow single-family and multi-family uses.
- maximum size cannot be less than 850 sf for a one-bedroom ADU or 1,000 sf for more than one bedroom (California Department of Housing and Community Development, 2020).

About 92% of the ADUs in California are being built in the single-family zoned parcels (University of California Berkeley, 2020). The increase in ADUs implies an increase in number of people per dwelling unit which potentially translates to higher water demand.

4 WATER USE CHARACTERIZATION

4.1 Water Use Overview

Water use within the City's service area has been relatively stable in the past decade with an annual average of 3,482 AF for potable use. In FY 2019-20, the City's water use was 3,273 AF of potable water (groundwater and imported). There is currently no recycled water use within the City's service area. In FY 2019-20, the City's water use profile was comprised of 70.4% residential use, 18.4% commercial, industrial, and institutional (CII) use, 0.5% large landscape/irrigation, with non-revenue water (NRW) comprising about 10.6%. As described in Section 3, the City's service area is almost completely built-out and is projected to add minimum land use and small population increase. Water demand is likely to decrease 3.0% over the next 5 years. In the longer term, water demand is projected to increase 4.1% from 2025 through 2045. The projected potable water use for 2045 is 3,306 AF. The passive savings are anticipated to continue for the next 25 years and are considered in the water use projections. Permanent water conservation requirements and water conservation strategies are discussed in Section 8 and 9 of this document.

4.2 Past and Current Water Use

Water use within the City's service area has been relatively stable in the past decade with an annual average of 3,482 AF. A stable trend is expected because the city is essentially built-out and the rate of population growth is small (expected to increase by only 1.5% over the 25-year period from 2020 to 2045). Water conservation efforts also kept per capita water use down.

As a result of Governor Jerry Brown's mandatory water conservation order in 2014, retail water use within the City's service area has been decreased from an average of 3,645 AF (FY 2010-11 and FY 2014-15) to the last five-year average of 3,319 AF (FY 2015-16 and FY 2019-20). Between FY2015-16 and FY 2019-20, water use within the City's service area ranged from 3,212 to 3,513 acre-feet per year (AFY).

All the water use within the City is for potable use and there is currently no recycled water use within the City's service area. As of February 2021, there are 5,350 metered service connections in the City's water distribution system. Table 4-1 summarizes the City's total water use for FY 2019-20. Approximately 70.4% of the City's water demand is residential. Commercial and institutional/governmental accounts for 15.0%, and 3.4% of the total water production, respectively. The City has a mix of commercial uses (markets, restaurants, etc.), public entities (schools, fire stations and government offices) and office complexes. Large landscape (irrigation) accounts for about 0.5%, while NRW constitutes 10.6% of total water production. Within the non-residential sector, commercial uses are the most dominant of the City's total demand.

The City sells a small amount of water, 25.9 AFY in 2020, to GSWC for 1) a small residential neighborhood located off of Lampson Avenue in the City of Los Alamitos, and 2) a commercial property located on Lampson Avenue.

Table 4-1: Retail: Demands for Potable and Non-Potable Water – Actual

DWR Submittal Table 4-1 Retail: Demands for Potable and Non-Potable Water - Actual			
Use Type	2020 Actual		
	Additional Description	Level of Treatment When Delivered	Volume (AF)
Single/Multi- Family Residential	See note below	Drinking Water	2,306
Commercial	Industrial uses included with commercial	Drinking Water	492
Institutional/Governmental	City Meters including Irrigation for City	Drinking Water	111
Landscape	Represents large landscape (with irrigation meters) served by potable water and not recycled water	Drinking Water	16
Losses	Non-revenue water	Drinking Water	347
		TOTAL	3,273
NOTES: Volumes in AF. Residential demands combined in FY2019-20 billing system. Beginning Summer 2021, the City's billing system will account for SF and MF residential usage separately.			

4.3 Water Use Projections

A key component of this 2020 UWMP is to provide an insight into the City's future water demand outlook. This section discusses the considerations and methodology used to estimate the 25-year water use projection. Overall, total water demand is projected to increase 1.0% between 2020 and 2045.

4.3.1 Water Use Projection Methodology

In 2021, MWDOC and OCWD, in collaboration with their member agencies, led the effort to update water demand projections originally done as part of the 2021 OC Water Demand Forecast for MWDOC and OCWD. The updated demand projections, prepared by CDM Smith, were for the Orange County region as a whole, and provided retail agency specific demands. The projections span the years of 2025-2050 and are based upon information surveyed from each Orange County water agency.

The forecast methodology began with a retail water agency survey that asked for FY 2017-18, FY 2018-19 and FY 2019-20 water use by major sector, including number of accounts. If a member agency provided recycled water to customers that information was also requested. Given that FY 2017-18 was a slightly above-normal demand year (warmer/drier than average) and FY 2018-19 was a slightly below-normal demand year (cooler/wetter than average), water use from these two years were averaged to represent an average-year base water demand.

For the residential sectors (single-family and multifamily) the base year water demand was divided by households in order to get a total per unit water use (gallons per home per day). In order to split household water use into indoor and outdoor uses, three sources of information were used, along with CDM Smith's expertise. The sources of information included: (1) *the Residential End Uses of Water* (Water Research Foundation, 2016); (2) California's plumbing codes and landscape ordinances; and (3) CA DWR's Model Water Efficient Landscape Ordinance (MWELO) calculator.

Three different periods of residential end uses of water were analyzed as follows:

- **Pre-2010 efficiency levels** – Has an average indoor water use that is considered to be moderately efficient, also does not include the most recent requirements for MWELO.
- **High-efficiency levels** – Includes the most recent plumbing codes that are considered to be highly efficient, and also includes the most recent requirements for MWELO.
- **Current average efficiency levels** – Represents the weighted average between pre-2010 efficiency and high efficiency levels, based on average age of homes for each retail water agency.

For outdoor residential water use, the indoor per capita total was multiplied by each member agency-specific persons per household in order to get an indoor residential household water use (gallons per day per home), and then was subtracted from the base year total household water use for single-family and multifamily for each agency based on actual water use as reported by the agency surveys.

For existing residential homes, the current average indoor and outdoor water use for each member agency were used for the year 2020. It was assumed that indoor water uses would reach the high efficiency level by 2040. Based on current age of homes, replacement/remodeling rates, and water utility rebate programs it is believed this assumption is very achievable. It was also assumed that current outdoor water use would be reduced by 5% by 2050.

For new homes, the indoor high efficiency level was assumed for the years 2025 through 2050. Outdoor uses for new homes were assumed to be 25% and 30% lower than current household water use for single-family and multifamily homes, respectively. This methodology is illustrated in Figure 4-1 below.

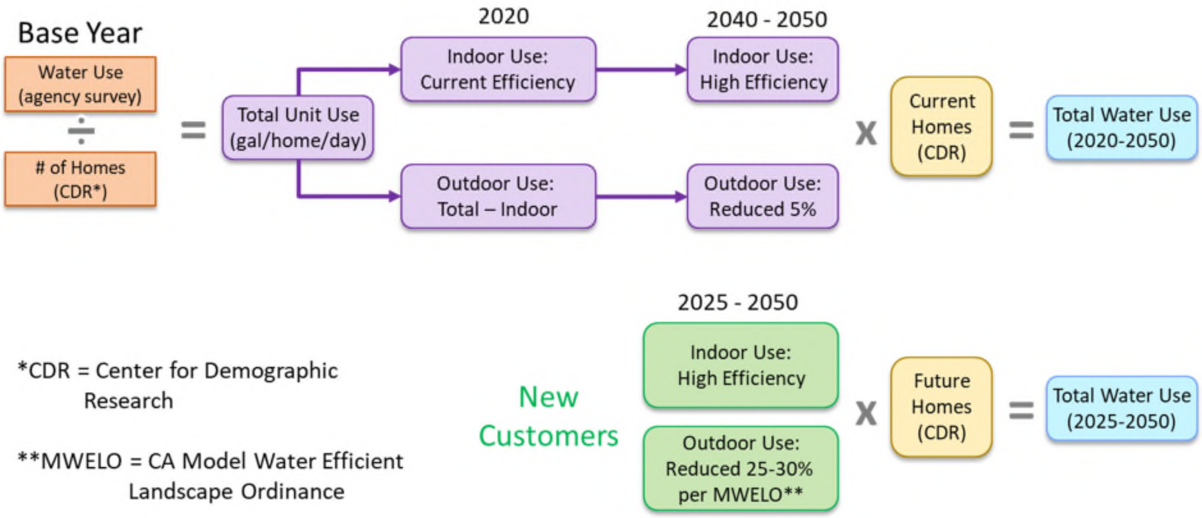


Figure 4-1: Water Use Projection Methodology Diagram

Existing and projected population, single-family and multifamily households for each retail water agency were provided by CDR under contract by MWDOC and OCWD. CDR provides historical and future demographics by census tracts for all of Orange County (Section 3.4). Census tract data is then clipped to retail water agency service boundaries in order to produce historical and projected demographic data by agency.

For the CII water demands, which have been fairly stable from a unit use perspective (gallons/account/day), it was assumed that the unit demand in FY 2019-20 would remain the same from 2020-2025 to represent COVID-19 impacts. Reviewing agency water use data from FY 2017-18 through FY2019-20 revealed that residential water use increased slightly in FY 2019-20 while CII demands decreased slightly as a result of COVID-19. From 2030 to 2050, the average CII unit use from FY 2017-18 and 2018-19 was used. These unit use factors were then multiplied by an assumed growth of CII accounts under three broad scenarios:

- Low Scenario – assuming no growth in CII accounts
- Mid Scenario – assuming 0.5% annual growth in CII accounts
- High Scenario – assuming 1.5% annual growth in CII accounts

For most retail agencies, the Mid Scenario of CII account growth was used, but for those retail agencies that have had faster historical growth the High Scenario was used. For those retail agencies that have had relatively stable CII water demand, the Low Scenario was used. For the City of Seal Beach, the mid-scenario was used.

For those agencies that supply recycled water for non-potable demands, MWDOC used agency-specified growth assumptions. Most agencies have already maximized their recycled water and thus are not expecting for this category of demand to grow. However, a few agencies in South Orange County do expect moderate growth in recycled water customers.

For large landscape customers served currently by potable water use, MWDOC assumed these demands to be constant through 2050, except for agencies that have growing recycled water demands. For the agencies that have growing recycled water demands, large landscape demands served by potable water reduced accordingly. For non-revenue water, which represents the difference in total water production less all water billed to customers, this percentage was held constant through 2050. Note that 2050 data was not presented in the UWMP.

A member agency's water use demand projection is the summation of their residential water demand, CII demands, large landscape and recycled water demands, and water losses all projected over the 25-year time horizon. These demands were provided to each of the Orange County water agencies for their review, feedback, and revision before being finalized.

The MWDOC regional water demand projection was collaboratively developed between MWDOC and its member agencies. MWDOC's projections were built upon the same model developed by CDM Smith, and took into consideration specific assumptions and projections provided to MWDOC by its member agencies.

4.3.1.1 Weather Variability and Long-Term Climate Change Impacts

In any given year water demands can vary substantially due to weather. In addition, long-term climate change can have an impact on water demands into the future. For the 2014 OC Water Reliability Study, CDM Smith developed a statistical model of total water monthly production from 1990 to 2014 from a sample of retail water agencies. This model removed impacts from population growth, the economy and drought restrictions in order to estimate the impact on water use from temperature and precipitation.

The results of this statistical analysis are:

- Hot/dry weather demands will be 5.5% greater than current average weather demands
- Cooler/wet weather demands will be 6% lower than current average weather demands
- Climate change impacts will increase current average weather demands by:
    - 2% in 2030
    - 4% in 2040
    - 6% in 2050

4.3.2 25-Year Water Use Projection

The projected demand values were provided by MWDOC and reviewed by the City as part of the UWMP effort. As the regional wholesale supplier for much of Orange County, MWDOC works in collaboration with each of its retail agencies as well as MET, its wholesaler, to develop demand projections for imported water. The City has been proactively decreasing its reliance on imported water by pursuing a variety of water conservation strategies within the service area. Future water savings and low-income water use are included in these projected values.

4.3.2.1 Water Use Projections for 2021-2025

The water use projection for normal year conditions without drought conditions for 2021-2025 is presented in Table 4-2. A linear decrease in total water demand is expected between 2021 and 2025. This table will be adjusted to estimate the five-years' cumulative drought effects as described in the five-year DRA in Section 7.

Table 4-2: Water Use Projections for 2021 to 2025

Retail: Total Water Demand					
FY Ending	2021	2022	2023	2024	2025
Total Water Demand (AF)	3,254	3,234	3,215	3,195	3,175
NOTES:					

Water Use Projections for 2025-2045Table 4-3 is a projection of the City's water demand for 2025-2045. The volume of residential use is projected to decrease in this timeframe, while usage by CII is projected to increase. CII projections for 2025 through 2045 were broken down into commercial, industrial, and institutional/governmental using proportions reported for each billing sector in FY 2019-20. Demands for large landscape applications are projected to stay consistent, while projections for the volume of NRW loss slightly increase (although holds constant as a percentage of total water use).

The demand data presented in this section accounts for passive savings in the future. Passive savings are water savings as a result of codes, standards, ordinances and public outreach on water conservation and higher efficiency fixtures. Passive savings are anticipated to continue through 2045 and will result in continued water saving and reduced consumption levels. Permanent water conservation requirements and water conservation strategies are discussed in Section 8 and 9 of this document.

Table 4-3: Retail: Use for Potable and Non-Potable Water - Projected

DWR Submittal Table 4-2 Retail: Use for Potable and Non-Potable Water - Projected						
Use Type	Additional Description	Projected Water Use				
		2025	2030	2035	2040	2045
Single/Multi- Family Residential	See note below	2,467	2,442	2,417	2,393	2,382
Commercial		490	663	663	663	663
Institutional/Governmental		111	150	150	150	150
Landscape		24	24	24	24	24
Losses	Non-revenue water	84	89	89	88	88
	TOTAL	3,175	3,368	3,342	3,317	3,306
NOTES: Residential demands combined in current billing system. Beginning Summer 2021, the City's billing system will account for SF and MF residential usage separately.						

Based on the information provided above, the total demand for potable water is listed below in Table 4-4.

Table 4-4 Retail: Total Water Use (Potable and Non-Potable)

DWR Submittal Table 4-3 Retail: Total Gross Water Use (Potable and Non-Potable)						
	2020	2025	2030	2035	2040	2045
Potable Water, Raw, Other Non-potable	3,273	3,175	3,368	3,342	3,317	3,306
Recycled Water Demand	0	0	0	0	0	0
TOTAL WATER USE	3,273	3,175	3,368	3,342	3,317	3,306
NOTES: Volumes in AF.						

The City has been proactively decreasing its reliance on imported water by pursuing a variety of water conservation strategies. Future water savings and low-income water use are included in these projected values (Table 4-5).

Table 4-5: Retail Only: Inclusion in Water Use Projections

DWR Submittal Table 4-5 Retail Only: Inclusion in Water Use Projections	
Are Future Water Savings Included in Projections? (Refer to Appendix K of UWMP Guidebook)	Yes
If "Yes" to above, state the section or page number, in the cell to the right, where citations of the codes, ordinances, etc. utilized in demand projections are found.	Section 8 and 9
Are Lower Income Residential Demands Included in Projections?	Yes
NOTES:	

4.3.2.2 Water Use Projections for Lower Income Households

Since 2010, the UWMP Act has required retail water suppliers to include water use projections for single-family and multi-family residential housing for lower income and affordable households. This will assist the City in complying with the requirement under Government Code Section 65589.7 granting priority for providing water service to lower income households. A lower income household is defined as a household earning below 80% of the MHI.

DWR recommends retail suppliers rely on the housing elements of city or county general plans to quantify planned lower income housing with the City's service area (DWR, 2020). RHNA assists jurisdictions in updating general plan's housing elements section. The RHNA identifies additional housing needs and assesses households by income level for the City through 2010 decennial Census and 2005-2009 American Community Survey data. The sixth cycle of the RHNA covers the planning period of October 2021 to October 2029. The SCAG adopted the RHNA Allocation Plan for this cycle on March 4, 2021. The California Department of Housing and Community Development reviewed the housing elements data submitted by jurisdictions in the SCAG region and concluded the data meets statutory requirements for the assessment of current housing needs.

Under the assumption that the RHNA household allocations adequately represent ratios of the City's overall future income categories (not the exact ratio of all household by income but a conservative one for low-income household estimates), the RHNA low-income percentage can be used to estimate future low income demands. One objective of RHNA is to increase affordable housing, therefore RHNA has been allocating additional low-income households to various regions. Because relying on the RHNA distribution of households by income category is likely to produce an overestimate of low-income water demands, this approach represents a conservative projection of future low-income water use.

Table 4-6 presents the City's RHNA housing allocation. RHNA classifies low income housing into two categories: very low income (<30% - 50% MHI), and low income (51% - 80% MHI). Altogether 36.9% of the City's allocated housing need for the planning period of October 2021 to October 2029 are considered low-income housing (SCAG, 2021).

Table 4-6: SCAG 6th Cycle Household Allocation Based on Median Household Income

Household Category by Income	Number of Households	% of Total Allocated Households
Very Low Income	258	20.8%
Low Income	201	16.2%
Moderate Income	239	19.2%
Above Moderate Income	545	43.8%
Total Future Allocated Households	1,243	100.0%

By applying the percentage of low-income housing from the SCAG report to the total projected SF/MF residential demand calculated in Table 4-3 above, low-income demand can be conservatively estimated through 2045. For example, the total low-income residential demand (SF and MF residential use) is projected to be 911 AF in 2025 and 880 AF in 2045 (Table 4-7).

Table 4-7: Projected Water Use for Housing Needed for Low Income Households (AF)

Water Use Sector	FY Ending				
	2025	2030	2035	2040	2045
Total Residential Demand (AF)	2,467	2,442	2,417	2,393	2,382
SF and MF Residential Demand – Low Income Households (AF)	911	902	893	884	880
Total Low Income Households Demand (AF)	911	902	893	884	880
NOTES: Residential demands combined in current billing system. Beginning Summer 2021, the City's billing system will account for SF and MF residential usage separately.					

4.4 Water Loss

The City has conducted annual water loss audit since 2016 per the American Water Works Association (AWWA) methodology per SB 555 to understand the relationship between water loss, operating costs, and revenue losses. NRW for CY 2016-2019 (Figure 4-2) consists of three components: real losses (e.g., leakage in mains and service lines, and storage tank overflows), apparent losses (unauthorized consumption, customer metering inaccuracies and systematic data handling errors), and unbilled water (e.g., hydrant flushing, firefighting, and blow-off water from well start-ups). The City's real losses ranged from 103 AFY to 196 AFY and apparent losses ranged from 23 AFY to 37 AFY in the last four years. The unbilled water ranged from 128 AFY to 182 AFY in the last four year.

In the latest water loss audit (CY 2019), the City's total water loss was 220 AFY (Table 4-8), compared to the total water use of 3,221 AF in the same timeframe. The total water loss consists of real loss of 190 AFY and apparent loss of 30 AFY in CY 2019. The NRW was 347 AFY. The reported active and inactive service connections were relatively consistent in the last four years with 5,428 connections in CY 2019. The real loss performance indicator was 31 gals/connection/day in CY 2019. Figure 4-3 presents the performance indicators of gallons of real and apparent loss per connection per day. Understanding and controlling water loss from a distribution system is an effective way for the City to achieve regulatory standards and manage their existing resources. The California State Water Resources Control Board (SWRCB) is still developing water loss performance standards; these standards have not yet been adopted.

Table 4-8: Retail: Last 5 Years of Water Loss Audit Reporting

Submittal Table 4-4 Retail: Last Five Years of Water Loss Audit Reporting

Reporting Period Start Date	Volume of Water Loss [1,2]
01/2016	233
01/2017	212
01/2018	136
01/2019	220

[1] Taken from the field "Water Losses" (a combination of apparent losses and real losses) from the AWWA worksheet.

*[2] **Units of measure (AF, CCF, MG)** must remain consistent throughout the UWMP as reported in Table 2-3.*

NOTES: Water loss in AFY. No water loss audit available for CY 2015.

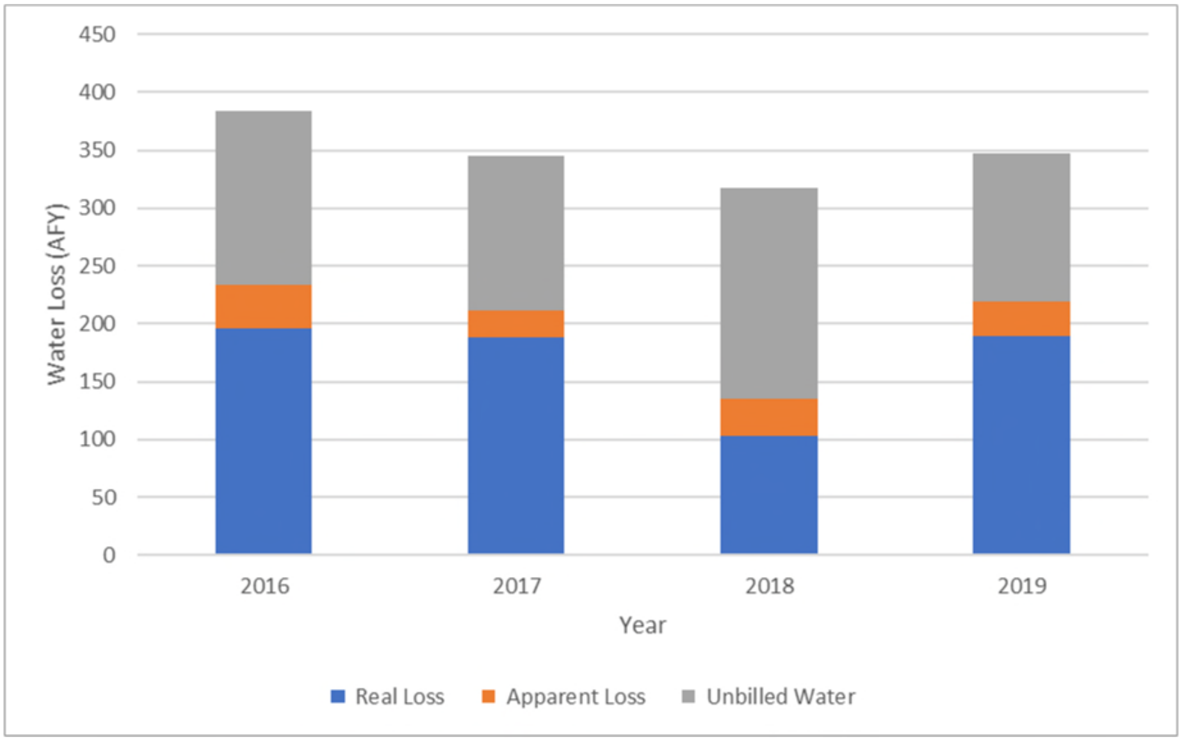


Figure 4-2: Water Loss Audit for CY2016-2019

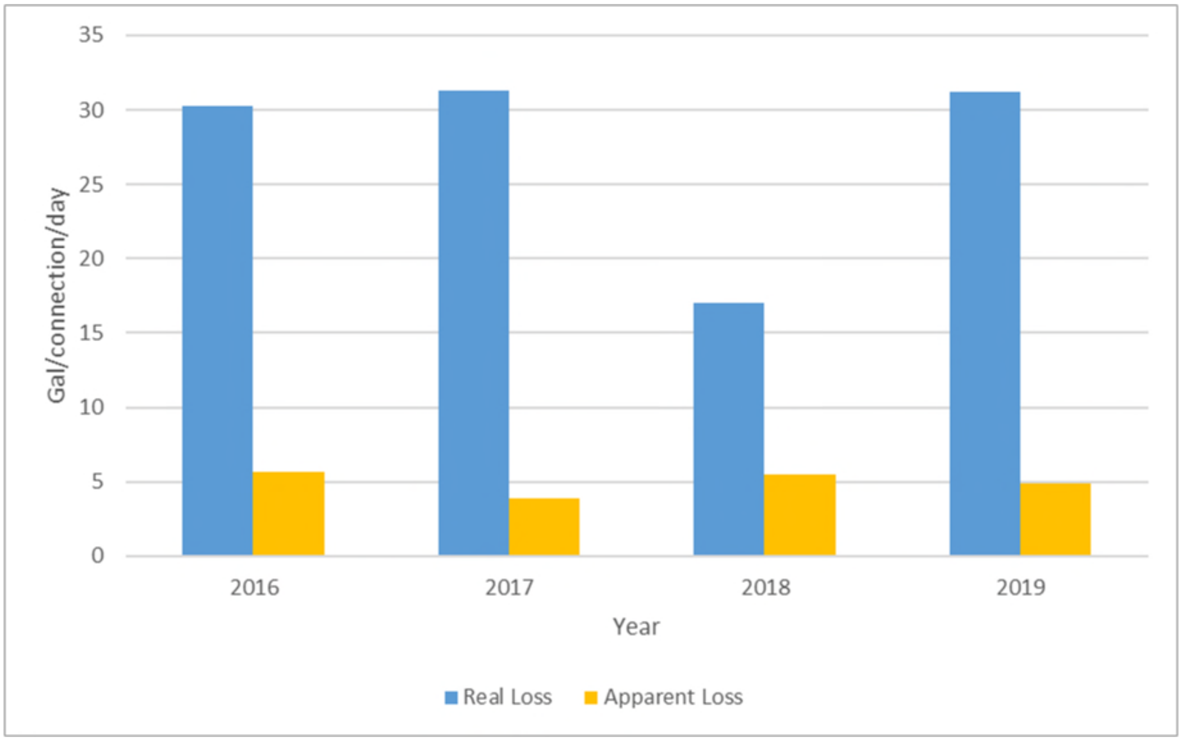


Figure 4-3: Water Loss Performance Indicators for CY2016-2019

5 CONSERVATION TARGET COMPLIANCE

The Water Conservation Act of 2009, also known as SBx7-7 (Senate Bill 7 as part of the Seventh Extraordinary Session), signed into law on February 3, 2010, requires the State of California to reduce urban water use by 20% by the year 2020 (20x2020). To achieve this each retail urban water supplier must determine baseline water use during their baseline period and target water use for the years 2015 and 2020 to meet the state's water reduction goal. Retail water suppliers are required to comply with SBx7-7 individually or as a region in collaboration with other retail water suppliers, or demonstrate they have a plan or have secured funding to be in compliance, in order to be eligible for water related state grants and loans on or after July 16, 2016.

The City's actual 2020 water use is lower than its 2020 water use target, therefore, demonstrating compliance with SBx7-7. In its 2015 UWMP, the City revised its baseline per capita water use calculations using 2010 U.S. Census data. Changes in the baseline calculations resulted in updated per capita water use targets.

The following sections describe the efforts by the City to comply with the requirements of SBx7-7 and efforts by MWDOC to assist retail agencies, including the formation of a Regional Alliance to provide additional flexibility to all water suppliers in Orange County. A discussion of programs implemented to support retail agencies in achieving their per capita water reduction goals is covered in Section 9 – Demand Management Measures of this UWMP.

Complimentary to information presented in this section are SBx7-7 Verification and Compliance Forms, a set of standardized tables required by DWR to demonstrate compliance with the Water Conservation Act in this 2020 UWMP (Appendix D) including calculations of recycled water used for groundwater recharge (indirect reuse) to offset a portion of the agency's potable demand when meeting the regional as well as individual water use targets.

5.1 Baseline Water Use

The baseline water use is the City's gross water use divided by its service area population, reported in GPCD. Gross water use is a measure of water that enters the distribution system of the supplier over a 12-month period with certain allowable exclusions. These exclusions are:

- Recycled water delivered within the service area
- Indirect recycled water
- Water placed in long term storage
- Water conveyed to another urban supplier
- Water delivered for agricultural use
- Process water

Water suppliers within the OCWD Groundwater Basin, including the City, have the option of choosing to deduct recycled water used for indirect potable reuse (IPR) from their gross water use to account for the recharge of recycled water into the OC Basin by OCWD, historically through Water Factory 21 (WF-21), and now by the GWRS.

Water suppliers must report baseline water use for two baseline periods, the 10- to 15-year baseline (baseline GPCD) and the five-year baseline (target confirmation) as described below.

5.1.1 Ten to 15-Year Baseline Period (Baseline GPCD)

The first step to calculating the City's water use targets is to determine its base daily per capita water use (baseline water use). The baseline water use is calculated as a continuous (rolling) 10-year average during a period, which ends no earlier than December 31, 2004 and no later than December 31, 2010. Water suppliers whose recycled water made up 10% or more of their 2008 retail water delivery can use up to a 15-year average for the calculation. Recycled water use was less than 10% of the City's retail delivery in 2008; therefore, a 10-year baseline period is used.

The City's baseline water use is 156 GPCD, obtained from the 10-year period July 1, 1998 to June 30, 2008.

5.1.2 Five-Year Baseline Period (Target Confirmation)

Water suppliers are required to calculate water use, in GPCD, for a five-year baseline period. This number is used to confirm that the selected 2020 target meets the minimum water use reduction requirements. Regardless of the compliance option adopted by the City, it will need to meet a minimum water use target of 5% reduction from the five-year baseline water use. This five-year baseline water use is calculated as a continuous five-year average during a period, which ends no earlier than December 31, 2007 and no later than December 31, 2010. The City's five-year baseline water use is 155 GPCD, obtained from the five-year period July 1, 2003 to June 30, 2008.

5.1.3 Service Area Population

The City's service area boundaries correspond with the boundaries for a city or census designated place. This allows the City to use service area population estimates prepared by the DOF. CDR is the entity which compiles population data for Orange County based on DOF data. The calculation of the City's baseline water use and water use targets in the 2010 UWMP was based on the 2000 U.S. Census population numbers obtained from CDR. The baseline water use and water use targets in the 2015 UWMP were revised based on the 2010 U.S. Census population obtained from CDR in 2012. That baseline remained in use in the 2020 calculations.

5.2 SBx7-7 Water Use Targets

In the 2020 UWMP, the City may update its 2020 water use target by selecting a different target method than what was used previously. The target methods and determination of the 2015 and 2020 targets are described below. The City selected Option 3 consistent with 2015 and maintained the same 2015 and 2020 target water uses as reported in its 2015 UWMP.

5.2.1 SBx7-7 Target Methods

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

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

With MWDOC's assistance in the calculation of the City's base daily per capita use and water use targets, the City selected to comply with Option 3 consistent with the option selected in 2010 and 2015.

5.2.2 2020 Targets and Compliance

Under Compliance Option 3, to achieve 95% of the South Coast Hydrologic Region target as set forth in the State's 20x2020 Water Conservation Plan, the City's 2020 target is 142 GPCD as summarized in Table 5-1. In addition, the confirmed 2020 target needs to meet a minimum of 5% reduction from the five-year baseline water use.

Table 5-1: Baselines and Targets Summary

DWR Submittal Table 5-1 Baselines and Targets Summary From SB X7-7 Verification Form				
Baseline Period	Start Year *	End Year *	Average Baseline GPCD*	Confirmed 2020 Target*
10-15 year	*1999*	*2008*	*156*	*142*
5 Year	*2004*	*2008*	*155*	
**All cells in this table should be populated manually from the supplier's SBX7-7 Verification Form and reported in Gallons per Capita per Day (GPCD)*				
NOTES:				

The City's actual 2020 consumption is 95 GPCD which is below its 2020 target of 142 GPCD (Table 5-2). The City met its 2020 water use target and is in compliance with SBx7-7.

Table 5-2: 2020 Compliance

DWR Submittal Table 5-2: 2020 Compliance From SB X7-7 2020 Compliance Form				
2020 GPCD			2020 Confirmed Target GPCD*	Did Supplier Achieve Targeted Reduction for 2020?
Actual 2020 GPCD*	2020 TOTAL Adjustments*	Adjusted 2020 GPCD*		
95	0	95	142	Y
**All cells in this table should be populated manually from the supplier's SBX7-7 2020 Compliance Form and reported in Gallons per Capita per Day (GPCD)*				
NOTES:				

5.3 Orange County 20x2020 Regional Alliance

A retail supplier may choose to meet the SBx7-7 targets on its own or it may form a regional alliance with other retail suppliers to meet the water use target as a region. Within a Regional Alliance, each retail water supplier will have an additional opportunity to achieve compliance under both an individual target and a regional target.

- If the Regional Alliance meets its water use target on a regional basis, all agencies in the alliance are deemed compliant.

- If the Regional Alliance fails to meet its water use target, each individual supplier will have an opportunity to meet their water use targets individually.

The City is a member of the Orange County 20x2020 Regional Alliance formed by MWDOC, its wholesaler. This regional alliance consists of 29 retail agencies in Orange County as described in MWDOC's 2020 UWMP. MWDOC provides assistance in the calculation of each retail agency's baseline water use and water use targets.

In 2015, the regional baseline and targets were revised to account for any revisions made by the retail agencies to their individual 2015 and 2020 targets. The regional water use target is the weighted average of the individual retail agencies' targets (by population). The Orange County 20x2020 Regional Alliance weighted 2020 target is 159 GPCD. The actual 2020 water use in the region is 109 GPCD, i.e., the region met its 2020 GPCD goal.

6 WATER SUPPLY CHARACTERIZATION

As a counterpart to Section 4's Water Use Characterization, this section characterizes the City's Water Supply. This section includes identification and quantification of water supply sources through 2045, descriptions of each water supply source and their management, opportunities for exchanges and transfers, and discussion regarding any planned future water supply projects. This section also includes the energy intensity of the water service, a new UWMP requirement.

6.1 Water Supply Overview

The City meets its demands with a combination of imported water and local groundwater. The City works together with two primary agencies, MWDOC and OCWD, to ensure a safe and reliable water supply that will continue to serve the community in periods of drought and shortage. The sources of imported water supplies include water from the Colorado River and the SWP provided by MET and delivered through MWDOC.

The City's main source of water supply is groundwater from the Orange County Groundwater Basin. Imported water makes up the rest of the City's water supply portfolio. In FY 2019-20, the City relied on 65% groundwater and 35% imported water (Table 6-1).

It is projected that by 2045, the water supply portfolio will change to approximately 85% groundwater and 15% imported water (Table 6-2 and Figure 6-1). Note that these representations of supply match the projected demand. However, the City can purchase more MET water through MWDOC, should the need arise. Additionally, GWRS supplies are included as part of groundwater pumping numbers.

The following subsections provide a detailed discussion of the City's water sources as well as the future water supply portfolio for the next 25 years.

Table 6-1: Retail: Water Supplies – Actual

DWR Submittal Table 6-8 Retail: Water Supplies — Actual			
Water Supply	Additional Detail on Water Supply	2020	
		Actual Volume (AF)	Water Quality
Groundwater (not desalinated)	Orange County Groundwater Basin	2,141	Drinking Water
Purchased or Imported Water	MWDOC	1,132	Drinking Water
	Total	3,273	
NOTES: Source – OC Retail Water Usage FY 2015 to FY 2020 (MWDOC, 2020)			

Table 6-2: Retail: Water Supplies – Projected

DWR Submittal Table 6-9 Retail: Water Supplies — Projected

Water Supply	Additional Detail on Water Supply	Projected Water Supply (AF)				
		2025	**2030**	**2035**	**2040**	**2045**
		Reasonably Available Volume	Reasonably Available Volume	Reasonably Available Volume	Reasonably Available Volume	Reasonably Available Volume
Groundwater (not desalinated)	Orange County Groundwater Basin	2,699	2,862	2,841	2,820	2,810
Purchased or Imported Water	MWDOC	476	505	501	498	496
	Total	3,175	3,368	3,342	3,317	3,306

NOTES:
Source - CDM Smith, 2021
Groundwater volumes assume OCWD’s basin production percentage (BPP) to be 85% starting in 2025 (Refer to Section 6.3.4). Volumes of groundwater and imported water may vary depending on OCWD's actual BPP projections, which are established annually.

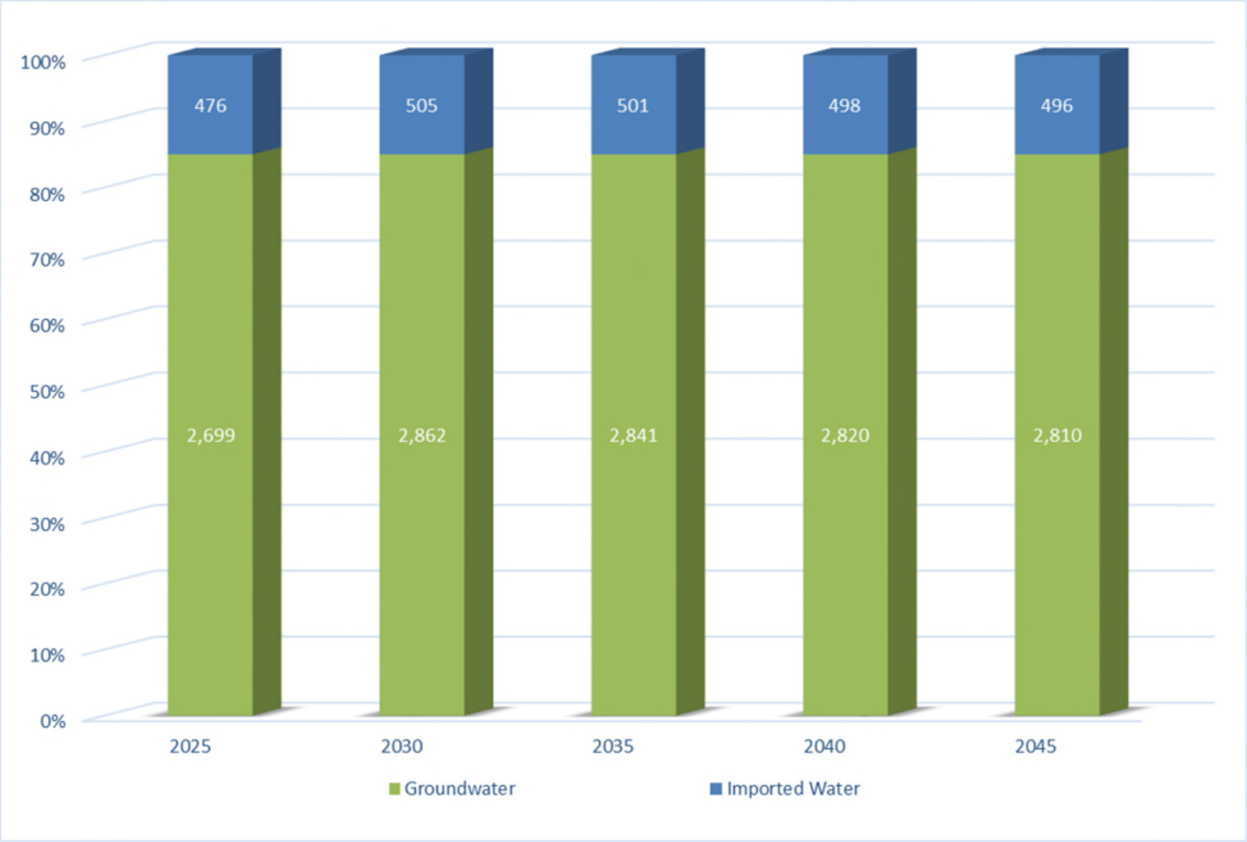


Figure 6-1: City's Projected Water Supply Sources (AF)

6.2 Imported Water

The City supplements its water supply with imported water purchased from MET through MWDOC. In FY 2019-20, the City relied on approximately 1,132 AFY – approximately 35% of the City's water supply portfolio for FY 2019-20 – of imported water from MET / MWDOC to meet its demands. MET's principal sources of water are the Colorado River via the CRA and the Lake Oroville watershed in Northern California through the SWP. For Orange County, the water obtained from these sources is treated at the Robert B. Diemer Filtration Plant located in Yorba Linda. Typically, the Diemer Filtration Plant receives a blend of Colorado River water from Lake Mathews through the MET Lower Feeder and SWP water through the Yorba Linda Feeder.

Imported water is supplied to the City by MWDOC via West Orange County Water Board (WOCWB), which is a joint powers agency formed in 1955 with the purpose of providing a reliable imported water supply to its member agencies. MWDOC supplies WOCWB member agencies imported water through two turnouts, OC-9 and OC-35. WOCWB Feeder No. 2 originates at OC-35 and conveys water to the City as well as to the Cities of Huntington Beach, Garden Grove, and Westminster. The maximum flow capacity at the City's turnout is 10 cubic feet per second (cfs).

Imported water is conveyed to the City via the OC-35 Connection to the MET system. The connection is located at Springdale Street and Westminster Avenue and is shared with the City of Huntington Beach, who is responsible for operating the facility and communicating flow data to MWDOC and MET. The maximum capacity of the connection for the City is 9.9 cfs (Seal Beach, 2012).

6.2.1 Colorado River Supplies

Background

The Colorado River was MET's original source of water after MET's establishment in 1928. The CRA, which is owned and operated by MET, transports water from the Colorado River to its terminus Lake Mathews, in Riverside County. The actual amount of water per year that may be conveyed through the CRA to MET's member agencies is subject to the availability of Colorado River water. Approximately 40 million people rely on the Colorado River and its tributaries for water with 5.5 million acres of land using Colorado River water for irrigation. The CRA includes supplies from the implementation of the Quantification Settlement Agreement and its related agreements to transfer water from agricultural agencies to urban uses. The 2003 Quantification Settlement Agreement enabled California to implement major Colorado River water conservation and transfer programs, in order to stabilize water supplies and reduce the state's demand on the river to its 4.4 MAF entitlement. Colorado River transactions are potentially available to supply additional water up to the CRA capacity of 1.25 million acre-feet (MAF) on an as-needed basis. Water from the Colorado River or its tributaries is available to users in California, Arizona, Colorado, Nevada, New Mexico, Utah, Wyoming, and Mexico. California is apportioned the use of 4.4 MAF of water from the Colorado River each year plus one-half of any surplus that may be available for use collectively in Arizona, California, and Nevada. In addition, California has historically been allowed to use Colorado River water apportioned to, but not used by, Arizona or Nevada. MET has a basic entitlement of 550,000 AFY of Colorado River water, plus surplus water up to an additional 662,000 AFY when the following conditions exists (MET, 2021):

- Water is unused by the California holders of priorities 1 through 3
- Water is saved by the Palo Verde land management, crop rotation, and water supply program
- When the U.S. Secretary of the Interior makes available either one or both of the following:
    - Surplus water
    - Colorado River water that is apportioned to but unused by Arizona and/or Nevada.

Current Conditions and Supply

MET has not received surplus water for a number of years. The Colorado River supply faces current and future imbalances between water supply and demand in the Colorado River Basin due to long-term drought conditions. Analysis of historical records suggests a potential change in the relationship between precipitation and runoff in the Colorado River Basin. The past 21 years (1999-2020) have seen an overall drying trend, even though the period included several wet or average years. The river basin has substantial storage capacity, but the significant reduction in system reservoir storage in the last two decades is great enough to consider the period a drought (DWR, 2020a). At the close of 2020, system storage was at or near its lowest since 2000, so there is very little buffer to avoid a shortage from any future period of reduced precipitation and runoff (MET, 2021). Looking ahead, the long-term imbalance in the Colorado River Basin's future supply and demand is projected to be approximately 3.2 MAF by the year 2060 (USBR, 2012).

Over the years, MET has helped fund and implement various programs to improve Colorado River supply reliability and help resolve the imbalance between supply and demand. Implementation of such programs have contributed to achievements like achieving a record low diversion of the Colorado River in 2019, a level not seen since the 1950s. Colorado River water management programs include:

- **Imperial Irrigation District / MET Conservation Program** – Under agreements executed in 1988 and 1989, this program allows MET to fund water efficiency improvements within Imperial Irrigation District's service area in return for the right to divert the water conserved by those investments. An average of 105,000 AFY of water has been conserved since the program's implementation.
- **Palo Verde Land Management, Crop Rotation, and Water Supply Program** – Authorized in 2004, this 35-year program allows MET to pay participating farmers to reduce their water use, and for MET to receive the saved water. Over the life of the program, an average of 84,500 AFY has been saved and made available to MET.
- **Bard Seasonal Fallowing Program** – Authorized in 2019, this program allows MET to pay participating farmers in Bard to reduce their water use between the late spring and summer months of selected years, which provides up to 6,000 AF of water to be available to MET in certain years.
- **Management of MET-Owned Land in Palo Verde** – Since 2001, MET has acquired approximately 21,000 acres of irrigable farmland that are leased to growers, with incentives to grow low water-using crops and experiment with low water-consumption practices. If long-term water savings are realized, MET may explore ways to formally account them for Colorado River supplies.
- **Southern Nevada Water Authority (SNWA) and MET Storage and Interstate Release Agreement** – Entered in 2004, this agreement allows SNWA to store its unused, conserved water with MET, in exchange for MET to receive additional Colorado River water supply. MET has relied on the additional water during dry years, especially during the 2011-2016 California drought, and SNWA is not expected to call upon MET to return water until after 2026.
- **Lower Colorado Water Supply Projects** – Authorized in 1980s, this project provides up to 10,000 AFY of water to certain entities that do not have or have insufficient rights to use Colorado River water. A contract executed in 2007 allowed MET to receive project water left unused by the project contractors along the River – nearly 10,000 AF was received by MET in 2019 and is estimated for 2020.
- **Exchange Programs** – MET is involved in separate exchange programs with the United States Bureau of Reclamation, which takes place at the Colorado River Intake and with San Diego County Water Authority (SDCWA), which exchanges conserved Colorado River water.
- **Lake Mead Storage Program** – Executed in 2006, this program allows MET to leave excessively conserved water in Lake Mead, for exclusive use by MET in later years.
- **Quagga Mussel Control Program** – Developed in 2007, this program introduced surveillance activities and control measures to combat quagga mussels, an invasive species that impact the Colorado River's water quality.

- **Lower Basin Drought Contingency Plan** – Signed in 2019, this agreement incentivizes storage in Lake Mead through 2026 and overall, it increases MET's flexibility to fill the CRA as needed (MET, 2021).

Future Programs / Plans

The Colorado River faces long-term challenges of water demands exceeding available supply with additional uncertainties due to climate change. Climate change impacts expected in the Colorado River Basin include the following:

- More frequent, more intense, and longer lasting droughts, which will result in water deficits
- Continued dryness in the Colorado River Basin, which will increase the likelihood of triggering a first-ever shortage in the Lower Basin
- Increased temperatures, which will affect the percentage of precipitation that falls as rain or snow, as well as the amount and timing of mountain snowpack (DWR, 2020b)

Acknowledging the various uncertainties regarding reliability, MET plans to continue ongoing programs, such as those listed earlier in this section. Additionally, MET supports increasing water recycling in the Colorado River Basin and is in the process of developing additional transfer programs for the future (MET, 2021).

6.2.2 State Water Project Supplies

Background

The SWP consists of a series of pump stations, reservoirs, aqueducts, tunnels, and power plants operated by DWR and is an integral part of the effort to ensure that business and industry, urban and suburban residents, and farmers throughout much of California have sufficient water. Water from the SWP originates at Lake Oroville, which is located on the Feather River in Northern California. Much of the SWP water supply passes through the Delta. The SWP is the largest state-built, multipurpose, user-financed water project in the United States. Nearly two-thirds of residents in California receive at least part of their water from the SWP, with approximately 70% of SWP's contracted water supply going to urban users and 30% to agricultural users. The primary purpose of the SWP is to divert and store water during wet periods in Northern and Central California and distribute it to areas of need in Northern California, the San Francisco Bay area, the San Joaquin Valley, the Central Coast, and Southern California (MET, 2021).

The Delta is key to the SWP's ability to deliver water to its agricultural and urban contractors. All but five of the 29 SWP contractors receive water deliveries below the Delta (pumped via the Harvey O. Banks or Barker Slough pumping plants). However, the Delta faces many challenges concerning its long-term sustainability such as climate change posing a threat of increased variability in floods and droughts. Sea level rise complicates efforts in managing salinity levels and preserving water quality in the Delta to ensure a suitable water supply for urban and agricultural use. Furthermore, other challenges include continued subsidence of Delta islands, many of which are below sea level, and the related threat of a catastrophic levee failure as the water pressure increases, or as a result of a major seismic event.

Current Conditions and Supply

“Table A” water is the maximum entitlement of SWP water for each water contracting agency. Currently, the combined maximum Table A amount is 4.17 million acre-feet per year (MAFY). Of this amount, 4.13 MAFY is the maximum Table A water available for delivery from the Delta. On average, deliveries are approximately 60% of the maximum Table A amount (DWR, 2020b).

SWP contractors may receive Article 21 water on a short-term basis in addition to Table A water if requested. Article 21 of SWP contracts allows contractors to receive additional water deliveries only under specific conditions, generally during wet months of the year (December through March). Because a SWP contractor must have an immediate use for Article 21 supply or a place to store it outside of the SWP, there are few contractors like MET that can access such supplies.

Carryover water is SWP water allocated to an SWP contractor and approved for delivery to the contractor in a given year, but not used by the end of the year. The unused water is stored in the SWP’s share of San Luis Reservoir, when space is available, for the contractor to use in the following year.

Turnback pool water is Table A water that has been allocated to SWP contractors that has exceeded their demands. This water can then be purchased by another contractor depending on its availability.

SWP Delta exports are the water supplies that are transferred directly to SWP contractors or to San Luis Reservoir storage south of the Delta via the Harvey O. Banks pumping plant. Estimated average annual Delta exports and SWP Table A water deliveries have generally decreased since 2005, when Delta export regulations affecting SWP pumping operations became more restrictive due to federal biological opinions (Biops). The Biops protect species listed as threatened or endangered under the federal and state Endangered Species Acts (ESAs) and affect the SWP’s water delivery capability because they restrict SWP exports in the Delta and include Delta outflow requirements during certain times of the year, thus reducing the available supply for export or storage.

Before being updated by the 2019 Long-Term Operations Plan, the prior 2008 and 2009 Biops resulted in an estimated reduction in SWP deliveries of 0.3 MAF during critically dry years to 1.3 MAF in above normal water years as compared to the previous baseline. However, the 2019 Long-Term Operations Plan and Biops are expected to increase SWP deliveries by an annual average of 20,000 AF as compared to the previous Biops (MET, 2021). Average Table A deliveries decreased in the 2019 SWP Final Delivery Capability Report compared to 2017, mainly due to the 2018 Coordinated Operation Agreement (COA) Addendum and the increase in the end of September storage target for Lake Oroville. Other factors that also affected deliveries included changes in regulations associated with the Incidental Take Permit (ITP) and the Reinitiation of Consultation for Long-Term Operations (RoC on LTO), a shift in Table A to Article 21 deliveries which occurred due to higher storage in SWP San Luis, and other operational updates to the SWP and federal Central Valley Project (CVP) (DWR, 2020b). Since 2005, there are similar decreasing trends for both the average annual Delta exports and the average annual Table A deliveries (Table 6-3).

Table 6-3: MET SWP Program Capabilities

Year	Average Annual Delta Exports (MAF)	Average Annual Table A Deliveries (MAF)
2005	2.96	2.82
2013	2.61	2.55
2019	2.52	2.41
Percent Change*	-14.8%	-14.3%

*Percent change is between the years 2019 and 2005.

Ongoing regulatory restrictions, such as those imposed by the Biops on the effects of SWP and the CVP operations on certain marine life, also contribute to the challenge of determining the SWP's water delivery reliability. In dry, below-normal conditions, MET has increased the supplies delivered through the California Aqueduct by developing flexible CVP/SWP storage and transfer programs. The goal of the storage/transfer programs is to develop additional dry-year supplies that can be conveyed through the available Harvey O. Banks pumping plant capacity to maximize deliveries through the California Aqueduct during dry hydrologic conditions and regulatory restrictions. In addition, SWRCB has set water quality objectives that must be met by the SWP including minimum Delta outflows, limits on SWP and CVP Delta exports, and maximum allowable salinity level.

The following factors affect the ability to estimate existing and future water delivery reliability:

- **Water availability at the source:** Availability can be highly variable and depends on the amount and timing of rain and snow that fall in any given year. Generally, during a single-dry year or two, surface and groundwater storage can supply most water deliveries, but multiple-dry years can result in critically low water reserves. Fisheries issues can also restrict the operations of the export pumps even when water supplies are available.
- **Water rights with priority over the SWP:** Water users with prior water rights are assigned higher priority in DWR's modeling of the SWP's water delivery reliability, even ahead of SWP Table A water.
- **Climate change:** Mean temperatures are predicted to vary more significantly than previously expected. This change in climate is anticipated to bring warmer winter storms that result in less snowfall at lower elevations, reducing total snowpack. From historical data, DWR projects that by 2050, the Sierra snowpack will be reduced from its historical average by 25 to 40%. Increased precipitation as rain could result in a larger number of "rain-on-snow" events, causing snow to melt earlier in the year and over fewer days than historically, affecting the availability of water for pumping by the SWP during summer. Furthermore, water quality may be adversely affected due to the anticipated increase in wildfires. Rising sea levels may result in potential pumping cutbacks on the SWP and CVP.
- **Regulatory restrictions on SWP Delta exports:** The Biops protect special-status species such as delta smelt and spring- and winter-run Chinook salmon and imposed substantial constraints on

Delta water supply operations through requirements for Delta inflow and outflow and export pumping restrictions. Restrictions on SWP operations imposed by state and federal agencies contribute substantially to the challenge of accurately determining the SWP's water delivery reliability in any given year (DWR, 2020b).

- **Ongoing environmental and policy planning efforts:** Governor Gavin Newsom ended California WaterFix in May 2019 and announced a new approach to modernize Delta Conveyance through a single tunnel alternative. The EcoRestore Program aims to restore at least 30,000 acres of Delta habitat, with the near-term goal of making significant strides toward that objective by 2020 (DWR, 2020b).
- **Delta levee failure:** The levees are vulnerable to failure because most original levees were simply built with soils dredged from nearby channels and were not engineered. A breach of one or more levees and island flooding could affect Delta water quality and SWP operations for several months. When islands are flooded, DWR may need to drastically decrease or even cease SWP Delta exports to evaluate damage caused by salinity in the Delta.

Operational constraints will likely continue until a long-term solution to the problems in the Bay-Delta is identified and implemented. New Biops for listed species under the Federal ESA or by the California Department of Fish and Game's issuance of incidental take authorizations under the Federal ESA and California ESA might further adversely affect SWP and CVP operations. Additionally, new litigation, listings of additional species or new regulatory requirements could further adversely affect SWP operations in the future by requiring additional export reductions, releases of additional water from storage or other operational changes impacting water supply operations.

Future Programs / Plans

MET's Board approved a Delta Action Plan in June 2007 that provides a framework for staff to pursue actions with other agencies and stakeholders to build a sustainable Delta and reduce conflicts between water supply conveyance and the environment. The Delta Action Plan aims to prioritize immediate short-term actions to stabilize the Delta while an ultimate solution is selected, and mid-term steps to maintain the Delta while a long-term solution is implemented. Currently, MET is working towards addressing four elements: Delta ecosystem restoration, water supply conveyance, flood control protection, and storage development.

In May 2019, Governor Newsom ended California WaterFix, announced a new approach to modernize Delta Conveyance through a single tunnel alternative, and released Executive Order 10-19 that directed state agencies to inventory and assess new planning for the project. DWR then withdrew all project approvals and permit applications for California WaterFix, effectively ending the project. The purpose of the Delta Conveyance Project (DCP) gives rise to several project objectives (MET, 2021). In proposing to make physical improvements to the SWP Delta conveyance system, the project objectives are:

- To address anticipated rising sea levels and other reasonably foreseeable consequences of climate change and extreme weather events.
- To minimize the potential for public health and safety impacts from reduced quantity and quality of SWP water deliveries, and potentially CVP water deliveries, south of the Delta resulting from a

major earthquake that causes breaching of Delta levees and the inundation of brackish water into the areas in which existing pumping plants operate.

- To protect the ability of the SWP, and potentially the CVP, to deliver water when hydrologic conditions result in the availability of sufficient amounts, consistent with the requirements of state and federal law.
- To provide operational flexibility to improve aquatic conditions in the Delta and better manage risks of further regulatory constraints on project operations.

6.2.3 Storage

Storage is a major component of MET's dry year resource management strategy. MET's likelihood of having adequate supply capability to meet projected demands, without implementing its Water Supply Allocation Plan (WSAP), is dependent on its storage resources. Due to the pattern of generally drier hydrology, the groundwater basins and local reservoirs have dropped to low operating levels and remain below healthy storage levels. For example, the Colorado River Basin's system storage at the close of 2020, was at or near its lowest since 2000, so there is very little buffer to avoid a shortage from any future period of reduced precipitation and runoff (MET, 2021).

MET stores water in both DWR and MET surface water reservoirs. MET's surface water reservoirs are Lake Mathews, Lake Skinner, and Diamond Valley Lake (DVL), which have a combined storage capacity of over 1 MAF. Approximately 650,000 AF are stored for seasonal, regulatory, and drought use, while approximately 370,000 AF are stored for emergency use.

MET also has contractual rights to DWR surface Reservoirs, such as 65 thousand acre-feet (TAF) of flexible storage at Lake Perris (East Branch terminal reservoir) and 154 TAF of flexible storage at Castaic Lake (West Branch terminal reservoir) that provides MET with additional options for managing SWP deliveries to maximize the yield from the project. This storage can provide MET with up to 44 TAF of additional supply over multiple dry years, or up to 219 TAF to Southern California in a single dry year (MET, 2021).

MET endeavors to increase the reliability of water supplies through the development of flexible storage and transfer programs including groundwater storage (MET, 2021). These include:

- **Lake Mead Storage Program:** Executed in 2006, this program allows MET to leave excessively conserved water in Lake Mead, for exclusive use by MET in later years. MET created "Intentionally Created Surplus" (ICS) water in 2006-2007, 2009-2012, and 2016-2019, and withdrew ICS water in 2008 and 2013-2015. As of January 1, 2021, MET had a total of 1.3 MAF of Extraordinary Conservation ICS water.
- **Semitropic Storage Program:** The maximum storage capacity of the program is 350 TAF, and the minimum and maximum annual yields available to MET are 34.7 TAF and 236.2 TAF, respectively. The specific amount of water MET can expect to store in and subsequently receive from the program depends on hydrologic conditions, any regulatory requirements restricting MET's ability to export water for storage and demands placed by other program participants. During wet years, MET has the discretion to use the program to store portions of its SWP supplies which are in excess, and during dry years, the Semitropic Water Storage District returns

MET's previously stored water to MET by direct groundwater pump-in or by exchange of surface water supplies.

- **Arvin-Edison Storage Program:** The storage program is estimated to deliver 75 TAF, and the specific amount of water MET can expect to store in and subsequently receive from the program depends on hydrologic conditions and any regulatory requirements restricting MET's ability to export water for storage. During wet years, MET has the discretion to use to program to store portions of its SWP supplies which are in excess, and during dry years, the Arvin-Edison Water Storage District returns MET's previously stored water to MET by direct groundwater pump-in or by exchange of surface water supplies.
- **Antelope Valley-East Kern (AVEK) Water Agency Exchange and Storage Program:** Under the exchange program, for every two AF MET receives, MET returns 1 AF back to AVEK, and MET will also be able to store up to 30 TAF in the AVEK's groundwater basin, with a dry-year return capability of 10 TAF.
- **High Desert Water Bank Program:** Under this program, MET will have the ability to store up to 280 TAF of its SWP Table A or other supplies in the Antelope Valley groundwater basin, and in exchange will provide funding for the construction of monitoring and production wells, turnouts from the California Aqueduct, pipelines, recharge basins, water storage, and booster pump facilities. The project is anticipated to be in operation by 2025.
- **Kern-Delta Water District Storage Program:** This groundwater storage program has 250 TAF of storage capacity, and water for storage can either be directly recharged into the groundwater basin or delivered to Kern-Delta Water District farmers in lieu of pumping groundwater. During dry years, the Kern-Delta Water District returns MET's previously stored water to MET by direct groundwater pump-in return or by exchange of surface water supplies.

- **Mojave Storage Program:** MET entered into a groundwater banking and exchange transfer agreement with Mojave Water Agency that allows for the cumulative storage of up to 390 TAF. The agreement allows for MET to store water in an exchange account for later return.

6.2.4 Planned Future Sources

Beyond the programs highlighted in Sections 6.2.1 through 6.2.3, MET continues to invest in efforts to meet its goal of long-term regional water supply reliability, focusing on the following:

- Continuing water conservation
- Developing water supply management programs outside of the region
- Developing storage programs related to the Colorado River and the SWP
- Developing storage and groundwater management programs within the Southern California region
- Increasing water recycling, groundwater recovery, stormwater, and seawater desalination
- Pursuing long-term solutions for the ecosystem, regulatory and water supply issues in the California Bay-Delta (MET, 2021).

6.3 Groundwater

Historically, local groundwater has been the cheapest and most reliable source of supply for the City. The City draws water from the Basin. In FY 2019-20, the City relied on approximately 2,141 AFY – approximately 65% of the City's water supply portfolio for FY 2019-20 – of groundwater from the OC Basin.

This section describes the OC Basin and the management measures taken by OCWD, the basin manager to optimize local supply and minimize overdraft. This section also provides information on historical groundwater production as well as a 25-year projection of the City's groundwater supply.

The OCWD was formed in 1933 by a special legislative act of the California State Legislature to protect and manage the County's vast, natural, groundwater supply using the best available technology and defend its water rights to the OC Basin. This legislation is found in the State of California Statutes, Water – Uncodified Acts, Act 5683, as amended. The OC Basin is managed by OCWD under the Act, which functions as a statutorily-imposed physical solution. The OCWD Management Area includes approximately 89% of the land area of the OC Basin, and 98% of all groundwater production occurs within the area. OCWD monitors the basin by collecting groundwater elevation and quality data from wells and manages an electronic database that stores water elevation, water quality, production, recharge, and other data on over 2,000 wells and facilities within and outside OCWD boundaries (City of La Habra et al., 2017).

Groundwater levels are managed within a safe basin operating range to protect the long-term sustainability of the OC Basin and to protect against land subsidence. OCWD regulates groundwater levels in the OC Basin by regulating the annual amount of pumping and setting the Basin Production Percentage (BPP) for the water year. As defined in the District Act, the BPP is the ratio of water produced from groundwater supplies within the district to all water produced within the district from both supplemental sources and groundwater within the district (OCWD, 2020).

6.3.1 Historical Groundwater Production

Although the City has four groundwater wells, as of 2021, one of the City's wells (Leisure World Well) is inactive. The remaining three active wells are sufficient for the City's water supply. Pumping limitations set by the BPP and the pumping capacity of the wells are the only constraints affecting the groundwater supply to the City. The groundwater volume pumped by the City has remained stable over the last five years (Table 6-4).

Table 6-4: Retail: Groundwater Volume Pumped

<table>
<tr><th colspan="7">DWR Submittal Table 6-1 Retail: Groundwater Volume Pumped (AF)</th></tr>
<tr><td>☐</td><td colspan="6">Supplier does not pump groundwater.
The supplier will not complete the table below.</td></tr>
<tr><td>☐</td><td colspan="6">All or part of the groundwater described below is desalinated.</td></tr>
<tr><td>Groundwater Type</td><td>Location or Basin Name</td><td>2016</td><td>2017</td><td>2018</td><td>2019</td><td>2020</td></tr>
<tr><td>Alluvial Basin</td><td>Orange County Groundwater Basin</td><td>2,199</td><td>2,247</td><td>1,722</td><td>2,400</td><td>2,141</td></tr>
<tr><td colspan="2">**TOTAL**</td><td>2,199</td><td>2,247</td><td>1,722</td><td>2,400</td><td>2,141</td></tr>
<tr><td colspan="7">NOTES:
Source - OC Retail Water Usage FY 2015 to FY 2020 (MWDOC, 2020)</td></tr>
</table>

6.3.2 Basin Characteristics

The OC Basin underlies the northerly half of Orange County beneath broad lowlands. The OC Basin managed by OCWD covers an area of approximately 350 square miles, bordered by the Coyote and Chino Hills to the north, the Santa Ana Mountains to the northeast, and the Pacific Ocean to the southwest. The OC Basin boundary extends to the Orange County-Los Angeles Line to the northwest, where groundwater flows across the county line into the Central Groundwater Basin of Los Angeles County. A map of the OC Basin is shown in Figure 6-2. The total thickness of sedimentary rocks in the OC Basin is over 20,000 feet, with only the upper 2,000 to 4,000 feet containing fresh water. The OC Basin’s full volume is approximately 66 MAF.

There are three major aquifer systems that have been subdivided by OCWD, the Shallow Aquifer System, the Principal Aquifer System, and the Deep Aquifer System. These three aquifer systems are hydraulically connected as groundwater is able to flow between each other through intervening aquitards or discontinuities in the aquitards. The Shallow Aquifer system occurs from the surface to approximately 250 feet below ground surface. Most of the groundwater from this aquifer system is pumped by small water systems for industrial and agricultural use. The Principal Aquifer system occurs at depths between 200 and 1,300 feet below ground surface. Over 90% of groundwater production is from wells that are screened within the Principal Aquifer system. Only a minor amount of groundwater is pumped from the Deep Aquifer system, which underlies the Principal Aquifer system and is up to 2,000 feet deep in the center of the OC Basin.

Per- and polyfluoroalkyl substances (PFAS) are a group of thousands of manmade chemicals that includes PFOA and PFOS. PFAS compounds were once commonly used in many products including, among many others, stain- and water-repellent fabrics, nonstick products (e.g., Teflon), polishes, waxes, paints, cleaning products, and fire-fighting foams. Beginning in the summer of 2019, the California State Division of Drinking Water (DDW) began requiring testing for PFAS compounds in some groundwater production wells in the OCWD area.

Groundwater production in FY 2019-20 was expected to be approximately 325,000 AF but declined to 286,550 AF primarily due to PFAS impacted wells being turned off around February 2020. OCWD expects groundwater production to be in the area of 245,000 AF in FY 2020-21 due to the currently idled wells and additional wells being impacted by PFAS and turned off. As PFAS treatment systems are constructed, OCWD expects total annual groundwater production to slowly increase back to normal levels (310,000 to 330,000 AF) (OCWD, 2020).

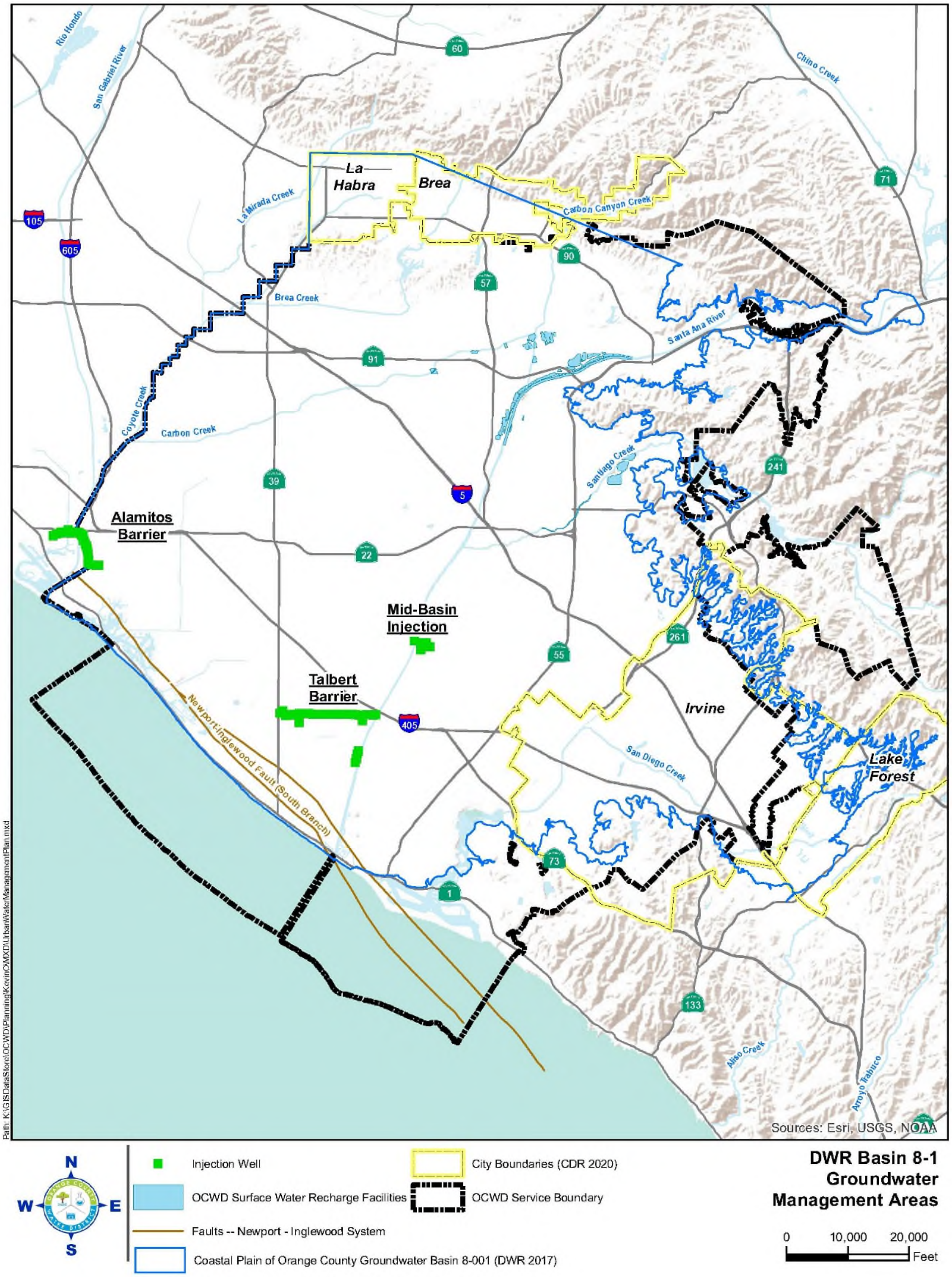


Figure 6-2: Map of the OC Basin

6.3.3 Sustainable Groundwater Management Act

In 2014, the State of California adopted the Sustainable Groundwater Management Act (SGMA) to help manage its groundwater sustainably, and limit adverse effects such as significant groundwater-level declines, land subsidence, and water quality degradation. SGMA requires all high- and medium-priority basins, as designated by DWR, be sustainably managed. DWR designated the non-adjudicated Coastal Plain of OC Basin ("Basin 8-1" or "Basin") as a medium-priority basin, primarily due to heavy reliance on the Basin's groundwater as a source of water supply. Compliance with SGMA can be achieved in one of two ways:

1) A Groundwater Sustainability Agency (GSA) is formed and a GSP is adopted, or
2) Special Act Districts created by statute, such as OCWD, and other agencies may prepare and submit an Alternative to a GSP (City of La Habra et al., 2017).

The agencies within Basin 8-1, led by OCWD collaborated to submit an Alternative to a GSP in 2017, titled the "Basin 8-1 Alternative" to meet SGMA compliance. This document will be updated every five years. The current (2017) version is included in Appendix G.

6.3.4 Basin Production Percentage

The OC Basin is not adjudicated and as such, pumping from the OC Basin is managed through a process that uses financial incentives to encourage groundwater producers to pump a sustainable amount of water. The framework for the financial incentives is based on establishing the BPP, the percentage of each Producer's total water supply that comes from groundwater pumped from the OC Basin. Groundwater production at or below the BPP is assessed the Replenishment Assessment (RA). While there is no legal limit as to how much an agency pumps from the OC Basin, there is a financial disincentive to pump above the BPP. The BPP is set uniformly for all Producers by OCWD on an annual basis. Agencies that pump above the BPP are charged the RA plus the Basin Equity Assessment (BEA). The BEA is presently calculated so that the cost of groundwater production is equivalent to the cost of importing potable water supplies. This approach serves to discourage, but not eliminate, production above the BPP, and the BEA can be increased to discourage production above the BPP if necessary.

The BPP is set based on groundwater conditions, availability of imported water supplies, and Basin management objectives. The supplies available for recharge must be estimated for a given year. The supplies of recharge water that are estimated are: 1) Santa Ana River stormflow, 2) Natural incidental recharge, 3) Santa Ana River baseflow, 4) GWRS supplies, and 5) other supplies such as imported water and recycled water purchased for the Alamitos Barrier. The BPP is a major factor in determining the cost of groundwater production from the OC Basin for that year. The BPP set for Water Year 2021-22 is 77%.

BPP Adjustments for Basin Management

OCWD has established management guidelines that are used to establish future BPPs, as seen in Table 6-5. Raising or lowering the BPP allows OCWD to manage the amount of pumping from the basin. OCWD has a policy to manage the groundwater basin within a sustainable range to avoid adverse impacts to the basin. OCWD seeks to maintain some available storage space in the basin to maximize surface water recharge when such supplies are available, especially in relatively wet years. By keeping the basin relatively full during wet years, and for as long as possible in years with near-normal recharge, the maximum amount of groundwater could be maintained in storage to support pumping in future drought conditions. During dry hydrologic years when less water would be available for recharge, the BPP could be lowered to maintain groundwater storage levels. A component of OCWD's BPP policy is to manage the groundwater basin so that the BPP will not fluctuate more that 5% from year to year.

Based on most recent modeling of water supplies available for groundwater recharge and water demand forecasts, OCWD anticipates being able to sustain the BPP at 85% starting in 2025. The primary reasons for the higher BPP are the expected completion of the GWRS Final Expansion (GWRSFE) in 2023 and the relatively low water demands of approximately 400,000 AFY.

Modeling and forecasts generate estimates based on historical averages. Consequently, forecasts use average hydrologic conditions which smooth the dynamic and unpredictable local hydrology. Variations in local hydrology are the most significant impact to supplies of water available to recharge the groundwater basin. The BPP projection of 85% is provided based upon average annual rainfall weather patterns. If the City were to experience a relatively dry period, the BPP could be reduced to maintain water storage levels, by as much as 5%.

Table 6-5: Management Actions Based on Changes in Groundwater Storage

Available Storage Space (amount below full basin condition, AF)	Considered Basin Management Action
Less than 100,000	Raise BPP
100,000 to 300,000	Maintain and / or raise BPP towards 75% goal
300,000 to 350,000	Seek additional supplies to refill basin and / or lower the BPP
Greater than 350,000	Seek additional supplies to refill basin and lower the BPP

BPP Exemptions

In some cases, OCWD encourages pumping and treating groundwater that does not meet drinking water standards in order to protect water quality. This is achieved by using a financial incentive called the BEA Exemption. A BEA Exemption is used to promote beneficial uses of poor-quality groundwater and reduce or prevent the spread of poor-quality groundwater into non-degraded aquifer zones. OCWD uses a partial or total exemption of the BEA to compensate a qualified participating agency or Producer for the costs of treating poor quality groundwater, which typically include capital, interest and operations and maintenance costs for treatment facilities. When OCWD authorizes a BEA exemption for a project, it is obligated to provide the replenishment water for the production above the BPP and forgo the BEA revenue that OCWD would otherwise receive from the producer (City of La Habra et al., 2017). Similarly, for proactive water quality management, OCWD exempts a portion of the BEA for their Coastal Pumping Transfer Program (CPTP). The CPTP encourages inland groundwater producers to increase pumping and coastal producers to decrease pumping in order to reduce the groundwater basin drawdown at the coast and protect against seawater intrusion. Inland pumpers can pump above the BPP without having to pay the full BEA for the amount pumped above the BPP (OCWD, 2015). Coastal pumpers receive BEA revenue from OCWD to assist in offsetting their additional water supply cost from taking less groundwater.

6.3.4.1 2020 OCWD Groundwater Reliability Plan

In order to adapt to the substantial growth in water demands in OCWD’s management area, it is paramount to anticipate and understand future water demands and develop projects to increase future water supplies proactively to match demands. The GRP is a continuation of these planning efforts that estimates the OC Basin’s sustainable average annual production and extrapolates water needs of the OC Basin by combining recently completed water demand projections and modeling of Santa Ana River flows available for recharge. These data will be used to evaluate future water supply projects and guide management of the OC Basin. OCWD is currently developing the GRP, and the first public draft is expected to be available May 2021.

Current water demand projections show a relatively slow increase over the 25-year planning horizon, which is generally of similar magnitude as the additional production from the GWRSFE in early 2023. Once complete, the GWRSFE will increase capacity from 100,000 to 134,000 AFY of high-quality recycled water. This locally controlled, drought proof supply of water reduces the region’s dependance on imported water.

Historically, the Santa Ana River has served as the primary source of water to recharge the OC Basin. To determine the availability of future Santa Ana River flows, OCWD utilized surface water flow modeling of the upper watershed. Modeling was developed to predict the impacts future stormwater capture and wastewater recycling projects in the upper watershed would have on future Santa Ana River flow rates at Prado Dam. Santa Ana River base flows are expected to decrease as more water recycling projects are built in the upper watershed. OCWD continues to work closely with the US Army Corps of Engineers to temporarily impound and slowly release up to approximately 20,000 AF of stormwater in the Prado Dam Conservation Pool. To some extent, the losses in baseflow are partially offset through the capture of additional stormwater held in the Prado Dam Conservation Pool. When available, OCWD will continue to augment groundwater recharge through the purchase of imported water through MET. OCWD will diligently monitor and evaluate future water supply projects to sustainably manage and protect the OC Basin for future generations.

6.3.4.2 OCWD Engineer’s Report

The OCWD Engineer’s Report reports on the groundwater conditions and investigates information related to water supply and groundwater basin usage within OCWD’s service area.

The overall BPP achieved in the 2019 to 2020 water year within OCWD for non-irrigation use was 75.9%. The achieved pumping was less than the BPP established for the 2019 to 2020 water year primarily due to the water quality impacts of PFAS. As indicated in Section 6.3.4, a BPP of 77% was established for water year 2021-22. Analysis of the groundwater basin’s projected accumulated overdraft, the available supplies to the OC Basin (assuming average hydrology) and the projected pumping demands indicate that this level of pumping can be sustained for 2021-22 without detriment to the OC Basin (OCWD, 2021).

In FY 2021-22 additional production of approximately 22,000 AF above the BPP will be undertaken by the City of Tustin, City of Garden Grove, City of Huntington Beach, Mesa Water District, and IRWD. These agencies use the additional pumping allowance in order to accommodate groundwater quality improvement projects. As in prior years, production above the BPP from these projects would be partially or fully exempt from the BEA as a result of the benefit provided to the OC Basin by removing poor-quality groundwater and treating it for beneficial use (OCWD, 2021).

6.3.5 Recharge Management

Recharging water into the OC Basin through natural and artificial means is essential to support pumping from the OC Basin. Active recharge of groundwater began in 1949, in response to increasing drawdown of the OC Basin and, consequently, the threat of seawater intrusion. The OC Basin's primary source of recharge is flow from the Santa Ana River, which is diverted into recharge basins and its main Orange County tributary, Santiago Creek. Other sources of recharge water include natural infiltration, recycled water, and imported water. Natural recharge consists of subsurface inflow from local hills and mountains, infiltration of precipitation and irrigation water, recharge in small flood control channels, and groundwater underflow to and from Los Angeles County and the ocean.

Recycled water for the OC Basin recharge is from two sources. The main source of recycled water is from the GWRS, which is injected into the Talbert Seawater Barrier and recharged in the Kraemer, Miller and Miraloma Basins (City of La Habra et al., 2017). The second source of recycled water is water purified at the Water Replenishment District's Leo J. Vander Lans Treatment Facility, which supplies water to the Alamitos Seawater Barrier (owned and operated by the Los Angeles County Department of Public Works). OCWD's share of the Alamitos Barrier injection total for water year 2018-19 was less than half of the total injection, based on barrier wells located within Orange County. The Water Replenishment District of Southern California (WRD) also works closely with OCWD to ensure that the water demands at the Alamitos Barrier are fulfilled through the use of recycled water as opposed to imported water, however the recycled portion was less than 33% for the last six years due to operational issues and wastewater supply interruptions (OCWD, 2020a). Injection of recycled water into these barriers is an effort by OCWD to control seawater intrusion into the OC Basin. Operation of the injection wells forms a hydraulic barrier to seawater intrusion.

OCWD purchases imported water for recharge from MWDOC. Untreated imported water can be used to recharge the OC Basin through the surface water recharge system in multiple locations, such as Anaheim Lake, Santa Ana River, Irvine Lake, and San Antonio Creek. Treated imported water can be used for in-lieu recharge, as was performed extensively from 1977 to 2007 (City of La Habra et al., 2017). For detailed recharge management efforts from OCWD, refer to OCWD's 2017 "Basin 8-1 Alternative Plan" (Appendix G).

6.3.6 MET Groundwater Replenishment Program

In the past, OCWD, MWDOC, and MET have coordinated water management to increase storage in the OC Basin when imported supplies are available for this purpose. MET's groundwater replenishment program was discontinued on January 1, 2013, and currently MET via MWDOC sells replenishment water to OCWD at the full service untreated MET rate.

MWDOC's imported water sales to OCWD since FY 1990-91 averages approximately 31,200 AF per year. Recently, due to low Santa Ana River flows as a result of low precipitation and increased use along the river, OCWD has needed to purchase more imported replenishment water per year than the average of 31,200 AFY over the last 25 years (this does not include water amounts from MET's Conjunctive Use Program (CUP) or its Cyclic Storage Account). However, with the emergence of PFAS affecting groundwater production, the need to purchase imported water has been temporary suspended. Until PFAS treatment is in place for most groundwater producers in the region, imported replenishment water will be significantly reduced.

6.3.7 MET Conjunctive Use Program / Cyclic Storage Program with OCWD

Since 2004, OCWD, MWDOC, and certain groundwater producers have participated in MET's CUP. This program allows for the storage of MET water in the OC Basin. The existing MET program provides storage up to 66,000 AF of water in the OC Basin to be pumped by participating producers in place of receiving imported supplies during water shortage events. In exchange, MET contributes to improvements in basin management facilities and an annual administrative fee. These improvements include eight new groundwater production wells, improvements to the seawater intrusion barrier, and construction of the Diemer Bypass Pipeline. The water is accounted for via the CUP program administered by the wholesale agencies and is controlled by MET such that it can be withdrawn over a three-year time period (OCWD, 2020). As of 2021, the CUP has not been in use since 2014. The CUP contract ends in 2028.

The Cyclic Storage account is an alternative storage account with MET. However, unlike the CUP program, OCWD controls when the water is used. The Cyclic Water Storage Program allows MET to store water in a local groundwater basin during surplus conditions, where MET has limited space in its regional storage locations. Once the water is stored via direct delivery or In-lieu the groundwater agency has the ability to purchase this water at a future date or over a 5-year period.

6.3.8 Overdraft Conditions

Annual groundwater basin overdraft, as defined in OCWD's Act, is the quantity by which production of groundwater supplies exceeds natural replenishment of groundwater supplies during a water year. This difference between extraction and replenishment can be estimated by determining the change in volume of groundwater in storage that would have occurred had supplemental water not been used for any groundwater recharge purpose, including seawater intrusion protection, advanced water reclamation, and the in-Lieu Program.

The annual analysis of basin storage change and accumulated overdraft for water year 2019-20 has been completed. Based on the three-layer methodology, an accumulated overdraft of 200,000 AF was calculated for the water year ending June 30, 2020. The accumulated overdraft for the water year ending June 30, 2019 was 236,000 AF, which was also calculated using the three-layer storage method. Therefore, an annual increase of 36,000 AF in stored groundwater was calculated as the difference between the June 2019 and June 2020 accumulated overdrafts (OCWD, 2021).

6.3.9 Planned Future Sources

The City has included improvement projects for all of their wells, to continue the reliability of their local groundwater sources. These projects are further described in Section 6.9.

On a regional scale, OCWD regularly evaluates potential projects and conducts studies to review the feasibility of new projects or sources. A few groundwater basin-related projects that are planned or in progress are described below.

- **GWRSFE –** The Final Expansion of the GWRS is currently underway and is the third and final phase of the project. When the Final Expansion is completed in early 2023, the plant's treatment capacity will increase from 100 to 130 MGD. To produce 130 MGD, additional treated wastewater from Orange County Sanitation District (OC San)'s Treatment Plant 2 is required. This recycled water represents a high quality, drought-proof source of water to protect and enhance the OC Basin. The Final Expansion project will include expanding the existing GWRS treatment facilities, constructing new conveyance facilities at OC San Plant 2, and rehabilitating an existing pipeline between OC San Plant 2 and the GWRS. Once completed, the GWRS plant will recycle 100% of OC San's reclaimable sources and produce enough water to meet the needs of over one million people.
- **Forecast Informed Reservoir Operations (FIRO) at Prado Dam** – Stormwater represents a significant source of water used by OCWD to recharge the OC Basin. Much of this recharge is made possible by the capture of Santa Ana River stormflows behind Prado Dam in the Conservation Pool. FIRO represents the next generation of operating water reservoirs using the best available technology. Advances in weather and stormwater runoff forecasting hold promise to allow USACE to safety impound more stormwater while maintaining equivalent flood risk management capability behind Prado Dam. Preliminary modeling show that by expanding the Conservation Pool from elevation 505 to 512 ft msl, annual recharge to the groundwater basin could increase by as much as 4,500 to 7,000 AFY.

6.4 Surface Water

6.4.1 Existing Sources

There are, currently, no direct surface water uses in the City's service area.

6.4.2 Planned Future Sources

As of 2021, there are no planned direct uses of surface water in the City's service area.

6.5 Stormwater

6.5.1 Existing Sources

There are, currently, no direct stormwater uses in the City's Service area.

6.5.2 Planned Future Sources

As of 2021, there are no planned stormwater uses in the City's service area.

6.6 Wastewater and Recycled Water

The City is directly involved in wastewater services through its ownership and operation of the wastewater collection system in its service area. However, the City does not own or operate wastewater treatment facilities. The sewer system service area encompasses about 1,705 acres and includes approximately 34 miles of sewer main. The wastewater system serves about 5,000 customers (Seal Beach's Sewer Master Plan, 2007). For additional details on the City's wastewater services, refer to the 2018 The City of Seal Beach Sewer Master Plan.

Recycled water is wastewater that is treated through primary, secondary and tertiary processes and is acceptable for most non-potable water purposes such as irrigation, and commercial and industrial process water per Title 22 requirements. Recycled water opportunities have continued to grow in Southern California as public acceptance and the need to expand local water resources continues to be a priority. Recycled water also provides a degree of flexibility and added reliability during drought conditions when imported water supplies are restricted. The City is indirectly involved in recycled water production, through its supply of wastewater for IPR. The following sections expand on the existing agency collaboration involved in these efforts as well as the City's projected recycled water use over the next 25 years.

6.6.1 Agency Coordination

The City does not own or operate wastewater treatment facilities and sends all collected wastewater to OC San for treatment and disposal. OC San provides treated water to OCWD, the manager of the Orange County Groundwater Basin. OCWD strives to maintain and increase the reliability of the Orange County Groundwater Basin through replenishment with imported water, stormwater, and advanced treated wastewater. A full description of the Orange County Groundwater Basin is available in Section 0. OCWD and OC San have jointly constructed and expanded two water recycling projects to meet this goal that include: 1) OCWD GAP and 2) OCWD GWRS.

6.6.1.1 OCWD Green Acres Project

OCWD owns and operates the GAP, a water recycling system that provides up to 8,400 AFY of recycled water for irrigation and industrial uses. GAP provides an alternate source of water that is mainly delivered to parks, golf courses, greenbelts, cemeteries, and nurseries in the cities of Costa Mesa, Fountain Valley, Newport Beach, and Santa Ana. Approximately 100 sites use GAP water, current recycled water users include Mile Square Park and Golf Courses in Fountain Valley, Costa Mesa Country Club, Chroma Systems carpet dyeing, Kaiser Permanente, and Caltrans. The City does not receive any GAP water.

6.6.1.2 OCWD Groundwater Replenishment System

OCWD's GWRS allows Southern California to decrease its dependency on imported water and creates a local and reliable source of water. OCWD's GWRS purifies secondary treated wastewater from OC San to levels that meet and exceed all state and federal drinking water standards. The GWRS Phase 1 plant has been operational since January 2008 and uses a three-step advanced treatment process consisting of microfiltration (MF), reverse osmosis (RO), and ultraviolet (UV) light with hydrogen peroxide (H_2O_2). A portion of the treated water is injected into the seawater barrier to prevent seawater intrusion into the groundwater basin. The other portion of the water is pumped to ponds where the water percolates into deep aquifers and becomes part of Orange County's water supply. The treatment process described on OCWD's website is provided below (OCWD, GWRS, 2020).

The GWRS first began operating in 2008 producing 70 MGD and in 2015, it underwent a 30 MGD expansion. Approximately 39,200 AFY of the highly purified water is pumped into the injection wells and 72,900 AFY is pumped to the percolation ponds in the City of Anaheim where the water is naturally filtered through sand and gravel to deep aquifers of the groundwater basin. The Orange County Groundwater Basin provides approximately 72% of the potable water supply for north and central Orange County. The design and construction of the first phase (78,500 AFY) of the GWRS project was jointly funded by OCWD and OC San; Phase 2 expansion (33,600 AFY) was funded solely by OCWD.

The Final Expansion of the GWRS is currently underway and is the third and final phase of the project. When the Final Expansion is completed in 2023, the plant will produce 130 MGD. To produce 130 MGD, additional treated wastewater from OC San is required. This additional water will come from OC San's Treatment Plant 2, which is in the City of Huntington Beach approximately 3.5 miles south of the GWRS. The Final Expansion project will include expanding the existing GWRS treatment facilities, constructing new conveyance facilities at OC San Plant 2 and rehabilitating an existing pipeline between OC San Plant 2 and the GWRS. Once completed, the GWRS plant will recycle 100% of OC San's reclaimable sources and produce enough water to meet the needs of over one million people.

6.6.2 Wastewater Description and Disposal

The City operates and maintains the local sewer collection pipes that feed into the OC San's trunk sewer system to convey wastewater to OC San's treatment plants. The City's sewer system includes 34 miles of sewer lines, 780 manholes and seven lift stations. The wastewater collected in the City's system is conveyed to OC San's extensive system of gravity flow sewers, pump stations, and pressurized sewers. Ultimately, the wastewater is treated at OC San treatment plants in Fountain Valley (Plant No. 1) and Huntington Beach (Plant No. 2). Plant No. 1 has a total rated primary capacity of 108 MGD and a secondary treatment capacity of 80 MGD. Plant No. 2 has a rated primary capacity of 168 MGD and secondary treatment capacity of 90 MGD. Both plants share a common ocean outfall, but Plant No. 1 currently provides all its secondary treated wastewater to OCWD's GWRS for beneficial reuse. The 120-inch diameter ocean outfall extends 4 miles off the coast of Huntington Beach. A 78-inch diameter emergency outfall also extends 1.3 miles off the coast. Table 6-6 summarizes the wastewater collected by the City and transported to OC San's system in 2020.

Table 6-6: Retail: Wastewater Collected Within Service Area in 2020

DWR Submittal Table 6-2 Retail: Wastewater Collected Within Service Area in 2020

☐	There is no wastewater collection system. The supplier will not complete the table below.
	Percentage of 2020 service area covered by wastewater collection system
	Percentage of 2020 service area population covered by wastewater collection system

Wastewater Collection			**Recipient of Collected Wastewater**			
Name of Wastewater Collection Agency	Wastewater Volume Metered or Estimated?	Volume of Wastewater Collected from UWMP Service Area 2020	Name of Wastewater Treatment Agency Receiving Collected Wastewater	Treatment Plant Name	Is WWTP Located Within UWMP Area?	Is WWTP Operation Contracted to a Third Party?
The City of Seal Beach	Estimated	2,520	OCSD	Plant No. 1 / Plant No. 2	No	No
Total Wastewater Collected from Service Area in 2020:		2,520				

NOTES:
Assumes a return rate of 77% based on the 2018 Sewer Master Plan

6.6.3 Current Recycled Water Uses

There are currently no recycled water uses within the City's service area. For indirect use, the City also benefits from OCWD's GWRS system that provides IPR through replenishment of Orange County Groundwater Basin with water that meets state and federal drinking water standards.

6.6.4 Projected Recycled Water Uses

The City will continue to supply wastewater to support the region's IPR via GWRS. Although the 2015 UWMP acknowledged IPR of wastewater, it did not quantify projections. These projections will be prepared moving forward. The projected 2020 recycled water use from the City's 2015 UWMP are compared to the 2020 actual use in Table 6-7.

Table 6-7: Retail: 2015 UWMP Recycled Water Use Projection Compared to 2020 Actual

DWR Submittal Table 6-5 Retail: 2015 UWMP Recycled Water Use Projection Compared to 2020 Actual		
☐	Recycled water was not used in 2015 nor projected for use in 2020. The Supplier will not complete the table below.	
Use Type	**2015 Projection for 2020**	**2020 Actual Use**
Groundwater recharge (IPR)	N/A	713
Total	0	713
NOTES: Groundwater recharge (IPR) estimated based on OCWD Groundwater Basin Production and Percent of Total Basin Production for FY2019-20 (33.3%).		

6.6.5 Potential Recycled Water Uses

The City's wastewater is conveyed to OC San's regional treatment facility, where the wastewater is treated and reused. Recycled water analyses performed over the years have shown that installing local treatment and reuse facilities is not feasible. The City supports, encourages, and contributes to the continued development of recycled water and potential uses throughout the region with OCWD's GWRS. Currently, the City does not have any potential or projected uses for recycled water.

6.6.6 Optimization Plan

Studies of water recycling opportunities within Southern California provide a context for promoting the development of water recycling plans. It is recognized that broad public acceptance of recycled water requires continued education and public involvement. Currently, most of the recycled water available is being directed toward replenishment of the groundwater basin and improvements in groundwater quality.

As a user of groundwater, the City supports the efforts of OCWD and OC San to use recycled water as a primary resource for groundwater recharge in Orange County.

Public Education

The City participates in the MWDOC public education and school education programs, which include extensive sections on water recycling. MWDOC's water use efficiency public information programs are a partnership with agencies throughout the county.

Through a variety of public information programs, MWDOC reaches the public, including those in the City, with information regarding present and future water supplies, the demands for a suitable quantity and quality of water, including recycled water, and the importance of implementing water efficiency techniques and behaviors. Through MWDOC, water education programs have reached thousands of students in the City with grade-specific programs that include information on recycled water.

Financial Incentives

The implementation of recycled water projects involves a substantial upfront capital investment for planning studies, Environmental Impact Reports (EIRs), engineering design and construction before there recycled water is available to the market. The establishment of new supplemental funding sources through federal, state and regional programs now provides significant financial incentives for water agencies to develop and make use of recycled water locally. Potential sources of funding include federal, state and local funding opportunities. These funding sources include the United States Department of Interior Bureau of Reclamation (USBR), California Proposition 13 Water Bond, Proposition 84 and MET Local Resources Program (LRP). These funding opportunities may be sought by the City or possibly more appropriately by regional agencies. The City will continue to support seeking funding for regional water recycling projects and programs.

Optimization Plan

The City does not use recycled water, therefore, there is no need for a recycled water optimization plan. In other areas of Orange County, recycled water is used for irrigating golf courses, parks, schools, businesses, and communal landscaping, as well as for groundwater recharge. Analyses have indicated that present worth costs to incorporate recycled water within the City are not cost effective as compared to purchasing imported water from MWDOC or using groundwater. The City will continue to conduct feasibility studies for recycled water and seek out creative solutions such as funding, regulatory requirements, institutional arrangement, and public acceptance for recycled water use with MWDOC, OCWD, MET and other cooperative agencies.

6.7 Desalination Opportunities

In 2001, MET developed a Seawater Desalination Program (SDP) to provide incentives for developing new seawater desalination projects in MET’s service area. In 2014, MET modified the provisions of their LRP to include incentives for locally produced seawater desalination projects that reduce the need for imported supplies. To qualify for the incentive, proposed projects must replace an existing demand or prevent new demand on MET’s imported water supplies. In return, MET offers three incentive formulas under the program:

- Sliding scale incentive up to $340 per AF for a 25-year agreement term, depending on the unit cost of seawater produced compared to the cost of MET supplies.
- Sliding scale incentive up to $475 per AF for a 15-year agreement term, depending on the unit cost of seawater produced compared to the cost of MET supplies.
- Fixed incentive up to $305 per AF for a 25-year agreement term.

Developing local supplies within MET's service area is part of their IRP goal of improving water supply reliability in the region. Creating new local supplies reduce pressure on imported supplies from the SWP and Colorado River.

On May 6th, 2015, the SWRCB approved an amendment to the state’s Water Quality Control Plan for the Ocean Waters of California (California Ocean Plan) to address effects associated with the construction and operation of seawater desalination facilities (Desalination Amendment). The amendment supports the use of ocean water as a reliable supplement to traditional water supplies while protecting marine life and water quality. The California Ocean Plan now formally acknowledges seawater desalination as a beneficial use of the Pacific Ocean and the Desalination Amendment provides a uniform, consistent process for permitting seawater desalination facilities statewide.

If the following projects are developed, MET's imported water deliveries to Orange County could be reduced. These projects include the Huntington Beach Seawater Desalination Project and the Doheny Desalination Project.

As for City-led initiatives, the City has not investigated seawater desalination as a result of economic and physical impediments.

Brackish groundwater is groundwater with a salinity higher than freshwater, but lower than seawater. Brackish groundwater typically requires treatment using desalters.

6.7.1 Ocean Water Desalination

Huntington Beach Seawater Desalination Project – Poseidon Resources LLC (Poseidon), a private company, is developing the Huntington Beach Seawater Desalination Project to be co-located at the AES Power Plant in the City of Huntington Beach along Pacific Coast Highway and Newland Street. The proposed project would produce up to 50 MGD (56,000 AFY) of drinking water to provide approximately 10% of Orange County’s water supply needs.

Over the past several years, Poseidon has been working with OCWD on the general terms and conditions for selling the water to OCWD. OCWD and MWDOC have proposed a few distribution options to agencies in Orange County. The northern option proposes the water be distributed to the northern agencies closer to the plant within OCWD’s service area with the possibility of recharging/injecting a portion of the product water into the OC Basin. The southern option builds on the northern option by delivering a portion of the product water through the existing OC-44 pipeline for conveyance to the south Orange County water agencies. A third option is also being explored that includes all of the product water to be recharged into the OC Basin. Currently, a combination of these options could be pursued.

The Huntington Beach Seawater Desalination project plant capacity of 56,000 AFY would be the single largest source of new, local drinking water available to the region. In addition to offsetting imported demand, water from this project could provide OCWD with management flexibility in the OC Basin by augmenting supplies into the Talbert Seawater Barrier to prevent seawater intrusion.

In May 2015, OCWD and Poseidon entered into a non-binding Term Sheet that provided the overall partner structure in order to advance the project. Based on the initial Term Sheet, which was updated in 2018, Poseidon would be responsible for permitting, financing, design, construction, and operations of the treatment plant while OCWD would purchase the production volume, assuming the product water quality and quantity meet specific contract parameters and criteria. Furthermore, OCWD would then distribute the water in Orange County using one of the proposed distribution options described above.

Currently, the project is in the regulatory permit approval process with the Regional Water Quality Control Board and the California Coastal Commission. Once all of the required permits are approved, Poseidon will then work with OCWD and interested member agencies in developing a plan to distribute the water.

Subsequent to the regulatory permit approval process, and agreement with interested parties, Poseidon estimates that the project could be online as early as 2027.

Under guidance provided by DWR, the Huntington Beach Seawater Desalination Plant’s projected water supplies are not included in the supply projections due to its current status within the criteria established by State guidelines (DWR, 2020c).

Doheny Desalination Project – South Coast Water District (SCWD) is proposing to develop an ocean water desalination facility in Dana Point. SCWD intends to construct a facility with an initial capacity of up to 5 million gallons per day (MGD). The initial up to 5 MGD capacity would be available for SCWD and potential partnering water agencies to provide a high quality, locally-controlled, drought-proof water supply. The desalination facility would also provide emergency backup water supplies, should an earthquake, system shutdown, or other event disrupt the delivery of imported water to the area. The Project would consist of a subsurface slant well intake system (constructed within Doheny Beach State Park), raw (sea) water conveyance to the desalination facility site (located on SCWD owned property), a seawater reverse osmosis (SWRO) desalination facility, brine disposal through an existing wastewater ocean outfall, solids handling facilities, storage, and potable water conveyance interties to adjacent local and regional distribution infrastructure.

The Doheny Ocean Desalination Project has been determined as the best water supply option to meet reliability needs of SCWD and south Orange County. SCWD is pursuing the Project to ensure it meets the water use needs of its customers and the region by providing a drought-proof potable water supply, which diversifies SCWD’s supply portfolio and protects against long-term imported water emergency outages and supply shortfalls that could have significant impact to our coastal communities, public health, and local economy. Phase I of the Project (aka, the “Local” Project) will provide SCWD and the region with up to 5 MGD of critical potable water supply that, together with recycled water, groundwater, and conservation, will provide the majority of SCWD’s water supply through local reliable sources. An up to 15 MGD capacity project has been identified as a potential future “regional” project that could be phased incrementally, depending on regional needs.

On June 27, 2019, SCWD certified the final EIR and approved the Project. The Final EIR included considerable additional information provided at the request of the Coastal Commission and the Regional Board, including an updated coastal hazard analysis, updated brine discharge modeling, and updated groundwater modeling, updated hydrology analysis. The approval of the Project also included a commitment to 100 percent carbon neutrality through a 100 percent offset of emissions through the expansion of Project mitigation and use of renewable energy sources. SCWD is currently in the permitting process and finalizing additional due diligence studies. If implemented, SCWD anticipates an online date of 2025.

Under guidance provided by DWR, the Doheny Seawater Desalination Project's projected water supplies are not included in the supply projections due to its current status within the criteria established by State guidelines (DWR, 2020c).

6.7.2 Groundwater Desalination

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

6.8 Water Exchanges and Transfers

Interconnections with other agencies result in the ability to share water supplies during short term emergency situations or planned shutdowns of major imported water systems. However, beyond short-term outages, transfers can also be involved with longer term water exchanges to deal with droughts or water allocation situations. The following subsections describe the City's existing and planned exchanges and transfers.

6.8.1 Existing Exchanges and Transfers

The City maintains five emergency interconnections as follows:

- Golden State Water Company: in Rossmoor at Saint Cloud Dr.
- City of Westminster: Westminster Ave. east of Milan St.
- City of Long Beach: Marina Dr. and 1st St.
- City of Huntington Beach: Pacific Coast Highway and Philips Rd.
- City of Huntington Beach: Pacific Coast Highway and Anderson St.

6.8.2 Planned and Potential Exchanges and Transfers

The City does not currently have plans to introduce new exchanges and transfers. However, MWDOC continues to help its retail agencies develop transfer and exchange opportunities that promote reliability within their systems. Therefore, MWDOC will look to help its retail agencies navigate the operational and administrative issues of transfers within the MET distribution system.

On a regional scale, the Santa Ana River Conservation and Conjunctive Use Project (SARCCUP) is a joint project established by five regional water agencies within the Santa Ana River Watershed (Eastern Municipal Water District, Inland Empire Utilities Agency, Western Municipal Water District, OCWD, and San Bernardino Valley Municipal Water District).

In 2016, SARCCUP was successful in receiving $55 million in grant funds from Proposition 84 through the DWR. The overall SARCCUP program awarded by Proposition 84, consists of three main program elements:

- Watershed-Scale Cooperative Water Banking Program

- Water Use Efficiency: Landscape Design and Irrigation Improvements and Water Budget Assistance for Agencies
- Habitat Creation and *Arundo Donax* Removal from the Santa Ana River

The Watershed-Scale Cooperative Water Banking Program is the largest component of SARCCUP and since 2016, Valley, MET, and the four SARCCUP-MWD Member Agencies, with MWDOC representing OCWD, have been discussing terms and conditions for the ability to purchase surplus water from Valley to be stored in the Santa Ana River watershed. With the Valley and MET surplus water purchase agreement due for renewal, it was the desire of Valley to establish a new agreement with MET that allows a portion of its surplus water to be stored within the Santa Ana River watershed.

An agreement between MET and four SARCCUP-MWD Member Agencies was approved earlier this year that gives the SARCCUP agencies the ability to purchase a portion (up to 50%) of the surplus water that San Bernardino Valley Municipal Water District (Valley), a SWP Contractor, sells to MET. Such water will be stored in local groundwater basins throughout the Santa Ana River watershed and extract during dry years to reduce the impacts from multiyear droughts. In Orange County, 36,000 AF can be stored in the OC Basin for use during dry years. More importantly, this stored SARCCUP water can be categorized as “extraordinary supplies”, if used during a MET allocation, and can enhance a participating agencies’ reliability during a drought. Moreover, if excess water is available MWDOC can purchase additional water for its service area.

Further details remain to be developed between OCWD, retail agencies, and MWDOC in how the water will be distributed in Orange County and who participates.

6.9 Future Water Projects

The City continually reviews practices that will provide its customers with adequate and reliable supplies, including preparing a CIP every five years. Trained staff continue to ensure the water quality is safe and the water supply will meet present and future needs in an environmentally and economically responsible manner.

Although the City has various projects planned to maintain or improve the water system, there are currently no City-specific planned projects that have both a concrete timeline and a quantifiable increase in supply.

6.9.1 City Initiatives

The City anticipates water demand in the City to remain relatively constant over the next 25 years. The projects that have been identified by the City in the five-year Capital Improvement Program to improve the City’s water supply reliability include complete renovations of two of the City’s three water supply well facilities, construction of a wellhead treatment plant at the Lampson Well facility, and various routine system infrastructure rehabilitation/replacement efforts. A few of the proposed water capital projects are highlighted below. To review the complete five-year water CIP please refer to the City’s Adopted Fiscal Year 2020-21 Budget (City of Seal Beach, 2020).

Lampson Wellhead Treatment Plant – The Lampson Avenue Well is one of the City’s primary groundwater pumping facilities used to supply potable water to the City’s residents and water customers.

Shortly after it was placed in service in 2008, odor issues developed when pumping at higher flow rates caused by naturally occurring hydrogen sulfide (H2S) dissolved within the groundwater. This high concentration of H2S within groundwater has required the City to operate this well at only 40% of its intended flow rate/output. This well deficiency has in turn required the City to become more dependent on expensive and less reliable imported water. This project constructs a treatment plant to enable this critical water supply facility to operate at its full flow rate/output and thus maximizing the City's ability to use local groundwater supplies to meet annual City water demand.

Bolsa Chica Water Wellhead Rehabilitation Project – Bolsa Chica Well facility is one of the City's primary groundwater pumping facilities that enables the City to maximize local groundwater supplies to meet annual water demand, and thus minimize dependence on imported water. This facility was constructed in 1984 and is fast approaching its useful service life. This project reconstructs the wellhead and thus extends the well facility's service life for an additional 40 years.

Beverly Manor Booster Pump Station and Wellhead Rehabilitation – The Beverly Manor facility not only serves as a groundwater well but also as a booster pump station that draws water from one of the two City storage reservoirs. This facility also enables the City to maximize local groundwater supplies to meet annual water demand, and thus minimize dependence on imported water. In addition, it ensures system reliability through its booster pumping capabilities. This facility was constructed in 1978 and is fast approaching its useful service life. This project reconstructs the wellhead and booster pumping station extending its service life for an additional 40 years.

Smart Water Meter Replacement – The City's water meters average to 25 years in age, thus reaching their useful life. In 2019 the City commissioned a feasibility study to replace the City's aging water meters with Advance Metering Infrastructure (AMI), simply known as Smart Meters. This Study will provide a "blueprint" on how to proceed with the deployment of new Smart Meters citywide. Once installed these meters will allow for wireless real time data collection, leak detection, and it will minimize future O&M involved with manual meter readings.

SCADA Improvements – The City's water system is managed and monitored through the SCADA base station at the City's maintenance yard located off Adolfo Lopez Drive. The City's current SCADA system is outdated and is missing key infrastructure necessary for complete functionality. Upgrades to SCADA will supply operators the ability to further optimize operations of the water distribution system. This project will be completed in three phases. Phase 1, the selection of a new software program which has been completed. Phase 2, that consists of analyzing the current infrastructure and identifying needed improvements at all facilities, and Phase 3, the full installation and integration of the equipment. The new SCADA system is anticipated to be fully completed by 2023.

6.9.2 Regional Initiatives

Beyond City-specific projects, the City consistently coordinates its long-term water shortage planning with MWDOC and OCWD. MWDOC has identified the following future regional projects (CDM Smith, 2019):

Poseidon Huntington Beach Ocean Desalination Project – Poseidon proposes to construct and operate the Huntington Beach Ocean Desalination Plant on a 12-acre parcel adjacent to the AES Huntington Beach Generating Station. The facility would have a capacity of 50 MGD and 56,000 AFY, with its main components consisting of a water intake system, a desalination facility, a concentrate disposal system, and a product water storage tank. This project would provide both system and supply reliability benefits to the South Orange County (SOC), the OC Basin, and Huntington Beach. The capital cost in the initial year for the plant is $1.22 billion.

Doheny Ocean Desalination Project – SCWD is proposing to construct an ocean water desalination facility in Dana Point at Doheny State Beach. The facility would have an initial up to 5 MGD capacity, with the potential for future expansions up to 15 MGD. The project's main components are a subsurface water intake system, a raw ocean water conveyance pipeline, a desalination facility, a seawater reverse osmosis (SWRO) desalination facility, a brine disposal system, and a product water storage tank.

San Juan Watershed Project – Santa Margarita Water District (SMWD) and other project partners have proposed a multi-phased project within the San Juan Creek Watershed to capture local stormwater and develop, convey, and recharge recycled water into the San Juan Groundwater Basin and treat the water upon pumping it out of the basin. The first phase includes the installation of three rubber dams within San Juan Creek to promote in-stream recharge of the basin, with an anticipated production of 700 AFY on average. The second phase would develop additional surface water and groundwater management practices by using stormwater and introducing recycled water for infiltration into the basin and has an anticipated production of up to 2,660 to 4,920 AFY. The third phase will introduce recycled water directly into San Juan Creek through live stream recharge, with an anticipated production of up to 2,660 AFY (SMWD, 2021).

Cadiz Water Bank – SMWD and Cadiz, Inc. are developing this project to create a new water supply by conserving groundwater that is currently being lost to evaporation and recovering the conserved water by pumping it out of the Fenner Valley Groundwater Basin to convey to MET's CRA. The project consists of a groundwater pumping component that includes an average of 50 TAFY of groundwater that can be pumped from the basin over a 50-year period, and a water storage component that allows participants to send surplus water supplies to be recharged in spreading basins and held in storage.

South Orange County Emergency Interconnection Expansion – MWDOC has been working with the SOC agencies on improvements for system reliability primarily due to the risk of earthquakes causing outages of the MET imported water system as well as extended grid outages. Existing regional interconnection agreements between IRWD and SOC agencies provides for the delivery of water through the IRWWD system to participating SOC agencies in times of emergency. MWDOC and IRWD are currently studying an expansion of the program, including the potential East Orange County Feeder No. 2 pipeline and an expanded and scalable emergency groundwater program, with a capital cost of $867,451.

SARCCUP – SARCCUP is a joint project established between MET, MWDOC, Eastern MWD, Western MWD, Inland Empire Utilities Agency, and OCWD that can provide significant benefits in the form of additional supplies during dry years for Orange County. Surplus SWP water from San Bernardino Valley Water District (SBVMWD) can be purchased and stored for use during dry years. This water can even be considered an extraordinary supply under MET allocation Plan, if qualified under MET's extraordinary supply guidelines. OCWD has the ability to store 36,000 AF of SARCCUP water and if excess water is available MWDOC has the ability to purchase additional water. Further details remain to be developed between OCWD, retail agencies, and MWDOC in how the water will be distributed in Orange County and who participates.

Moulton Niguel Water District (MNWD) / OCWD Pilot Storage Program - OCWD entered into an agreement with MNWD to develop a pilot program to explore the opportunity to store water in the OC Basin. The purpose of such a storage account would provide MNWD water during emergencies and/or provide additional water during dry periods. As part of the agreement, OCWD hired consultants to evaluate where and how to extract groundwater from the OC Basin with several options to pump the water to MNWD via the East Orange County Feeder No. 2; as well as a review of existing banking/exchange programs in California to determine what compensation methodologies could OCWD assess for a storage/banking program.

6.10 Energy Intensity

A new requirement for this 2020 UWMP is an energy intensity analysis of the Supplier's water, wastewater, and recycled water systems, where applicable for a 12-month period. The City owns and operates a water distribution system and a wastewater collection system. This section reports the energy intensity for each system using data from CY2019.

Water and energy resources are inextricably connected. Known as the "water-energy nexus", the California Energy Commission estimates the transport and treatment of water, treatment and disposal of wastewater, and the energy used to heat and consume water account for nearly 20% of the total electricity and 30% of non-power plant related natural gas consumed in California. In 2015, California issued new rules requiring 50% of its power to come from renewables, along with a reduction in greenhouse gas (GHG) emissions to 40% below 1990 levels by 2030. Consistent with energy and water conservation, renewable energy production, and GHG mitigation initiatives, the City reports the energy intensity of its water and wastewater operations.

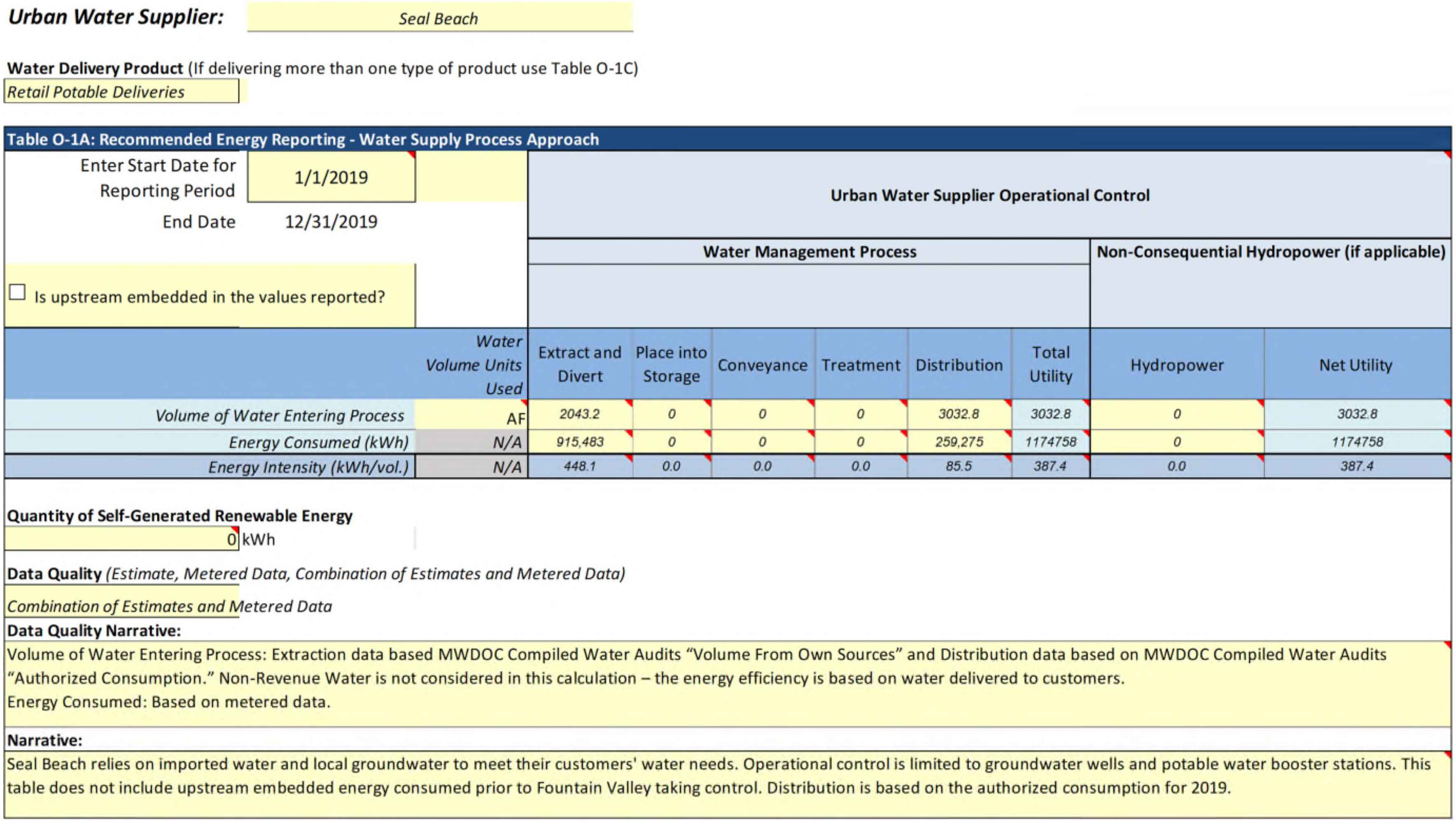
The methodology for calculating water energy intensity outlined in Appendix O of the UWMP Guidebook was adapted from the California Institute for Energy Efficiency exploratory research study titled "Methodology for Analysis of the Energy Intensity of California's Water Systems" (Wilkinson 2000). The study defines water energy intensity as 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.

UWMP reporting is limited to available energy intensity information associated with water processes occurring within an urban water supplier's direct operational control. Operational control is defined as authority over normal business operations at the operational level. Any energy embedded in water supplies imparted by an upstream water supplier (e.g., water wholesaler) or consequently by a downstream water purveyor (e.g., retail water provider) is not included in the UWMP energy intensity tables. The City's calculations conform to methodologies outlined in the UWMP Guidebook and Wilkinson study.

6.10.1 Water Supply Energy Intensity

In CY2019, the City consumed 387.4 kilowatt-hour (KWh) per AF for water extraction and distribution (Table 6-8). The basis for calculations is provided in more detail in the following subsections.

Table 6-8: Recommended Energy Intensity – Multiple Water Delivery Products



Urban Water Supplier: *Seal Beach*

Water Delivery Product (If delivering more than one type of product use Table O-1C)

Retail Potable Deliveries

Table O-1A: Recommended Energy Reporting - Water Supply Process Approach

Enter Start Date for Reporting Period 1/1/2019

End Date 12/31/2019

☐ Is upstream embedded in the values reported?

Urban Water Supplier Operational Control

		Water Management Process						**Non-Consequential Hydropower (if applicable)**	
	Water Volume Units Used	Extract and Divert	Place into Storage	Conveyance	Treatment	Distribution	Total Utility	Hydropower	Net Utility
Volume of Water Entering Process	AF	2043.2	0	0	0	3032.8	3032.8	0	3032.8
Energy Consumed (kWh)	N/A	915,483	0	0	0	259,275	1174758	0	1174758
Energy Intensity (kWh/vol.)	N/A	448.1	0.0	0.0	0.0	85.5	387.4	0.0	387.4

Quantity of Self-Generated Renewable Energy

0 kWh

Data Quality *(Estimate, Metered Data, Combination of Estimates and Metered Data)*

Combination of Estimates and Metered Data

Data Quality Narrative:

Volume of Water Entering Process: Extraction data based MWDOC Compiled Water Audits "Volume From Own Sources" and Distribution data based on MWDOC Compiled Water Audits "Authorized Consumption." Non-Revenue Water is not considered in this calculation – the energy efficiency is based on water delivered to customers.

Energy Consumed: Based on metered data.

Narrative:

Seal Beach relies on imported water and local groundwater to meet their customers' water needs. Operational control is limited to groundwater wells and potable water booster stations. This table does not include upstream embedded energy consumed prior to Fountain Valley taking control. Distribution is based on the authorized consumption for 2019.

6.10.1.1 Operational Control and Reporting Period

As described throughout the report, the City is a retail agency that relies on groundwater and imported water.

Water supply energy intensity was calculated for the 2019 calendar year. This is a standard for energy and GHG reporting to the Climate Registry, California Air Resources Board, and the United States Environmental Protection Agency. Calendar year reporting provides consistency when assessing direct and indirect energy consumption within a larger geographical context, as fiscal year starting dates can vary between utilities and organizations.

6.10.1.2 Volume of Water Entering Processes

According to MWDOC's Compiled Water Audits, the City extracted 2,043.2 AF of groundwater from the OC Basin and distributed 3,032.8 AF of both groundwater and imported water.

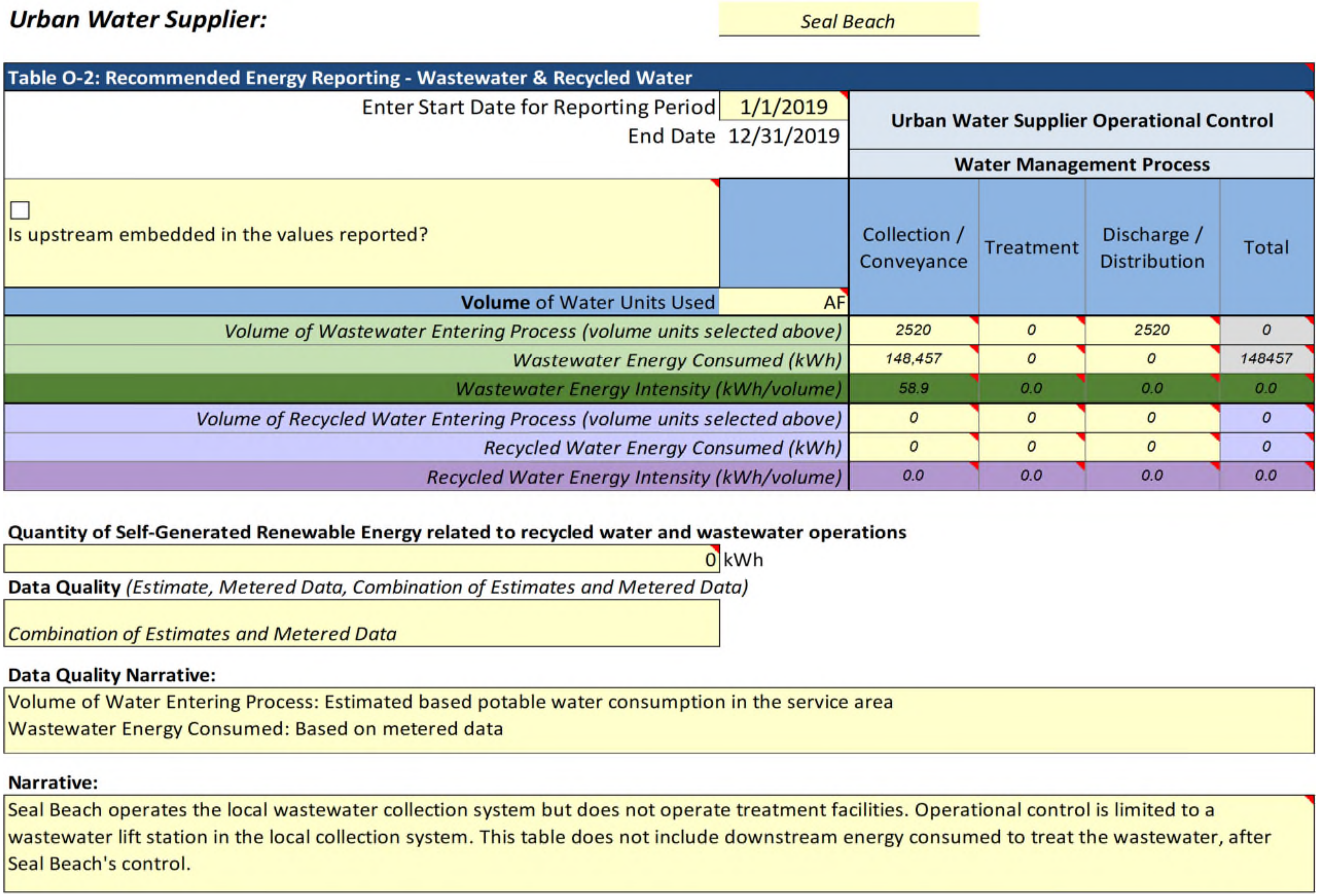
6.10.1.3 Energy Consumption and Generation

According to Southern California Edison (SCE) Electricity Bills, groundwater wells consumed 915,483 kWh of electricity and pump stations along the distribution system consumed 259,275 kWh of electricity. The City does not do any water treatment. Currently, the City does not generate renewable energy. Energy consumption is based on metered data.

6.10.2 Wastewater and Recycled Water Energy Intensity

In CY 2019, the City consumed 58.9 KWh per AF for wastewater services (Table 6-9). The basis for calculations is provided in more detail in the following subsections.

Table 6-9: Recommended Energy Intensity – Wastewater & Recycled Water



Urban Water Supplier: *Seal Beach*

Table O-2: Recommended Energy Reporting - Wastewater & Recycled Water

Enter Start Date for Reporting Period	1/1/2019	**Urban Water Supplier Operational Control**			
End Date	12/31/2019				
		Water Management Process			
☐ Is upstream embedded in the values reported?		Collection / Conveyance	Treatment	Discharge / Distribution	Total
Volume of Water Units Used	AF				
Volume of Wastewater Entering Process (volume units selected above)		*2520*	*0*	*2520*	*0*
Wastewater Energy Consumed (kWh)		*148,457*	*0*	*0*	*148457*
Wastewater Energy Intensity (kWh/volume)		*58.9*	*0.0*	*0.0*	*0.0*
Volume of Recycled Water Entering Process (volume units selected above)		*0*	*0*	*0*	*0*
Recycled Water Energy Consumed (kWh)		*0*	*0*	*0*	*0*
Recycled Water Energy Intensity (kWh/volume)		*0.0*	*0.0*	*0.0*	*0.0*

Quantity of Self-Generated Renewable Energy related to recycled water and wastewater operations

0 kWh

Data Quality *(Estimate, Metered Data, Combination of Estimates and Metered Data)*

Combination of Estimates and Metered Data

Data Quality Narrative:

Volume of Water Entering Process: Estimated based potable water consumption in the service area

Wastewater Energy Consumed: Based on metered data

Narrative:

Seal Beach operates the local wastewater collection system but does not operate treatment facilities. Operational control is limited to a wastewater lift station in the local collection system. This table does not include downstream energy consumed to treat the wastewater, after Seal Beach's control.

6.10.2.1 Operational Control and Reporting Period

The City's existing sewer system is made up of a network of gravity sewers. As explained in Section 6.5, the City owns and operates six wastewater lift stations but no treatment facilities. Similar to the water supply energy intensity, wastewater energy intensity was calculated for the 2019 calendar year.

6.10.2.2 Volume of Wastewater Entering Processes

In CY2019, the City collected and conveyed 2520 AF of wastewater to OC San. The City does not treat any of the wastewater generated within the City's boundary. Wastewater volume is based on estimated data.

6.10.2.3 Energy Consumption and Generation

According to estimates referencing Southern California Edison Electricity Bills, the City's six lift stations consumed 148,457 kWh of electricity in 2019. There are no other wastewater facilities that are owned and operated by the City. Currently, the City does not generate renewable energy.

6.10.3 Key Findings and Next Steps

Calculating and disclosing direct operationally-controlled energy intensities is another step towards understanding the water-energy nexus. However, much work is still needed to better understand upstream and downstream (indirect) water-energy impacts. When assessing water supply energy intensities or comparing intensities between providers, it is important to consider reporting boundaries as they do not convey the upstream embedded energy or impacts energy intensity has on downstream users. Engaging one's upstream and downstream supply chain can guide more informed decisions that holistically benefit the environment and are mutually beneficial to engaged parties. Suggestions for further study include:

- Supply-chain engagement – The City relies on a variety of water sources for their customers. While some studies have used life cycle assessment tools to estimate energy intensities, there is a need to confirm this data. The 2020 UWMP requirement for all agencies to calculate energy intensity will help the City and neighboring agencies make more informed decisions that would benefit the region as a whole regarding the energy and water nexus. A similar analysis could be performed with upstream supply chain energy, for example, with State Project Water.
- Internal benchmarking and goal setting – With a focus on energy conservation and a projected increase in water demand despite energy conservation efforts, the City's energy intensities will likely decrease with time. Conceivably, in a case where water demand decreases, energy intensities may rise as the energy required to pump or treat is not always proportional to water delivered. In the course of exploring the water-energy nexus and pursuing renewable energy goals, there is a need to assess whether energy intensity is a meaningful indicator or if it makes sense to use a different indicator to reflect the City's commitment to energy and water conservation.

- Regional sustainability – Water and energy efficiency are two components of a sustainable future. Efforts to conserve water and energy, however, may impact the social, environmental, and economic livelihood of the region. In addition to the relationship between water and energy, over time, it may also be important to consider and assess the connection these resources have on other aspects of a sustainable future.

7 WATER SERVICE RELIABILITY AND DROUGHT RISK ASSESSMENT

Building upon the water supply identified and projected in Section 6, this key section of the UWMP examines the City's projected water supplies, water demand, and the resulting water supply reliability. Water service reliability reflects the City's ability to meet the water needs of its customers under varying conditions. For the UWMP, water supply reliability is evaluated in two assessments: 1) the Water Service Reliability Assessment and 2) the DRA. The Water Service reliability assessment compares projected supply to projected demand in 2025 through 2045 for three hydrological conditions: a normal year, a single dry year, and a drought period lasting five consecutive years. The DRA, a new UWMP requirement, assesses near-term water supply reliability. It compares projected water supply and demand assuming the City experiences a drought period for the next five consecutive years. Factors affecting reliability, such as climate change and regulatory impacts, are accounted for in the assessment.

7.1 Water Service Reliability Overview

Every urban water supplier is required to assess the reliability of their water service to their customers under normal, single-dry, and multiple dry water years. The City depends on a combination of imported and local supplies to meet its water demands and has taken numerous steps to ensure it has adequate supplies. Development of local supplies augments the reliability of the water system. There are various factors that may impact reliability of supplies such as legal, environmental, water quality and climatic which are discussed below. MET's and MWDOC's 2020 UWMPs conclude that they are able to meet, full-service demands of their member agencies starting 2025 through 2045 during normal years, a single-dry year, and multiple-dry years. Consequently, the City is projected to meet full-service demands through 2045 for the same scenarios.

MET's 2020 IRP update describes the core water resources that will be used to meet full-service demands at the retail level under all foreseeable hydrologic conditions from 2025 through 2045. The foundation of MET's resource strategy for achieving regional water supply reliability has been to develop and implement water resources programs and activities through its IRP preferred resource mix. This preferred resource mix includes conservation, local resources such as water recycling and groundwater recovery, Colorado River supplies and transfers, SWP supplies and transfers, in-region surface reservoir storage, in-region groundwater storage, out-of-region banking, treatment, conveyance, and infrastructure improvements.

Table 7-1 shows the basis of water year data used to predict drought supply availability. The average (normal) hydrologic condition for the MWDOC service area, which the City is a part of, is represented by FY 2017-18 and FY 2018-19 and the single-dry year hydrologic condition by FY 2013-14. The five consecutive years of FY 2011-12 to FY 2015-16 represent the driest five-consecutive year historic sequence for MWDOC's service area. Locally, Orange County rainfall for the five-year period totaled 36 inches, the driest on record.

Table 7-1 Retail: Basis of Water Year Data (Reliability Assessment)

DWR Submittal Table 7-1 Retail: Basis of Water Year Data (Reliability Assessment)			
Year Type	**Base Year**	**Available Supplies if Year Type Repeats**	
		☐	Quantification of available supplies is not compatible with this table and is provided elsewhere in the UWMP. Location ______
		☑	Quantification of available supplies is provided in this table as either volume only, percent only, or both.
		Volume Available	**% of Average Supply**
Average Year	2018-2019	-	100%
Single-Dry Year	2014	-	106%
Consecutive Dry Years 1st Year	2012	-	106%
Consecutive Dry Years 2nd Year	2013	-	106%
Consecutive Dry Years 3rd Year	2014	-	106%
Consecutive Dry Years 4th Year	2015	-	106%
Consecutive Dry Years 5th Year	2016	-	106%
NOTES: Assumes an increase of 6% above average year demands in dry and multiple dry years based on the Demand Forecast TM (CDM Smith, 2021). 106% represents the percent of average supply needed to meet demands of a single-dry and multiple-dry years. Since the City is able to meet all of its demand with imported water from MWDOC/MET (on top of local groundwater), the percent of average supply value reported is equivalent to the percent of average demand under the corresponding hydrologic condition.			

7.2 Factors Affecting Reliability

In order to prepare realistic water supply reliability assessments, various factors affecting reliability were considered. These include climate change and environmental requirements, regulatory changes, water quality impacts, and locally applicable criteria.

7.2.1 Climate Change and the Environment

Changing climate patterns are expected to shift precipitation patterns and affect water supply availability. Unpredictable weather patterns will make water supply planning more challenging. Although climate change impacts are associated with exact timing, magnitude, and regional impacts of these temperature and precipitation changes, researchers have identified several areas of concern for California water planners (MET, 2021). These areas include:

- A reduction in Sierra Nevada Mountain snowpack.
- Increased intensity and frequency of extreme weather events.
- Prolonged drought periods.
- Water quality issues associated with increase in wildfires.
- Changes in runoff pattern and amount.
- Rising sea levels resulting in:
    - Impacts to coastal groundwater basins due to seawater intrusion.
    - Increased risk of damage from storms, high-tide events, and the erosion of levees.
    - Potential pumping cutbacks to the SWP and CVP.

Other important issues of concern due to global climate change include:

- Effects on local supplies such as groundwater.
- Changes in urban and agricultural demand levels and patterns.
- Increased evapotranspiration from higher temperatures.
- Impacts to human health from water-borne pathogens and water quality degradation.
- Declines in ecosystem health and function.
- Alterations to power generation and pumping regime.
- Increases in ocean algal blooms affected seawater desalination supplies.

The major impact in California is that without additional surface storage, the earlier and heavier runoff (rather than snowpack retaining water in storage in the mountains), will result in more water being lost to the oceans. A heavy emphasis on storage is needed in California.

In addition, the Colorado River Basin supplies have been inconsistent since about the year 2000, with precipitation near normal while runoff has been less than average in two out of every three years. Climate models are predicting a continuation of this pattern whereby hotter and drier weather conditions will result in continuing lower runoff, pushing the system toward a drying trend that is often characterized as long-term drought.

Dramatic swings in annual hydrologic conditions have impacted water supplies available from the SWP over the last decade. The declining ecosystem in the Delta has also led to a reduction in water supply deliveries, and operational constraints, which will likely continue until a long-term solution to these problems is identified and implemented (MET, 2021).

Legal, environmental, and water quality issues may have impacts on MET supplies. It is felt, however, that climatic factors would have more of an impact than legal, water quality, and environmental factors. Climatic conditions have been projected based on historical patterns, but severe pattern changes are still a possibility in the future (MET, 2021).

7.2.2 Regulatory and Legal

Ongoing regulatory restrictions, such as those imposed by the Biops on the effects of SWP and the federal CVP operations on certain marine life, also contributes to the challenge of determining water delivery reliability. Endangered species protection and conveyance needs in the Delta have resulted in operational constraints that are particularly important because pumping restrictions impact many water resources programs – SWP supplies and additional voluntary transfers, Central Valley storage and transfers, and in-region groundwater and surface water storage. Biops protect special-status species listed as threatened or endangered under the ESAs and imposed substantial constraints on Delta water supply operations through requirements for Delta inflow and outflow and export pumping restrictions.

In addition, the SWRCB has set water quality objectives that must be met by the SWP including minimum Delta outflows, limits on SWP and CVP Delta exports, and maximum allowable salinity level. SWRCB plans to fully implement the new Lower San Joaquin River (LSJR) flow objectives from the Phase 1 Delta Plan amendments through adjudicatory (water rights) and regulatory (water quality) processes by 2022. These LSJR flow objectives are estimated to reduce water available for human consumptive use. New litigation, listings of additional species under the ESAs, or regulatory requirements imposed by the SWRCB could further adversely affect SWP operations in the future by requiring additional export reductions, releases of additional water from storage, or other operational changes impacting water supply operations.

The difficulty and implications of environmental review, documentation, and permitting pose challenges for multi-year transfer agreements, recycled water projects, and seawater desalination plants. The timeline and roadmap for getting a permit for recycled water projects are challenging and inconsistently implemented in different regions of the state. IPR projects face regulatory restraints such as treatment, blend water, retention time, and Basin Plan Objectives, which may limit how much recycled water can feasibly be recharged into the groundwater basins. New regulations and permitting uncertainty are also barriers to seawater desalination supplies, including updated Ocean Plan Regulations, Marine Life Protected Areas, and Once-Through Cooling Regulations (MET, 2021).

7.2.3 Water Quality

The following sub-sections include narratives on water quality issues experienced in various water supplies, if any, and the measures being taken to improve the water quality of these sources.

7.2.3.1 Imported Water

MET is responsible for providing high quality potable water throughout its service area. Over 300,000 water quality tests are performed per year on MET’s water to test for regulated contaminants and additional contaminants of concern to ensure the safety of its waters. MET’s supplies originate primarily from the CRA and from the SWP. A blend of these two sources, proportional to each year’s availability of the source, is then delivered throughout MET’s service area.

MET’s primary water sources face individual water quality issues of concern. The CRA water source contains higher total dissolved solids (TDS) and the SWP contains higher levels of organic matter, lending to the formation of disinfection byproducts. To remediate the CRA’s high level of salinity and the SWP’s high level of organic matter, MET blends CRA and SWP supplies and has upgraded all of its treatment facilities to include ozone treatment processes. In addition, MET has been engaged in efforts to protect its Colorado River supplies from threats of uranium, perchlorate, and chromium VI while also investigating the potential water quality impact of the following emerging contaminants: N-nitrosodimethylamine (NDMA), pharmaceuticals and personal care products (PPCP), microplastics, PFAS, and 1,4-dioxane (MET, 2021). While unforeseeable water quality issues could alter reliability, MET's current strategies ensure the delivery of high-quality water.

The presence of quagga mussels in water sources is a water quality concern. Quagga mussels are an invasive species that was first discovered in 2007 at Lake Mead, on the Colorado River. This species of mussels forms massive colonies in short periods of time, disrupting ecosystems and blocking water intakes. They can cause significant disruption and damage to water distribution systems. MET has had success in controlling the spread and impacts of the quagga mussels within the CRA, however the future could require more extensive maintenance and reduced operational flexibility than current operations allow. It also resulted in MET eliminating deliveries of CRA water into DVL to keep the reservoir free from quagga mussels (MET, 2021).

7.2.3.2 Groundwater

OCWD is responsible for managing the OC Basin. To maintain groundwater quality, OCWD conducts an extensive monitoring program that serves to manage the OC Basin's groundwater production, control groundwater contamination, and comply with all required laws and regulations. A network of nearly 700 wells provides OCWD a source for samples, which are tested for a variety of purposes.
OCWD collects samples each month to monitor Basin water quality. The total number of water samples analyzed varies year-to-year due to regulatory requirements, conditions in the basin and applied research and/or special study demands. These samples are collected and tested according to approved federal and state procedures as well as industry-recognized quality assurance and control protocols (City of La Habra et al., 2017).

PFAS are of particular concern for groundwater quality, and since the summer of 2019, DDW requires testing for PFAS compounds in some groundwater production wells in the OCWD area. In February 2020, the DDW lowered its RLs for PFOA and PFOS to 10 and 40 parts per trillion (ppt) respectively. The DDW recommends Producers not serve any water exceeding the RL – effectively making the RL an interim Maximum Contaminant Level (MCL) while DDW undertakes administrative action to set an MCL. In response to DDW's issuance of the revised RL, as of December 2020, approximately 45 wells in the OCWD service area have been temporarily turned off until treatment systems can be constructed. As additional wells are tested, OCWD expects this figure may increase to at least 70 to 80 wells. The state has begun the process of establishing MCLs for PFOA and PFOS and anticipates these MCLs to be in effect by the Fall of 2023. OCWD anticipates the MCLs will be set at or below the RLs.

In April 2020, OCWD as the groundwater basin manager, executed an agreement with the impacted Producers to fund and construct the necessary treatment systems for production wells impacted by PFAS compounds. The PFAS treatment projects includes the design, permitting, construction, and operation of PFAS removal systems for impacted Producer production wells. Each well treatment system will be evaluated for use with either granular activated carbon (GAC) or ion exchange (IX) for the removal of PFAS compounds. These treatment systems utilize vessels in a lead-lag configuration to remove PFOA and PFOS to less than 2 ppt (the current non-detect limit). Use of these PFAS treatment systems are designed to ensure the groundwater supplied by Producer wells can be served in compliance with current and future PFAS regulations. With financial assistance from OCWD, the Producers will operate and maintain the new treatment systems once they are constructed.

To minimize expenses and provide maximum protection to the public water supply, OCWD initiated design, permitting, and construction of the PFAS treatment projects on a schedule that allows rapid deployment of treatment systems. Construction contracts were awarded for treatment systems for production wells in the City of Fullerton and Serrano Water District in Year 2020. Additional construction contracts will likely be awarded in the first and second quarters of 2021. OCWD expects the treatment systems to be constructed for most of the initial 45 wells above the RL within the next 2 to 3 years.

As additional data are collected and new wells experience PFAS detections at or near the current RL, and/or above a future MCL, and are turned off, OCWD will continue to partner with the affected Producers and take action to design and construct necessary treatment systems to bring the impacted wells back online as quickly as possible.

Groundwater production in FY 2019-20 was expected to be approximately 325,000 AF but declined to 286,550 AF primarily due to PFAS impacted wells being turned off around February 2020. OCWD expects groundwater production to be in the area of 245,000 AF in FY 2020-21 due to the currently idled wells and additional wells being impacted by PFAS and turned off. As PFAS treatment systems are constructed, OCWD expects total annual groundwater production to slowly increase back to normal levels (310,000 to 330,000 AF) (OCWD, 2020).

Salinity is a significant water quality problem in many parts of Southern California, including Orange County. Salinity is a measure of the dissolved minerals in water including both TDS and nitrates.

OCWD continuously monitors the levels of TDS in wells throughout the OC Basin. TDS currently has a California Secondary MCL of 500 mg/L. The portions of the OC Basin with the highest levels are generally located in the cities of Irvine, Tustin, Yorba Linda, Anaheim, and Fullerton. There is also a broad area in the central portion of the OC Basin where TDS ranges from 500 to 700 mg/L. Sources of TDS include the water supplies used to recharge the OC Basin and from onsite wastewater treatment systems, also known as septic systems. The TDS concentration in the OC Basin is expected to decrease over time as the TDS concentration of GWRS water used to recharge the OC Basin is approximately 50 mg/L (City of La Habra et al., 2017).

Nitrates are one of the most common and widespread contaminants in groundwater supplies, originating from fertilizer use, animal feedlots, wastewater disposal systems, and other sources. The MCL for nitrate in drinking water is set at 10 mg/L. OCWD regularly monitors nitrate levels in groundwater and works with producers to treat wells that have exceeded safe levels of nitrate concentrations. OCWD manages the nitrate concentration of water recharged by its facilities to reduce nitrate concentrations in groundwater. This includes the operation of the Prado Wetlands, which was designed to remove nitrogen and other pollutants from the Santa Ana River before the water is diverted to be percolated into OCWD’s surface water recharge system.

Although water from the Deep Aquifer System is of very high quality, it is amber-colored and contains a sulfuric odor due to buried natural organic material. These negative aesthetic qualities require treatment before use as a source of drinking water. The total volume of the amber-colored groundwater is estimated to be approximately 1 MAF.

There are other potential contaminants that are of concern to and are monitored by OCWD. These include:

- **Methyl Tertiary Butyl Ether (MTBE) –** MTBE is an additive to gasoline that increases octane ratings but became a widespread contaminant in groundwater supplies. The greatest source of MTBE contamination comes from underground fuel tank releases. The primary MCL for MTBE in drinking water is 13 µg/L.
- **Volatile Organic Compounds (VOC) –** VOCs come from a variety of sources including industrial degreasers, paint thinners, and dry cleaning solvents. Locations of VOC contamination within the OC Basin include the former El Toro marine Corps Air Station, the Shallow Aquifer System, and portions of the Principal Aquifer System in the Cities of Fullerton and Anaheim.
- **NDMA –** NDMA is a compound that can occur in wastewater that contains its precursors and is disinfected via chlorination and/or chloramination. It is also found in food products such as cured meat, fish, beer, milk, and tobacco smoke. The California Notification Level for NDMA is 10 ng/L and the RL is 300 ng/L. In the past, NDMA has been found in groundwater near the Talbert Barrier, which was traced to industrial wastewater dischargers.
- **1,4-Dioxane –** 1,4-Dioxane is a suspected human carcinogen. It is used as a solvent in various industrial processes such as the manufacture of adhesive products and membranes.
- **Perchlorate –** Perchlorate enters groundwater through application of fertilizer containing perchlorate, water imported from the Colorado River, industrial or military sites that have perchlorate, and natural occurrence. Perchlorate was not detected in 84% of the 219 production wells tested between the years 2010 through 2014.
- **Selenium –** Selenium is a naturally occurring micronutrient found in soils and groundwater in the Newport Bay watershed. The bio-accumulation of selenium in the food chain may result in deformities, stunted growth, reduced hatching success, and suppression of immune systems in fish and wildlife. Management of selenium is difficult as there is no off-the-shelf treatment technology available.
- **Constituents of Emerging Concern (CEC) –** CECs are either synthetic or naturally occurring substances that are not currently regulated in water supplies or wastewater discharged but can be detected using very sensitive analytical techniques. The newest group of CECs include pharmaceuticals, personal care products, and endocrine disruptors. OCWD's laboratory is one of a few in the state of California that continuously develops capabilities to analyze for new compounds (City of La Habra et al., 2017).

7.2.4 Locally Applicable Criteria

Within Orange County, there are no significant local applicable criteria that directly affect reliability. Through the years, the water agencies in Orange County have made tremendous efforts to integrate their systems to provide flexibility to interchange with different sources of supplies. There are emergency agreements in place to ensure all parts of the County have an adequate supply of water. In the northern part of the County, agencies are able to meet a majority of their demands through groundwater with very little limitation, except for the OCWD BPP. For the agencies in southern Orange County, most of their demands are met with imported water where their limitation is based on the capacity of their system, which is very robust.

However, if a major earthquake on the San Andreas Fault occurs, it will be damaging to all three key regional water aqueducts and disrupt imported supplies for up to six months. The region would likely impose a water use reduction ranging from 10-25% until the system is repaired. However, MET has taken proactive steps to handle such disruption, such as constructing DVL, which mitigates potential impacts. DVL, along with other local reservoirs, can store a six to twelve-month supply of emergency water (MET, 2021).

7.3 Water Service Reliability Assessment

This Section assesses the City's reliability to provide water services to its customers under various hydrological conditions. This is completed by comparing the projected long-term water demand (Section 4), to the projected water supply sources available to the City (Section 6), in five-year increments, for a normal water year, a single dry water year, and a drought lasting five consecutive water years.

7.3.1 Normal Year Reliability

The water demand forecasting model developed for the Demand Forecast TM (described in Section 4.3), to project the 25-year demand for Orange County water agencies, also isolated the impacts that weather and future climate can have on water demand through the use of a statistical model. The explanatory variables of population, temperature, precipitation, unemployment rate, drought restrictions, and conservation measures were used to create the statistical model. The impacts of hot/dry weather condition are reflected as a percentage increase in water demands from the average condition. The average (normal) demand is represented by the average water demand of FY 2017-18 and FY 2018-19 (CDM Smith, 2021).

The City is 100% reliable for normal year demands from 2025 through 2045 (Table 7-2) due to diversified supply and conservation measures. The City has entitlements to receive imported water from MET through MWDOC via connections to MET's regional distribution system. For simplicity, the table shows supply to balance demand in the table. However, the City can purchase more MET water through MWDOC, should the need arise. The City has entitlements to receive imported water from MET through MWDOC via connections to MET's regional distribution system. All imported water supplies are assumed available to the City from existing water transmission facilities, as per MET and MWDOC's 2020 UWMPs. The demand and supplies listed in Table 7-2 also include local groundwater supplies that are available to the City through OCWD by an assumed BPP of 85%.

Table 7-2: Retail: Normal Year Supply and Demand Comparison

DWR Submittal Table 7-2 Retail: Normal Year Supply and Demand Comparison					
	2025	2030	2035	2040	2045
Supply totals (AF)	3,175	3,368	3,342	3,317	3,306
Demand totals (AF)	3,175	3,368	3,342	3,317	3,306
Difference (AF)	0	0	0	0	0
NOTES: This table compares the projected demand and supply volumes determined in Sections 4.3.2 and 6.1, respectively.					

7.3.2 Single Dry Year Reliability

A single dry year is defined as a single year of minimal to no rainfall within a period where average precipitation is expected to occur. The water demand forecasting model developed for the Demand Forecast TM (described in Section 4.3) isolated the impacts that weather and future climate can have on water demand through the use of a statistical model. The impacts of hot/dry weather condition are reflected as a percentage increase in water demands from the normal year condition (average of FY 2017-18 and FY 2018-19). For a single dry year condition (FY 2013-14), the model projects a 6% increase in demand for the OC Basin area where the City's service area is located (CDM Smith, 2021). Detailed information of the model is included in Appendix E.

The City has documented that it is 100% reliable for single dry year demands from 2025 through 2045 with a demand increase of 6% from normal demand with significant reserves held by MET, local groundwater supplies, and conservation. A comparison between the supply and the demand in a single dry year is shown in Table 7-3. For simplicity, the table shows supply to balance demand in the table. However, the City can purchase more MET water through MWDOC, should the need arise.

Table 7-3: Retail: Single Dry Year Supply and Demand Comparison

DWR Submittal Table 7-3 Retail: Single Dry Year Supply and Demand Comparison					
	2025	2030	2035	2040	2045
Supply totals (AF)	3,366	3,570	3,543	3,516	3,504
Demand totals (AF)	3,366	3,570	3,543	3,516	3,504
Difference (AF)	0	0	0	0	0
NOTES: It is conservatively assumed that a single dry year demand is 6% greater than each respective year's normally projected total water demand. Groundwater is sustainably managed through the BPP and robust management measures (Section 6.3.4 and Appendix G), indirect recycled water uses provide additional local supply (Section 6.6), and based on MET’s and MWDOC's UWMPs, imported water is available to close any local water supply gap (Section 7.5.1).					

7.3.3 Multiple Dry Year Reliability

Assessing the reliability to meet demand for five consecutive dry years is a new requirement for the 2020 UWMP, as compared to the previous requirement of assessing three or more consecutive dry years. Multiple dry years are defined as five or more consecutive dry years with minimal rainfall within a period of average precipitation. The water demand forecasting model developed for the Demand Forecast TM (described in Section 4.3) isolated the impacts that weather and future climate can have on water demand through the use of a statistical model. The impacts of hot/dry weather condition are reflected as a percentage increase in water demands from the normal year condition (average of FY 2017-18 and FY 2018-19). For a single dry year condition (FY 2013-14), the model projects a 6% increase in demand for the OC Basin area where the City’s service area is located (CDM Smith, 2021). It is conservatively assumed that a five consecutive dry year scenario is a repeat of the single dry year over five consecutive years.

Even with a conservative demand increase of 6% each year for five consecutive years, the City is capable of meeting all customers’ demands from 2025 through 2045 (Table 7-4), with significant reserves held by MET and conservation. For simplicity, the table shows supply to balance demand in the table. However, the City can purchase more MET water through MWDOC, should the need arise.

Table 7-4: Retail: Multiple Dry Years Supply and Demand Comparison

DWR Submittal Table 7-4 Retail: Multiple Dry Years Supply and Demand Comparison (AF)						
		2025	2030	2035	2040	2045
First year	Supply totals	3,448	3,407	3,564	3,538	3,514
	Demand totals	3,448	3,407	3,564	3,538	3,514
	Difference	0	0	0	0	0
Second year	Supply totals	3,428	3,447	3,559	3,532	3,511
	Demand totals	3,428	3,447	3,559	3,532	3,511
	Difference	0	0	0	0	0
Third year	Supply totals	3,407	3,488	3,554	3,527	3,509
	Demand totals	3,407	3,488	3,554	3,527	3,509
	Difference	0	0	0	0	0
Fourth year	Supply totals	3,386	3,529	3,548	3,521	3,507
	Demand totals	3,386	3,529	3,548	3,521	3,507
	Difference	0	0	0	0	0
Fifth year	Supply totals	3,366	3,570	3,543	3,516	3,504
	Demand totals	3,366	3,570	3,543	3,516	3,504
	Difference	0	0	0	0	0

NOTES:
It is conservatively assumed that a five consecutive dry year scenario is a repeat of the single dry year (106% of projected values) over five consecutive years. The 2025 column assesses supply and demand for FY 2020-21 through FY 2024-25; the 2030 column assesses FY 2025-26 through FY 2029-30 and so forth, in order to end the water service reliability assessment in FY 2044-45.

Groundwater is sustainably managed through the BPP and robust management measures (Section 6.3.4 and Appendix G), indirect recycled water uses provide additional local supply (Section 6.6), and based on MET and MWDOC's UWMP, imported water is available to close any local water supply gap (Section 7.5.1).

7.4 Management Tools and Options

Existing and planned water management tools and options for the City and MWDOC's service area that seek to maximize local resources and result in minimizing the need to import water are described below.

- **Reduced Delta Reliance:** MET has demonstrated consistency with Reduced Reliance on the Delta Through Improved Regional Water Self-Reliance (Delta Plan policy WR P1) by reporting the expected outcomes for measurable reductions in supplies from the Delta. MET has improved its self-reliance through methods including water use efficiency, water recycling, stormwater capture and reuse, advanced water technologies, conjunctive use projects, local and regional water supply and storage programs, and other programs and projects. In 2020, MET had a 602,000 AF change in supplies contributing to regional-self-reliance, corresponding to a 15.3% change, and this amount is projected to increase through 2045 (MET, 2021). For detailed information on the Delta Plan Policy WR P1, refer to Appendix C.

- **The continued and planned use of groundwater:** The water supply resources within MWDOC's service area are enhanced by the existence of groundwater basins that account for the majority of local supplies available and are used as reservoirs to store water during wet years and draw from storage during dry years, subsequently minimizing MWDOC's reliance on imported water. Groundwater basins are managed within a safe basin operating range so that groundwater wells are only pumped as needed to meet water use. Although MWDOC does not produce or manage recycled water, MWDOC supports and partners in recycled water efforts, including groundwater recharge.

- **Groundwater storage and transfer programs:** MWDOC and OCWD's involvement in SARCCUP includes participation in a CUP that improves water supply resiliency and increases available dry-year yield from local groundwater basins. The groundwater bank has 137,000 AF of storage (OCWD, 2020b). Additionally, MET has numerous groundwater storage and transfer programs in which MET endeavors to increase the reliability of water supplies, including the AVEK Waster Agency Exchange and Storage Program and the High Desert Water Bank Program. The IRWD Strand Ranch Water Banking Program has approximately 23,000 AF stored for IRWD's benefit, and by agreement, the water is defined to be an "Extraordinary Supply" by MET and counts essentially 1:1 during a drought/water shortage condition under MET's WSAP. In addition, MET has encouraged storage through its cyclic and conjunctive use programs that allow MET to deliver water into a groundwater basin in advance of agency demands, such as the Cyclic Storage Agreements under the Main San Gabriel Basin Judgement.

- **Water Loss Program:** The water loss audit program reduces MWDOC's dependency on imported water from the Delta by implementing water loss control technologies after assessing audit data and leak detection.

- **Increased use of recycled water:** MWDOC partners with local agencies in recycled water efforts, including OCWD to identify opportunities for the use of recycled water for irrigation purposes, groundwater recharge and some non-irrigation applications. OCWD's GWRS and GAP allow Southern California to decrease its dependency on imported water and create a local and reliable source of water that meet or exceed all federal and state drinking level standards. Expansion of the GWRS is currently underway to increase the plant's production to 130 MGD, and further reduce reliance on imported water.

Implementation of demand management measures during dry periods: During dry periods, water reduction methods to be applied to the public through the retail agencies, will in turn reduce MWDOC's overall demands on MET and reliance on imported water. MWDOC is assisting its retail agencies by leading the coordination of Orange County Regional Alliance for all of the retail agencies in Orange County. MWDOC assists each retail water supplier in Orange County in analyzing the requirements of and establishing their baseline and target water use, as guided by DWR. The City's specific demand management measures (DMMs) are further discussed in Section 9.

7.5 Drought Risk Assessment

Water Code Section 10635(b) requires every urban water supplier include, as part of its UWMP, a DRA for its water service as part of information considered in developing its DMMs and water supply projects and programs. The DRA is a specific planning action that assumes the City is experiencing a drought over the next five years and addresses the City's water supply reliability in the context of presumed drought conditions. Together, the water service reliability assessment (Sections 7.1 through 7.3) DRA, and WSCP (Section 8 and Appendix H) allow the City to have a comprehensive picture of its short-term and long-term water service reliability and to identify the tools to address any perceived or actual shortage conditions.

Water Code Section 10612 requires the DRA to be based on the driest five-year historic sequence of the City's water supply. However, Water Code Section 10635 also requires that the analysis consider plausible changes on projected supplies and demands due to climate change, anticipated regulatory changes, and other locally applicable criteria.

The following sections describe the City's methodology and results of its DRA.

7.5.1 DRA Methodology

The water demand forecasting model developed for the Demand Forecast TM (described in Section 4.3 isolated the impacts that weather and future climate can have on water demand through the use of a statistical model. The impacts of hot/dry weather condition are reflected as a percentage increase in water demands from the average condition (average of FY 2017-18 and FY 2018-19). For a single dry year condition (FY 2013-14), the model projects a 6% increase in demand for the region encompassing the City's service area (CDM Smith, 2021).

Locally, the five-consecutive years of FY 2011-12 through FY 2015-16 represent the driest five-consecutive year historic sequence for the City's water supply. This period that spanned water years 2012 through 2016 included the driest four-year statewide precipitation on record (2012-2015) and the smallest Sierra-Cascades snowpack on record (2015, with 5% of average). It was marked by extraordinary heat: 2014, 2015 and 2016 were California's first, second and third warmest year in terms of statewide average temperatures. Locally, Orange County rainfall for the five-year period totaled 36 inches, the driest on record.

As explained in Section 6, the City currently relies on, and will continue to rely on, two main water sources: local groundwater and imported water supply from MWDOC / MET. The City maximizes local water supply use before the purchase of imported water. The difference between total forecasted potable demands and local groundwater supply projections is the demand on MWDOC's imported water supplies, which are supplied by MET. Local groundwater supply for the City comes from the OC Basin and is dictated by the BPP set annually by OCWD. Therefore, the City's DRA focuses on the assessment of imported water from MWDOC / MET, which will be used to close any local water supply gap. This assessment aligns with the DRA presented in MWDOC's 2020 UWMP.

Water Demand Characterization

All of MWDOC's water supplies are purchased from MET, regardless of hydrologic conditions. As described in Section 6.2, MET's supplies are from the Colorado River, SWP, and in-region storage. In its 2020 UWMP, MET's DRA concluded that even without activating WSCP actions, MET can reliably provide water to all of their member agencies, including MWDOC, and in effect the City, assuming a five-year drought from FY 2020-21 through FY 2024-25. Beyond this, MET's DRA indicated a surplus of supplies that would be available to all of its member agencies, including MWDOC, should the need arise. Therefore, any increase in demand that is experienced in MWDOC's service area, which includes the City, will be met by MET's water supplies.

Based on the Demand Forecast TM, in a single dry year, demand is expected to increase by 6% above a normal year. Both MWDOC and the City's DRA conservatively assumes a drought from FY 2020-21 through FY 2024-25 is a repeat of the single dry year over five consecutive years.

The City's demand projections were developed as part of the Demand Forecast TM, led by MWDOC. As part of the study, MWDOC first estimated total retail demands for its service area. This was based on estimated future demands using historical water use trends, future expected water use efficiency measures, additional projected land-use development, and changes in population. The City's projected water use, linearly interpolated per the demand forecast, is presented annually for the next five years in in Table 4-2. Next, MWDOC estimated the projections of local supplies derived from current and expected local supply programs from their member agencies. Finally, the demand model calculated the difference between total forecasted demands and local supply projections. The resulting difference between total demands net of savings from conservation and local supplies is the expected regional demands on MWDOC from their member agencies, such as the City.

Water Supply Characterization

MWDOC's assumptions for its supply capabilities are discussed and presented in 5-year increments under its 2020 UWMP water reliability assessment. For MWDOC's DRA, these supply capabilities are further refined and presented annually for the years 2021 to 2025 by assuming a repeat of historic conditions from FY 2011-12 to FY 2015-16. For its DRA, MWDOC assessed the reliability of supplies available to MWDOC through MET using historical supply availability under dry-year conditions. MET's supply sources under the Colorado River, SWP, and in-region supply categories are individually listed and discussed in detail in MET's UWMP. Future supply capabilities for each of these supply sources are also individually tabulated in Appendix 3 of MET's UWMP, with consideration for plausible changes on projected supplies under climate change conditions, anticipated regulatory changes, and other factors. MWDOC's supplies are used to meet consumptive use, surface water and groundwater recharge needs that are in excess of locally available supplies. In addition, MWDOC has access to supply augmentation actions through MET. MET may exercise these actions based on regional need, and in accordance with their WSCP, and may include the use of supplies and storage programs within the Colorado River, SWP, and in-region storage.

7.5.2 Total Water Supply and Use Comparison

The City's DRA reveals that its supply capabilities are expected to balance anticipated total water use and supply, assuming a five-year consecutive drought from FY 2020-21 through FY 2024-25 (Table 7-5). For simplicity, the table shows supply to balance the modeled demand in the table. However, the City can purchase more MET water from MWDOC, should the need arise.

Table 7-5: Five-Year Drought Risk Assessment Tables to Address Water Code Section 10635(b)

Submittal Table 7-5: Five-Year Drought Risk Assessment Tables to address Water Code Section 10635(b)

2021	Total
Total Water Use	3,448
Total Supplies	3,448
Surplus/Shortfall w/o WSCP Action	0
Planned WSCP Actions (use reduction and supply augmentation)	
WSCP - supply augmentation benefit	0
WSCP - use reduction savings benefit	0
Revised Surplus/(shortfall)	0
Resulting % Use Reduction from WSCP action	0%

2022	Total
Total Water Use	3,428
Total Supplies	3,428
Surplus/Shortfall w/o WSCP Action	0
Planned WSCP Actions (use reduction and supply augmentation)	
WSCP - supply augmentation benefit	0
WSCP - use reduction savings benefit	0
Revised Surplus/(shortfall)	0
Resulting % Use Reduction from WSCP action	0%

2023	Total
Total Water Use	3,407
Total Supplies	3,407
Surplus/Shortfall w/o WSCP Action	0
Planned WSCP Actions (use reduction and supply augmentation)	
WSCP - supply augmentation benefit	0
WSCP - use reduction savings benefit	0
Revised Surplus/(shortfall)	0
Resulting % Use Reduction from WSCP action	0%

Submittal Table 7-5: Five-Year Drought Risk Assessment Tables to address Water Code Section 10635(b)

2024	Total
Total Water Use	3,386
Total Supplies	3,386
Surplus/Shortfall w/o WSCP Action	0
Planned WSCP Actions (use reduction and supply augmentation)	
WSCP - supply augmentation benefit	0
WSCP - use reduction savings benefit	0
Revised Surplus/(shortfall)	0
Resulting % Use Reduction from WSCP action	0%

2025	Total
Total Water Use	3,366
Total Supplies	3,366
Surplus/Shortfall w/o WSCP Action	0
Planned WSCP Actions (use reduction and supply augmentation)	
WSCP - supply augmentation benefit	0
WSCP - use reduction savings benefit	0
Revised Surplus/(shortfall)	0
Resulting % Use Reduction from WSCP action	0%

Note: Groundwater is sustainably managed through the BPP and robust management measures (Section 6.3.4 and Appendix G), indirect recycled water uses provide additional local supply (Section 6.6), and based on MET's and MWDOC's UWMPs, imported water is available to close any local water supply gap (Section 7.5.1).

7.5.3 Water Source Reliability

Locally, approximately 77% (BPP for Water Year 2021-22) of the City's total water supply can rely on OC Basin groundwater through FY 2024-25. The BPP is projected to increase to 85% starting in FY 2024-25. Based on various storage thresholds and hydrologic conditions, OCWD, who manages the OC Basin, has numerous management measures that can be taken, such as adjusting the BPP or seeking additional supplies to refill the basin, to ensure the reliability of the Basin. For more information on the OC Basin's management efforts, refer to Section 6.3.

Additionally, the City's use of indirect recycled water (OCWD GWRS) should also be considered. The ability to continue producing water locally greatly improves the City's water reliability. More detail on these programs is available in Section 6.6.

Moreover, although not normally considered part of the City's water portfolio, the interconnections the City has with the Cities of Westminster, Long Beach, and Huntington Beach, as well as Golden State Water Company can help mitigate any water supply shortages, though shortages are not expected. These are briefly described in Section 6.8.

The City's DRA concludes that its water supplies meet total water demand, assuming a five-year consecutive drought from FY 2020-21 through FY 2024-25 (Table 7-5). For simplicity, the table shows supply to balance the modeled demand in the table. However, the City can purchase more MET water from MWDOC, should the need arise.

As detailed in Section 8, the City has in place a robust WSCP and comprehensive shortage response planning efforts that include demand reduction measures and supply augmentation actions. However, since the City's DRA shows a balance between water supply and demand, no water service reliability concern is anticipated, and no shortfall mitigation measures are expected to be exercised over the next five years. The City and its wholesale supplier, MWDOC, will periodically revisit its representation of the supply sources and of the gross water use estimated for each year, and will revise its DRA if needed.

8 WATER SHORTAGE CONTINGENCY PLANNING

8.1 Layperson Description

Water shortage contingency planning is a strategic planning process that the City engages to prepare for and respond to water shortages. A water shortage, when water supply available is insufficient to meet the normally expected customer water use at a given point in time, may occur due to a number of reasons, such as water supply quality changes, climate change, drought, and catastrophic events (e.g., earthquake). The City's WSCP provides real-time water supply availability assessment and structured steps designed to respond to actual conditions. This level of detailed planning and preparation will help maintain reliable supplies and reduce the impacts of supply interruptions.

The Water Code Section 10632 requires that every urban water supplier that serves more than 3,000 AF per year or have more than 3,000 connections prepared and adopt a standalone WSCP as part of its UWMP. The WSCP is required to plan for a greater than 50% supply shortage. This WSCP due to be updated based on new requirements every five years and will be adopted as a current update for submission to DWR by July 1, 2021.

8.2 Overview of the WSCP

The WSCP serves as the operating manual that the City will use to prevent catastrophic service disruptions through proactive, rather than reactive, mitigation of water shortages. The WSCP contains processes and procedures documented in the WSCP, which are given legal authority through the Water Shortage Contingency Response Ordinance. This way, when shortage conditions arise, the City's governing body, its staff, and the public can easily identify and efficiently implement pre-determined steps to mitigate a water shortage to the level appropriate to the degree of water shortfall anticipated. Figure 8-1 illustrates the interdependent relationship between the three procedural documents related to planning for and responding to water shortages.

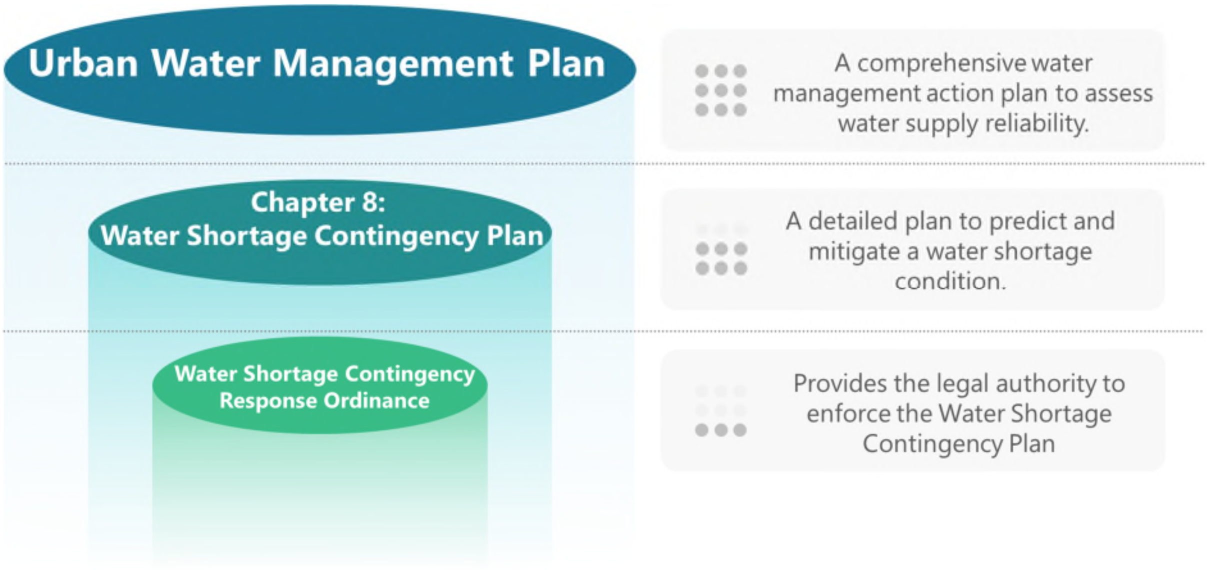


Figure 8-1: UWMP Overview

A copy of the City's WSCP is provided in Appendix H and includes the steps to assess if a water shortage is occurring, and what level of shortage drought actions to trigger the best response as appropriate to the water shortage conditions. WSCP has prescriptive elements, including an analysis of water supply reliability; the drought shortage actions for each of the six standard water shortage levels, that correspond to water shortage percentages ranging from 10% to greater than 50%; an estimate of potential to close supply gap for each measure; protocols and procedures to communicate identified actions for any current or predicted water shortage conditions; procedures for an annual water supply and demand assessment; monitoring and reporting requirements to determine customer compliance; and reevaluation and improvement procedures for evaluating the WSCP.

8.3 Summary of Water Shortage Response Strategy and Required DWR Tables

This WSCP is organized into three main sections, with Section 3 aligned with the Water Code Section 16032 requirements.

Section 1 Introduction and WSCP Overview gives an overview of the WSCP fundamentals.

Section 2 Background provides a background on the City's water service area.

Section 3.1 Water Supply Reliability Analysis provides a summary of the water supply analysis and water reliability findings from the 2020 UWMP.

Section 3.2 Annual Water Supply and Demand Assessment Procedures provide a description of procedures to conduct and approve the Annual Assessment.

Section 3.3 Six Standard Water Shortage Stages explains the WSCP's six standard water shortage levels corresponding to progressive ranges of up to 10, 20, 30, 40, 50, and more than 50% shortages.

Section 3.4 Shortage Response Actions describes the WSCP's shortage response actions that align with the defined shortage levels.

Section 3.5 Communication Protocols addresses communication protocols and procedures to inform customers, the public, interested parties, and local, regional, and state governments, regarding any current or predicted shortages and any resulting shortage response actions.

Section 3.6 Compliance and Enforcement describes customer compliance, enforcement, appeal, and exemption procedures for triggered shortage response actions.

Section 3.7 Legal Authorities is a description of the legal authorities that enable the City to implement and enforce its shortage response actions.

Section 3.8 Financial Consequences of the WSCP provides a description of the financial consequences of and responses for drought conditions.

Section 3.9 Monitoring and Reporting describes monitoring and reporting requirements and procedures that ensure appropriate data is collected, tracked, and analyzed for purposes of monitoring customer compliance and to meet state reporting requirements**.**

Section 3.10 WSCP Refinement Procedures addresses reevaluation and improvement procedures for monitoring and evaluating the functionality of the WSCP.

Section 3.11 Special Water Feature Distinction is a required definition for inclusion in a WSCP per the Water Code.

Section 3.12 Plan Adoption, Submittal, and Implementation provides a record of the process the City followed to adopt and implement its WSCP.

The WSCP is based on adequate details of demand reduction and supply augmentation measures that are structured to match varying degrees of shortage will ensure the relevant stakeholders understand what to expect during a water shortage situation. Water Code Section 10632 (a)(3)(A) provides an option for urban water suppliers to align with six standard water shortage levels; however, the City has selected to retain its existing water shortage levels as defined in the City Code (Table 8-1). Table 8-2 shows the City's water shortage levels in relation to the six standard water shortage levels prescribed by statue. This crosswalk is intended to clearly translate the City's water shortage levels to those mandated by statute.

The supply augmentation actions that align with each shortage level are described in DWR Table 8-3 (Appendix B). These augmentations represent short-term management objectives triggered by the WSCP and do not overlap with the long-term new water supply development or supply reliability enhancement projects.

The demand reduction measures that align with each shortage level are described in DWR Table 8-2 (Appendix B). This table also estimates the extent to which that action will reduce the gap between supplies and demands to demonstrate to the that choose suite of shortage response actions can be expected to deliver the expected outcomes necessary to meet the requirements of a given shortage level.

Table 8-1: Water Shortage Contingency Plan Levels

Submittal Table 8-1 Water Shortage Contingency Plan Levels		
Shortage Level	**Percent Shortage Range**	**Shortage Response Actions**
1	Up to 20%	A Phase 1 water supply shortage exists when the city council determines, in its sole discretion, that due to drought or other water supply conditions, a water supply shortage or threatened shortage exists and a 20% consumer demand of reduction is necessary to make more efficient use of water and appropriately respond to existing water conditions. Upon the declaration by the city council of a Phase 1 water supply shortage condition, the city council will implement the mandatory Phase 1 conservation measures identified in this section.
2	Up to 40%	A Phase 2 water supply shortage exists when the city council determines, in its sole discretion, that due to drought or other water supply conditions, a severe water supply shortage or threatened shortage exists and a 40% consumer demand reduction is necessary to make more efficient use of water and appropriately respond to existing water conditions. Upon the declaration by the city council of a Phase 2 water supply shortage condition, the city council will implement the mandatory Phase 2 conservation measures identified in this section.
3	Greater than 40%	A Phase 3 water supply shortage condition is also referred to as an “emergency” condition. A Phase 3 condition exists when the city council declares a water shortage emergency and notifies its residents and businesses that a significant reduction of greater than 40% in consumer demand is necessary to maintain sufficient water supplies for public health and safety. Upon the declaration of a Phase 3 water supply shortage condition, the city council will implement the mandatory Phase 3 conservation measures identified in this section.
NOTES:		

Table 8-2: Relationship Between the District’s Water Shortage Levels and Mandated Shortage Levels

Relationship Between City of Seal Beach Water Shortage Levels and Mandated Shortage Levels (DWR Table 8-1)			
City of Seal Beach Water Shortage Levels		**Mandated Shortage Levels**	
Shortage Level	**Percent Shortage Range**	**Shortage Level**	**Percent Shortage Range**
Permanent Water Conservation Requirements	0%	**N/A**	0%
1	Up to 20%	**1** **2**	Up to 10% 10-20%
2	20-40%	**3** **4**	20 – 30% 30 - 40%
3	>40%	**5** **6**	40 - 50% >50%

Water shortage contingency planning is a strategic planning process to prepare for and respond to water shortages. Detailed planning and preparation can help maintain reliable supplies and reduce the impacts of supply interruptions. This chapter provides a structured plan for dealing with water shortages, incorporating prescriptive information and standardized action levels, along with implementation actions in the event of a catastrophic supply interruption.

A well-structured WSCP allows real-time water supply availability assessment and structured steps designed to respond to actual conditions, to allow for efficient management of any shortage with predictability and accountability. A water shortage, when water supply available is insufficient to meet the normally expected customer water use at a given point in time, may occur due to a number of reasons, such as population growth, climate change, drought, and catastrophic events. The WSCP is the City’s operating manual that is used to prevent catastrophic service disruptions through proactive, rather than reactive, management. This way, if and when shortage conditions arise, the City’s governing body, its staff, and the public can easily identify and efficiently implement pre-determined steps to manage a water shortage.

9 DEMAND MANAGEMENT MEASURES

The City, along with other Retail water agencies throughout Orange County, recognizes the need to use existing water supplies efficiently. This ethic of efficient use of water has evolved as a result of the development and implementation of water use efficiency programs that make good economic sense and reflect responsible stewardship of the region's water resources. The City works closely with MWDOC to promote regional efficiency by participating in the regional water savings programs, leveraging MWDOC local program assistance, and applying the findings of MWDOCs research and evaluation efforts. This chapter communicates the City's efforts to promote conservation and to reduce demand on water supplies. A detailed description of demand management measures is available in Appendix J.

9.1 Demand Management Measures for Retail Suppliers

The goal of the DMM section is to provide a comprehensive description of the water conservation programs that a supplier has implemented, is currently implementing, and plans to implement in order to meet its urban water use reduction targets. The reporting requirements for DMM has been significantly modified and streamlined in 2014 by Assembly Bill 2067. Additionally, this section of the UWMP will report on the role of MWDOC's programs in meeting new state regulations for complying with the SWRCB's new Conservation Framework. These categories of demand management measures are as follows:

- Water waste prevention ordinances;
- Metering;
- Conservation pricing;
- Public education and outreach;
- Programs to assess and manage distribution system real loss;
- Water conservation program coordination and staffing support;
- Other DMMs that have a significant impact on water use as measured in GPCD, including innovative measures, if implemented;
- Programs to assist retailers with Conservation Framework Compliance.

9.1.1 Water Waste Prevention Ordinances

City Council adopted a Water and Water Conservation ordinance (Ordinance 1586) on June 8, 2009 revising and supplementing the City's previous water conservation provisions. The ordinance established provisions for leak repair, runoff prevention, limits on watering hours and duration, and serving water at restaurants, excessive runoff from landscape irrigation, use of hose outdoors without a shut off nozzle, use of single pass cooling systems, and use of decorative water features with no recirculation, among other prohibitions against waste.

The ordinance has a permanent water conservation clause i.e., the City's water conservation ordinance is effective at all times and is not dependent upon a water shortage for implementation. In the event of a water supply shortage, the ordinance established provisions for three water conservation phases associated with increasingly restrictive prohibitions. Phase 1 corresponds to a water supply shortage or a threatened shortage, Phase 2 corresponds to a severe water supply shortage, and Phase 3 corresponds to an emergency condition. The provisions and water conservation measures to be implemented in response to each shortage level are described in the WSCP located in Appendix H of this 2020 UWMP. The City's water conservation ordinance is included in Appendix B of the WSCP.

Implementation of the City's water conservation ordinance over the past five years, from 2016 through 2020, involved making significant efforts to educate the public of the ordinance and the provisions, and generate drought awareness. Water customers were notified via billing inserts about the drought and water conservation ordinance, and the conservation measures required therein. There have been newspaper articles and internet articles regarding the ordinance. The ordinance is highlighted on the City's website. All Public Works Department vehicles have magnetic signs promoting water conservation. The City sent letters to all restaurant owners in the City advising them of the restrictions on serving water to customers. The letters included table placards to notify the public of the reason water was not being served.

City staff has been trained on the provisions of the ordinance. Any time they observe a violation they take the opportunity to education the public on the requirements of the ordinance. The enforcement provisions of the ordinance allow for a three step enforcement program. The first step is a written notice from the City outlining the violation and the corrective measures needed. The second step allows for a 15% surcharge added to the water bill of the offending customer. The third step is for the City to install a flow restrictor on the water service. Violators are provided an appeal process. All citations and violations are reported annually. Over the period of this DMM implementation the City has seen a reduction in the number of violations.

9.1.2 Metering

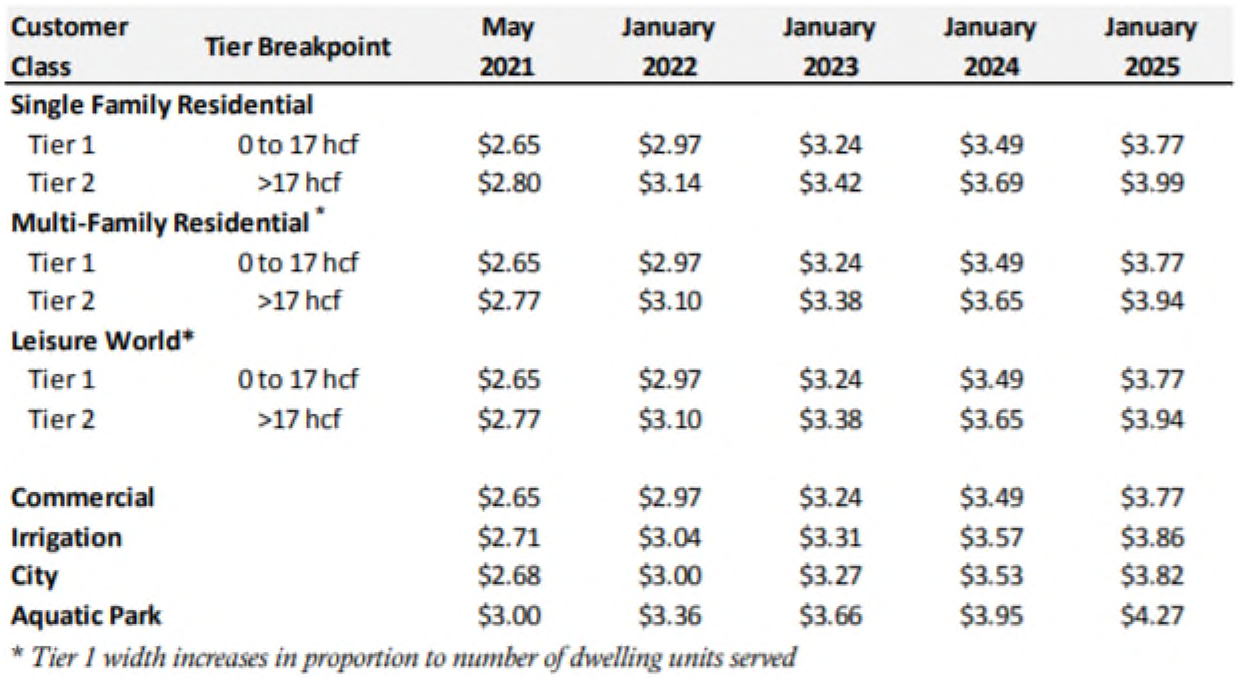
The City is fully metered for all customer sectors, including separate meters for single-family and multi-family residential, CII, dedicated landscape, and City-owned meters. The City will continue to install and read meters on all new services.

The City's program for meter replacement and calibration consists of replacing meters when stuck or when meters are reading low or high. After replacement, they are subsequently tested by flow testing and calibration. The City uses direct or touch meter reading.

9.1.3 Conservation Pricing

The City completed a Water and Water Rate Study in December 2020 (City of Seal Beach, 2020) and adopted new rates in early 2021. The City has a two-tier inclining block rate structure for residential and commercial customer sectors. The water rate also includes a minimum fixed charge based on meter size. The current residential rates are provided in Table 9-1.

Table 9-1: Seal Beach Water Usage Rates



Customer Class	Tier Breakpoint	May 2021	January 2022	January 2023	January 2024	January 2025
Single Family Residential						
Tier 1	0 to 17 hcf	$2.65	$2.97	$3.24	$3.49	$3.77
Tier 2	>17 hcf	$2.80	$3.14	$3.42	$3.69	$3.99
Multi-Family Residential *						
Tier 1	0 to 17 hcf	$2.65	$2.97	$3.24	$3.49	$3.77
Tier 2	>17 hcf	$2.77	$3.10	$3.38	$3.65	$3.94
Leisure World*						
Tier 1	0 to 17 hcf	$2.65	$2.97	$3.24	$3.49	$3.77
Tier 2	>17 hcf	$2.77	$3.10	$3.38	$3.65	$3.94
Commercial		$2.65	$2.97	$3.24	$3.49	$3.77
Irrigation		$2.71	$3.04	$3.31	$3.57	$3.86
City		$2.68	$3.00	$3.27	$3.53	$3.82
Aquatic Park		$3.00	$3.36	$3.66	$3.95	$4.27

* *Tier 1 width increases in proportion to number of dwelling units served*

The City implements a two-tier structure for residential customers based on usage and a uniform rate for CII. The City's conservation pricing structure is always in place and is not dependent upon a water shortage for implementation. Although the rate structure includes a drought rate structure that would be implemented as needed. Drought rate structures and surcharges are addressed in the Water Shortage Contingency Planning section.

9.1.4 Public Education and Outreach

The City's public education and outreach program is administered by MWDOC, its wholesale supplier. MWDOC develops, coordinates, and delivers a substantial number of public information, education, and outreach programs aimed at elevating water agency and consumer awareness and understanding of current water issues as well as efficient water use and water-saving practices, sound policy, and water reliability investments that are in the best interest of the region. These efforts encourage good water stewardship that benefit all City residents, businesses, and industries across all demographics. Several examples are included below:

Print and Electronic Materials

MWDOC offers a variety of print and electronic materials that are designed to assist City water users of all ages in discovering where their water comes from, what the MWDOC and other water industry professionals are doing to address water challenges, how to use water most efficiently, and more. Through the MWDOC's robust social media presence, award-winning website, eCurrents newsletter, media tool kits, public service announcements (PSAs), flyers, brochures, and other outreach materials, MWDOC ensures that stakeholders are equipped with sufficient information and subject knowledge to assist them in making good behavioral and civic choices that ultimately affect the quality and quantity of the region's water supply.

Public Events

Each year, MWDOC hosts an array of public events intended to engage a diverse range of water users in targeted discussions and actions that homes in on their specific interests or needs. Some of these public events include:

- **MWDOC Water Policy Forums and Orange County Water Summit** are innovative and interactive symposiums that bring together hundreds of business professionals, elected officials, water industry stakeholders, and community leaders from throughout the state for a discussion on new and ongoing water supply challenges, water policy issues, and other important topics that impact our water supply, economy, and public health.
- **Inspection Trips** of the state's water supply systems are sponsored each year by MWDOC and MET. Orange County elected officials, residents, business owners, and community leaders are invited to tour key water facilities throughout the state and learn more about the critical planning, procurement, and management of Southern California's water supply, as well as the issues surrounding delivery and management of our most precious natural resource – water.
- **Community Events and Events Featuring MWDOC Mascot Ricky the Rambunctious Raindrop** provide opportunities to interact with Orange County water users in a fun and friendly way, offer useful water-related information or education, and engage them in important discussions about the value of water and how their decisions at home, at work, and as tax- or ratepayers may impact Orange County's quality and quantity of water for generations to come.

Education Programs and Initiatives

Over the past several years, MWDOC has amplified its efforts in water education programs and activities for Orange County's youngest water users. This is accomplished by continuing to grow professional networks and partnerships that consist of leading education groups, advisors, and teachers, and by leading the way for the MWDOC and its 28 member agencies to be key contributors of both Southern California and Orange County water-centric learning. Several key water education programs and initiatives include:

- **Environmental Literacy** is an individual's awareness of the interconnectedness and interdependency between people and natural systems, being able to identify patterns and systems within their communities, while also gathering evidence to argue points and solve problems. By using the environment as the context for learning, K-12 students gain real-world knowledge by asking questions and solving problems that directly affect them, their families, and their communities. This approach to K-12 education builds critical thinking skills and promotes inquiry, and is the foundation for all MWDOC education programs, initiatives, and activities.
- **MWDOC Choice School Programs** have provided Orange County K-12 students water-focused learning experiences for nearly five (5) decades. Interactive, grade-specific lessons invite students to connect with, and learn from, their local ecosystems, guiding them to identify and solve local water-related environmental challenges affecting their communities. Choice School Programs are aligned with state standards, and participation includes a dynamic in-class or virtual

presentation, and pre- and post-activities that encourage and support Science Technology Engineering Arts and Mathematics (STEAM)-based learning and good water stewardship.

- **Water Energy Education Alliance (WEEA)** is a coalition of education and water and energy industry professionals led by MWDOC that works together to build and bolster Career Technical Education programs (CTE) for Southern California high school students. These CTEs focus on workforce pathways in the Energy, Environment, and Utility Sectors, and connections established through this powerful Southern California alliance assist stakeholders as they thoughtfully step up their investment in the education and career success of California's future workforce.
- **MWDOC Water Awareness Poster Contest** is an annual activity developed to encourage Orange County's K-12 students to investigate and explore their relationship to water, connect the importance of good water stewardship to their daily lives, and express their conclusions creatively through art. Each year, MWDOC receives hundreds of entries, and 40 winners from across Orange County are invited to attend a special awards ceremony with their parents and teachers, and Ricky the Rambunctious Raindrop.
- **Boy Scouts Soil and Water Conservation Merit Badge and Girl Scouts Water Resources and Conservation Patch Programs** guide Orange County Scouts on a learning adventure of where their water comes from, the importance of Orange County water resources, and how to be water efficient. These STEAM-based clinics are hosted by MWDOC and include interactive learning stations, hands-on activities, and a guided tour of an Orange County water source, water treatment facility, or ecological reserve
- **Partnerships** are an integral part of achieving water-related goals that impact all Orange County water users. MWDOC's partner list is extensive, and acts as a collective catalyst for all those involved to grow and prosper. Some of the MWDOC's most recognized partners include local, regional, state, and federal legislators, educators, water and energy industry leaders, environmental groups, media, and business associations all focused on the common goals of water education, water use efficiency, and advocacy on behalf of the region.

9.1.5 Programs to Assess and Manage Distribution System Real Loss

The City has been conducting water audits and leak detection and repair since 1991 in order to assess and manage distribution system real loss. The City performs water audit and leak detection when it receives high bill complaints from customers. It has also incorporated meter calibration (production and customer meters) programs into its utility operations. City staff is trained at AWWA sponsored training programs. On average, City Water Department crews spend about 30 days surveying approximately 10 miles of main and laterals per year. The City replaces and/or calibrates a minimum of 250 meters per year, which is approximately 5% of the total meters in the system. The City also has an annual valve exercise program, to ensure that interconnections with adjacent utilities actually work. The City repairs leaks in the distribution system as they occur.

The City does not have an advanced program in place to detect leaks. Leaks are repaired when they are visually identified at meters and valves or along mainlines after observing leakage protruding through the ground surface.

Senate Bill 1420 signed into law in September 2014 requires urban water suppliers that submit UWMPs to calculate annual system water losses using the water audit methodology developed by the AWWA. SB 1420 requires the water loss audit be submitted to DWR every five years as part of the urban water supplier's UWMP. Water auditing is the basis for effective water loss control. DWR's UWMP Guidebook include a water audit manual intended to help water utilities complete the AWWA Water Audit on an annual basis. A Water Loss Audit was completed for the City which identified areas for improvement and quantified total loss. Based on the data presented, the three priority areas identified were water imported, billed metered water, and unauthorized consumption. Multiple criteria are a part of each validity score and a system wide approach will need to be implemented for the City's improvement. Expressing water loss audit results in terms of Real Losses per Service Connection per Day allows for standardized comparison across MWDOC retailer agencies and is a metric consistent with the Water Board's forthcoming economic model. The Real Losses per Service Connection per Day for CY2019 was 31.22 gal/connection/day.

9.1.6 Water Conservation Program Coordination and Staffing Support

The City's Public Works Director provides oversight of the City's water use efficiency programs while the Deputy Director performs day-to-day water conservation coordinator activities and acts as the liaison between the City's water department, MET, MWDOC, and other parties. The City has also hired a consultant to assist with the implementation of the Water Conservation Ordinance by conduct public outreach and inspection.

Sources of funding for the City's water conservation program include the City's General Water Funds and Proprietary Funds.

9.1.7 Other Demand Management Measures

9.1.7.1 Residential Program

MWDOC assists the City with the implementation of residential DMMs by making available the following programs aimed at increasing landscape and indoor water use efficiency for residential customers.

High Efficiency Clothes Washer Rebate Program

The High Efficiency Clothes Washer (HECW) Rebate Program provides residential customers with rebates for purchasing and installing HECWs that. Approximately 15% of home water use goes towards laundry, and HECWs use 35-50% less water than standard washer models, with savings of approximately 10,500 gallons per year, per device. Devices must meet or exceed the Consortium for Energy Efficiency (CEE) Tier 1 Standard, and a listing of qualified products can be found at ocwatersmart.com. There is a maximum of one rebate per home.

Premium High Efficiency Toilet Rebate Program

The largest amount of water used inside a home, 30%, goes toward flushing the toilet. The Premium High Efficiency Toilet (HET) Rebate Program offers incentives to residential customers for replacing their toilets using 1.6 gallons per flush (gpf) or more. Premium HETs use just 1.1 gallons of water or less per flush, which is 20% less water than WaterSense standard toilets. In addition, Premium HETS save an average of 9 gallons of water per day while maintaining high performance standards.

9.1.7.2 CII Programs

MWDOC provides a variety of financial incentives to help City businesses, restaurants, institutions, hotels, hospitals, industrial facilities, and public sector sites achieve their efficiency goals. Water users in these sectors have options to choose from a standardized list of water efficient equipment/devices or may complete customized projects through a pay-for-performance where the incentive is proportional to the amount of water saved. Such projects include high efficiency commercial equipment installation and manufacturing process improvements.

Water Savings Incentive Program

The Water Savings Incentive Program (WSIP) is designed for non-residential customers to improve their water efficiency through upgraded equipment or services that do not qualify for standard rebates. WSIP is unique because it provides an incentive based on the amount of water customers actually save.
This “pay-for-performance” design lets customers implement custom projects for their sites.

Projects must save at least 10 MG of water to qualify for the Program and are offered from $195 to $390 per acre foot of water saved. Examples of successfully projects include but are not limited to changing industrial process system water, capturing condensation and using it to supplement cooling tower supply, and replacing water-using equipment with more efficient products.

On-site Retrofit Program

The On-site Retrofit Program (ORP) provides another pay-for-performance financial incentive to commercial, industrial, and institutional property owners, including Homeowner Associations (HOAs), who convert potable water irrigation or industrial water systems to recycled water use.

Projects commonly include the conversion of mixed or dedicated irrigation meters using potable water to irrigate with reclaimed water, or convert industrial processes use to recycled water, such as a cooling towers. Financial incentives of up to $1,300 per AF of potable water saved are available for customer-side on the meter retrofits. Funding is provided by MET, USBR, and DWR.

Multi-Family Premium High Efficiency Toilet Incentive Program

MWDOC makes an effort to reach all water-users in Orange County. For the Multi-Family Premium HET Rebate Program, MWDOC targets multi-family buildings in both disadvantaged communities (DAC) and non-DAC communities, in addition to targeting all commercial buildings, and SF residential homes through Premium HET device rebates.

MWDOC offers the DAC Multi-Family HET Program, a special version of the HET Program, to ensure regardless of economic status all water-users in Orange County can benefit from the rebate.
This Program targets 3.5 gpf or greater toilets to replace them with WaterSense Labeled 1.1 gpf or less. For this purpose, DAC are referenced as communities facing economic hardship. This is defined using criteria established by DWR and the County of Orange, which includes communities where the MHI is less than 85% of the Orange County MHI.

The DAC Multi-Family Program is contractor-driven, where a contractor works with building owners to replace all of the toilets in the building(s). To avoid any cost to tenants, the rebate is $200 per toilet paid to the contractor, essentially covering the contractor's cost; therefore, there is little to no charge to the building owners that may be passed through to tenants. This process was formed after consulting contractors and multi-family building owners in Orange County. To serve those in multi-family buildings outside of designated DAC locations, MWDOC offers $75 per toilet through the same contractor-driven format. An additional option is available through SoCalWater$mart, which offers up to $250 per toilet to multi-family buildings that were built before 1994, therefore targeting buildings built before legislation required low-flow plumbing fixtures in new construction.

Device Retrofits

MWDOC offers additional financial incentives under the Socal Water$mart Rebate Program which offers rebates for various water efficient devices to CII customers. Core funding is provided by MET and supplemental funding is sourced from MWDOC via grant funds and/or retail water agencies.

9.1.7.3 Landscape Programs

One of the most active and exciting water use efficiency sectors MWDOC provides services for are those programs that target the reduction of outdoor water use. With close to 60% of water consumed outdoors, this sector has been and will continue to be a focus for MWDOC and the City.

Turf Removal Program

The Orange County Turf Removal Program offers incentives to remove turf grass from residential, commercial, and public properties throughout the County. This program is a partnership between MWDOC, MET, and local retail water agencies. The goals of this program are to increase water use efficiency through sustainable landscaping practices that result in multi-benefit projects across Orange County. Participants replace their turf grass with drought-tolerant, CA Friendly, or CA Native landscaping, and retrofit their irrigation systems to high efficiency equipment, such as drip, or remove it entirely, and are encouraged to utilize smart irrigation timers. Furthermore, projects are required to include a stormwater capture feature, such as a rain garden or dry stream bed, and have a minimum of three plants per 100 square feet to increase plant density and promote healthy soils. These projects save water and also reduce dry and wet weather runoff, increase urban biomass, and sequester more carbon than turf landscapes.

Landscape Design and Maintenance Plan Assistance Programs

To maximize the water efficiency and quality of Orange County's Turf Removal Program Projects, MWDOC offers free landscape designs and free landscape maintenance plans to participating residential customers. The Landscape Design Assistance Program is offered at the beginning stages of their turf removal project so that customers may receive a customized, professionally designed landscape to replace their turf. Landscape designs include plant selection, layout, irrigation plans, and a stormwater capture feature. These designs help ensure climate appropriate plants are chosen and planted by hydrozone, that appropriate high efficiency irrigation is properly utilized, that water savings are maximized as a result of the transformation. Landscape maintenance plans are offered after a project is complete to ensure that the new landscape is cared for properly and water savings are maximized.

Smart Timer Rebate Program

Smart Timers are irrigation clocks that are either weather-based irrigation controllers (WBICs) or soil moisture sensor systems. WBICs adjust automatically to reflect changes in local weather and site-specific landscape needs, such as soil type, slopes, and plant material. When WBICs are programmed properly, turf and plants receive the proper amount of water throughout the year. During the fall months, when property owners and landscape professionals often overwater, Smart Timers can save significant amounts of water.

Rotating Nozzles Rebate Program

The Rotating Nozzle Rebate Program provides incentives to residential and commercial properties for the replacement of high-precipitation rate spray nozzles with low-precipitation rate multi-stream, multi-trajectory rotating nozzles. The rebate offered through this Program aims to offset the cost of the device and installation.

Spray-to-Drip Rebate Program

The Spray to Drip Rebate Program offers residential, commercial, and public agency customers rebates for converting areas irrigated by traditional high-precipitation rate spray heads to low-precipitation rate drip irrigation. Drip irrigation systems are extremely water-efficient. Rather than spraying wide areas subject to wind drift, overspray and runoff, drip systems use point emitters to deliver water to specific locations at or near plant root zones. Water drips slowly from the emitters either onto the soil surface or below ground. As a result, less water is lost to wind, evaporation, and overspray, saving water and reducing irrigation runoff and non-point source pollution.

Socal Water$mart Rebate Program for Landscape

The City through MWDOC also offers financial incentives under the SoCal Water$mart Rebate Program for a variety of water efficient landscape devices, such as Central Computer Irrigation Controllers, large rotary nozzles, and in-stem flow regulators.

Landscape Training Classes

The California Friendly and Native Landscape Training and the Turf Removal and Garden Transformation Workshops provide education to residential homeowners, property managers, and professional landscape contractors on a variety of landscape water efficiency practices that they can employ and use to help design a beautiful garden using California Friendly and native plant landscaping principles.
The California Friendly and Native Landscape Class demonstrates how to: implement storm water capture features in the landscape; create a living soil sponge that holds water; treat rainwater by a resource; select and arrange plants to maximize biodiversity and minimize water use; and control irrigation to minimize water waste, runoff and non-point source pollution.

The Turf Removal and Garden Transformation Workshop teaches participants how to transform thirsty turfgrass into a beautiful, climate-appropriate water efficient garden. This class teaches how to: evaluate the landscape’s potential; plan for garden transformation; identify the type of turfgrass in the yard; remove grass without chemicals; build healthy, living soils; select climate-appropriate plants that minimize water use and maximize beauty and biodiversity; and implement a maintenance schedule to maintain the garden.

Qualified Water Efficient Landscape Certification (Commercial)

Since 2018, MWDOC along with the City, has offered free Qualified Water Efficient Landscaper (QWEL) certification classes designed for landscape professionals. Classes are open to any city staff, professional landscaper, water district employee, or maintenance personnel that would like to become a Qualified Water Efficient Landscaper. The QWEL certification program provides 20 hours of instruction on water efficient areas of expertise such as local water supply, sustainable landscaping, soil types, irrigation systems and maintenance, as well as irrigation controller scheduling and programing. QWEL has received recognition from EPA WaterSense for continued promotion of water use efficiency. To earn the QWEL certification, class participants must demonstrate their ability to perform an irrigation audit as well as pass the QWEL exam. Successful graduates will be listed as a Certified Professional on the WaterSense website as well as on MWDOC's landscape resources page, to encourage Turf Removal participants or those making any landscape improvements to hire a QWEL certified professional.

Started in December 2020, a hybrid version of QWEL is available in conjunction with the California Landscape Contractors Association's Water Management Certification Program. This joint effort allows landscape industry an opportunity to obtain two nationally recognized EPA WaterSense Professional Certifications with one course and one written test. This option is offered through MET.

Orange County Water Smart Gardens Resource Page

MWDOC's Orange County Water Smart Gardens webpage provides a surplus of helpful guides and fact sheets, as well as an interactive photo gallery of water-saving landscape ideas. The purpose of this resource is to help Orange County residents find a broad variety of solutions for their water efficient landscaping needs. This includes a detailed plant database with advanced to search features; photo and/or video-based garden tours; garden gallery with images organized into helpful landscape categories such as back yards, hillsides, full sun, and/or shade with detailed plant information; and the ability to select and store plants in a list that the user can print for use when shopping.

Additional technical resources are available such as a watering calculator calibrated for local evapotranspiration rates, and a garden resources section with fact sheets on sustainable landscape fundamentals, water and soil management, composting, solving run-off, and other appropriate topics. Web page is accessible through mwdoc.com and directly at www.ocwatersmartgardens.com.

9.2 Implementation over the Past Five Years

During the past five years, FY 2015-16 to 2020-21, the City, with the assistance of MWDOC, has continued water use efficiency programs for its residential, CII, and landscape customers as described below. Implementation data is provided in Appendix I. The City will continue to implement all applicable programs in the next five years.

Table 9-2: City of Seal Beach Water Use Efficiency Program Participation

Measure	Unit	FY 2015-16	FY 2016-17	FY 2017-18	FY 2018-19	FY 2019-20
Central Computer Irrigation Controllers	computer controller	-	-	-	-	-

Measure	Unit	FY 2015-16	FY 2016-17	FY 2017-18	FY 2018-19	FY 2019-20
	s					
Flow Restrictor	restrictors	-	-	-	-	-
He Efficiency Clothes Washers	washers	23	9	18	8	21
High Efficiency Toilets	toilets	70	1	-	-	-
Rain Barrels	barrels	41	4	2	2	-
Cisterns	cisterns	-	-	-	-	-
Premium High Efficiency Toilets	toilets	-	184	-	-	-
Rotating Nozzles	nozzles	4,746	-	3,908	-	-
CII Weather Based Irrigation Controllers	clocks	-	4	-	31	-
Residential Weather Based Irrigation Controllers	clocks	2	2	5	8	10
Zero Water Urinals	urinals	-	-	-	-	-
Plumbing Flow Control	valves	-	-	278	-	-
Soil Moisture Sensor	controllers	-	-	-	-	-
Ice-Making Machine	machines	-	-	-	-	-

Measure	Unit	FY 2015-16	FY 2016-17	FY 2017-18	FY 2018-19	FY 2019-20
Turf Removal	sqft	1,775	1,234	752	-	996
Spray-to-Drip	sqft	-	-	-	-	-
Landscape Design Assistance		-	-	-	-	-
Water Savings Incentive Program		-	-	-	-	-
On Site Retrofit Program	sites	-	-	-	-	-

9.3 Water Use Objectives (Future Requirements)

To support Orange County retailers with SB 606 and AB 1668 compliance (Conservation Framework), MWDOC is providing multi-level support to members agencies to ensure they meet the primary goals of the legislation including to Use Water More Wisely and to Eliminate Water Waste. Beginning in 2023, Urban water suppliers are required to calculate and report their annual urban water use objective (WUO), submit validated water audits annually, and to implement and report best management practice (BMP) CII performance measures.

Urban Water Use Objective

An Urban Water Supplier's urban WUO is based on efficient water use of the following:

- Aggregate estimated efficient **indoor residential** water use;
- Aggregate estimated efficient **outdoor residential** water use;
- Aggregate estimated efficient **outdoor** irrigation landscape areas with dedicated irrigation meters or equivalent technology in connection with **CII** water use;
- Aggregate estimated efficient **water losses;**
- Aggregate estimated water use for variances approved the State Water Board;
- Allowable **potable reuse water** bonus incentive adjustments.

MWDOC offers a large suite of programs, described in detail throughout section 1.3.6, that will assist Orange County retailers in meeting and calculating their WUO.

Table 9-3 describes MWDOC's programs that will assist agencies in meeting their WUO through both direct measures: programs/activities that result in directly quantifiable water savings; and indirectly: programs that provide resources promoting water efficiencies to the public that are impactful but not directly measurable.

Table 9-3: MWDOC Programs to Assist in Meeting WUO

WUO Component	Calculation	Program	Impact
Indoor Residential	Population and GPCD standard	**Direct Impact** • HECW • HET • Multi-Family HET (DAC/ non-DAC)	**Direct Impact** Increase of indoor residential efficiencies and reductions of GPCD use
Outdoor Residential	Irrigated/irrigable area measurement and a percent factor of local ETo	**Direct Impact** • Turf Removal • Spray-to-Dip • Smart Timer • High Efficiency Nozzle (HEN) • Rain Barrels/Cisterns **Indirect Impact** • Landscape Design and Maintenance Assistance • Orange County Friendly Gardens Webpage • CA Friendly/Turf Removal Classes • QWEL	**Direct Impact** Increase outdoor residential efficiencies and reductions of gallons per ft^2 of irrigated/ irrigable area used **Indirect Impact** Provide information, resources, and education to promote efficiencies in the landscape
Outdoor Dedicated Irrigation Meters	Irrigated/irrigable area measurement and a percent factor of local ETo	**Direct Impact** • Turf Removal • Spray-to-Dip • Smart Timer • HEN • Central Computer Irrigation Controllers • Large Rotary Nozzles • In-Stem Flow Regulators	**Direct Impact** Increase outdoor residential efficiencies and reductions of gallons per ft^2 of irrigated/ irrigable area used **Indirect Impact** Provide information,

WUO Component	Calculation	Program	Impact
		Indirect Impact • Orange County Friendly Gardens Webpage • CA Friendly/Turf Removal Classes • QWEL	resources, and education to promote efficiencies in the landscape
Water Loss	Following the AWWA M36 Water Audits and Water Loss Control Program, Fourth Edition and AWWA Water Audit Software V5	**Direct Impact** • Water Balance Validation • Customer Meter Accuracy Testing • Distribution System Pressure Surveys • Distribution System Leak Detection • No-Discharge Distribution System Flushing • Water Audit Compilation • Component Analysis	**Direct Impact** Identify areas of the distribution system that need repair, replacement or other action
Bonus Incentives	One of the following: • Volume of potable reuse water from existing facilities, not to exceed 15% of WUO • Volume of potable	**Direct Impact** • GWRS	**Direct Impact** The GWRS (run by OCWD) significantly increases the availability of potable reuse water

WUO Component	Calculation	Program	Impact
	reuse water from new facilities, not to exceed 10% of WUO		

In addition, MWDOC is providing support to agencies to assist with the calculation of WUOs. DWR will provide residential outdoor landscape measurements; however, Urban Water Suppliers are responsible for measuring landscape that is irrigated/irrigable by dedicated irrigation meters. MWDOC is contracting for consultant services to assist agencies in obtaining these measurements. Services may include but are not limited to:

- Accounting/database clean up (e.g., data mining billing software to determine dedicated irrigation customers);
- Geolocation of dedicated irrigation meters;
- In-field measurements;
- GIS/Aerial imagery measurements;
- Transformation of static/paper maps to digital/GIS maps.

These services will help agencies organize and/or update their databases to determine which accounts are dedicated irrigation meters and provide landscape area measurements for those accounts.
These data points are integral when calculating the WUO. MWDOC is also exploring funding options to help reduce retail agencies' costs of obtaining landscape area measurements for dedicated irrigation meters.

CII Performance Measures

Urban water supplies are expected to report BMPs and more for CII customers. MWDOC offers a broad variety of programs and incentives to help CII customers implement BMPs and increase their water efficiencies.

Table 9-4: CII Performance Measures and Programs

Component	Program Offered	Impact
CII Performance Measures	• WSIP • ORPs • HETs • HE Urinals • Plumbing Flow Control Valves • Connectionless Food Steamers • Air-cooled Ice Machines • Cooling Tower Conductivity controllers • Cooling Tower pH Controllers • Dry Vacuum Pumps • Laminar Flow Restrictors	WSIP incentivizes customized CII water efficiency projects that utilize BMPs. ORP incentivizes the conversion of potable to recycled water and is applicable to CII dedicated irrigation meters or CII mixed-use meters that may be split to utilize recycled water for irrigation. Additional CII rebates based on BMPs increase the economic feasibility of increasing water efficiencies.

These efforts to assist Orange County retail agencies are only just beginning. Our plan is to ensure that all agencies are fully ready to begin complying with the new water use efficiency standards framework called for in SB 606 and SB 1668 by the start date of 2023.

10 PLAN ADOPTION, SUBMITTAL, AND IMPLEMENTATION

The Water Code requires the UWMP to be adopted by the Supplier's governing body. Before the adoption of the UWMP, the Supplier has to notify the public and the cities and counties within its service area per the Water Code and hold a public hearing to receive input from the public on the UWMP. Post adoption, the Supplier submits the UWMP to DWR and the other key agencies and makes it available for public review.

This section provides a record of the process the City followed to adopt and implement its UWMP.

10.1 Overview

Recognizing that close coordination among other relevant public agencies is key to the success of its UWMP, the City worked closely with many other entities, including representation from diverse social, cultural, and economic elements of the population within the City's service area, to develop and update this planning document. The City also encouraged public involvement through its public hearing process, which provided residents with an opportunity to learn and ask questions about their water supply management and reliability. Through the public hearing, the public has an opportunity to comment and put forward any suggestions for revisions of the Plan.

Table 10-1 summarizes external coordination and outreach activities carried out by the City and their corresponding dates. The UWMP checklist to confirm compliance with the Water Code is provided in Appendix A.

Table 10-1: External Coordination and Outreach

External Coordination and Outreach	Date	Reference
Notified the cities and counties within the Supplier's service area that Supplier is preparing an updated UWMP (at least 60 days prior to public hearing)	3/4/2021	Appendix K
Public Hearing Notice	6/1/2021 & 6/8/2021	Appendix K
Held Public Hearing	6/14/2021	Appendix K
Adopted UWMP	6/14/2021	Appendix L
Submitted UWMP to DWR (no later than 30 days after adoption)	7/1/2021	-
Submitted UWMP to the California State Library (no later than 30 days after adoption)	7/1/2021	-
Submitted UWMP to the cities and counties within the Supplier's service area (no later than 30 days after adoption)	7/1/2021	-
Made UWMP available for public review (no later than 30 days after filing with DWR)	7/31/2021	-

This UWMP was adopted by the City Council on June 14, 2021. A copy of the adopted resolution is provided in Appendix L.

10.2 Agency Coordination

The Water Code requires the Suppliers preparing UWMPs to notify any city or county within their service area at least 60 days prior to the public hearing. As shown in Table 10-2, the City sent a Letter of Notification to the County of Orange on March 4, 2021 to state that it was in the process of preparing an updated UWMP (Appendix K).

Table 10-2: Retail: Notification to Cities and Counties

DWR Submittal Table 10-1 Retail: Notification to Cities and Counties		
County Name	60 Day Notice	Notice of Public Hearing
Orange County	☑	☑

The City's water supply planning relates to the policies, rules, and regulations of its regional and local water providers. The City is dependent on imported water from MET through MWDOC, its regional wholesaler. The City is also dependent on groundwater from OCWD, the agency that manages the OC Basin. As such, the City involved the relevant agencies in this 2020 UWMP at various levels of contribution as described below.

MWDOC provided assistance to the City's 2020 UWMP development by providing much of the data and analysis such as population projections from the California State University at Fullerton CDR and the information quantifying water availability to meet the City's projected demands for the next 25 years, in five-year increments. Additionally, MWDOC led the effort to develop a Model Water Shortage Ordinance that its retail suppliers can adopt as is or customize and adopt as part of developing their WSCPs. This 2020 UWMP was developed in collaboration with MWDOC's 2020 UWMP to ensure consistency between the two documents.

As a groundwater producer who relies on supplies from the OCWD-managed OC Basin, the City coordinated the preparation of this 2020 UWMP with OCWD. Several OCWD documents, such as the Groundwater Reliability Plan, Engineer's Report, and 2017 Basin 8-1 Alternative were used to retrieve the required relevant information, including the projections of the amount of groundwater the City is allowed to extract in the 25-year planning horizon.

The various planning documents of the key agencies that were used to develop this UWMP are listed in Section 2.2.1.

10.3 Public Participation

The City encouraged community and public interest involvement in the plan update through a public hearing and inspection of the draft document on June 14, 2021. As part of the public hearing, the City discussed adoption of the UWMP, SBx7-7 baseline values, compliance with the water use targets (Section 5), implementation, and economic impacts of the water use targets (Section 9).

Copies of the draft plan were available at the City Hall and Library.

Notices of public meetings were posted in the City Hall. Legal public notices for the meeting were published in the local newspaper and posted at City facilities. A copy of the published Notice of Public Hearing is included in Appendix K.

The hearing was conducted during a regularly scheduled meeting of the City Council.

10.4 UWMP Submittal

The City Council reviewed and approved the 2020 UWMP at its June 14, 2021meeting after public hearing. See Appendix L for the resolution approving the Plan.

By July 1, 2021, the City's adopted 2020 UWMP was filed with DWR, California State Library and the County of Orange. The submission to DWR was done electronically through the online submittal tool – WUE Data Portal. The City will make the Plan available for public review on its website no later than 30 days after filing with DWR.

10.5 Amending the Adopted UWMP or WSCP

Based on DWR’s review of the UWMP, the City will make any amendments in its adopted UWMP, as required and directed by DWR and will follow each of the steps for notification, public hearing, adoption, and submittal for the amending the adopted UWMP.

If the City revises its WSCP after UWMP is approved by DWR, then an electronic copy of the revised WSCP will be submitted to DWR within 30 days of its adoption.

11 REFERENCES

California Department of Housing and Community Development. (2020). *Accessory Dwelling Units (ADUs) and Junior Accessory Dwelling Units (JADUs)*. https://www.hcd.ca.gov/policy-research/accessorydwellingunits.shtml

California Department of Water Resources (DWR). (2020a, January). *California's Most Significant Droughts: Comparing Historical and Recent Conditions*. https://water.ca.gov/-/media/DWR-Website/Web-Pages/What-We-Do/Drought-Mitigation/Files/Publications-And-Reports/a6022_CalSigDroughts19_v9_ay11.pdf. Accessed on October 12, 2020.

California Department of Water Resources (DWR). (2020b, August 26). *The Final State Water Project Delivery Capability Report (DCR) 2019*. https://data.cnra.ca.gov/dataset/state-water-project-delivery-capability-report-dcr-2019. Accessed on December 28, 2020.

California Department of Water Resources (DWR). (2020c, August). *Draft Urban Water Management Plan Guidebook 2020.* https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Water-Use-And-Efficiency/Urban-Water-Use-Efficiency/Urban-Water-Management-Plans/Draft-2020-UWMP-Guidebook.pdf?la=en&hash=266FE747760481ACF779F0F2AAEE615314693456. Accessed on December 28, 2020.

CDM Smith. (2021, March 30). *Orange County Water Demand Forecast for MWDOC and OCWD Technical Memorandum.*

City of La Habra, Irvine Ranch Water District, & Orange County Water District. (2017, January 1). *Basin 8-1 Alternative*. https://www.ocwd.com/media/4918/basin-8-1-alternative-final-report-1.pdf. Accessed on December 29, 2020.

City of Seal Beach. (June, 2020). *Adopted Operating & Capital Improvement Budget: Fiscal Year 2020-2021.*

City of Seal Beach. (December, 2020). *Water and Wastewater Rate Study: Final Report.*

Metropolitan Water District of Southern California (MET). (2021, June). *2020 Urban Water Management Plan.*

Orange County Local Agency Formation Commission (OC LAFCO). (2020, September). *Municipal Service Review for the Municipal Water District of Orange County.*

Orange County Water District. (2021). *2019-2020 Engineer's Report on the Groundwater Conditions, Water Supply and Basin Utilization in the Orange County Water District.*

Orange County Water District. (2020, February). *2018-2019 Engineer's Report on the Groundwater Conditions, Water Supply and Basin Utilization in the Orange County Water District.* https://www.ocwd.com/media/8791/2018-19-engineers-report-final.pdf. Accessed on December 30, 2020.

Santa Margarita Water District (SMWD). (2021). San Juan Watershed Project. *About the Project: Phases.* http://sanjuanwatershed.com/about-the-project/eir/phases/. Accessed on April 20, 2021.

The Metropolitan Water District Act. (1969). http://www.mwdh2o.com/Who%20We%20Are%20%20Fact%20Sheets/1.2_Metropolitan_Act.pdf

United States Bureau of Reclamation (USBR). (2012, December). *Colorado River Basin Water Supply and Demand Study: Study Report.* https://www.usbr.gov/lc/region/programs/crbstudy/finalreport/Study%20Report/CRBS_Study_Report_FINAL.pdf. Accessed on December 29, 2020.

University of California Berkeley. (2020). *About Accessory Dwelling Units.* https://www.aducalifornia.org/. Accessed on December 9, 2020.

APPENDICES

APPENDIX A

UWMP Water Code Checklist

Water Code Requirements Checklist

Water Code Section	Summary as Applies to UWMP	Subject	2020 Guidebook Location	2020 UWMP Location
10615	A plan shall describe and evaluate sources of supply, reasonable and practical efficient uses, reclamation and demand management activities.	Introduction and Overview	Chapter 1	Section 1.2
10630.5	Each plan shall include a simple description of the supplier's plan including water availability, future requirements, a strategy for meeting needs, and other pertinent information. Additionally, a supplier may also choose to include a simple description at the beginning of each chapter.	Summary	Chapter 1	Executive Summary
10620(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.	Plan Preparation	Section 2.2	Sections 1 and 2.1
10620(d)(2)	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.	Plan Preparation	Section 2.6	Sections 2.2.1 and 10.2
10642	Provide supporting documentation that the water supplier has encouraged active involvement of diverse social, cultural, and economic elements of the population within the service area prior to and during the preparation of the plan and contingency plan.	Plan Preparation	Section 2.6.2	Sections 2.2.3, 10.1 and 10.3, Appendix K
10631(h)	Retail suppliers will include documentation that they have provided their wholesale supplier(s) - if any - with water use projections from that source.	System Supplies	Section 2.6, Section 6.1	Sections 2.2.2 and 4.3

10631(h)	Wholesale suppliers will include documentation that they have provided their urban water suppliers with identification and quantification of the existing and planned sources of water available from the wholesale to the urban supplier during various water year types.	System Supplies	Section 2.6	N/A for Retailers
10631(a)	Describe the water supplier service area.	System Description	Section 3.1	Section 3.2
10631(a)	Describe the climate of the service area of the supplier.	System Description	Section 3.3	Section 3.3
10631(a)	Provide population projections for 2025, 2030, 2035, 2040 and optionally 2045.	System Description	Section 3.4	Section 3.4.1
10631(a)	Describe other social, economic, and demographic factors affecting the supplier's water management planning.	System Description	Section 3.4.2	Section 3.4.2
10631(a)	Indicate the current population of the service area.	System Description and Baselines and Targets	Sections 3.4 and 5.4	Section 3.4.1
10631(a)	Describe the land uses within the service area.	System Description	Section 3.5	Section 3.5
10631(d)(1)	Quantify past, current, and projected water use, identifying the uses among water use sectors.	System Water Use	Section 4.2	Section 4.2 and 4.3
10631(d)(3)(C)	Retail suppliers shall provide data to show the distribution loss standards were met.	System Water Use	Section 4.2.4	Section 4.4
10631(d)(4)(A)	In projected water use, include estimates of water savings from adopted codes, plans and other policies or laws.	System Water Use	Section 4.2.6	Section 4.3
10631(d)(4)(B)	Provide citations of codes, standards, ordinances, or plans used to make water use projections.	System Water Use	Section 4.2.6	Section 4.3
10631(d)(3)(A)	Report the distribution system water loss for each of the 5 years preceding the plan update.	System Water Use	Section 4.3.2.4	Section 4.4
10631.1(a)	Include projected water use needed for lower income housing	System Water Use	Section 4.4	Section 4.3.2.3

	projected in the service area of the supplier.			
10635(b)	Demands under climate change considerations must be included as part of the drought risk assessment.	System Water Use	Section 4.5	Section 4.3.1.1, 7.5.1
10608.20(e)	Retail suppliers shall 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.	Baselines and Targets	Chapter 5	Section 5.1 and 5.2
10608.24(a)	Retail suppliers shall meet their water use target by December 31, 2020.	Baselines and Targets	Chapter 5	Section 5.2.2
10608.36	Wholesale suppliers shall include an assessment of present and proposed future measures, programs, and policies to help their retail water suppliers achieve targeted water use reductions.	Baselines and Targets	Section 5.1	N/A for retailers
10608.24(d)(2)	If the retail supplier adjusts its compliance GPCD using weather normalization, economic adjustment, or extraordinary events, it shall provide the basis for, and data supporting the adjustment.	Baselines and Targets	Section 5.2	Section 5.2.2
10608.22	Retail suppliers' per capita daily water use reduction shall be no less than 5 percent of base daily per capita water use of the 5 year baseline. This does not apply if the suppliers base GPCD is at or below 100.	Baselines and Targets	Section 5.5	Section 5.1.2 and 5.2.2
10608.4	Retail suppliers shall report on their compliance in meeting their water use targets. The data shall be reported using a standardized form in the SBX7-7 2020 Compliance Form.	Baselines and Targets	Section 5.5 and Appendix E	Section 5.2.2 and Appendix D

10631(b)(1)	Provide a discussion of anticipated supply availability under a normal, single dry year, and a drought lasting five years, as well as more frequent and severe periods of drought.	System Supplies	Sections 6.1 and 6.2	Sections 7.1, 7.3, 7.5
10631(b)(1)	Provide a discussion of anticipated supply availability under a normal, single dry year, and a drought lasting five years, as well as more frequent and severe periods of drought, *including changes in supply due to climate change.*	System Supplies	Sections 6.1	Sections 7.1, 7.2, 7.3, 7.5
10631(b)(2)	When multiple sources of water supply are identified, describe the management of each supply in relationship to other identified supplies.	System Supplies	Section 6.1	Section 6.1, 6.2, 6.3, 6.6, 6.8
10631(b)(3)	Describe measures taken to acquire and develop planned sources of water.	System Supplies	Section 6.1.1	Sections 6.7, 6.8, 6.9
10631(b)	Identify and quantify the existing and planned sources of water available for 2020, 2025, 2030, 2035, 2040 and optionally 2045.	System Supplies	Section 6.2.8	Section 6.1
10631(b)	Indicate whether groundwater is an existing or planned source of water available to the supplier.	System Supplies	Section 6.2	Sections 6.1 and 6.3
10631(b)(4)(A)	Indicate whether a groundwater sustainability plan or groundwater management plan has been adopted by the water supplier or if there is any other specific authorization for groundwater management. Include a copy of the plan or authorization.	System Supplies	Section 6.2.2	Section 6.3.3 and Appendix G
10631(b)(4)(B)	Describe the groundwater basin.	System Supplies	Section 6.2.2	Section 6.3.2
10631(b)(4)(B)	Indicate if the basin has been adjudicated and include a copy of the court order or decree and a description of the amount of water the supplier has the legal right to pump.	System Supplies	Section 6.2.2	Sections 6.3.3 and 6.3.4

10631(b)(4)(B)	For unadjudicated basins, indicate whether or not the department has identified the basin as a high or medium priority. Describe efforts by the supplier to coordinate with sustainability or groundwater agencies to achieve sustainable groundwater conditions.	System Supplies	Section 6.2.2.1	Sections 6.3.3, 6.3.4, 6.3.5, 6.3.6, 6.3.7, 6.3.8
10631(b)(4)(C)	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	System Supplies	Section 6.2.2.4	Sections 6.3.1, 6.3.2
10631(b)(4)(D)	Provide a detailed description and analysis of the amount and location of groundwater that is projected to be pumped.	System Supplies	Section 6.2.2	Sections 6.1, 6.3.2, 6.3.9
10631(c)	Describe the opportunities for exchanges or transfers of water on a short-term or long- term basis.	System Supplies	Section 6.2.7	Section 6.8
10633(b)	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.	System Supplies (Recycled Water)	Section 6.2.5	Section 6.5.2
10633(c)	Describe the recycled water currently being used in the supplier's service area.	System Supplies (Recycled Water)	Section 6.2.5	Section 6.5.3
10633(d)	Describe and quantify the potential uses of recycled water and provide a determination of the technical and economic feasibility of those uses.	System Supplies (Recycled Water)	Section 6.2.5	Section 6.5.5
10633(e)	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.	System Supplies (Recycled Water)	Section 6.2.5	Section 6.5.4, 4.3.2.2
10633(f)	Describe the actions which may be taken to encourage the use of recycled water and the projected results of these actions in terms of	System Supplies (Recycled Water)	Section 6.2.5	Section 6.5.4, 6.5.6

	acre-feet of recycled water used per year.			
10633(g)	Provide a plan for optimizing the use of recycled water in the supplier's service area.	System Supplies (Recycled Water)	Section 6.2.5	Section 6.5.6
10631(g)	Describe desalinated water project opportunities for long-term supply.	System Supplies	Section 6.2.6	Section 6.7
10633(a)	Describe the wastewater collection and treatment systems in the supplier’s service area with quantified amount of collection and treatment and the disposal methods.	System Supplies (Recycled Water)	Section 6.2.5	Section 6.5.2
10631(f)	Describe the expected future water supply projects and programs that may be undertaken by the water supplier to address water supply reliability in average, single-dry, and for a period of drought lasting 5 consecutive water years.	System Supplies	Section 6.2.8, Section 6.3.7	Sections 6.2.4, 6.3.9, 6.6.4, 6.8.2, 6.9
10631.2(a)	The UWMP must include energy information, as stated in the code, that a supplier can readily obtain.	System Suppliers, Energy Intensity	Section 6.4 and Appendix O	Section 6.10
10634	Provide information on the quality of existing sources of water available to the supplier and the manner in which water quality affects water management strategies and supply reliability	Water Supply Reliability Assessment	Section 7.2	Sections 6.3.2 and 7.2.3
10620(f)	Describe water management tools and options to maximize resources and minimize the need to import water from other regions.	Water Supply Reliability Assessment	Section 7.2.4	Section 7.4
10635(a)	Service Reliability Assessment: Assess the water supply reliability during normal, dry, and a drought lasting five consecutive water years by comparing the total water supply sources available to the water supplier with the total projected water use over the next 20 years.	Water Supply Reliability Assessment	Section 7.3	Section 7.3

10635(b)	Provide a drought risk assessment as part of information considered in developing the demand management measures and water supply projects.	Water Supply Reliability Assessment	Section 7.3	Section 7.5
10635(b)(1)	Include a description of the data, methodology, and basis for one or more supply shortage conditions that are necessary to conduct a drought risk assessment for a drought period that lasts 5 consecutive years.	Water Supply Reliability Assessment	Section 7.3	Section 7.5.1
10635(b)(2)	Include a determination of the reliability of each source of supply under a variety of water shortage conditions.	Water Supply Reliability Assessment	Section 7.3	Sections 7.3, 7.5.2 and 7.5.3
10635(b)(3)	Include a comparison of the total water supply sources available to the water supplier with the total projected water use for the drought period.	Water Supply Reliability Assessment	Section 7.3	Section 7.5.2
10635(b)(4)	Include considerations of the historical drought hydrology, plausible changes on projected supplies and demands under climate change conditions, anticipated regulatory changes, and other locally applicable criteria.	Water Supply Reliability Assessment	Section 7.3	Sections 7.2 and 7.5.1
10632(a)	Provide a water shortage contingency plan (WSCP) with specified elements below.	Water Shortage Contingency Planning	Chapter 8	2020 UWMP Appendix H - WSCP
10632(a)(1)	Provide the analysis of water supply reliability (from Chapter 7 of Guidebook) in the WSCP	Water Shortage Contingency Planning	Chapter 8	2020 UWMP Appendix H - WSCP (Section 3.1)
10632(a)(10)	Describe reevaluation and improvement procedures for monitoring and evaluation the water shortage contingency plan to ensure risk tolerance is adequate and appropriate water shortage mitigation strategies are implemented.	Water Shortage Contingency Planning	Section 8.10	2020 UWMP Appendix H - WSCP (Section 3.10)

10632(a)(2)(A)	Provide the written decision-making process and other methods that the supplier will use each year to determine its water reliability.	Water Shortage Contingency Planning	Section 8.2	2020 UWMP Appendix H - WSCP (Section 3.2)
10632(a)(2)(B)	Provide data and methodology to evaluate the supplier's water reliability for the current year and one dry year pursuant to factors in the code.	Water Shortage Contingency Planning	Section 8.2	2020 UWMP Appendix H - WSCP (Section 3.2.2.5)
10632(a)(3)(A)	Define six standard water shortage levels of 10, 20, 30, 40, 50 percent shortage and greater than 50 percent shortage. These levels shall be based on supply conditions, including percent reductions in supply, changes in groundwater levels, changes in surface elevation, or other conditions. The shortage levels shall also apply to a catastrophic interruption of supply.	Water Shortage Contingency Planning	Section 8.3	2020 UWMP Appendix H - WSCP (Section 3.3)
10632(a)(3)(B)	Suppliers with an existing water shortage contingency plan that uses different water shortage levels must cross reference their categories with the six standard categories.	Water Shortage Contingency Planning	Section 8.3	2020 UWMP Appendix H - WSCP (Section 3.3)
10632(a)(4)(A)	Suppliers with water shortage contingency plans that align with the defined shortage levels must specify locally appropriate supply augmentation actions.	Water Shortage Contingency Planning	Section 8.4	2020 UWMP Appendix H - WSCP (Section 3.4)
10632(a)(4)(B)	Specify locally appropriate demand reduction actions to adequately respond to shortages.	Water Shortage Contingency Planning	Section 8.4	2020 UWMP Appendix H - WSCP (Section 3.4.1)
10632(a)(4)(C)	Specify locally appropriate operational changes.	Water Shortage Contingency Planning	Section 8.4	2020 UWMP Appendix H - WSCP (Section 3.4.3)
10632(a)(4)(D)	Specify additional mandatory prohibitions against specific water use practices that are in addition to	Water Shortage Contingency Planning	Section 8.4	2020 UWMP Appendix H - WSCP

	state-mandated prohibitions are appropriate to local conditions.			(Section 3.4.4)
10632(a)(4)(E)	Estimate the extent to which the gap between supplies and demand will be reduced by implementation of the action.	Water Shortage Contingency Planning	Section 8.4	2020 UWMP Appendix H - WSCP (Section 3.4.7)
10632.5	The plan shall include a seismic risk assessment and mitigation plan.	Water Shortage Contingency Plan	Section 8.4.6	2020 UWMP Appendix H - WSCP (Section 3.4.6)
10632(a)(5)(A)	Suppliers must describe that they will inform customers, the public and others regarding any current or predicted water shortages.	Water Shortage Contingency Planning	Section 8.5	2020 UWMP Appendix H - WSCP (Section 3.5)
10632(a)(5)(B) 10632(a)(5)(C)	Suppliers must describe that they will inform customers, the public and others regarding any shortage response actions triggered or anticipated to be triggered and other relevant communications.	Water Shortage Contingency Planning	Section 8.5 and 8.6	2020 UWMP Appendix H - WSCP (Section 3.5)
10632(a)(6)	Retail supplier must describe how it will ensure compliance with and enforce provisions of the WSCP.	Water Shortage Contingency Planning	Section 8.6	2020 UWMP Appendix H - WSCP (Section 3.6)
10632(a)(7)(A)	Describe the legal authority that empowers the supplier to enforce shortage response actions.	Water Shortage Contingency Planning	Section 8.7	2020 UWMP Appendix H - WSCP (Section 3.7)
10632(a)(7)(B)	Provide a statement that the supplier will declare a water shortage emergency Water Code Chapter 3.	Water Shortage Contingency Planning	Section 8.7	2020 UWMP Appendix H - WSCP (Section 3.7)
10632(a)(7)(C)	Provide a statement that the supplier will coordinate with any city or county within which it provides water for the possible proclamation of a local emergency.	Water Shortage Contingency Planning	Section 8.7	2020 UWMP Appendix H - WSCP (Section 3.7)
10632(a)(8)(A)	Describe the potential revenue reductions and expense increases associated with activated shortage response actions.	Water Shortage Contingency Planning	Section 8.8	2020 UWMP Appendix H - WSCP (Section 3.8)

10632(a)(8)(B)	Provide a description of mitigation actions needed to address revenue reductions and expense increases associated with activated shortage response actions.	Water Shortage Contingency Planning	Section 8.8	2020 UWMP Appendix H - WSCP (Section 3.8)
10632(a)(8)(C)	Retail suppliers must describe the cost of compliance with Water Code Chapter 3.3: Excessive Residential Water Use During Drought	Water Shortage Contingency Planning	Section 8.8	2020 UWMP Appendix H - WSCP (Section 3.8)
10632(a)(9)	Retail suppliers must describe the monitoring and reporting requirements and procedures that ensure appropriate data is collected, tracked, and analyzed for purposes of monitoring customer compliance.	Water Shortage Contingency Planning	Section 8.9	2020 UWMP Appendix H - WSCP (Section 3.9)
10632(b)	Analyze and define water features that are artificially supplied with water, including ponds, lakes, waterfalls, and fountains, separately from swimming pools and spas.	Water Shortage Contingency Planning	Section 8.11	2020 UWMP Appendix H - WSCP (Section 3.11)
10635(c)	Provide supporting documentation that Water Shortage Contingency Plan has been, or will be, provided to any city or county within which it provides water, no later than 30 days after the submission of the plan to DWR.	Plan Adoption, Submittal, and Implementation	Sections 8.12 and 10.4	2020 UWMP Appendix H - WSCP (Section 3.12)
10632(c)	Make available the Water Shortage Contingency Plan to customers and any city or county where it provides water within 30 after adopted the plan.	Water Shortage Contingency Planning	Section 8.12	2020 UWMP Appendix H - WSCP (Section 3.12)
10631(e)(2)	Wholesale suppliers shall describe specific demand management measures listed in code, their distribution system asset management program, and supplier assistance program.	Demand Management Measures	Sections 9.1 and 9.3	Section 9.1
10631(e)(1)	Retail suppliers shall provide a description of the nature and extent of each demand management measure implemented over the past five years. The description will	Demand Management Measures	Sections 9.2 and 9.3	Sections 9.1 and 9.2

	address specific measures listed in code.			
10608.26(a)	Retail suppliers shall conduct a public hearing to discuss adoption, implementation, and economic impact of water use targets (recommended to discuss compliance).	Plan Adoption, Submittal, and Implementation	Chapter 10	Sections 2.2.3, 10.1 and 10.3
10621(b)	Notify, at least 60 days prior to the public hearing, any city or county within which the supplier provides water that the urban water supplier will be reviewing the plan and considering amendments or changes to the plan. Reported in Table 10-1.	Plan Adoption, Submittal, and Implementation	Section 10.2.1	Sections 10.1 and 10.2, Appendix K
10621(f)	Each urban water supplier shall update and submit its 2020 plan to the department by July 1, 2021.	Plan Adoption, Submittal, and Implementation	Section 10.4	Sections 10.1 and 10.4
10642	Provide supporting documentation that the urban water supplier made the plan and contingency plan available for public inspection, published notice of the public hearing, and held a public hearing about the plan and contingency plan.	Plan Adoption, Submittal, and Implementation	Sections 10.2.2, 10.3, and 10.5	Sections 2.2.3, 10.1 and 10.3, Appendix K
10642	The water supplier is to provide the time and place of the hearing to any city or county within which the supplier provides water.	Plan Adoption, Submittal, and Implementation	Section 10.2.2	Appendix K
10642	Provide supporting documentation that the plan and contingency plan has been adopted as prepared or modified.	Plan Adoption, Submittal, and Implementation	Section 10.3.2	Appendix L of UWMP and Appendix D of WSCP
10644(a)	Provide supporting documentation that the urban water supplier has submitted this UWMP to the California State Library.	Plan Adoption, Submittal, and Implementation	Section 10.4	Sections 10.1 and 10.4

10644(a)(1)	Provide supporting documentation that the urban water supplier has submitted this UWMP to any city or county within which the supplier provides water no later than 30 days after adoption.	Plan Adoption, Submittal, and Implementation	Section 10.4	Sections 10.1 and 10.4
10644(a)(2)	The plan, or amendments to the plan, submitted to the department shall be submitted electronically.	Plan Adoption, Submittal, and Implementation	Sections 10.4.1 and 10.4.2	Section 10.5
10645(a)	Provide supporting documentation that, not later than 30 days after filing a copy of its plan with the department, the supplier has or will make the plan available for public review during normal business hours.	Plan Adoption, Submittal, and Implementation	Section 10.5	Sections 10.1 and 10.4
10645(b)	Provide supporting documentation that, not later than 30 days after filing a copy of its water shortage contingency plan with the department, the supplier has or will make the plan available for public review during normal business hours.	Plan Adoption, Submittal, and Implementation	Section 10.5	Sections 10.1 and 10.4, Appendix H
10621(c)	If supplier is regulated by the Public Utilities Commission, include its plan and contingency plan as part of its general rate case filings.	Plan Adoption, Submittal, and Implementation	Section 10.6	N/A – City is not regulated by Public Utilities Commission
10644(b)	If revised, submit a copy of the water shortage contingency plan to DWR within 30 days of adoption.	Plan Adoption, Submittal, and Implementation	Section 10.7.2	Section 10.5 of UWMP and Section 3.12 of WSCP

APPENDIX B

DWR Standardized Tables

Submittal Table 2-1 Retail Only: Public Water Systems

Public Water System Number	Public Water System Name	Number of Municipal Connections 2020	Volume of Water Supplied 2020 *
CA3010041	City of Seal Beach	5,350	3,273
	TOTAL	5,350	3,273

**** Units of measure (AF, CCF, MG)*** *must remain consistent throughout the UWMP as reported in Table 2-3.*

NOTES:

Submittal Table 2-2: Plan Identification

Select Only One	Type of Plan		Name of RUWMP or Regional Alliance *if applicable* (select from drop down list)
☑	**Individual UWMP**		
	☐	Water Supplier is also a member of a RUWMP	
	☑	Water Supplier is also a member of a Regional Alliance	Orange County 20x2020 Regional Alliance
☐	**Regional Urban Water Management Plan (RUWMP)**		
NOTES:			

Submittal Table 2-3: Supplier Identification	
Type of Supplier (select one or both)	
☐	Supplier is a wholesaler
☑	Supplier is a retailer
Fiscal or Calendar Year (select one)	
☐	UWMP Tables are in calendar years
☑	UWMP Tables are in fiscal years
If using fiscal years provide month and date that the fiscal year begins (mm/dd)	
7/1	
Units of measure used in UWMP * (select from drop down)	
Unit	AF
**** Units of measure (AF, CCF, MG)*** *must remain consistent throughout the UWMP as reported in Table 2-3.*	
NOTES: The energy intensity data is reported in calendar year consistent with the Greenhouse Gas Protocol.	

Submittal Table 2-4 Retail: Water Supplier Information Exchange

The retail Supplier has informed the following wholesale supplier(s) of projected water use in accordance with Water Code Section 10631.

Wholesale Water Supplier Name
Municipal Water District of Orange County

NOTES:

Submittal Table 3-1 Retail: Population - Current and Projected

Population Served	2020	2025	2030	2035	2040	2045*(opt)*
	24,000	24,110	24,527	24,652	24,554	24,357

NOTES:
Source - Center for Demographic Research at California State University, Fullerton, 2020

Submittal Table 4-1 Retail: Demands for Potable and Non-Potable[1] Water - Actual

Use Type	2020 Actual		
Drop down list May select each use multiple times These are the only Use Types that will be recognized by the WUEdata online submittal tool	Additional Description (as needed)	Level of Treatment When Delivered Drop down list	Volume[2]
Single Family	See note below	Drinking Water	2,306
Commercial	Industrial uses included with commercial	Drinking Water	492
Institutional/Governmental	City Meters including Irrigation for City	Drinking Water	111
Landscape	Represents large landscape (with irrigation meters) served by potable water and not recycled water	Drinking Water	16
Losses	Non-revenue water	Drinking Water	347
		TOTAL	3,273

[1] *Recycled water demands are NOT reported in this table. Recycled water demands are reported in Table 6-4.*

[2] *Units of measure (AF, CCF, MG) must remain consistent throughout the UWMP as reported in Table 2-3.*

NOTES:
Volumes in AF.
Residential demands combined in FY2019-20 billing system. Beginning Summer 2021, the City’s billing system will account for SF and MF residential usage separately.

Submittal Table 4-2 Retail: Use for Potable and Non-Potable[1] Water - Projected

Use Type	Additional Description (as needed)	Projected Water Use[2] *Report To the Extent that Records are Available*				
Drop down list May select each use multiple times These are the only Use Types that will be recognized by the WUEdata online submittal tool		2025	2030	2035	2040	2045 (opt)
Single Family	See note below	2,467	2,442	2,417	2,393	2,382
Institutional/Governmental		111	150	150	150	150
Commercial		490	663	663	663	663
Landscape		24	24	24	24	24
Losses	Non-revenue water	84	89	89	88	88
	TOTAL	3,175	3,368	3,342	3,317	3,306

[1] *Recycled water demands are NOT reported in this table. Recycled water demands are reported in Table 6-4.* [2] *Units of measure (AF, CCF, MG) must remain consistent throughout the UWMP as reported in Table 2-3.*

NOTES: Residential demands combined in current billing system. Beginning Summer 2021, the City's billing system will account for SF and MF residential usage separately.

Submittal Table 4-3 Retail: Total Water Use (Potable and Non-Potable)

	2020	2025	2030	2035	2040	2045 (opt)
Potable Water, Raw, Other Non-potable *From Tables 4-1R and 4-2 R*	3,273	3,175	3,368	3,342	3,317	3,306
Recycled Water Demand[1] *From Table 6-4*	0	0	0	0	0	0
Optional Deduction of Recycled Water Put Into Long-Term Storage[2]						
TOTAL WATER USE	3,273	3,175	3,368	3,342	3,317	3,306

[1] Recycled water demand fields will be blank until Table 6-4 is complete

[2] Long term storage means water placed into groundwater or surface storage that is not removed from storage in the same year. Supplier ***may*** *deduct recycled water placed in long-term storage from their reported demand. This value is manually entered into Table 4-3.*

NOTES: Volumes in AF.

Submittal Table 4-4 Retail: Last Five Years of Water Loss Audit Reporting

Reporting Period Start Date (mm/yyyy)	Volume of Water Loss [1,2]
01/2016	233
01/2017	212
01/2018	136
01/2019	220

[1] Taken from the field "Water Losses" (a combination of apparent losses and real losses) from the AWWA worksheet.

*[2] **Units of measure (AF, CCF, MG)** must remain consistent throughout the UWMP as reported in Table 2-3.*

NOTES:
Water loss in AFY. No water loss audit available for CY 2015.

Submittal Table 4-5 Retail Only: Inclusion in Water Use Projections

Are Future Water Savings Included in Projections? (Refer to Appendix K of UWMP Guidebook) *Drop down list (y/n)*	Yes
If "Yes" to above, state the section or page number, in the cell to the right, where citations of the codes, ordinances, or otherwise are utilized in demand projections are found.	Section 8 and 9
Are Lower Income Residential Demands Included In Projections? *Drop down list (y/n)*	Yes
NOTES:	

Submittal Table 5-1 Baselines and Targets Summary
From SB X7-7 Verification Form

Retail Supplier or Regional Alliance Only

Baseline Period	Start Year *	End Year *	Average Baseline GPCD*	Confirmed 2020 Target*
10-15 year	*1999*	*2008*	*156*	*142*
5 Year	*2004*	*2008*	*155*	

**All cells in this table should be populated manually from the supplier's SBX7-7 Verification Form and reported in Gallons per Capita per Day (GPCD)*

NOTES:

Submittal Table 5-2: 2020 Compliance From SB X7-7 2020 Compliance Form *Retail Supplier or Regional Alliance Only*				
2020 GPCD			2020 Confirmed Target GPCD*	Did Supplier Achieve Targeted Reduction for 2020? Y/N
Actual 2020 GPCD*	2020 TOTAL Adjustments*	Adjusted 2020 GPCD* *(Adjusted if applicable)*		
95	*0*	*95*	*142*	*Y*

**All cells in this table should be populated manually from the supplier's SBX7-7 2020 Compliance Form and reported in Gallons per Capita per Day (GPCD)*

NOTES:

Submittal Table 6-1 Retail: Groundwater Volume Pumped						
☐	Supplier does not pump groundwater. The supplier will not complete the table below.					
☐	All or part of the groundwater described below is desalinated.					
Groundwater Type ***Drop Down List*** *May use each category multiple times*	Location or Basin Name	2016*	2017*	2018*	2019*	2020*
Alluvial Basin	Orange County Groundwater Basin	2,199	2,247	1,722	2,400	2,141
	TOTAL	2,199	2,247	1,722	2,400	2,141
**** Units of measure (AF, CCF, MG)*** *must remain consistent throughout the UWMP as reported in Table 2-3.*						
NOTES: Source - OC Retail Water Usage FY 2015 to FY 2020 (MWDOC, 2020)						

Submittal Table 6-2 Retail: Wastewater Collected Within Service Area in 2020

☐	There is no wastewater collection system. The supplier will not complete the table below.
	Percentage of 2020 service area covered by wastewater collection system *(optional)*
	Percentage of 2020 service area population covered by wastewater collection system *(optional)*

Wastewater Collection			Recipient of Collected Wastewater			
Name of Wastewater Collection Agency	Wastewater Volume Metered or Estimated? *Drop Down List*	Volume of Wastewater Collected from UWMP Service Area 2020 *	Name of Wastewater Treatment Agency Receiving Collected Wastewater	Treatment Plant Name	Is WWTP Located Within UWMP Area? *Drop Down List*	Is WWTP Operation Contracted to a Third Party? *(optional)* *Drop Down List*
The City of Seal Beach	Estimated	2,520	OCSD	Plant No. 1 / Plant No. 2	No	No
Total Wastewater Collected from Service Area in 2020:		2,520				

**** Units of measure (AF, CCF, MG)** must remain consistent throughout the UWMP as reported in Table 2-3* **.**

NOTES:
Assumes a return rate of 77% based on the 2018 Sewer Master Plan

Submittal Table 6-3 Retail: Wastewater Treatment and Discharge Within Service Area in 2020

☑ **No wastewater is treated or disposed of within the UWMP service area.** The supplier will not complete the table below.

Wastewater Treatment Plant Name	Discharge Location Name or Identifier	Discharge Location Description	Wastewater Discharge ID Number *(optional)* [2]	Method of Disposal ***Drop down list***	Does This Plant Treat Wastewater Generated Outside the Service Area? ***Drop down list***	Treatment Level ***Drop down list***	**2020 volumes** [1]				
							Wastewater Treated	Discharged Treated Wastewater	Recycled Within Service Area	Recycled Outside of Service Area	Instream Flow Permit Requirement
						Total	0	0	0	0	0

[1] **Units of measure (AF, CCF, MG)** must remain consistent throughout the UWMP as reported in Table 2-3.

[2] If the **Wastewater Discharge ID Number** is not available to the UWMP preparer, access the SWRCB CIWQS regulated facility website at https://ciwqs.waterboards.ca.gov/ciwqs/readOnly/CiwqsReportServlet?inCommand=reset&reportName=RegulatedFacility

NOTES:

Submittal Table 6-4 Retail: Recycled Water Direct Beneficial Uses Within Service Area

☑ Recycled water is not used and is not planned for use within the service area of the supplier.
The supplier will not complete the table below.

Name of Supplier Producing (Treating) the Recycled Water:

Name of Supplier Operating the Recycled Water Distribution System:

Supplemental Water Added in 2020 (volume) *Include units*

Source of 2020 Supplemental Water

Beneficial Use Type *Insert additional rows if needed.*	**Potential** Beneficial Uses of Recycled Water (Describe)	Amount of **Potential** Uses of Recycled Water (Quantity) *Include volume units*[1]	General Description of 2020 Uses	Level of Treatment *Drop down list*	2020[1]	2025[1]	2030[1]	2035[1]	2040[1]	2045[1] (opt)
Agricultural irrigation										
Landscape irrigation (exc golf courses)										
Golf course irrigation										
Commercial use										
Industrial use										
Geothermal and other energy production										
Seawater intrusion barrier										
Recreational impoundment										
Wetlands or wildlife habitat										
Groundwater recharge (IPR)										
Reservoir water augmentation (IPR)										
Direct potable reuse										
Other (Description Required)										
				Total:	0	0	0	0	0	0
				2020 Internal Reuse						

---

[1] ***Units of measure (AF, CCF, MG)*** *must remain consistent throughout the UWMP as reported in Table 2-3.*

NOTES:

Submittal Table 6-5 Retail: 2015 UWMP Recycled Water Use Projection Compared to 2020 Actual

☐	Recycled water was not used in 2015 nor projected for use in 2020. The supplier will not complete the table below. If recycled water was not used in 2020, and was not predicted to be in 2015, then check the box and do not complete the table.

Beneficial Use Type	**2015 Projection for 2020** [1]	**2020 Actual Use**[1]
Agricultural irrigation		
Landscape irrigation (exc golf courses)		
Golf course irrigation		
Commercial use		
Industrial use		
Geothermal and other energy production		
Seawater intrusion barrier		
Recreational impoundment		
Wetlands or wildlife habitat		
Groundwater recharge (IPR)	N/A	713
Reservoir water augmentation (IPR)		
Direct potable reuse		
Other (Description Required)		
Total	0	713

[1] **Units of measure (AF, CCF, MG)** must remain consistent throughout the UWMP as reported in Table 2-3.

NOTE:
Groundwater recharge (IPR) estimated based on OCWD Groundwater Basin Production and Percent of Total Basin Production for FY2019-20 (33.3%).

Submittal Table 6-6 Retail: Methods to Expand Future Recycled Water Use

☑	Supplier does not plan to expand recycled water use in the future. Supplier will not complete the table below but will provide narrative explanation.		
	Provide page location of narrative in UWMP		
Name of Action	Description	Planned Implementation Year	Expected Increase in Recycled Water Use *
		Total	0

***Units of measure (AF, CCF, MG)** must remain consistent throughout the UWMP as reported in Table 2-3.*

NOTES:

Submittal Table 6-7 Retail: Expected Future Water Supply Projects or Programs

☑	No expected future water supply projects or programs that provide a quantifiable increase to the agency's water supply. Supplier will not complete the table below.					
☐	Some or all of the supplier's future water supply projects or programs are not compatible with this table and are described in a narrative format.					
	Provide page location of narrative in the UWMP					
Name of Future Projects or Programs	Joint Project with other suppliers?		Description (if needed)	Planned Implementation Year	Planned for Use in Year Type *Drop Down List*	Expected Increase in Water Supply to Supplier* *This may be a range*
	Drop Down List (y/n)	*If Yes, Supplier Name*				
****Units of measure (AF, CCF, MG)** must remain consistent throughout the UWMP as reported in Table 2-3.*						
NOTES:						

Submittal Table 6-8 Retail: Water Supplies — Actual

Water Supply	Additional Detail on Water Supply	2020	
Drop down list May use each category multiple times.These are the only water supply categories that will be recognized by the WUEdata online submittal tool		Actual Volume*	Water Quality Drop Down List
Groundwater (not desalinated)	Orange County Groundwater Basin	2,141	Drinking Water
Purchased or Imported Water	MWDOC	1,132	Drinking Water
	Total	3,273	

***Units of measure (AF, CCF, MG)** must remain consistent throughout the UWMP as reported in Table 2-3.*

NOTES:

Source – OC Retail Water Usage FY 2015 to FY 2020 (MWDOC, 2020)

Submittal Table 6-9 Retail: Water Supplies — Projected

Water Supply	Additional Detail on Water Supply	Projected Water Supply * Report To the Extent Practicable				
		2025	2030	2035	2040	2045
Drop down list May use each category multiple times. These are the only water supply categories that will be recognized by the WUEdata online submittal tool		Reasonably Available Volume	Reasonably Available Volume	Reasonably Available Volume	Reasonably Available Volume	Reasonably Available Volume
Groundwater (not desalinated)	Orange County Groundwater Basin	2,699	2,862	2,841	2,820	2,810
Purchased or Imported Water	MWDOC	476	505	501	498	496
	Total	3,175	3,368	3,342	3,317	3,306

***Units of measure (AF, CCF, MG)** must remain consistent throughout the UWMP as reported in Table 2-3.*

NOTES:
Source - CDM Smith, 2021
Groundwater volumes assume OCWD’s basin production percentage (BPP) to be 85% starting in 2025 (Refer to Section 6.3.4). Volumes of groundwater and imported water may vary depending on OCWD's actual BPP projections, which are established annually.

Submittal Table 7-1 Retail: Basis of Water Year Data (Reliability Assessment)

Year Type	**Base Year** If not using a calendar year, type in the last year of the fiscal, water year, or range of years, for example, water year 2019-2020, use 2020	**Available Supplies if Year Type Repeats**	
		☐ Quantification of available supplies is not compatible with this table and is provided elsewhere in the UWMP. Location ______________________________	
		☐ Quantification of available supplies is provided in this table as either volume only, percent only, or both.	
		Volume Available *	**% of Average Supply**
Average Year	2018-2019	-	100%
Single-Dry Year	2014	-	106%
Consecutive Dry Years 1st Year	2012	-	106%
Consecutive Dry Years 2nd Year	2013	-	106%
Consecutive Dry Years 3rd Year	2014	-	106%
Consecutive Dry Years 4th Year	2015	-	106%
Consecutive Dry Years 5th Year	2016	-	106%

Supplier may use multiple versions of Table 7-1 if different water sources have different base years and the supplier chooses to report the base years for each water source separately. If a Supplier uses multiple versions of Table 7-1, in the "Note" section of each table, state that multiple versions of Table 7-1 are being used and identify the particular water source that is being reported in each table.

***Units of measure (AF, CCF, MG**) must remain consistent throughout the UWMP as reported in Table 2-3.*

NOTES:
Assumes an increase of 6% above average year demands in dry and multiple dry years based on the Demand Forecast TM (CDM Smith, 2021). 106% represents the percent of average supply needed to meet demands of a single-dry and multiple-dry years. Since the City is able to meet all of its demand with imported water from MWDOC/MET (on top of local groundwater), the percent of average supply value reported is equivalent to the percent of average demand under the corresponding hydrologic condition.

Submittal Table 7-2 Retail: Normal Year Supply and Demand Comparison

	2025	2030	2035	2040	2045 *(Opt)*
Supply totals (*autofill from Table 6-9)*	3,175	3,368	3,342	3,317	3,306
Demand totals *(autofill from Table 4-3)*	3,175	3,368	3,342	3,317	3,306
Difference	0	0	0	0	0

NOTES:
This table compares the projected demand and supply volumes determined in Sections 4.3.2 and 6.1, respectively.

Submittal Table 7-3 Retail: Single Dry Year Supply and Demand Comparison

	2025	2030	2035	2040	2045 (Opt)
Supply totals*	3,366	3,570	3,543	3,516	3,504
Demand totals*	3,366	3570	3,543	3,516	3,504
Difference	0	0	0	0	0

***Units of measure (AF, CCF, MG)** must remain consistent throughout the UWMP as reported in Table 2-3.*

NOTES:
It is conservatively assumed that a single dry year demand is 6% greater than each respective year's normally projected total water demand. Groundwater is sustainably managed through the BPP and robust management measures (Section 6.3.4 and Appendix G), indirect recycled water uses provide additional local supply (Section 6.6), and based on MET’s and MWDOC's UWMPs, imported water is available to close any local water supply gap (Section 7.5.1).

Submittal Table 7-4 Retail: Multiple Dry Years Supply and Demand Comparison

		2025*	2030*	2035*	2040*	2045* (Opt)
First year	Supply totals	3,448	3,407	3,564	3,538	3,514
	Demand totals	3,448	3,407	3,564	3,538	3,514
	Difference	0	0	0	0	0
Second year	Supply totals	3,428	3,447	3,559	3,532	3,511
	Demand totals	3,428	3,447	3,559	3,532	3,511
	Difference	0	0	0	0	0
Third year	Supply totals	3,407	3,488	3,554	3,527	3,509
	Demand totals	3,407	3,488	3,554	3,527	3,509
	Difference	0	0	0	0	0
Fourth year	Supply totals	3,386	3,529	3,548	3,521	3,507
	Demand totals	3,386	3,529	3,548	3,521	3,507
	Difference	0	0	0	0	0
Fifth year	Supply totals	3,366	3,570	3,543	3,516	3,504
	Demand totals	3,366	3,570	3,543	3,516	3,504
	Difference	0	0	0	0	0

***Units of measure (AF, CCF, MG)** must remain consistent throughout the UWMP as reported in Table 2-3.*

NOTES:
It is conservatively assumed that a five consecutive dry year scenario is a repeat of the single dry year (106% of projected values) over five consecutive years. The 2025 column assesses supply and demand for FY 2020-21 through FY 2024-25; the 2030 column assesses FY 2025-26 through FY 2029-30 and so forth, in order to end the water service reliability assessment in FY 2044-45.

Groundwater is sustainably managed through the BPP and robust management measures (Section 6.3.4 and Appendix G), indirect recycled water uses provide additional local supply (Section 6.6), and based on MET's and MWDOC's UWMPs, imported water is available to close any local water supply gap (Section 7.5.1).

Submittal Table 7-5: Five-Year Drought Risk Assessment Tables to address Water Code Section 10635(b)

2021	Total
Total Water Use	3,448
Total Supplies	3,448
Surplus/Shortfall w/o WSCP Action	0
Planned WSCP Actions (use reduction and supply augmentation)	
WSCP - supply augmentation benefit	0
WSCP - use reduction savings benefit	0
Revised Surplus/(shortfall)	0
Resulting % Use Reduction from WSCP action	0%

2022	Total
Total Water Use	3,428
Total Supplies	3,428
Surplus/Shortfall w/o WSCP Action	0
Planned WSCP Actions (use reduction and supply augmentation)	
WSCP - supply augmentation benefit	0
WSCP - use reduction savings benefit	0
Revised Surplus/(shortfall)	0
Resulting % Use Reduction from WSCP action	0%

2023	Total
Total Water Use	3,407
Total Supplies	3,407
Surplus/Shortfall w/o WSCP Action	0
Planned WSCP Actions (use reduction and supply augmentation)	
WSCP - supply augmentation benefit	0
WSCP - use reduction savings benefit	0
Revised Surplus/(shortfall)	0
Resulting % Use Reduction from WSCP action	0%

2024	Total
Total Water Use	3,386
Total Supplies	3,386
Surplus/Shortfall w/o WSCP Action	0
Planned WSCP Actions (use reduction and supply augmentation)	
WSCP - supply augmentation benefit	0
WSCP - use reduction savings benefit	0
Revised Surplus/(shortfall)	0
Resulting % Use Reduction from WSCP action	0%

2025	Total
Total Water Use	3,366
Total Supplies	3,366
Surplus/Shortfall w/o WSCP Action	0
Planned WSCP Actions (use reduction and supply augmentation)	
WSCP - supply augmentation benefit	0
WSCP - use reduction savings benefit	0
Revised Surplus/(shortfall)	0
Resulting % Use Reduction from WSCP action	0%

Submittal Table 8-1
Water Shortage Contingency Plan Levels

Shortage Level	Percent Shortage Range	Shortage Response Actions *(Narrative description)*
1	Up to 20%	A Phase 1 water supply shortage exists when the city council determines, in its sole discretion, that due to drought or other water supply conditions, a water supply shortage or threatened shortage exists and a 20% consumer demand of reduction is necessary to make more efficient use of water and appropriately respond to existing water conditions. Upon the declaration by the city council of a Phase 1 water supply shortage condition, the city council will implement the mandatory Phase 1 conservation measures identified in this section.
2	Up to 40%	A Phase 2 water supply shortage exists when the city council determines, in its sole discretion, that due to drought or other water supply conditions, a severe water supply shortage or threatened shortage exists and a 40% consumer demand reduction is necessary to make more efficient use of water and appropriately respond to existing water conditions. Upon the declaration by the city council of a Phase 2 water supply shortage condition, the city council will implement the mandatory Phase 2 conservation measures identified in this section.
3	Greater than 40%	A Phase 3 water supply shortage condition is also referred to as an “emergency” condition. A Phase 3 condition exists when the city council declares a water shortage emergency and notifies its residents and businesses that a significant reduction of greater than 40% in consumer demand is necessary to maintain sufficient water supplies for public health and safety. Upon the declaration of a Phase 3 water supply shortage condition, the city council will implement the mandatory Phase 3 conservation measures identified in this section.

NOTES:

Submittal Table 8-2: Demand Reduction Actions

Shortage Level	Demand Reduction Actions ***Drop down list*** *These are the only categories that will be accepted by the WUEdata online submittal tool. Select those that apply.*	How much is this going to reduce the shortage gap? *Include units used (volume type or percentage)*	Additional Explanation or Reference *(optional)*	Penalty, Charge, or Other Enforcement? ***For Retail Suppliers Only*** *Drop Down List*
Permanent Year-Round	Landscape - Limit landscape irrigation to specific times	On-going Long Term-Conservation Savings Measure. Not applicable to Water Shortage Contingency Plan quantifiable savings.	Watering or irrigating of lawns, landscaping, and other vegetated areas with potable water between 9:00 a.m. and 5:00 p.m. on any day, except by use of a hand-water shut-off nozzle or device, or for a very short period of time for the limited purpose of adjusting or repairing an irrigaiton system.	

Submittal Table 8-2: Demand Reduction Actions

Shortage Level	Demand Reduction Actions ***Drop down list*** *These are the only categories that will be accepted by the WUEdata online submittal tool. Select those that apply.*	How much is this going to reduce the shortage gap? *Include units used (volume type or percentage)*	Additional Explanation or Reference *(optional)*	Penalty, Charge, or Other Enforcement? ***For Retail Suppliers Only*** *Drop Down List*
Permanent Year-Round	Landscape - Limit landscape irrigation to specific times	On-going Long Term-Conservation Savings Measure. Not applicable to Water Shortage Contingency Plan quantifiable savings.	No water user shall cuase or allow watering or irrigaiton of lawn, landscape or other vegetated area with potable water using a landscape irrigation system ora watering device that is not continuosly attended for longer than 15 mintues watering per day per station. This section does not apply to landscape irrigation systems that exclusively use very low-flow drip type irrigation systems wien no emitter produces more tha 2 gallons of water per hour and weather based controllers or stream rotor sprinklers that meet a 70% efficiency standard.	
Permanent Year-Round	Other - Require automatic shut of hoses	On-going Long Term-Conservation Savings Measure. Not applicable to Water Shortage Contingency Plan quantifiable savings.	No person shall wash a motor vehicle, trailer, boat or other type of mobile equipment other than by a hand-held bucket or by a hose equipped with a positive shut-off nozzle. This prohibition shall not apply to washing performed at a commercial car wash.	

Submittal Table 8-2: Demand Reduction Actions

Shortage Level	Demand Reduction Actions **_Drop down list_** *These are the only categories that will be accepted by the WUEdata online submittal tool. Select those that apply.*	How much is this going to reduce the shortage gap? *Include units used (volume type or percentage)*	Additional Explanation or Reference *(optional)*	Penalty, Charge, or Other Enforcement? **_For Retail Suppliers Only_** *Drop Down List*
Permanent Year-Round	Water Features - Restrict water use for decorative water features, such as fountains	On-going Long Term-Conservation Savings Measure. Not applicable to Water Shortage Contingency Plan quantifiable savings.	No person shall operate a water fountatin or other decorative water feature that does not use re-circulated water.	
Permanent Year-Round	Landscape - Restrict or prohibit runoff from landscape irrigation	On-going Long Term-Conservation Savings Measure. Not applicable to Water Shortage Contingency Plan quantifiable savings.	No water user shall cause or allow water to run off landscape areas into adjoining streets, sidewalks, driveways, alleys, gutters, ditches or any paved surfaces due to incorrectly maintained sprinklers, excessive watering or use.	
Permanent Year-Round	Other - Customers must repair leaks, breaks, and malfunctions in a timely manner	On-going Long Term-Conservation Savings Measure. Not applicable to Water Shortage Contingency Plan quantifiable savings.	Each water user shall repair all leaks from indoor and outdoor plumbing fixture at the user’s premises. Such water user shall eliminate any loss or escape of water through breaks, leaks or other malfunctions in the water user’s plumbing or distribution system promptly after discovering the leak and in no event in less than 7 days.	
Permanent Year-Round	CII - Restaurants may only serve water upon request	On-going Long Term-Conservation Savings Measure. Not applicable to Water Shortage Contingency Plan quantifiable savings.	Restaurants shall not offer water servce and shall servie water only to a customer that specifically requests water.	

Submittal Table 8-2: Demand Reduction Actions

Shortage Level	Demand Reduction Actions ***Drop down list*** *These are the only categories that will be accepted by the WUEdata online submittal tool. Select those that apply.*	How much is this going to reduce the shortage gap? *Include units used (volume type or percentage)*	Additional Explanation or Reference *(optional)*	Penalty, Charge, or Other Enforcement? ***For Retail Suppliers Only*** *Drop Down List*
Permanent Year-Round	Other - Prohibit vehicle washing except at facilities using recycled or recirculating water	On-going Long Term-Conservation Savings Measure. Not applicable to Water Shortage Contingency Plan quantifiable savings.	No person shall install non-recirculating water systems in connection with commercial conveyor car wash and commercial laundry systems. Effective on January 1, 2010, the owner or operator of any commercial conveyor car wash system shall install operational re-circulating water systems, or secure a waiver of this requirement from the director.	
Permanent Year-Round	CII - Other CII restriction or prohibition	On-going Long Term-Conservation Savings Measure. Not applicable to Water Shortage Contingency Plan quantifiable savings.	No person shall install single pass cooling systems in connection with new water service.	
1	Expand Public Information Campaign	5%	Community Outreach and Messaging (Expand Public Information Campaign to reflect Level 1 Shortage Response Actions)	No

Submittal Table 8-2: Demand Reduction Actions

Shortage Level	Demand Reduction Actions ***Drop down list*** *These are the only categories that will be accepted by the WUEdata online submittal tool. Select those that apply.*	How much is this going to reduce the shortage gap? *Include units used (volume type or percentage)*	Additional Explanation or Reference *(optional)*	Penalty, Charge, or Other Enforcement? ***For Retail Suppliers Only*** *Drop Down List*
1	Landscape - Limit landscape irrigation to specific times	2%	Irrigation shall not be performed except on designated irrigation days and between the hours of 6:00 p.m. and 6:00 a.m. Irrigation may be performed at any time if done by means of a hand-held hose equipped with a positive shut-off nozzle, a hand-held faucet filled bucket of 5 gallons or less, or a drip irrigation system.	Yes
1	Other	2%	Agricultural users and commercial nurseries shall curtail all non-essential water use, but are otherwise exempt from Phase 1 measures. Watering of livestock and irrigation of propagation beds are permitted at any time.	Yes

Submittal Table 8-2: Demand Reduction Actions

Shortage Level	Demand Reduction Actions ***Drop down list*** *These are the only categories that will be accepted by the WUEdata online submittal tool. Select those that apply.*	How much is this going to reduce the shortage gap? *Include units used (volume type or percentage)*	Additional Explanation or Reference *(optional)*	Penalty, Charge, or Other Enforcement? ***For Retail Suppliers Only*** *Drop Down List*
1	Other	1%	Washing of motor vehicles, boats, airplanes and other mobile equipment shall be performed only on designated irrigation days and between the hours of 6:00 p.m. and 6:00 a.m. This prohibition shall not apply to the washing of garbage trucks, vehicles used to transport food and perishables and other mobile equipment for which frequent cleaning is essential for the protection of the public health, safety and welfare.	Yes
1	Other water feature or swimming pool restriction	1%	Filling or refilling of swimming pools, spas, ponds and artificial lakes shall be performed only on designated irrigation days and between the hours of 6:00 p.m. and 6:00 a.m.	Yes

Submittal Table 8-2: Demand Reduction Actions

Shortage Level	Demand Reduction Actions ***Drop down list*** *These are the only categories that will be accepted by the WUEdata online submittal tool. Select those that apply.*	How much is this going to reduce the shortage gap? *Include units used (volume type or percentage)*	Additional Explanation or Reference *(optional)*	Penalty, Charge, or Other Enforcement? ***For Retail Suppliers Only*** *Drop Down List*
1	Landscape - Limit landscape irrigation to specific times	1%	Watering golf courses, parks, school grounds and recreational fields shall be performed only between the hours of 6:00 p.m. and 6:00 a.m. This prohibition does not apply to golf course greens.	Yes
1	Other - Prohibit use of potable water for washing hard surfaces	1%	Water shall not be used to wash down sidewalks, hard or paved surfaces, including but not limited to sidewalks, walkways, driveways, parking areas, tennis courts, patios or alleys. Notwithstanding this prohibition, a water user may wash down such surfaces when necessary to alleviate safety or sanitary hazards, and then only by use of a hand-held bucket or similar container, a hand-held hose equipped with a positive self-closing water shut-off device, a low-volume, high-pressure cleaning machine equipped to recycle any water used, or a low-volume high-pressure water broom	Yes

Submittal Table 8-2: Demand Reduction Actions

Shortage Level	Demand Reduction Actions ***Drop down list*** *These are the only categories that will be accepted by the WUEdata online submittal tool. Select those that apply.*	How much is this going to reduce the shortage gap? *Include units used (volume type or percentage)*	Additional Explanation or Reference *(optional)*	Penalty, Charge, or Other Enforcement? ***For Retail Suppliers Only*** *Drop Down List*
1	Other - Customers must repair leaks, breaks, and malfunctions in a timely manner	2%	Each water user shall repair all leaks from indoor and outdoor plumbing fixture at the user's premises. Such water user shall eliminate any loss or escape of water through breaks, leaks or other malfunctions in the water user's plumbing or distribution system promptly after discovering the leak and in no event in less than 5 days.	
1	Landscape - Limit landscape irrigation to specific days	15%	Watering or irrigating of lawn, landscape, or other vegetated area with potable water is limited to three (3) days per week.	Yes
1	Other water feature or swimming pool restriction	3%	Ornamental fountains and similar structures shall not be operated.	Yes
2	Expand Public Information Campaign	5%	Community Outreach and Messaging (Expand Public Information Campaign to reflect Level 2 Shortage Response Actions)	No

Submittal Table 8-2: Demand Reduction Actions

Shortage Level	Demand Reduction Actions ***Drop down list*** *These are the only categories that will be accepted by the WUEdata online submittal tool. Select those that apply.*	How much is this going to reduce the shortage gap? *Include units used (volume type or percentage)*	Additional Explanation or Reference *(optional)*	Penalty, Charge, or Other Enforcement? ***For Retail Suppliers Only*** *Drop Down List*
2	Other - Customers must repair leaks, breaks, and malfunctions in a timely manner	2%	Each water user shall repair all leaks from indoor and outdoor plumbing fixture at the user's premises. Such water user shall eliminate any loss or escape of water through breaks, leaks or other malfunctions in the water user's plumbing or distribution system promptly after discovering the leak and in no event in less than 3 days.	
2	Landscape - Limit landscape irrigation to specific days	15%	Watering or irrigating of lawn, landscape, or other vegetated area with potable water is limited to one (1) days per week.	Yes
2	Landscape - Limit landscape irrigation to specific times	1%	Irrigation shall not be performed except on designated irrigation days and between the hours of 10:00 p.m. and 6:00 a.m.	Yes

Submittal Table 8-2: Demand Reduction Actions

Shortage Level	Demand Reduction Actions *Drop down list* *These are the only categories that will be accepted by the WUEdata online submittal tool. Select those that apply.*	How much is this going to reduce the shortage gap? *Include units used (volume type or percentage)*	Additional Explanation or Reference *(optional)*	Penalty, Charge, or Other Enforcement? ***For Retail Suppliers Only*** *Drop Down List*
2	Landscape - Limit landscape irrigation to specific times	1%	Agricultural users and commercial nurseries shall use water only between the hours of 6:00 p.m. and 6:00 a.m. Watering of livestock and irrigation of propagation beds are permitted at any time.	Yes
2	Other - Prohibit vehicle washing except at facilities using recycled or recirculating water	2%	Washing of motor vehicles, boats, airplanes and other mobile equipment is prohibited except when performed at a commercial car wash. This prohibition shall not apply to the washing of garbage trucks, vehicles used to transport food and perishables and other mobile equipment for which frequent cleaning is essential for the protection of the public health, safety and welfare.	Yes
2	Other water feature or swimming pool restriction	1%	Filling or refilling of swimming pools, spas, ponds and artificial lakes shall be performed only on designated irrigation days and between the hours of 10:00 p.m. and 6:00 a.m.	Yes

Submittal Table 8-2: Demand Reduction Actions

Shortage Level	Demand Reduction Actions ***Drop down list*** *These are the only categories that will be accepted by the WUEdata online submittal tool. Select those that apply.*	How much is this going to reduce the shortage gap? *Include units used (volume type or percentage)*	Additional Explanation or Reference *(optional)*	Penalty, Charge, or Other Enforcement? ***For Retail Suppliers Only*** *Drop Down List*
2	Landscape - Limit landscape irrigation to specific times	2%	Watering golf courses, parks, school grounds and recreational fields shall be performed only between the hours of 10:00 p.m. and 6:00 a.m. This prohibition does not apply to golf course greens.	Yes
2	Moratorium or Net Zero Demand Increase on New Connections	3%	New construction meters and permits for unmetered service shall not be issued. Construction water shall not be used for earth work or road construction purposes.	Yes
2	Other	1%	The use of non-reclaimed and non-recycled water by commercial car washes shall be reduced in volume by 20%.	Yes
3	Expand Public Information Campaign	5%	Community Outreach and Messaging (Expand Public Information Campaign to reflect Level 3 Shortage Response Actions)	No

Submittal Table 8-2: Demand Reduction Actions

Shortage Level	Demand Reduction Actions ***Drop down list*** *These are the only categories that will be accepted by the WUEdata online submittal tool. Select those that apply.*	How much is this going to reduce the shortage gap? *Include units used (volume type or percentage)*	Additional Explanation or Reference *(optional)*	Penalty, Charge, or Other Enforcement? ***For Retail Suppliers Only*** *Drop Down List*
3	Other - Customers must repair leaks, breaks, and malfunctions in a timely manner	2%	Each water user shall repair all leaks from indoor and outdoor plumbing fixture at the user's premises. Such water user shall eliminate any loss or escape of water through breaks, leaks or other malfunctions in the water user's plumbing or distribution system promptly after discovering the leak and in no event in less than 1 day.	Yes
3	Landscape - Prohibit all landscape irrigation	15%	Outdoor irrigation is prohibited.	Yes
3	CII - Other CII restriction or prohibition	2%	Use of water for agricultural or commercial nursery purposes is prohibited. This prohibition shall not apply to watering of livestock.	Yes

Submittal Table 8-2: Demand Reduction Actions

Shortage Level	Demand Reduction Actions ***Drop down list*** *These are the only categories that will be accepted by the WUEdata online submittal tool. Select those that apply.*	How much is this going to reduce the shortage gap? *Include units used (volume type or percentage)*	Additional Explanation or Reference *(optional)*	Penalty, Charge, or Other Enforcement? ***For Retail Suppliers Only*** *Drop Down List*
3	Other - Prohibit vehicle washing except at facilities using recycled or recirculating water	1%	Washing of motor vehicles, boats, airplanes and other mobile equipment is prohibited except when performed at a commercial car wash. This prohibition shall not apply to the washing of garbage trucks, vehicles used to transport food and perishables and other mobile equipment for which frequent cleaning is essential for the protection of the public health, safety and welfare.	Yes
3	Other water feature or swimming pool restriction	2%	Filling or refilling of swimming pools, spas, ponds and artificial lakes is prohibited.	Yes
3	Landscape - Other landscape restriction or prohibition	5%	Watering golf course areas, other than greens, is prohibited. Watering of parks, school grounds and recreational fields is prohibited except for plant materials classified as rare, exceptionally valuable or essential to the well being of rare animals.	Yes

Submittal Table 8-2: Demand Reduction Actions

Shortage Level	Demand Reduction Actions **_Drop down list_** _These are the only categories that will be accepted by the WUEdata online submittal tool. Select those that apply._	How much is this going to reduce the shortage gap? _Include units used (volume type or percentage)_	Additional Explanation or Reference _(optional)_	Penalty, Charge, or Other Enforcement? **_For Retail Suppliers Only_** _Drop Down List_
3	Moratorium or Net Zero Demand Increase on New Connections	2%	New construction meters and permits for unmetered service shall not be issued. Construction water shall not be used for earth work or road construction purposes.	Yes
3	Other	2%	The use of non-reclaimed and non-recycled water by commercial car washes shall be reduced in volume by 50%.	Yes
3	CII - Other CII restriction or prohibition	2%	The use of water for commercial manufacturing or processing purposes shall be reduced in volume by 50%.	Yes
3	Other	2%	Water shall not be used for air conditioning purposes.	Yes
3	Other	50%	Water use for public health and safety purposes only.	Yes

NOTES:

Submittal Table 8-3: Supply Augmentation and Other Actions

Shortage Level	Supply Augmentation Methods and Other Actions by Water Supplier ***Drop down list*** *These are the only categories that will be accepted by the WUEdata online submittal tool*	How much is this going to reduce the shortage gap? *Include units used (volume type or percentage)*	Additional Explanation or Reference *(optional)*
1 through 3	Other Purchases	0 - 100%	Additional imported water purchase through MWDOC

NOTES:
Additional Imported Water Purchases to meet the supply gap may have financial ramifications per the MWDOC Water Supply Allocation Plan.

Submittal Table 10-1 Retail: Notification to Cities and Counties

County Name *Drop Down List*	60 Day Notice	Notice of Public Hearing
Orange County	Yes	Yes

NOTES:

Urban Water Supplier: *Seal Beach*

Water Delivery Product (If delivering more than one type of product use Table O-1C)

Retail Potable Deliveries

Table O-1A: Recommended Energy Reporting - Water Supply Process Approach

Enter Start Date for Reporting Period 1/1/2019

End Date 12/31/2019

☐ Is upstream embedded in the values reported?

		Urban Water Supplier Operational Control							
		Water Management Process						Non-Consequential Hydropower (if applicable)	
	Water Volume Units Used	Extract and Divert	Place into Storage	Conveyance	Treatment	Distribution	Total Utility	Hydropower	Net Utility
Volume of Water Entering Process	AF	*2043.2*	*0*	*0*	*0*	*3032.8*	*3032.8*	*0*	*3032.8*
Energy Consumed (kWh)	*N/A*	*915,483*	*0*	*0*	*0*	*259,275*	*1174758*	*0*	*1174758*
Energy Intensity (kWh/vol.)	*N/A*	*448.1*	*0.0*	*0.0*	*0.0*	*85.5*	*387.4*	*0.0*	*387.4*

Quantity of Self-Generated Renewable Energy

0 kWh

Data Quality *(Estimate, Metered Data, Combination of Estimates and Metered Data)*

Combination of Estimates and Metered Data

Data Quality Narrative:

Volume of Water Entering Process: Extraction data based MWDOC Compiled Water Audits “Volume From Own Sources” and Distribution data based on MWDOC Compiled Water Audits “Authorized Consumption.” Non-Revenue Water is not considered in this calculation – the energy efficiency is based on water delivered to customers.

Energy Consumed: Based on metered data.

Narrative:

Seal Beach relies on imported water and local groundwater to meet their customers' water needs. Operational control is limited to groundwater wells and potable water booster stations. This table does not include upstream embedded energy consumed prior to Fountain Valley taking control. Distribution is based on the authorized consumption for 2019.

Urban Water Supplier: *Seal Beach*

Table O-2: Recommended Energy Reporting - Wastewater & Recycled Water

Enter Start Date for Reporting Period 1/1/2019
End Date 12/31/2019

☐
Is upstream embedded in the values reported?

Volume of Water Units Used AF

	Urban Water Supplier Operational Control			
	Water Management Process			
	Collection / Conveyance	Treatment	Discharge / Distribution	Total
Volume of Wastewater Entering Process (volume units selected above)	*2520*	*0*	*2520*	*0*
Wastewater Energy Consumed (kWh)	*148,457*	*0*	*0*	*148457*
Wastewater Energy Intensity (kWh/volume)	*58.9*	*0.0*	*0.0*	*0.0*
Volume of Recycled Water Entering Process (volume units selected above)	*0*	*0*	*0*	*0*
Recycled Water Energy Consumed (kWh)	*0*	*0*	*0*	*0*
Recycled Water Energy Intensity (kWh/volume)	*0.0*	*0.0*	*0.0*	*0.0*

Quantity of Self-Generated Renewable Energy related to recycled water and wastewater operations

0 kWh

Data Quality *(Estimate, Metered Data, Combination of Estimates and Metered Data)*

Combination of Estimates and Metered Data

Data Quality Narrative:

Volume of Water Entering Process: Estimated based potable water consumption in the service area
Wastewater Energy Consumed: Based on metered data

Narrative:

Seal Beach operates the local wastewater collection system but does not operate treatment facilities. Operational control is limited to a wastewater lift station in the local collection system. This table does not include downstream energy consumed to treat the wastewater, after Seal Beach's control.

APPENDIX C

Reduced Delta Reliance

The City of Seal Beach
REDUCED DELTA RELIANCE REPORTING

C.1 Background

Under the Sacramento-San Joaquin Delta Reform Act of 2009, state and local public agencies proposing a covered action in the Delta, prior to initiating the implementation of that action, must prepare a written certification of consistency with detailed findings as to whether the covered action is consistent with applicable Delta Plan policies and submit that certification to the Delta Stewardship Council. Anyone may appeal a certification of consistency, and if the Delta Stewardship Council grants the appeal, the covered action may not be implemented until the agency proposing the covered action submits a revised certification of consistency, and either no appeal is filed, or the Delta Stewardship Council denies the subsequent appeal.

An urban water supplier that anticipates participating in or receiving water from a proposed covered action such as a multi-year water transfer, conveyance facility, or new diversion that involves transferring water through, exporting water from, or using water in the Delta should provide information in their 2015 and 2020 Urban Water Management Plans (UWMPs) that can then be used in the covered action process to demonstrate consistency with Delta Plan Policy WR P1, Reduce Reliance on the Delta Through Improved Regional Water Self-Reliance (WR P1).

WR P1 details what is needed for a covered action to demonstrate consistency with reduced reliance on the Delta and improved regional self-reliance. WR P1 subsection (a) states that:

(a) Water shall not be exported from, transferred through, or used in the Delta if all of the following apply:

(1) One or more water suppliers that would receive water as a result of the export, transfer, or use have failed to adequately contribute to reduced reliance on the Delta and improved regional self-reliance consistent with all of the requirements listed in paragraph of subsection (c);

(2) That failure has significantly caused the need for the export, transfer, or use; and

(3) The export, transfer, or use would have a significant adverse environmental impact in the Delta.

WR P1 subsection (c)(1) further defines what adequately contributing to reduced reliance on the Delta means in terms of (a)(1) above.

(c)(1) Water suppliers that have done all the following are contributing to reduced reliance on the Delta and improved regional self-reliance and are therefore consistent with this policy:

(A) Completed a current Urban or Agricultural Water Management Plan (Plan) which has been reviewed by the California Department of Water Resources for compliance with the applicable requirements of Water Code Division 6, Parts 2.55, 2.6, and 2.8;

(B) Identified, evaluated, and commenced implementation, consistent with the implementation schedule set forth in the Plan, of all programs and projects included in the Plan that are locally cost effective and technically feasible which reduce reliance on the Delta; and

(C) Included in the Plan, commencing in 2015, the expected outcome for measurable reduction in Delta reliance and improvement in regional self-reliance. The expected outcome for measurable reduction in Delta reliance and improvement in regional self- reliance shall be reported in the Plan as the reduction in the amount of water used, or in the percentage of water used, from the Delta watershed. For the purposes of reporting, water efficiency is considered a new source of water supply, consistent with Water Code section 1011(a).

The analysis and documentation provided below include all of the elements described in WR P1(c)(1) that need to be included in a water supplier's UWMP to support a certification of consistency for a future covered action.

C.2 Summary of Expected Outcomes for Reduced Reliance on the Delta

As stated in WR P1 (c)(1)(C), the policy requires that, commencing in 2015, UWMPs include expected outcomes for measurable reduction in Delta reliance and improved regional self- reliance. WR P1 further states that those outcomes shall be reported in the UWMP as the reduction in the amount of water used, or in the percentage of water used, from the Delta.

The expected outcomes for the City of Seal Beach (hereafter referred to as 'City') regional self-reliance were developed using the approach and guidance described in Appendix C of DWR's Urban Water Management Plan Guidebook 2020 – Final Draft (Guidebook Appendix C) issued in March 2021. The data used in this analysis represent the total regional efforts of Metropolitan, the city, and its member agencies and were developed in conjunction with Metropolitan as part of the UWMP coordination process.

The following provides a summary of the near-term (2025) and long-term (2045) expected outcomes for the city's Delta reliance and regional self-reliance. The results show that as a region, the City, Metropolitan, and its member agencies are measurably reducing reliance on the Delta and improving regional self-reliance, both as an amount of water used and as a percentage of water used.

Expected Outcomes for Regional Self-Reliance for the City

- Near-term (2025) – Normal water year regional self-reliance is expected to increase by 2,211 AF from the 2010 baseline; this represents an increase of about 45.9 percent of 2025 normal water year retail demands (Table C-2).
- Long-term (2040) – Normal water year regional self-reliance is expected to increase by nearly 2,407 AF from the 2010 baseline, this represents an increase of about 49.1 percent of 2045 normal water year retail demands (Table C-2).

C.3 Demonstration of Reduced Reliance on the Delta

The methodology used to determine the City's reduced Delta reliance and improved regional self-reliance is consistent with the approach detailed in DWR's UWMP Guidebook Appendix C, including the use of narrative justifications for the accounting of supplies and the documentation of specific data sources. Some of the key assumptions underlying the City's demonstration of reduced reliance include:

- All data were obtained from the current 2020 UWMP or previously adopted UWMPs and represent average or normal water year conditions.
- All analyses were conducted at the service area level, and all data reflect the total contributions of the City and MWDOC, in conjunction with information provided by Metropolitan.
- No projects or programs that are described in the UWMPs as "Projects Under Development" were included in the accounting of supplies.

Baseline and Expected Outcomes

In order to calculate the expected outcomes for measurable reduction in Delta reliance and improved regional self-reliance, a baseline is needed to compare against. This analysis uses a normal water year representation of 2010 as the baseline, which is consistent with the approach described in the Guidebook Appendix C. Data for the 2010 baseline were taken from the city's 2005 UWMP as the UWMPs generally do not provide normal water year data for the year that they are adopted (i.e., 2005 UWMP forecasts begin in 2010, 2010 UWMP forecasts begin in 2015, and so on).

Consistent with the 2010 baseline data approach, the expected outcomes for reduced Delta reliance and improved regional self-reliance for 2015 and 2020 were taken from the City's 2010 and 2015 UWMPs respectively. Expected outcomes for 2025-2040 are from the current 2020 UWMP. Documentation of the specific data sources and assumptions are included in the discussions below.

Service Area Demands without Water Use Efficiency

In alignment with the Guidebook Appendix C, this analysis uses normal water year demands, rather than normal water year supplies to calculate expected outcomes in terms of the percentage of water used. Using normal water year demands serves as a proxy for the amount of supplies that would be used in a normal water year, which helps alleviate issues associated with how supply capability is presented to fulfill requirements of the UWMP Act versus how supplies might be accounted for to demonstrate consistency with WR P1.

Because WR P1 considers water use efficiency savings a source of water supply, water suppliers such as the City need to explicitly calculate and report water use efficiency savings separate from service area demands to properly reflect normal water year demands in the calculation of reduced reliance. As explained in the Guidebook Appendix C, water use efficiency savings must be added back to the normal year demands to represent demands without water use efficiency savings accounted for; otherwise the effect of water use efficiency savings on regional self-reliance would be overestimated. Table C-1 shows the results of this adjustment for the City. Supporting narratives and documentation for the all of the data shown in Table C-1 are provided below.

Table C -1 – Calculation of Water Use Efficiency

Service Area Water Use Efficiency Demands	**Baseline (2010)**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
Service Area Water Demands with Water Use Efficiency	4,620	4,720	3,488	3,175	3,368	3,342	3,317
Non-Potable Water Demands							
Potable Service Area Demands with Water Use Efficiency	4,620	4,720	3,488	3,175	3,368	3,342	3,317

Total Service Area Population	**Baseline (2010)**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
Service Area Population	23,211	24,001	24,000	24,110	24,527	24,652	24,554

Water Use Efficiency Since Baseline	**Baseline (2010)**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
Per Capita Water Use (GPCD)	178	176	130	118	123	121	121
Change in Per Capita Water Use from Baseline (GPCD)		(2)	(48)	(60)	(55)	(57)	(57)
Estimated Water Use Efficiency Since Baseline		57	1,289	1,624	1,514	1,565	1,570

Total Service Area Water Demands	**Baseline (2010)**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
Service Area Water Demands with Water Use Efficiency	4,620	4,720	3,488	3,175	3,368	3,342	3,317
Estimated Water Use Efficiency Since Baseline		57	1,289	1,624	1,514	1,565	1,570
Service Area Water Demands without Water Use Efficiency	4,620	4,777	4,777	4,799	4,882	4,907	4,887

Service Area Demands with Water Use Efficiency

The service area demands shown in Table C-1 represent the total retail water demands for the City's service area and may include Signal Family Residential, Multi-family Residential, Commercial, and Institutional/Government demands. These demand types and the modeling methodologies used to calculate them are described in Section 4-3 of the City's UWMP.

Non-Potable Water Demands

Any non-potable water demands shown in Table C-1 represent demands for non-potable recycled water, water used for purposes such as surface reservoir storage, and replenishment water for groundwater basin recharge and sweater barrier demands. Additionally, non-potable supplies have a demand hardening effect due to the inability to shift non-potable supplies to meet potable water demands. When water use efficiency or conservation measures are implemented, they fall solely on the potable water users. This is consistent with the approach for water conservation reporting used by the State Water Resources Control Board. Note that the City of Seal Beach does not have recycled water/non-potable water demands; this is demonstrated in Table C-1.

Total Service Area Population

The City's total service area population as shown in Table C-1 come from the Center for Demographic Research, with actuals and projections further described in Section 3.4 of the City's 2020 UWMP.

Water Use Efficiency Since Baseline

The water use efficiency numbers shown in Table C-1 represent the formulation that City utilized, consistent with Appendix C of the UWMP Guidebook approach.

Service area demands, excluding non-potable demands, are divided by the service area population to get per capita water use in the service area in gallons per capita per day (GPCD) for each five-year period. The change in per capita water use from the baseline is the comparative GPCD from that five-year period compared to the 2010 baseline. Changes in per capita water use over time are then applied back to the City's service area population to calculate the estimated WUE Supply. This estimated WUE Supply is considered an additional supply that may be used to show reduced reliance on Delta water supplies.

The demand and water use efficiency data shown in Table C-1 were collected from the following sources:

- Baseline (2010) values – City's 2005 UWMP, Table 10
- 2015 values – City's 2010 UWMP, Table 2.8
- 2020 values – City's 2015 UWMP, Table 2-10
- 2025-2040 values – City's 2020 UWMP

It should be noted that the results of this calculation differ from what the City calculated under section 5.2 pertaining to the Water Conservation Act of 2009 (SB X7-7) due to differing formulas.

C.4 Supplies Contributing to Regional Self-Reliance

For a covered action to demonstrate consistency with the Delta Plan, WR P1 subsection (c)(1)(C) states that water suppliers must report the expected outcomes for measurable improvement in regional self-reliance. Table C-2 shows expected outcomes for supplies contributing to regional self-reliance both in amount and as a percentage. The numbers shown in Table C-2 represent efforts to improve regional self-reliance for the City's entire service area and include the total contributions of the City. Supporting narratives and documentation for the all of the data shown in Table C-2 are provided below.

The results shown in Table C-2 demonstrate that the City's service area is measurably improving its regional self-reliance. In the near-term (2025), the expected outcome for normal water year regional self-reliance increases by 2,211 AF from the 2010 baseline; this represents an increase of about 45.9 percent of 2025 normal water year retail demands. In the long-term (2040), normal water year regional self-reliance is expected to increase by more than 2,407 AF from the 2010 baseline; this represents an increase of about 49.1 percent of 2040 normal water year retail demands.

Table C-2 – Supplies Contributing to Regional Self Reliance

Water Supplies Contributing to Regional Self-Reliance (Acre-Feet)	Baseline (2010)	2015	2020	2025	2030	2035	2040
Water Use Efficiency	-	57	1,289	1,624	1,514	1,565	1,570
Water Recycling							
Stormwater Capture and Use							
Advanced Water Technologies	162	615	713	750	1,014	1,006	999
Conjunctive Use Projects							
Local and Regional Water Supply and Storage Projects							
Other Programs and Projects the Contribute to Regional Self-Reliance							
Water Supplies Contributing to Regional Self-Reliance	162	673	2,002	2,373	2,528	2,571	2,569

Service Area Water Demands without Water Use Efficiency	Baseline (2010)	2015	2020	2025	2030	2035	2040
Service Area Water Demands without Water Use Efficiency	4,620	4,777	4,777	4,799	4,882	4,907	4,887

Change in Regional Self Reliance (Acre-Feet)	Baseline (2010)	2015	2020	2025	2030	2035	2040
Water Supplies Contributing to Regional Self-Reliance	162	673	2,002	2,373	2,528	2,571	2,569
Change in Water Supplies Contributing to Regional Self-Reliance		510	1,840	2,211	2,366	2,409	2,407

Change in Regional Self Reliance (As a Percent of Water Demand w/out WUE)	Baseline (2010)	2015	2020	2025	2030	2035	2040
Water Supplies Contributing to Regional Self-Reliance	3.5%	14.1%	41.9%	49.5%	51.8%	52.4%	52.6%
Change in Water Supplies Contributing to Regional Self-Reliance		10.6%	38.4%	45.9%	48.3%	48.9%	49.1%

Water Use Efficiency

The water use efficiency information shown in Table C-2 is taken directly from Table C-1 above.

Advanced Water Technologies (AWT)

AWT is calculated by multiplying the estimated GW production for that year (Section 6.1 of the City's UWMP) with the percentage of Total Basin Production for that year.

C.5 Reliance on Water Supplies from the Delta Watershed

Metropolitan's service area as a whole, reduces reliance on the Delta through investments in non-Delta water supplies, local water supplies and demand management measures. Quantifying the City's investments in self-reliance, locally, regionally, and throughout Southern California is infeasible for the reasons as noted in Section C.6. Due to the regional nature of these investments, the City is relying on Metropolitan's regional accounting of measurable reductions in supplies from the Delta Watershed.

The results shown in Table A.11-3 demonstrate that Metropolitan's service area, including the City, is measurably reducing its Delta reliance. In the near-term (2025), the expected outcome for normal water year reliance on supplies from the Delta watershed decreased by 301 TAF from the 2010 baseline; this represents a decrease of 3 percent of 2025 normal water year retail demands. In the long- term (2045), normal water year reliance on supplies from the Delta watershed decreased by 314 TAF from the 2010 baseline; this represents a decrease of just over 5 percent of 2045 normal water year retail demands.

Table C-3

Metropolitan Reliance on Water Supplies from the Delta Watershed

Water Supplies from the Delta Watershed (Acre-Feet)	Baseline (2010)	2015	2020	2025	2030	2035	2040	2045
CVP/SWP Contract Supplies	1,472,000	1,029,000	984,000	1,133,000	1,130,000	1,128,000	1,126,000	1,126,000
Delta/Delta Tributary Diversions	-	-	-	-	-	-	-	-
Transfers and Exchanges of Supplies from the Delta Watershed	20,000	44,000	91,000	58,000	52,000	52,000	52,000	52,000
Other Water Supplies from the Delta Watershed	-	-	-	-	-	-	-	-
Total Water Supplies from the Delta Watershed	**1,492,000**	**1,073,000**	**1,075,000**	**1,191,000**	**1,182,000**	**1,180,000**	**1,178,000**	**1,178,000**

Service Area Demands without Water Use Efficiency (Acre-Feet)	Baseline (2010)	2015	2020	2025	2030	2035	2040	2045
Service Area Demands without Water Use Efficiency Accounted For	5,493,000	5,499,000	5,219,000	4,925,000	5,032,000	5,156,000	5,261,000	5,374,000

Change in Supplies from the Delta Watershed (Acre-Feet)	Baseline (2010)	2015	2020	2025	2030	2035	2040	2045
Water Supplies from the Delta Watershed	1,492,000	1,073,000	1,075,000	1,191,000	1,182,000	1,180,000	1,178,000	1,178,000
Change in Supplies from the Delta Watershed	**NA**	**(419,000)**	**(417,000)**	**(301,000)**	**(310,000)**	**(312,000)**	**(314,000)**	**(314,000)**
Percent Change in Supplies from the Delta Watershed (As a Percent of Demand w/out WUE)	**Baseline (2010)**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**	**2045**
Percent of Supplies from the Delta Watershed	27.2%	19.5%	20.6%	24.2%	23.5%	22.9%	22.4%	21.9%
Change in Percent of Supplies from the Delta Watershed	**NA**	**-7.6%**	**-6.6%**	**-3.0%**	**-3.7%**	**-4.3%**	**-4.8%**	**-5.2%**

C.6 Infeasibility of Accounting Supplies from the Delta Watershed for Metropolitan's Member Agencies and their Customers

Metropolitan's service area, as a whole, reduces reliance on the Delta through investments in non-Delta water supplies, local water supplies, and regional and local demand management measures. Metropolitan's member agencies coordinate reliance on the Delta through their membership in Metropolitan, a regional cooperative providing wholesale water service to its 26 member agencies. Accordingly, regional reliance on the Delta can only be measured regionally—not by individual Metropolitan member agencies and not by the customers of those member agencies.

Metropolitan's member agencies, and those agencies' customers, indirectly reduce reliance on the Delta through their collective efforts as a cooperative. Metropolitan's member agencies do not control the amount of Delta water they receive from Metropolitan. Metropolitan manages a statewide integrated conveyance system consisting of its participation in the State Water Project (SWP), its Colorado River Aqueduct (CRA) including Colorado River water resources, programs and water exchanges, and its regional storage portfolio. Along with the SWP, CRA, storage programs, and Metropolitan's conveyance and distribution facilities, demand management programs increase the future reliability of water resources for the region. In addition, demand management programs provide system-wide benefits by decreasing the demand for imported water, which helps to decrease the burden on the district's infrastructure and reduce system costs, and free up conveyance capacity to the benefit of all member agencies.

Metropolitan's costs are funded almost entirely from its service area, with the exception of grants and other assistance from government programs. Most of Metropolitan's revenues are collected directly from its member agencies. Properties within Metropolitan's service area pay a property tax that currently provides approximately 8 percent of the fiscal year 2021 annual budgeted revenues. The rest of Metropolitan's costs are funded through rates and charges paid by Metropolitan's member agencies for the wholesale services it provides to them.[1] Thus, Metropolitan's member agencies fund nearly all operations Metropolitan undertakes to reduce reliance on the Delta, including Colorado River Programs, storage facilities, Local Resources Programs and Conservation Programs within Metropolitan's service area.

Because of the integrated nature of Metropolitan's systems and operations, and the collective nature of Metropolitan's regional efforts, it is infeasible to quantify each of Metropolitan member agencies' individual reliance on the Delta. It is infeasible to attempt to segregate an entity and a system that were designed to work as an integrated regional cooperative.

In addition to the member agencies funding Metropolitan's regional efforts, they also invest in their own local programs to reduce their reliance on any imported water. Moreover, the customers of those member agencies may also invest in their own local programs to reduce water demand. However, to the extent those efforts result in reduction of demands on Metropolitan, that reduction does not equate to a like reduction of reliance on the Delta. Demands on Metropolitan are not commensurate with demands on the Delta because most of Metropolitan member agencies receive blended resources from Metropolitan as determined by Metropolitan—not the individual member agency—and for most member agencies, the blend varies from month-to-month and year-to-year due to hydrology, operational constraints, use of storage and other factors.

Colorado River Programs

As a regional cooperative of member agencies, Metropolitan invests in programs to ensure the continued reliability and sustainability of Colorado River supplies. Metropolitan was established to obtain an allotment of Colorado River water, and its first mission was to construct and operate the CRA. The CRA consists of five pumping plants, 450 miles of high voltage power lines, one electric substation, four regulating reservoirs, and 242 miles of aqueducts, siphons, canals, conduits and pipelines terminating at Lake Mathews in Riverside County. Metropolitan owns, operates, and manages the CRA. Metropolitan is responsible for operating, maintaining, rehabilitating, and repairing the CRA, and is responsible for obtaining and scheduling energy resources adequate to power pumps at the CRA's five pumping stations.

Colorado River supplies include Metropolitan's basic Colorado River apportionment, along with supplies that result from existing and committed programs, including supplies from the Imperial Irrigation District (IID)-Metropolitan Conservation Program, the implementation of the Quantification Settlement Agreement (QSA) and related agreements, and the exchange agreement with San Diego County Water Authority (SDCWA). The QSA established the baseline water use for each of the agreement parties and facilitates the transfer of water from agricultural agencies to urban uses. Since the QSA, additional programs have been implemented to increase Metropolitan's CRA supplies. These include the PVID Land Management, Crop Rotation, and Water Supply Program, as well as the Lower Colorado River Water Supply Project. The 2007 Interim Guidelines provided for the coordinated operation of Lake Powell and Lake Mead, as well as the Intentionally Created Surplus (ICS) program that allows Metropolitan to store water in Lake Mead.

Storage Investments/Facilities

Surface and groundwater storage are critical elements of Southern California's water resources strategy and help Metropolitan reduce its reliance on the Delta. Because California experiences dramatic swings in weather and hydrology, storage is important to regulate those swings and mitigate possible supply shortages. Surface and groundwater storage provide a means of storing water during normal and wet years for later use during dry years, when imported supplies are limited. The Metropolitan system, for purposes of meeting demands during times of shortage, regulating system flows, and ensuring system reliability in the event of a system outage, provides over 1,000,000 acre-feet of system storage capacity. Diamond Valley Lake provides 810,000 acre-feet of that storage capacity, effectively doubling Southern California's previous surface water storage capacity. Other existing imported

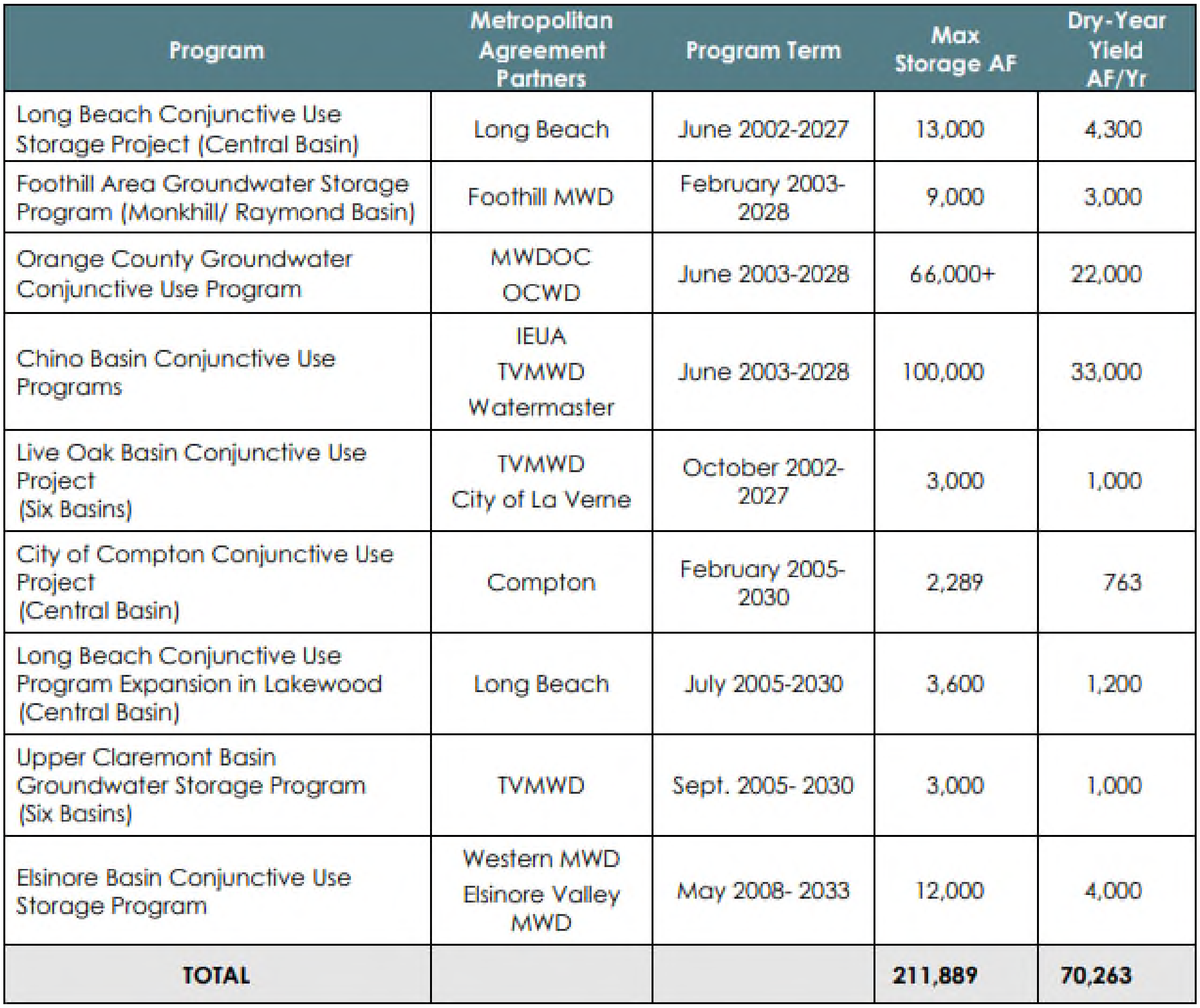
---

[1] A standby charge is collected from properties within the service areas of 21 of Metropolitan's 26 member agencies, ranging from $5 to $14.20 per acre annually, or per parcel if smaller than an acre. Standby charges go towards those member agencies' obligations to Metropolitan for the Readiness-to-Serve Charge. The total amount collected annually is approximately $43.8 million, approximately 2 percent of Metropolitan's fiscal year 2021 annual budgeted revenues.

water storage available to the region consists of Metropolitan's raw water reservoirs, a share of the SWP's raw water reservoirs in and near the service area, and the portion of the groundwater basins used for conjunctive-use storage.

Since the early twentieth century, DWR and Metropolitan have constructed surface water reservoirs to meet emergency, drought/seasonal, and regulatory water needs for Southern California. These reservoirs include Pyramid Lake, Castaic Lake, Elderberry Forebay, Silverwood Lake, Lake Perris, Lake Skinner, Lake Mathews, Live Oak Reservoir, Garvey Reservoir, Palos Verdes Reservoir, Orange County Reservoir, and Metropolitan's Diamond Valley Lake (DVL). Some reservoirs such as Live Oak Reservoir, Garvey Reservoir, Palos Verdes Reservoir, and Orange County Reservoir, which have a total combined capacity of about 3,500 AF, are used solely for regulating purposes. The total gross storage capacity for the larger remaining reservoirs is 1,757,600 AF. However, not all of the gross storage capacity is available to Metropolitan; dead storage and storage allocated to others reduce the amount of storage that is available to Metropolitan to 1,665,200 AF.

Conjunctive use of the aquifers offers another important source of dry year supplies. Unused storage in Southern California groundwater basins can be used to optimize imported water supplies, and the development of groundwater storage projects allows effective management and regulation of the region's major imported supplies from the Colorado River and SWP. Over the years, Metropolitan has implemented conjunctive use through various programs in the service area; the following table lists the groundwater conjunctive use programs that have been developed in the region.



Program	Metropolitan Agreement Partners	Program Term	Max Storage AF	Dry-Year Yield AF/Yr
Long Beach Conjunctive Use Storage Project (Central Basin)	Long Beach	June 2002-2027	13,000	4,300
Foothill Area Groundwater Storage Program (Monkhill/ Raymond Basin)	Foothill MWD	February 2003-2028	9,000	3,000
Orange County Groundwater Conjunctive Use Program	MWDOC OCWD	June 2003-2028	66,000+	22,000
Chino Basin Conjunctive Use Programs	IEUA TVMWD Watermaster	June 2003-2028	100,000	33,000
Live Oak Basin Conjunctive Use Project (Six Basins)	TVMWD City of La Verne	October 2002-2027	3,000	1,000
City of Compton Conjunctive Use Project (Central Basin)	Compton	February 2005-2030	2,289	763
Long Beach Conjunctive Use Program Expansion in Lakewood (Central Basin)	Long Beach	July 2005-2030	3,600	1,200
Upper Claremont Basin Groundwater Storage Program (Six Basins)	TVMWD	Sept. 2005- 2030	3,000	1,000
Elsinore Basin Conjunctive Use Storage Program	Western MWD Elsinore Valley MWD	May 2008- 2033	12,000	4,000
TOTAL			**211,889**	**70,263**

Metropolitan Demand Management Programs

Demand management costs are Metropolitan's expenditures for funding local water resource development programs and water conservation programs. These Demand Management Programs incentivize the development of local water supplies and the conservation of water to reduce the need to import water to deliver to Metropolitan's member agencies. These programs are implemented below the delivery points between Metropolitan's and its member agencies' distribution systems and, as such, do not add any water to Metropolitan's supplies. Rather, the effect of these downstream programs is to produce a local supply of water for the local agencies and to reduce demands by member agencies for water imported through Metropolitan's system. The following discussions outline how Metropolitan funds local resources and conservation programs for the benefit of all of its member agencies and the entire Metropolitan service area. Notably, the history of demand management by Metropolitan's member agencies and the local agencies that purchase water from Metropolitan's members has spanned more than four decades. The significant history of the programs is another reason it would be difficult to attempt to assign a portion of such funding to any one individual member agency.

Local Resources Programs

In 1982, Metropolitan began providing financial incentives to its member agencies to develop new local supplies to assist in meeting the region's water needs. Because of Metropolitan's regional distribution system, these programs benefit all member agencies regardless of project location because they help to increase regional water supply reliability, reduce demands for imported water supplies, decrease the burden on Metropolitan's infrastructure, reduce system costs and free up conveyance capacity to the benefit of all the agencies that rely on water from Metropolitan.

For example, the Groundwater Replenishment System (GWRS) operated by the Orange County Water District is the world's largest water purification system for indirect potable reuse. It was funded, in part, by Metropolitan's member agencies through the Local Resources Program. Annually, the GWRS produces approximately 103,000 acre-feet of reliable, locally controlled, drought-proof supply of high-quality water to recharge the Orange County Groundwater Basin and protect it from seawater intrusion. The GWRS is a premier example of a regional project that significantly reduced the need to utilize imported water for groundwater replenishment in Metropolitan's service area, increasing regional and local supply reliability and reducing the region's reliance on imported supplies, including supplies from the State Water Project.

Metropolitan's local resource programs have evolved through the years to better assist Metropolitan's member agencies in increasing local supply production. The following is a description and history of the local supply incentive programs.

Local Projects Program

In 1982, Metropolitan initiated the Local Projects Program (LPP), which provided funding to member agencies to facilitate the development of recycled water projects. Under this approach, Metropolitan contributed a negotiated up-front funding amount to help finance project capital costs. Participating member agencies were obligated to reimburse Metropolitan over time. In 1986, the LPP was revised, changing the up-front funding approach to an incentive-based approach. Metropolitan contributed an amount equal to the avoided State Water Project pumping costs for each acre-foot of recycled water delivered to end-use consumers. This funding incentive was based on the premise that local projects resulted in the reduction of water imported from the Delta and the associated pumping cost. The incentive amount varied from year to year depending on the actual variable power cost paid for State Water Project imports. In 1990, Metropolitan's Board increased the LPP contribution to a fixed rate of $154 per acre-foot, which was calculated based on Metropolitan's avoided capital and operational costs to convey, treat, and distribute water, and included considerations of reliability and service area demands.

Groundwater Recovery Program

The drought of the early 1990s sparked the need to develop additional local water resources, aside from recycled water, to meet regional demand and increase regional water supply reliability. In 1991, Metropolitan conducted the Brackish Groundwater Reclamation Study which determined that large amounts of degraded groundwater in the region were not being utilized. Subsequently, the Groundwater Recovery Program (GRP) was established to assist the recovery of otherwise unusable groundwater degraded by minerals and other contaminants, provide access to the storage assets of the degraded groundwater, and maintain the quality of groundwater resources by reducing the spread of degraded plumes.

Local Resources Program

In 1995, Metropolitan's Board adopted the Local Resources Program (LRP), which combined the LPP and GRP into one program. The Board allowed for existing LPP agreements with a fixed incentive rate to convert to the sliding scale up to $250 per acre-foot, similar to GRP incentive terms. Those agreements that were converted to LRP are known as “LRP Conversions.”

Competitive Local Projects Program

In 1998, the Competitive Local Resources Program (Competitive Program) was established. The Competitive Program encouraged the development of recycled water and recovered groundwater through a process that emphasized cost-efficiency to Metropolitan, timing new production according to regional need while minimizing program administration cost. Under the Competitive Program, agencies requested an incentive rate up to $250 per acre-foot of production over 25 years under a Request for Proposals (RFP) for the development of up to 53,000 acre-feet per year of new water recycling and groundwater recovery projects. In 2003, a second RFP was issued for the development of an additional 65,000 acre-feet of new recycled water and recovered groundwater projects through the LRP.

Seawater Desalination Program

Metropolitan established the Seawater Desalination Program (SDP) in 2001 to provide financial incentives to member agencies for the development of seawater desalination projects. In 2014, seawater desalination projects became eligible for funding under the LRP, and the SDP was ended.

2007 Local Resources Program

In 2006, a task force comprised of member agency representatives was formed to identify and recommend program improvements to the LRP. As a result of the task force process, the 2007 LRP was established with a goal of 174,000 acre-feet per year of additional local water resource development. The new program allowed for an open application process and eliminated the previous competitive process. This program offered sliding scale incentives of up to $250 per acre-foot, calculated annually based on a member agency’s actual local resource project costs exceeding Metropolitan’s prevailing water rate.

2014 Local Resources Program

A series of workgroup meetings with member agencies was held to identify the reasons why there was a lack of new LRP applications coming into the program. The main constraint identified by the member agencies was that the $250 per acre-foot was not providing enough of an incentive for developing new projects due to higher construction costs to meet water quality requirements and to develop the infrastructure to reach end-use consumers located further from treatment plants. As a result, in 2014, the Board authorized an increase in the maximum incentive amount, provided alternative payment structures, included onsite retrofit costs and reimbursable services as part of the LRP, and added eligibility for seawater desalination projects. The current LRP incentive payment options are structured as follows:

- Option 1 – Sliding scale incentive up to $340/AF for a 25-year agreement term
- Option 2 – Sliding scale incentive up to $475/AF for a 15-year agreement term
- Option 3 – Fixed incentive up to $305/AF for a 25-year agreement term

On-site Retrofit Programs

In 2014, Metropolitan’s Board also approved the On-site Retrofit Pilot Program which provided financial incentives to public or private entities toward the cost of small-scale improvements to their existing irrigation and industrial systems to allow connection to existing recycled water pipelines. The On-site Retrofit Pilot Program helped reduce recycled water retrofit costs to the end-use consumer which is a key constraint that limited recycled water LRP projects from reaching full production capacity. The program incentive was equal to the actual eligible costs of the on-site retrofit, or $975 per acre-foot of up-front cost, which equates to $195 per acre-foot for an estimated five years of water savings ($195/AF x 5 years) multiplied by the average annual water use in previous three years, whichever is less. The Pilot Program lasted two years and was successful in meeting its goal of accelerating the use of recycled water.

In 2016, Metropolitan’s Board authorized the On-site Retrofit Program (ORP), with an additional budget of $10 million. This program encompassed lessons learned from the Pilot Program and feedback from member agencies to make the program more streamlined and improve its efficiency. As of fiscal year 2019/20, the ORP has successfully converted 440 sites, increasing the use of recycled water by 12,691 acre-feet per year.

Stormwater Pilot Programs

In 2019, Metropolitan's Board authorized both the Stormwater for Direct Use Pilot Program and a Stormwater for Recharge Pilot Program to study the feasibility of reusing stormwater to help meet regional demands in Southern California. These pilot programs are intended to encourage the development, monitoring, and study of new and existing stormwater projects by providing financial incentives for their construction/retrofit and monitoring/reporting costs. These pilot programs will help evaluate the potential benefits delivered by stormwater capture projects and provide a basis for potential future funding approaches. Metropolitan's Board authorized a total of $12.5 million for the stormwater pilot programs ($5 million for the District Use Pilot and $7.5 million for the Recharge Pilot).

Current Status and Results of Metropolitan's Local Resource Programs

Today, nearly one-half of the total recycled water and groundwater recovery production in the region has been developed with an incentive from one or more of Metropolitan's local resource programs. During fiscal year 2020, Metropolitan provided about $13 million for production of 71,000 acre-feet of recycled water for non-potable and indirect potable uses. Metropolitan provided about $4 million to support projects that produced about 50,000 acre-feet of recovered groundwater for municipal use. Since 1982, Metropolitan has invested $680 million to fund 85 recycled water projects and 27 groundwater recovery projects that have produced a cumulative total of about 4 million acre-feet.

Conservation Programs

Metropolitan's regional conservation programs and approaches have a long history. Decades ago, Metropolitan recognized that demand management at the consumer level would be an important part of balancing regional supplies and demands. Water conservation efforts were seen as a way to reduce the need for imported supplies and offset the need to transport or store additional water into or within the Metropolitan service area. The actual conservation of water takes place at the retail consumer level. Regional conservation approaches have proven to be effective at reaching retail consumers throughout Metropolitan's service area and successfully implementing water saving devices, programs and practices. Through the pooling of funding by Metropolitan's member agencies, Metropolitan is able to engage in regional campaigns with wide-reaching impact. Regional investments in demand management programs, of which conservation is a key part along with local supply programs, benefit all member agencies regardless of project location. These programs help to increase regional water supply reliability, reduce demands for imported water supplies, decrease the burden on Metropolitan's infrastructure, reduce system costs, and free up conveyance capacity to the benefit of all member agencies.

Incentive-Based Conservation Programs

Conservation Credits Program

In 1988, Metropolitan's Board approved the Water Conservation Credits Program (Credits Program). The Credits Program is similar in concept to the Local Projects Program (LPP). The purpose of the Credits Program is to encourage local water agencies to implement effective water conservation projects through the use of financial incentives. The Credits Program provides financial assistance for water conservation projects that reduce demands on Metropolitan's imported water supplies and require Metropolitan's assistance to be financially feasible.

Initially, the Credits Program provided 50 percent of a member agency's program cost, up to a maximum of $75 per acre-foot of estimated water savings. The $75 Base Conservation Rate was established based Metropolitan's avoided cost of pumping SWP supplies. The Base Conservation Rate has been revisited by Metropolitan's Board and revised twice since 1988, from $75 to $154 per acre-foot in 1990 and from $154 to $195 per acre-foot in 2005.

In fiscal year 2020 Metropolitan processed more than 30,400 rebate applications totaling $18.9 million.

Member Agency Administered Program

Some member agencies also have unique programs within their service areas that provide local rebates that may differ from Metropolitan's regional program. Metropolitan continues to support these local efforts through a member agency administered funding program that adheres to the same funding guidelines as the Credits Program. The Member Agency Administered Program allows member agencies to receive funding for local conservation efforts that supplement, but do not duplicate, the rebates offered through Metropolitan's regional rebate program.

Water Savings Incentive Program

There are numerous commercial entities and industries within Metropolitan's service area that pursue unique savings opportunities that do not fall within the general rebate programs that Metropolitan provides. In 2012, Metropolitan designed the Water Savings Incentive Program (WSIP) to target these unique commercial and industrial projects. In addition to rebates for devices, under this program, Metropolitan provides financial incentives to businesses and industries that created their own custom water efficiency projects. Qualifying custom projects can receive funding for permanent water efficiency changes that result in reduced potable demand.

Non-Incentive Conservation Programs

In addition to its incentive-based conservation programs, Metropolitan also undertakes additional efforts throughout its service area that help achieve water savings without the use of rebates. Metropolitan's non-incentive conservation efforts include:

- residential and professional water efficient landscape training classes
- water audits for large landscapes
- research, development and studies of new water saving technologies
- advertising and outreach campaigns
- community outreach and education programs
- advocacy for legislation, codes, and standards that lead to increased water savings

Current Status and Results of Metropolitan's Conservation Programs

Since 1990, Metropolitan has invested $824 million in conservation rebates that have resulted in a cumulative savings of 3.27 million acre-feet of water. These investments include $450 million in turf removal and other rebates during the last drought which resulted in 175 million square feet of lawn turf removed. During fiscal year 2020, 1.06 million acre-feet of water is estimated to have been conserved. This annual total includes Metropolitan's Conservation Credits Program; code-based conservation achieved through Metropolitan-sponsored legislation; building plumbing codes and ordinances; reduced consumption resulting from changes in water pricing; and pre-1990 device retrofits.

Infeasibility of Accounting Regional Investments in Reduced Reliance Below the Regional Level

The accounting of regional investments that contribute to reduced reliance on supplies from the Delta watershed is straightforward to calculate and report at the regional aggregate level. However, any similar accounting is infeasible for the individual member agencies or their customers. As described above, the region (through Metropolitan) makes significant investments in projects, programs and other resources that reduce reliance on the Delta. In fact, all of Metropolitan's investments in Colorado River supplies, groundwater and surface storage, local resources development and demand management measures that reduce reliance on the Delta are collectively funded by revenues generated from the member agencies through rates and charges.

Metropolitan's revenues cannot be matched to the demands or supply production history of an individual agency, or consistently across the agencies within the service area. Each project or program funded by the region has a different online date, useful life, incentive rate and structure, and production schedule. It is infeasible to account for all these things over the life of each project or program and provide a nexus to each member agency's contributions to Metropolitan's revenue stream over time. Accounting at the regional level allows for the incorporation of the local supplies and water use efficiency programs done by member agencies and their customers through both the regional programs and through their own specific local programs. As shown above, despite the infeasibility of accounting reduced Delta reliance below the regional level, Metropolitan's member agencies and their customers have together made substantial contributions to the region's reduced reliance.

References

http://www.mwdh2o.com/WhoWeAre/Board/Board-Meeting/Board%20Archives/2017/12-Dec/Reports/064863458.pdf

http://www.mwdh2o.com/PDF_About_Your_Water/Annual_Achievement_Report.pdf

http://www.mwdh2o.com/WhoWeAre/Board/Board-Meeting/Board%20Archives/2016/12-Dec/Reports/064845868.pdf

http://www.mwdh2o.com/WhoWeAre/Board/Board-Meeting/Board%20Archives/2012/05%20-%20May/Letters/064774100.pdf

http://www.mwdh2o.com/WhoWeAre/Board/Board-Meeting/Board%20Archives/2020/10%20-%20Oct/Letters/10132020%20BOD%209-3%20B-L.pdf

http://www.mwdh2o.com/WhoWeAre/Board/Board-Meeting/Board%20Archives/2001/10-October/Letters/003909849.pdf

APPENDIX D

SBx7-7 Verification and Compliance Forms

SB X7-7 Table 0: Units of Measure Used in UWMP* *(select one from the drop down list)*
Acre Feet
**The unit of measure must be consistent with Submittal Table 2-3*
NOTES:

SB X7-7 Table-1: Baseline Period Ranges

Baseline	Parameter	Value	Units
10- to 15-year baseline period	2008 total water deliveries	4,012	Acre Feet
	2008 total volume of delivered recycled water	24	Acre Feet
	2008 recycled water as a percent of total deliveries	1%	**See Note 1**
	Number of years in baseline period[1, 2]	10	Years
	Year beginning baseline period range	1999	▨
	Year ending baseline period range[3]	2008	▨
5-year baseline period	Number of years in baseline period	5	Years
	Year beginning baseline period range	2004	▨
	Year ending baseline period range[4]	2008	▨

[1] *If the 2008 recycled water delivery is less than 10 percent of total water deliveries, then the 10-15year baseline period is a continuous 10-year period. If the amount of recycled water delivered in 2008 is 10 percent or greater of total deliveries, the 10-15 year baseline period is a continuous 10- to 15-year period.*

[2] *The Water Code requires that the baseline period is between 10 and 15 years. However, DWR recognizes that some water suppliers may not have the minimum 10 years of baseline data.*

[3] *The ending year for the 10-15 year baseline period must be between December 31, 2004 and December 31, 2010.*

[4] *The ending year for the 5 year baseline period must be between December 31, 2007 and December 31, 2010.*

NOTES:

SB X7-7 Table 2: Method for Population Estimates	
Method Used to Determine Population (may check more than one)	
☑	**1. Department of Finance** (DOF) or **American Community Survey** (ACS)
☐	**2. Persons-per-Connection Method**
☐	**3. DWR Population Tool**
☐	**4. Other** DWR recommends pre-review
NOTES:	

SB X7-7 Table 3: Service Area Population

Year		Population
10 to 15 Year Baseline Population		
Year 1	1999	23,995
Year 2	2000	23,781
Year 3	2001	23,975
Year 4	2002	24,025
Year 5	2003	24,036
Year 6	2004	23,856
Year 7	2005	23,885
Year 8	2006	23,653
Year 9	2007	23,829
Year 10	2008	23,739
Year 11		
Year 12		
Year 13		
Year 14		
Year 15		
5 Year Baseline Population		
Year 1	2004	23,856
Year 2	2005	23,885
Year 3	2006	23,653
Year 4	2007	23,829
Year 5	2008	23,739

NOTES:

SB X7-7 Table 4: Annual Gross Water Use *

Baseline Year *Fm SB X7-7 Table 3*		Volume Into Distribution System *This column will remain blank until SB X7-7 Table 4-A is completed.*	Deductions					Acre Feet
			Exported Water	Change in Dist. System Storage (+/-)	Indirect Recycled Water *This column will remain blank until SB X7-7 Table 4-B is completed.*	Water Delivered for Agricultural Use	Process Water *This column will remain blank until SB X7-7 Table 4-D is completed.*	Annual Gross Water Use
10 to 15 Year Baseline - Gross Water Use								
Year 1	1999	4,151			36		-	4,114
Year 2	2000	4,359			36		-	4,323
Year 3	2001	4,225			39		-	4,185
Year 4	2002	4,322			32		-	4,290
Year 5	2003	4,245			39		-	4,206
Year 6	2004	4,355			43		-	4,312
Year 7	2005	4,071			36		-	4,035
Year 8	2006	4,001			36		-	3,965
Year 9	2007	4,321			39		-	4,283
Year 10	2008	4,036			24		-	4,012
Year 11	0	-			-		-	-
Year 12	0	-			-		-	-
Year 13	0	-			-		-	-
Year 14	0	-			-		-	-
Year 15	0	-			-		-	-
10 - 15 year baseline average gross water use								**4,173**
5 Year Baseline - Gross Water Use								
Year 1	2004	4,355			43		-	4,312
Year 2	2005	4,071			36		-	4,035
Year 3	2006	4,001			36		-	3,965
Year 4	2007	4,321			39		-	4,283
Year 5	2008	4,036			24		-	4,012
5 year baseline average gross water use								**4,121**

* **Units of measure** (AF, MG , or CCF) must remain consistent throughout the UWMP, as reported in Table 2-3.

NOTES:

SB X7-7 Table 4-A: Volume Entering the Distribution System(s)

Complete one table for each source.

Name of Source OCWD GW

This water source is:

☑ The supplier's own water source

☐ A purchased or imported source

Baseline Year *Fm SB X7-7 Table 3*		Volume Entering Distribution System[1]	Meter Error Adjustment [2] *Optional* *(+/-)*	Corrected Volume Entering Distribution System
10 to 15 Year Baseline - Water into Distribution System				
Year 1	1999	3,191		3,191
Year 2	2000	3,396		3,396
Year 3	2001	3,219		3,219
Year 4	2002	2,914		2,914
Year 5	2003	3,095		3,095
Year 6	2004	3,139		3,139
Year 7	2005	2,473		2,473
Year 8	2006	2,514		2,514
Year 9	2007	3,162		3,162
Year 10	2008	3,107		3,107
Year 11	0			-
Year 12	0			-
Year 13	0			-
Year 14	0			-
Year 15	0			-
5 Year Baseline - Water into Distribution System				
Year 1	2004	3,139		3,139
Year 2	2005	2,473		2,473
Year 3	2006	2,514		2,514
Year 4	2007	3,162		3,162
Year 5	2008	3,107		3,107

[1] ***Units of measure*** *(AF, MG , or CCF) must remain consistent throughout the UWMP, as reported in Table 2-3.*

[2] ***Meter Error Adjustment*** *- See guidance in Methodology 1, Step 3 of Methodologies Document*

NOTES:

SB X7-7 Table 4-A: Volume Entering the Distribution System(s)

Complete one table for each source.

Name of Source	MWDOC/MET

This water source is:

☐ The supplier's own water source

☑ A purchased or imported source

Baseline Year *Fm SB X7-7 Table 3*		Volume Entering Distribution System[1]	Meter Error Adjustment[2] *Optional* *(+/-)*	Corrected Volume Entering Distribution System
10 to 15 Year Baseline - Water into Distribution System				
Year 1	1999	959.9		960
Year 2	2000	962.5		963
Year 3	2001	1005.9		1,006
Year 4	2002	1407.4		1,407
Year 5	2003	1149.6		1,150
Year 6	2004	1215.6		1,216
Year 7	2005	1598.4		1,598
Year 8	2006	1487.5		1,488
Year 9	2007	1159.6		1,160
Year 10	2008	929.4		929
Year 11	0			0
Year 12	0			0
Year 13	0			0
Year 14	0			0
Year 15	0			0
5 Year Baseline - Water into Distribution System				
Year 1	2004	1215.6		1,216
Year 2	2005	1598.4		1,598
Year 3	2006	1487.5		1,488
Year 4	2007	1159.6		1,160
Year 5	2008	929.4		929

[1] ***Units of measure*** *(AF, MG , or CCF) must remain consistent throughout the UWMP, as reported in Table 2-3.*

[2] ***Meter Error Adjustment*** *- See guidance in Methodology 1, Step 3 of Methodologies Document*

NOTES:

SB X7-7 Table 4-B: Indirect Recycled Water Use Deduction *(For use only by agencies that are deducting indirect recycled water)*

Baseline Year *Fm SB X7-7 Table 3*		Surface Reservoir Augmentation					Groundwater Recharge			**Total Deductible Volume of Indirect Recycled Water Entering the Distribution System**
		Volume Discharged from Reservoir for Distribution System Delivery [1]	Percent Recycled Water	Recycled Water Delivered to Treatment Plant	Transmission/ Treatment Loss [1]	Recycled Volume Entering Distribution System from Surface Reservoir Augmentation	Recycled Water Pumped by Utility [1, 2]	Transmission/ Treatment Losses [1]	Recycled Volume Entering Distribution System from Groundwater Recharge	
10-15 Year Baseline - Indirect Recycled Water Use										
Year 1	1999			-		-	36		36	36
Year 2	2000			-		-	36		36	36
Year 3	2001			-		-	39		39	39
Year 4	2002			-		-	32		32	32
Year 5	2003			-		-	39		39	39
Year 6	2004			-		-	43		43	43
Year 7	2005			-		-	36		36	36
Year 8	2006			-		-	36		36	36
Year 9	2007			-		-	39		39	39
Year 10	2008			-		-	24		24	24
Year 11	0			-		-			-	-
Year 12	0			-		-			-	-
Year 13	0			-		-			-	-
Year 14	0			-		-			-	-
Year 15	0			-		-			-	-
5 Year Baseline - Indirect Recycled Water Use										
Year 1	2004			-		-	43		43	43
Year 2	2005			-		-	36		36	36
Year 3	2006			-		-	36		36	36
Year 4	2007			-		-	39		39	39
Year 5	2008			-		-	24		24	24

[1] ***Units of measure*** *(AF, MG , or CCF) must remain consistent throughout the UWMP, as reported in Table 2-3.*

[2] *Suppliers will provide supplemental sheets to document the calculation for their input into "Recycled Water Pumped by Utility". The volume reported in this cell must be less than total groundwater pumped - See Methodology 1, Step 8, section 2.c.*

NOTES:

SB X7-7 Table 4-C: Process Water Deduction Eligibility *(For use only by agencies that are deducting process water) Choose Only One*	
☐	**Criteria 1**- Industrial water use is equal to or greater than 12% of gross water use. Complete SB X7-7 Table 4-C.1
☐	**Criteria 2** - Industrial water use is equal to or greater than 15 GPCD. Complete SB X7-7 Table 4-C.2
☐	**Criteria 3** - Non-industrial use is equal to or less than 120 GPCD. Complete SB X7-7 Table 4-C.3
☐	**Criteria 4** - Disadvantaged Community. Complete SB x7-7 Table 4-C.4
NOTES:	

SB X7-7 Table 4-C.1: Process Water Deduction Eligibility

Criteria 1

Industrial water use is equal to or greater than 12% of gross water use

Baseline Year *Fm SB X7-7 Table 3*		Gross Water Use Without Process Water Deduction	Industrial Water Use *	Percent Industrial Water	**Eligible for Exclusion Y/N**
10 to 15 Year Baseline - Process Water Deduction Eligibility					
Year 1	1999	4,114		0%	NO
Year 2	2000	4,323		0%	NO
Year 3	2001	4,185		0%	NO
Year 4	2002	4,290		0%	NO
Year 5	2003	4,206		0%	NO
Year 6	2004	4,312		0%	NO
Year 7	2005	4,035		0%	NO
Year 8	2006	3,965		0%	NO
Year 9	2007	4,283		0%	NO
Year 10	2008	4,012		0%	NO
Year 11	0	-			NO
Year 12	0	-			NO
Year 13	0	-			NO
Year 14	0	-			NO
Year 15	0	-			NO
5 Year Baseline - Process Water Deduction Eligibility					
Year 1	2004	4,312		0%	NO
Year 2	2005	4,035		0%	NO
Year 3	2006	3,965		0%	NO
Year 4	2007	4,283		0%	NO
Year 5	2008	4,012		0%	NO

*** Units of Measure** *(AF, MG , or CCF) must remain consistent throughout the UWMP, as reported in Table 2-3.*

NOTES:

SB X7-7 Table 4-C.2: Process Water Deduction Eligibility

Criteria 2

Industrial water use is equal to or greater than 15 GPCD

Baseline Year *Fm SB X7-7 Table 3*		Industrial Water Use *	Population	Industrial GPCD	**Eligible for Exclusion Y/N**
10 to 15 Year Baseline - Process Water Deduction Eligibility					
Year 1	1999		23,995	-	NO
Year 2	2000		23,781	-	NO
Year 3	2001		23,975	-	NO
Year 4	2002		24,025	-	NO
Year 5	2003		24,036	-	NO
Year 6	2004		23,856	-	NO
Year 7	2005		23,885	-	NO
Year 8	2006		23,653	-	NO
Year 9	2007		23,829	-	NO
Year 10	2008		23,739	-	NO
Year 11	0		-		NO
Year 12	0		-		NO
Year 13	0		-		NO
Year 14	0		-		NO
Year 15	0		-		NO
5 Year Baseline - Process Water Deduction Eligibility					
Year 1	2004		23,856	-	NO
Year 2	2005		23,885	-	NO
Year 3	2006		23,653	-	NO
Year 4	2007		23,829	-	NO
Year 5	2008		23,739	-	NO

*** Units of Measure** (AF, MG , or CCF) must remain consistent throughout the UWMP, as reported in Table 2-3.*

NOTES:

SB X7-7 Table 4-C.3: Process Water Deduction Eligibility

Criteria 3

Non-industrial use is equal to or less than 120 GPCD

Baseline Year *Fm SB X7-7 Table 3*		Gross Water Use Without Process Water Deduction *Fm SB X7-7 Table 4*	Industrial Water Use *	Non-industrial Water Use	Population *Fm SB X7-7 Table 3*	Non-Industrial GPCD	**Eligible for Exclusion Y/N**
10 to 15 Year Baseline - Process Water Deduction Eligibility							
Year 1	1999	4,114		4,114	23,995	153	NO
Year 2	2000	4,323		4,323	23,781	162	NO
Year 3	2001	4,185		4,185	23,975	156	NO
Year 4	2002	4,290		4,290	24,025	159	NO
Year 5	2003	4,206		4,206	24,036	156	NO
Year 6	2004	4,312		4,312	23,856	161	NO
Year 7	2005	4,035		4,035	23,885	151	NO
Year 8	2006	3,965		3,965	23,653	150	NO
Year 9	2007	4,283		4,283	23,829	160	NO
Year 10	2008	4,012		4,012	23,739	151	NO
Year 11	0	-		-	-		NO
Year 12	0	-		-	-		NO
Year 13	0	-		-	-		NO
Year 14	0	-		-	-		NO
Year 15	0	-		-	-		NO
5 Year Baseline - Process Water Deduction Eligibility							
Year 1	2004	4,312		4,312	23,856	161	NO
Year 2	2005	4,035		4,035	23,885	151	NO
Year 3	2006	3,965		3,965	23,653	150	NO
Year 4	2007	4,283		4,283	23,829	160	NO
Year 5	2008	4,012		4,012	23,739	151	NO

**** Units of Measure*** *(AF, MG , or CCF) must remain consistent throughout the UWMP, as reported in Table 2-3.*

NOTES:

SB X7-7 Table 4-C.4: Process Water Deduction Eligibility

Criteria 4

Disadvantaged Community. A “Disadvantaged Community” (DAC) is a community with a median household income less than 80 percent of the statewide average.

SELECT ONE

"Disadvantaged Community" status was determined using one of the methods listed below:

☐ **1. IRWM DAC Mapping tool https://gis.water.ca.gov/app/dacs/**

If using the IRWM DAC Mapping Tool, include a screen shot from the tool showing that the service area is considered a DAC.

☐ **2. 2010 Median Income**

California Median Household Income		Service Area Median Household Income	Percentage of Statewide Average	**Eligible for Exclusion? Y/N**
2010	$60,883		0%	YES

NOTES:

SB X7-7 Table 4-D: Process Water Deduction - Volume

Complete a separate table for each industrial customer with a process water exclusion

Name of Industrial Customer		*Enter Name of Industrial Customer 1*				
Baseline Year *Fm SB X7-7 Table 3*		Industrial Customer's Total Water Use *	Total Volume Supplied by Water Agency*	% of Water Supplied by Water Agency	Customer's Total Process Water Use*	Volume of Process Water Eligible for Exclusion for this Customer
10 to 15 Year Baseline - Process Water Deduction						
Year 1	1999					-
Year 2	2000					-
Year 3	2001					-
Year 4	2002					-
Year 5	2003					-
Year 6	2004					-
Year 7	2005					-
Year 8	2006					-
Year 9	2007					-
Year 10	2008					-
Year 11	0					-
Year 12	0					-
Year 13	0					-
Year 14	0					-
Year 15	0					-
5 Year Baseline - Process Water Deduction						
Year 1	2004					-
Year 2	2005					-
Year 3	2006					-
Year 4	2007					-
Year 5	2008					-

**** Units of Measure*** *(AF, MG , or CCF) must remain consistent throughout the UWMP, as reported in Table 2-3.*

NOTES:

SB X7-7 Table 5: Baseline Gallons Per Capita Per Day (GPCD)

Baseline Year *Fm SB X7-7 Table 3*		Service Area Population *Fm SB X7-7 Table 3*	Annual Gross Water Use *Fm SB X7-7 Table 4*	Daily Per Capita Water Use (GPCD)
10 to 15 Year Baseline GPCD				
Year 1	1999	23,995	4,114	153
Year 2	2000	23,781	4,323	162
Year 3	2001	23,975	4,185	156
Year 4	2002	24,025	4,290	159
Year 5	2003	24,036	4,206	156
Year 6	2004	23,856	4,312	161
Year 7	2005	23,885	4,035	151
Year 8	2006	23,653	3,965	150
Year 9	2007	23,829	4,283	160
Year 10	2008	23,739	4,012	151
Year 11	0	-	-	
Year 12	0	-	-	
Year 13	0	-	-	
Year 14	0	-	-	
Year 15	0	-	-	
10-15 Year Average Baseline GPCD				**156**

5 Year Baseline GPCD

Baseline Year *Fm SB X7-7 Table 3*		Service Area Population *Fm SB X7-7 Table 3*	Gross Water Use *Fm SB X7-7 Table 4*	Daily Per Capita Water Use
Year 1	2004	23,856	4,312	161
Year 2	2005	23,885	4,035	151
Year 3	2006	23,653	3,965	150
Year 4	2007	23,829	4,283	160
Year 5	2008	23,739	4,012	151
5 Year Average Baseline GPCD				**155**

NOTES:

SB X7-7 Table 6: Baseline GPCD *Summary*
From Table SB X7-7 Table 5

10-15 Year Baseline GPCD	156
5 Year Baseline GPCD	155

NOTES:

SB X7-7 Table 7: 2020 Target Method

Select Only One

Target Method		Supporting Tables
☐	Method 1	SB X7-7 Table 7A
☐	Method 2	SB X7-7 Tables 7B, 7C, and 7D
☑	Method 3	SB X7-7 Table 7-E
☐	Method 4	Method 4 Calculator *Located in the WUE Data Portal at wuedata.water.ca.gov* Resources *button*

NOTES:

SB X7-7 Table 7-A: Target Method 1

20% Reduction

10-15 Year Baseline GPCD	**2020 Target GPCD**
156	**125**

NOTES:

SB X7-7 Table 7-B: Target Method 2

Target Landscape Water Use

Units of Measure		Acre Feet
Reference Evapotranspiration Rate (ET0)[1] for Service Area (inches/year)		
Acres of Irrigated Landscape and Applicable ETAF	**Acres**	**Water Use[3]**
Acres of landscape installed pre-2010 (ETAF 0.8)[2]		-
Acres of landscape installed post-2010 (ETAF 0.7)[2]		-
Acres of residential landscape installed post 2015 (ETAF .55)		-
Acres of CII landscape installed post 2015 (ETAF .45)		-
Acres of Special Landscape Area (ETAF 1.0)[2]		-
Target Landscape Water Use for 2020		**-**

[1] *ETo information can be found at https://cimis.water.ca.gov. If the water supplier's service area spans more than one ETo Zone, the supplier will use multiple versions of SB X7-7 Table 7B for each ETo zone that they serve.*

[2] *ETAF - Evapotranspiration Adjustment Factor. Refer to the Model Water Efficient Landscape Ordinance at https://water.ca.gov/Programs/Water-Use-And-Efficiency/Model-Water-Efficient-Landscape-Ordinance*

[3] *Water Use Unit of Measure (AF, MG, CCF) is automatically converted to the units selected by the user in Table 0.*

NOTES

SB X7-7 Table 7-C: Target Method 2

Target CII Water Use

Baseline Year *Fm SB X7-7 Table 3*		**CII Water Use** [1,2]	**Process Water Exclusion** (Optional) *Fm SB X7-7 Table 4*	**CII Water Use Minus Process Water**	**Population** *Fm SB X7-7 Table 3*	**CII GPCD**
Unit of Measure						**Acre Feet**
Year 1	1999		0	0	23,995	0
Year 2	2000		0	0	23,781	0
Year 3	2001		0	0	23,975	0
Year 4	2002		0	0	24,025	0
Year 5	2003		0	0	24,036	0
Year 6	2004		0	0	23,856	0
Year 7	2005		0	0	23,885	0
Year 8	2006		0	0	23,653	0
Year 9	2007		0	0	23,829	0
Year 10	2008		0	0	23,739	0
Year 11	0		0	0	-	
Year 12	0		0	0	-	
Year 13	0		0	0	-	
Year 14	0		0	0	-	
Year 15	0		0	0	-	
Average Annual 10 to 15 Year Baseline CII Water Use (GPCD)						0
10% Reduction						0.0
2020 Target CII Water Use						**0**

[1] *CII water use for each year of the baseline period must be provided by the user.*

[2] *Units of measure (AF, MG , or CCF) must remain consistent throughout the UWMP, as reported in Table 2-3.*

NOTES

SB X7-7 Table 7-D: Target Method 2 Summary

2020 Population	24,000	
Sector	**Volume**	**GPCD**
	Acre Feet	
Target Indoor Residential Water Use	1,479	55
Target Landscape Water Use* *From SB X7-7 Table 7-B*	-	0
Target CII Water Use *From SB X7-7 Table 7-C*	-	0
2020 Target	1,479	**55**

**Additional rows may be added for Target Landscape Water Use if the service area spans more than one Eto Zone.*

NOTES:

SB X7-7 Table 7-E: Target Method 3

Agency May Select More Than One as Applicable	Percentage of Service Area in This Hydrological Region	Hydrologic Region	"2020 Plan" Regional Targets	Method 3 Regional Targets (95%)
☐		North Coast	137	130
☐		North Lahontan	173	164
☐		Sacramento River	176	167
☐		San Francisco Bay	131	124
☐		San Joaquin River	174	165
☐		Central Coast	123	117
☐		Tulare Lake	188	179
☐		South Lahontan	170	162
☑	100%	South Coast	149	142
☐		Colorado River	211	200
2020 Target *(If more than one region is selected, this value is calculated.)*				**142**

NOTES:

SB X7-7 Table 7-F: Confirm Minimum Reduction for 2020 Target

5 Year Baseline GPCD *From SB X7-7 Table 5*	Maximum 2020 Target[1]	**Calculated 2020 Target [2]**			**Confirmed 2020 Target[4]**
		As calculated by supplier in this SB X7-7 Verification Form	**Special Situations[3]**		
			Prorated 2020 Target	Population Weighted Average 2020 Target	
155	147	142			**142**

[1] ***Maximum 2020 Target*** *is 95% of the 5 Year Baseline GPCD except for suppliers at or below 100 GPCD.*

[2] ***Calculated 2020 Target*** *is the target calculated by the Supplier based on the selected Target Method, see SB X7-7 Table 7 and corresponding tables for agency's calculated target. Supplier may only enter one calculated target.*

[3] ***Prorated targets and population weighted target*** *are allowed for special situations only. These situations are described in Appendix P, Section P.3*

[4] ***Confirmed Target*** *is the lesser of the Calculated 2020 Target (C5, D5, or E5) or the Maximum 2020 Target (Cell B5)*

NOTES:

SB X7-7 Table 0: Units of Measure Used in 2020 UWMP* *(select one from the drop down list)*
Acre Feet
**The unit of measure must be consistent throughout the UWMP, as reported in Submittal Table 2-3.*
NOTES:

SB X7-7 Table 2: Method for 2020 Population Estimate	
Method Used to Determine 2020 Population (may check more than one)	
☑	**1. Department of Finance** (DOF) or **American Community Survey** (ACS)
☐	**2. Persons-per-Connection Method**
☐	**3. DWR Population Tool**
☐	**4. Other** DWR recommends pre-review
NOTES:	

SB X7-7 Table 3: 2020 Service Area Population

2020 Compliance Year Population	
2020	24,000

NOTES:

SB X7-7 Table 4: 2020 Gross Water Use

Compliance Year 2020	**2020 Volume Into Distribution System** *This column will remain blank until SB X7-7 Table 4-A is completed.*	**2020 Deductions**					**2020 Gross Water Use**
		Exported Water *	**Change in Dist. System Storage*** (+/-)	**Indirect Recycled Water** *This column will remain blank until SB X7-7 Table 4-B is completed.*	**Water Delivered for Agricultural Use***	**Process Water** *This column will remain blank until SB X7-7 Table 4-D is completed.*	
	3,273			713		-	**2,559**

*** Units of measure (AF, MG , or CCF)** must remain consistent throughout the UWMP, as reported in SB X7-7 Table 0 and Submittal Table 2-3.

NOTES:

SB X7-7 Table 4-A: 2020 Volume Entering the Distribution System(s), Meter Error Adjustment

Complete one table for each source.

Name of Source OCWD GW

This water source is *(check one)* **:**

☑ The supplier's own water source

☐ A purchased or imported source

Compliance Year 2020	Volume Entering Distribution System [1]	Meter Error Adjustment [2] *Optional* *(+/-)*	Corrected Volume Entering Distribution System
	2,141	-	2,141

[1] ***Units of measure (AF, MG , or CCF)*** *must remain consistent throughout the UWMP, as reported in SB X7-7 Table 0 and Submittal Table 2-3.*

[2] ***Meter Error Adjustment*** *- See guidance in Methodology 1, Step 3 of Methodologies Document*

NOTES

SB X7-7 Table 4-A: 2020 Volume Entering the Distribution System(s) Meter Error Adjustment

Complete one table for each source.

Name of Source MWDOC/MET

This water source is *(check one)* **:**

☐ The supplier's own water source

☑ A purchased or imported source

Compliance Year 2020	Volume Entering Distribution System [1]	Meter Error Adjustment [2] *Optional* *(+/-)*	Corrected Volume Entering Distribution System
	1,132		1,132

[1] ***Units of measure (AF, MG , or CCF)*** *must remain consistent throughout the UWMP, as reported in SB X7-7 Table 0 and Submittal Table 2-3.*

[2] ***Meter Error Adjustment*** *- See guidance in Methodology 1, Step 3 of Methodologies Document*

NOTES:

SB X7-7 Table 4-B: 2020 Indirect Recycled Water Use Deduction *(For use only by agencies that are deducting indirect recycled water)*

2020 Compliance Year	**2020 Surface Reservoir Augmentation**					**2020 Groundwater Recharge**			**Total Deductible Volume of Indirect Recycled Water Entering the Distribution System**
	Volume Discharged from Reservoir for Distribution System Delivery[1]	Percent Recycled Water	Recycled Water Delivered to Treatment Plant	Transmission/ Treatment Loss[1]	Recycled Volume Entering Distribution System from Surface Reservoir Augmentation	Recycled Water Pumped by Utility[1,2]	Transmission/ Treatment Losses[1]	Recycled Volume Entering Distribution System from Groundwater Recharge	
			-		-	713		713	713

[1] ***Units of measure (AF, MG , or CCF)*** *must remain consistent throughout the UWMP, as reported in SB X7-7 Table 0 and Submittal Table 2-3.*

[2] *Suppliers will provide supplemental sheets to document the calculation for their input into "Recycled Water Pumped by Utility". The volume reported in this cell must be less than total groundwater pumped - See Methodology 1, Step 8, section 2.c.*

SB X7-7 Table 4-C: 2020 Process Water Deduction Eligibility (For use only by agencies that are deducting process water) Choose Only One	
☐	**Criteria 1**- Industrial water use is equal to or greater than 12% of gross water use. Complete SB X7-7 Table 4-C.1
☐	**Criteria 2** - Industrial water use is equal to or greater than 15 GPCD. Complete SB X7-7 Table 4-C.2
☐	**Criteria 3** - Non-industrial use is equal to or less than 120 GPCD. Complete SB X7-7 Table 4-C.3
☐	**Criteria 4** - Disadvantaged Community. Complete SB x7-7 Table 4-C.4
NOTES:	

SB X7-7 Table 4-C.1: 2020 Process Water Deduction Eligibility *(For use only by agencies that are deducting process water using Criteria 1)*

Criteria 1

Industrial water use is equal to or greater than 12% of gross water use

2020 Compliance Year	2020 Gross Water Use Without Process Water Deduction	2020 Industrial Water Use	Percent Industrial Water	**Eligible for Exclusion Y/N**
	2,559		0%	NO

NOTES:

SB X7-7 Table 4-C.2: 2020 Process Water Deduction Eligibility

(For use only by agencies that are deducting process water using Criteria 2)

Criteria 2

Industrial water use is equal to or greater than 15 GPCD

2020 Compliance Year	2020 Industrial Water Use	2020 Population	2020 Industrial GPCD	**Eligible for Exclusion Y/N**
		24,000	-	NO

NOTES:

SB X7-7 Table 4-C.3: 2020 Process Water Deduction Eligibility

(For use only by agencies that are deducting process water using Criteria 3)

Criteria 3

Non-industrial use is equal to or less than 120 GPCD

2020 Compliance Year	2020 Gross Water Use Without Process Water Deduction *Fm SB X7-7 Table 4*	2020 Industrial Water Use	2020 Non-industrial Water Use	2020 Population *Fm SB X7-7 Table 3*	Non-Industrial GPCD	**Eligible for Exclusion Y/N**
	2,559		2,559	24,000	95	YES

NOTES:

SB X7-7 Table 4-C.4: 2020 Process Water Deduction Eligibility *(For use only by agencies that are deducting process water using Criteria 4)*

Criteria 4

Disadvantaged Community. A “Disadvantaged Community” (DAC) is a community with a median household income less than 80 percent of the statewide average.

SELECT ONE

"Disadvantaged Community" status was determined using one of the methods listed below:

1. IRWM DAC Mapping tool https://gis.water.ca.gov/app/dacs/

☐ If using the IRWM DAC Mapping Tool, include a screen shot from the tool showing that the service area is considered a DAC.

2. 2020 Median Income

	California Median Household Income*		Service Area Median Household Income	Percentage of Statewide Average	**Eligible for Exclusion? Y/N**
☐	**2020**	**$75,235**		0%	YES

*California median household income 2015 -2019 as reported in US Census Bureau QuickFacts.

NOTES

SB X7-7 Table 4-D: 2020 Process Water Deduction - Volume

Complete a separate table for each industrial customer with a process water exclusion

Name of Industrial Customer		*Enter Name of Industrial Customer 1*			
Compliance Year 2020	Industrial Customer's Total Water Use *	Total Volume Provided by Supplier*	% of Water Provided by Supplier	Customer's Total Process Water Use*	Volume of Process Water Eligible for Exclusion for this Customer
					-

*** Units of measure (AF, MG , or CCF)** must remain consistent throughout the UWMP, as reported in SB X7-7 Table 0 and Submittal Table 2-3.

NOTES:

SB X7-7 Table 5: 2020 Gallons Per Capita Per Day (GPCD)

2020 Gross Water *Fm SB X7-7 Table 4*	2020 Population *Fm SB X7-7 Table 3*	2020 GPCD
2,559	24,000	**95**

NOTES:

SB X7-7 Table 9: 2020 Compliance

Actual 2020 GPCD[1]	Optional Adjustments to 2020 GPCD					2020 Confirmed Target GPCD [1, 2]	**Did Supplier Achieve Targeted Reduction for 2020?**
	Enter "0" if Adjustment Not Used			TOTAL Adjustments[1]	Adjusted 2020 GPCD [1] *(Adjusted if applicable)*		
	Extraordinary Events[1]	Weather Normalization[1]	Economic Adjustment[1]				
95	-	-	-	-	95	142	**YES**

[1] *All values are reported in GPCD*

[2] ***2020 Confirmed Target GPCD*** *is taken from the Supplier's SB X7-7 Verification Form Table SB X7-7, 7-F.*

NOTES:

APPENDIX E

2021 OC Water Demand Forecast for MWDOC and OCWD Technical Memorandum

CDM Smith

Memorandum

To: *Rob Hunter, General Manager, MWDOC*
John Kennedy, Assistant General Manager, OCWD

From: *Dan Rodrigo, CDM Smith*

Date: *March 30, 2021*

Subject: *Orange County Water Demand Forecast for MWDOC and OCWD*

Purpose and Background

For the purposes of water supply reliability planning and to support the preparation of 2020 UWMPs, CDM Smith prepared water demand forecasts for the MWDOC and OCWD service areas using a consistent forecast methodology. While the methodology was a bottoms-up approach—meaning water demand forecasts were developed for every retail water agency in Orange County—the results presented in this technical memorandum are for the total service areas for MWDOC and OCWD, as well as a total for Orange County. All retail water agencies were given an opportunity to review both the forecast methodology and forecast results to determine if they wanted to utilize the information for their own 2020 UWMPs and local planning.

CDM Smith developed and presented a draft forecast methodology to a meeting of both MWDOC and OCWD member agencies for input. CDM Smith then developed draft retail agency forecasts for agency review. Based on interest, several retail water agencies met with CDM Smith individually to refine assumptions specific to their agency. We believe these meetings with the retail agencies improved both the methodology and demand forecast results. In the end, six retail water agencies decided to utilize their own water demand forecast.

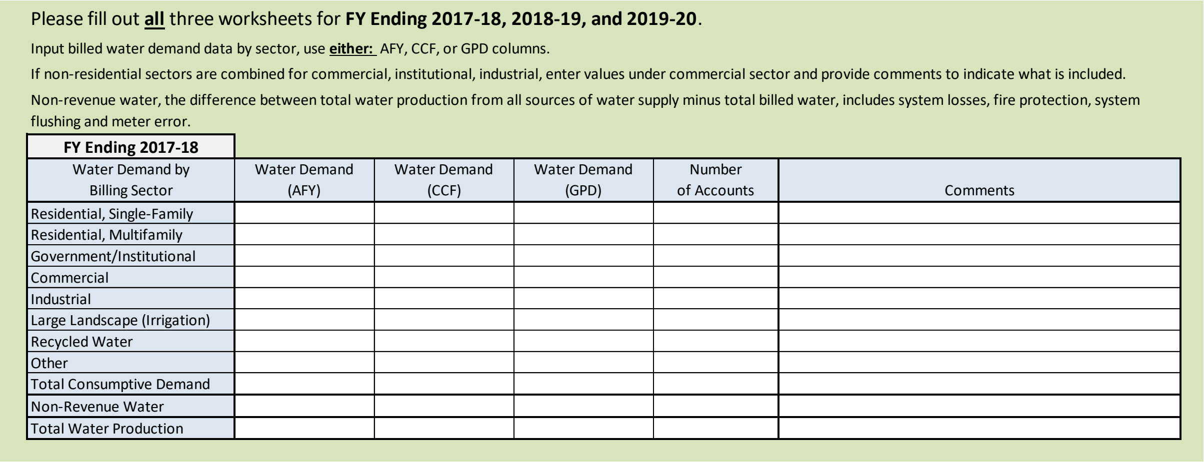
Demand Forecast Methodology

Given the significant changes in residential water use in the past 5 years due to California plumbing codes and landscape ordinances, as well as substantial customer participation in agency rebates for water use efficiency programs, the focus of the forecast methodology was on single-family and multifamily residential sectors. This decision to focus more on residential sectors was also supported by the relatively constant commercial/institutional/industrial (CII) water demands on a per account basis for the last five years.

The forecast methodology for residential sectors also provided the ability to separate indoor vs outdoor water use to support agency reporting for California's indoor residential target of 55 gallons per capita per day (gpcd) by 2025 and approximately 50 gpcd by 2030.

The forecast methodology began with a retail water agency survey that asked for FY2018, 2019 and 2020 water use by major sector, including number of accounts (see Figure 1 for example survey for FY2018). If an agency provided recycled water to customers that information was also requested. All retail agencies had provided the requested information to MWDOC and OCWD by December of 2020.

Figure 1. Member Agency Water Use Survey



Please fill out **all** three worksheets for **FY Ending 2017-18, 2018-19, and 2019-20**.

Input billed water demand data by sector, use **either:** AFY, CCF, or GPD columns.

If non-residential sectors are combined for commercial, institutional, industrial, enter values under commercial sector and provide comments to indicate what is included.

Non-revenue water, the difference between total water production from all sources of water supply minus total billed water, includes system losses, fire protection, system flushing and meter error.

FY Ending 2017-18

Water Demand by Billing Sector	Water Demand (AFY)	Water Demand (CCF)	Water Demand (GPD)	Number of Accounts	Comments
Residential, Single-Family					
Residential, Multifamily					
Government/Institutional					
Commercial					
Industrial					
Large Landscape (Irrigation)					
Recycled Water					
Other					
Total Consumptive Demand					
Non-Revenue Water					
Total Water Production					

Given that FY 2018 was a slightly above-normal demand year (warmer/drier than average) and FY 2019 was a slightly below-normal demand year (cooler/wetter than average), water use from these two years were averaged to represent an average-year base water demand. FY 2020 was examined to determine potential impacts of the COVID-19 pandemic on water use.

Residential Forecast Methodology

For the residential sectors (single-family and multifamily) the base year water demand was divided by households in order to get a total per unit water use (gallons per home per day). In order to split household water use into indoor and outdoor uses, three sources of information were used, along with professional judgement. The sources of information included: (1) *the Residential End Uses of Water* (Water Research Foundation, 2016); (2) California's plumbing codes and landscape ordinances; and (3) CA DWR's Model Water Efficient Landscape Ordinance (MWELO) calculator.

Three different periods of residential end uses of water were analyzed as follows:

- **Pre-2010 efficiency levels** – Has an average indoor water use that is considered to be moderately efficient, also does not include the most recent requirements for MWELO.
- **High-efficiency levels** – Includes the most recent plumbing codes that are considered to be highly efficient, and also includes the most recent requirements for MWELO.
- **Current average efficiency levels** – Represents the weighted average between pre-2010 efficiency and high efficiency levels, based on average age of homes for each retail water agency.

Table 1. Shows the three indoor single-family residential end uses of water for the three efficiency levels assumed for the Orange County water demand forecast.

Table 1. Single-Family Residential Indoor End Uses of Water Used for OC Water Demand Forecast

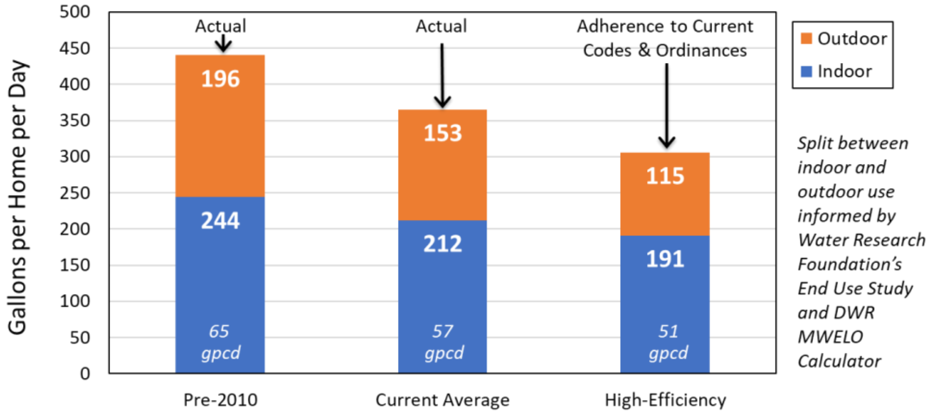
			Pre-2010 Efficiency Level		High Efficiency Level		Current Avg. Efficiency Level	
Indoor Single-Family End Use of Water	**Unit**	**Per Person Use Rate**	**Flow Rate per Day**	**Per Capita Use (gal/day)**	**Flow Rate per Day**	**Per Capita Use (gal/day)**	**Flow Rate per Day**	**Per Capita Use (gal/day)**
Toilet (gal/flush)	gal/flush	5	1.4	7.0	1.28	6.40	1.36	6.80
Shower (gmp)	gal/min	5.1	2.1	10.7	1.8	9.18	2.00	10.19
Bathroom Faucet (gpm)	gal/min	4.2	1.8	7.6	1.2	5.04	1.60	6.71
Kitchen Faucet (gpm)	gal/min	6.2	2.1	13.0	1.8	11.16	2.00	12.39
Dishwashing	gal/load	0.1	12	1.2	9	0.90	10.98	1.10
Clotheswashing	gal/load	0.3	30	9.0	28	8.40	29.32	8.80
All Others	gal/day	1	3.5	3.5	3	3.00	3.33	3.33
Leaks	gal/day	1	6.8	6.8	6.5	6.50	6.70	6.70
Total				**58.79**		**50.58**		**56.01**

The multifamily residential uses were similar in magnitude as shown in Table 1, although slightly lower for certain end uses.

For outdoor residential water use, the indoor per capita total was multiplied by each retail agency-specific persons per household in order to get an indoor residential household water use (gallons per day per home), and then was subtracted from the base year total household water use for single-family and multifamily for each agency based on actual water use as reported by the agency surveys.

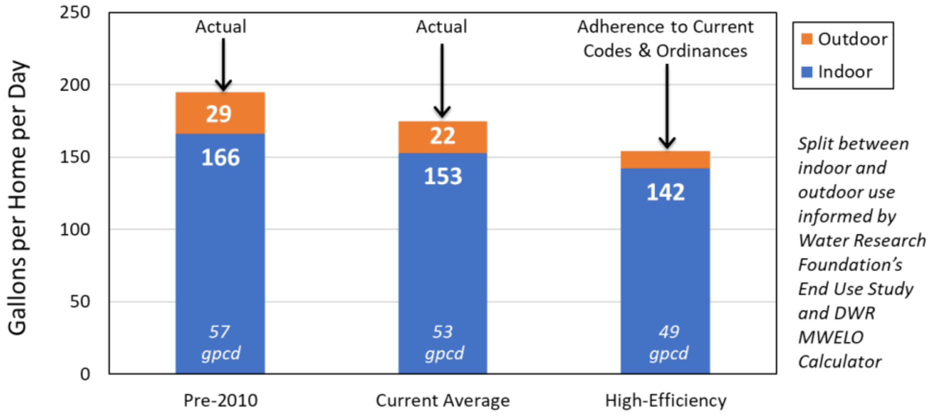
For illustrative purposes, the average single-family household water use for Orange County was derived showing indoor and outdoor water uses for both single-family and multifamily homes (see Figures 2 and 3).

Figure 2. Single-Family Indoor and Outdoor Water Use per Household



Split between indoor and outdoor use informed by Water Research Foundation's End Use Study and DWR MWELO Calculator

Figure 3. Multifamily Indoor and Outdoor Water Use per Household



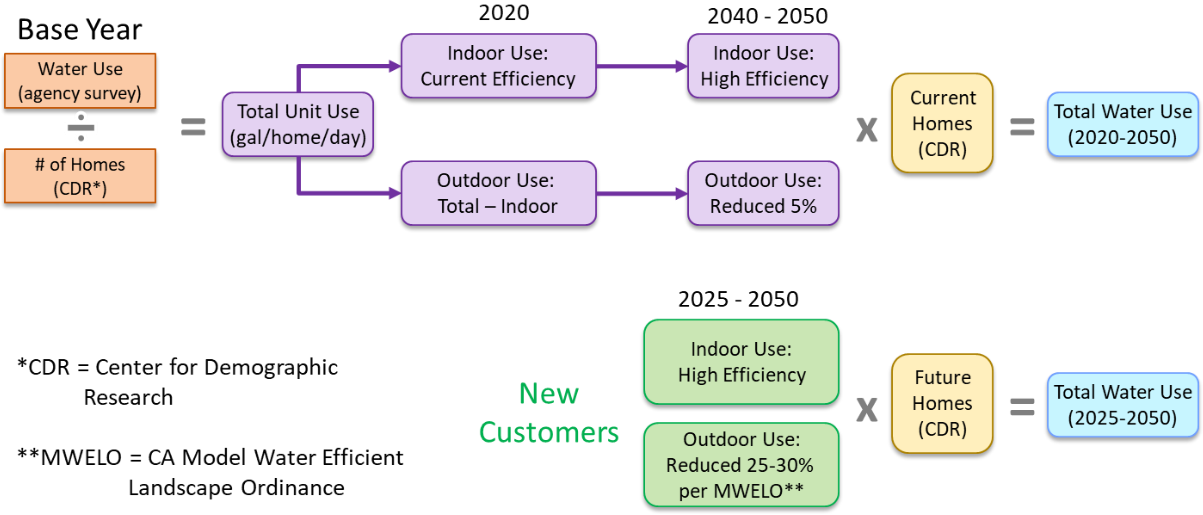
Split between indoor and outdoor use informed by Water Research Foundation's End Use Study and DWR MWELO Calculator

For existing residential homes, the current average indoor and outdoor water use (as illustrated in Figures 2 and 3) for each agency were used for the year 2020. It was assumed that indoor water uses would reach the high efficiency level by 2040. Based on current age of homes, replacement/remodeling rates, and water utility rebate programs it is believed this assumption is very achievable. It was also assumed that current outdoor water use would be reduced by 5% by 2050.

For new homes, the indoor high efficiency level was assumed for the years 2025 through 2050. Outdoor uses for new homes were assumed to be 25% and 30% lower than current household water use for single-family and multifamily homes, respectively.

The residential water demand methodology is depicted in Figure 4.

Figure 4. Residential Water Demand Methodology for Orange County



*CDR = Center for Demographic Research

**MWELO = CA Model Water Efficient Landscape Ordinance

Existing and projected population, single-family and multifamily households for each retail water agency were provided by the Center for Demographic Research (CDR) under contract by MWDOC and OCWD. CDR provides historical and future demographics by census tracts for all of Orange County. Census tract data is then clipped to retail water agency service boundaries in order to produce historical and projected demographic data by agency.

CII Forecast Methodology

For the CII water demands, which have been fairly stable from a unit use perspective (gallons/account/day), it was assumed that the unit demand in FY2020 would remain the same from 2020-2025 to represent COVID-19 impacts. Reviewing agency water use data from FY2018 through FY2020 revealed that residential water use increased slightly in FY2020 while CII demands decreased slightly as a result of COVID-19. From 2030 to 2050, the average CII unit use from FY2018 and 2019 was used. These unit use factors were then multiplied by an assumed growth of CII accounts under three broad scenarios:

- Low Scenario – assuming no growth in CII accounts
- Mid Scenario – assuming 0.5% annual growth in CII accounts
- High Scenario – assuming 1.5% annual growth in CII accounts

For most retail agencies, the Mid Scenario of CII account growth was used, but for those retail agencies that have had faster historical growth the High Scenario was used. For those retail agencies that have had relatively stable CII water demand, the Low Scenario was used.

Other Demand Categories Forecast Methodology

For those agencies that supply recycled water for non-potable demands, we used agency-specified growth assumptions. Most agencies have already maximized their recycled water and thus are not expecting for this category of demand to grow. However, a few agencies in South Orange County do expect moderate growth in recycled water customers.

For large landscape customers served currently by potable water use, we assumed these demands to be constant through 2050, except for agencies that have growing recycled water demands. For the agencies that have growing recycled water demands, we reduced the large landscape demands served by potable water accordingly.

For non-revenue water, which represents the difference in total water production less all water billed to customers, we held this percentage constant through 2050.

Demand Forecast Results

The results of the water demand forecast for MWDOC's service area are presented in Table 2 by major category of demand and for average weather under Mid Scenario for CII. MWDOC's service area includes all retail water agencies in Orange County except Anaheim, Fullerton and Santa Ana.

Table 2. MWDOC Service Area Water Demand Under Average Weather and Mid Scenario Growth

Sector Demand (AFY)	2020	2025	2030	2035	2040	2045	2050
Single-Family Residential	171,622	170,108	168,573	167,335	164,546	163,979	163,411
Multifamily Residential	60,013	61,411	60,994	60,916	60,364	61,123	61,882
CII	65,252	66,868	76,557	78,450	80,391	80,391	80,391
Large Landscape Potable	36,819	35,439	35,169	35,119	35,094	35,094	35,094
Non-Potable Recycled Water	50,174	52,645	54,094	56,774	56,829	56,829	56,829
Non-Revenue	27,102	27,267	28,198	28,384	28,470	28,507	28,544
Grand Total	**410,982**	**413,738**	**423,584**	**426,978**	**425,694**	**425,923**	**426,151**

As CDR is projecting only slight single-family housing growth for MWDOC's area, plus the impacts of highly efficient plumbing codes and MWELO on new development and retrofits, it is forecasted that single-family water use will steadily decrease from current 171,622 acre-feet (AFY) in 2020 to 163,411 AFY in 2050. While plumbing codes and MWELO will impact multifamily water demand in similar ways as single-family, CDR is projecting significantly more multifamily units—thus, these two factors are countering each other somewhat and results in a relatively constant multifamily water demand. CII water demands, based on 0.5% annual growth in CII accounts, are forecasted to increase from 65,252 AFY in 2020 to 80,391 AFY in 2040 and then hold relatively constant. Large landscape demands served by potable water are expected to decrease somewhat due to increases in non-potable recycled water (although not on a one to one basis). Finally, there will be a slight increase in non-revenue water in the planning horizon. In total, MWDOC's average year water demands under Mid Scenario CII growth are expected to increase from 410,982 AFY in 2020 to 426,978 AFY in 2035, and then level off through 2050.

The results of the water demand forecast for OCWD's service area are presented in Table 3 by major category of demand and for average weather under Mid Scenario for CII. OCWD's service area includes all retail water agencies in Orange County that produce groundwater from the Orange County Basin, including Anaheim, Fullerton and Santa Ana. It also includes a portion of IWRD's service area that overlays the groundwater basin.

Table 3. OCWD Service Area Water Demand Under Average Weather and Mid Scenario Growth

Sector Demand (AFY)	2020	2025	2030	2035	2040	2045	2050
Single-Family Residential	157,755	155,725	153,616	151,319	148,737	148,311	147,885
Multifamily Residential	69,188	72,351	72,778	73,137	73,132	74,534	75,937
CII	86,886	89,043	100,752	103,251	105,812	105,812	105,812
Large Landscape Potable	22,988	22,988	22,988	22,988	22,988	22,988	22,988
Non-Potable Recycled Water	24,899	24,899	24,899	24,899	24,899	24,899	24,899
Non-Revenue	22,406	22,719	23,671	23,881	24,044	24,111	24,178
Grand Total	**384,123**	**387,726**	**398,705**	**399,475**	**399,613**	**400,656**	**401,699**

OCWD's service area demands for single-family are decreasing until 2040, but then stabilize due to the older housing stock which uses more water per home than new development in Anaheim, Fullerton and Santa Ana. Multifamily water demands for OCWD's area are expected to increase from 2020 to 2050 due to significantly greater projected multifamily housing in Anaheim, Fullerton, and Santa Ana. CII water demands, based on 0.5% annual growth in CII accounts, are forecasted to increase from 86,886 AFY in 2020 to 105,812 AFY in 2040 and then hold relatively constant. Large landscape served by potable water and non-potable recycled water demands served by potable water are forecasted to remain fairly constant. Finally, there will be a slight increase in non-revenue water in the planning horizon. In total, OCWD's average year water demands under Mid Scenario CII growth are expected to increase from 384,123 AFY in 2020 to 401,699 AFY in 2050.

The results of the water demand forecast for the total Orange County are presented in Table 4 by major category of demand and for average weather under Mid Scenario for CII. The total Orange County area includes all retail water agencies in Orange County.

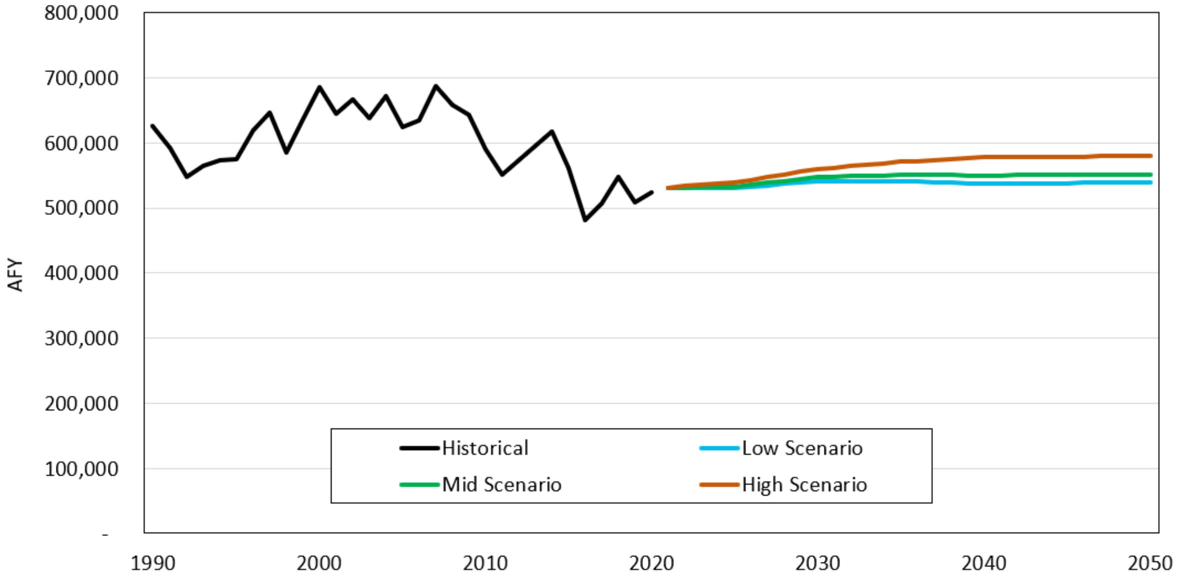
Table 4. Total Orange County Water Demand Under Average Weather and Mid Scenario Growth

Sector Demand (AFY)	2020	2025	2030	2035	2040	2045	2050
Single-Family Residential	215,900	213,658	211,302	209,257	205,649	204,951	204,253
Multifamily Residential	86,584	89,866	90,222	90,473	90,262	91,853	93,443
CII	101,418	103,939	118,298	121,235	124,246	124,246	124,246
Large Landscape Potable	39,545	38,165	37,895	37,845	37,820	37,820	37,820
Non-Potable Recycled Water	50,518	52,989	54,438	57,118	57,173	57,173	57,173
Non-Revenue	31,739	32,012	33,181	33,432	33,587	33,656	33,725
Grand Total	**525,704**	**530,628**	**545,335**	**549,360**	**548,737**	**549,698**	**550,659**

The total water demand for all of Orange County is forecasted to increase from 525,704 AFY in 2020 to 550,659 AFY in 2050.

Figure 5 presents the historical and forecasted water demand over time for the total Orange County area under average weather and for all three scenarios of CII growth.

Figure 5. Total Orange County Water Demand Forecast Under Average Weather



For comparison, the previous water demand used for the 2014 Orange County Water Reliability Study was approximately 580,000 AFY in 2050. Which compares closely with the demands under the High Scenario of CII growth for this forecast of 579,500 AFY. However, the Mid Scenario demand forecast is about 30,000 AFY lower than the 2014 forecast in 2050.

Weather Variability and Long-Term Climate Change Impacts

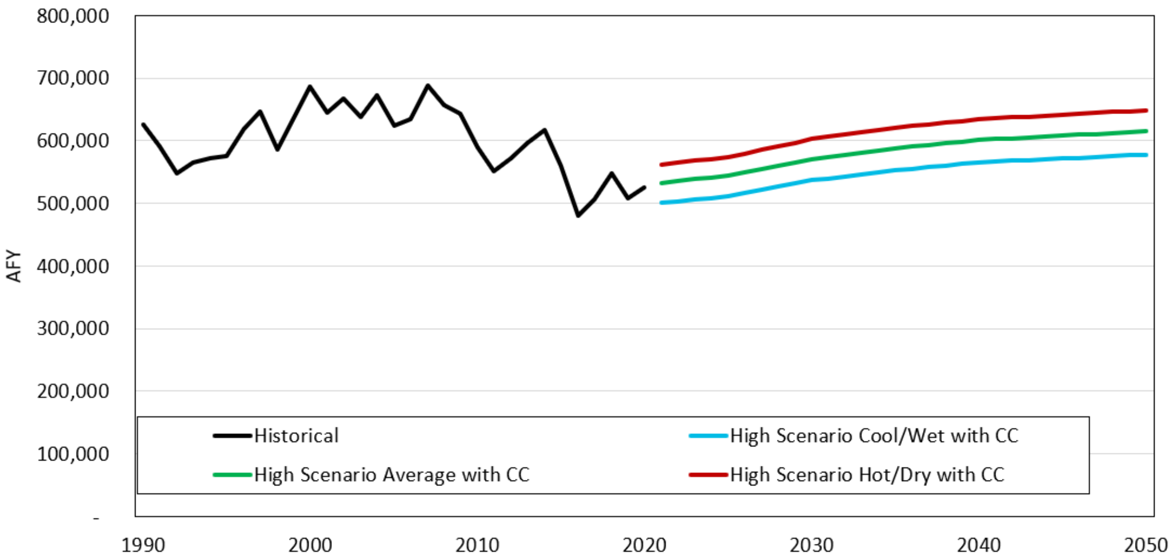
In any given year water demands can vary substantially due to weather. In addition, long-term climate change can have an impact on water demands into the future. For the 2014 OC Water Reliability Study, CDM Smith developed a robust statistical model of total water monthly production from 1990 to 2014 from a sample of retail water agencies. This model removed impacts from population growth, the economy and drought restrictions in order to estimate the impact on water use from temperature and precipitation.

The results of this statistical analysis are:

- Hot/dry weather demands will be 5.5% greater than current average weather demands
- Cooler/wet weather demands will be 6% lower than current average weather demands
- Climate change impacts will increase current average weather demands by:
    - 2% in 2030
    - 4% in 2040
    - 6% in 2050

Figure 6 presents the water demand forecast for the total Orange County area under the High Scenario showing climate change impacts and year-to-year weather variability. This forecast represents the likely higher-end range of future water demands.

Figure 6. Total Orange County Water Demand Forecast Under High Scenario with Climate Change



Comparison with Retail Agency Specified Demand Forecasts

At the start of this effort, MWDOC and OCWD committed to use retail water agency generated water demand forecasts for official reporting purposes (i.e., MWDOC's 2020 UWMP) if agencies decided not to use CDM Smith's methodology. As stated earlier, six retail water agencies either provided their own water demand forecast or made significant modifications to CDM Smith's methodology such that it was no longer considered uniform.

Table 5 compares the water demand forecast generated using CDM Smith's methodology applied uniformly across all retail agencies with a forecast that represents a combination of agency-generated forecasts (for the six retail agencies that supplied them) along with CDM Smith's methodology applied to the rest of the retail agencies for MWDOC and OCWD service areas.

Table 5. Comparison of Water Demand Forecasts Under Average Weather without Climate Change

	MWDOC Service Area			OCWD Service Area		
Year	CDM Smith Method Uniformly Applied	CDM Smith + Agency Provided Method	Difference	CDM Smith Method Uniformly Applied	CDM Smith + Agency Provided Method	Difference
Act. 2020	409,025	409,025	NA	387,317	387,317	NA
2025	413,738	431,130	(17,392)	387,726	400,460	(12,734)
2030	423,584	440,341	(16,757)	398,705	412,568	(13,863)
2035	426,978	446,398	(19,420)	399,475	415,973	(16,498)
2040	425,694	445,870	(20,176)	399,613	417,371	(17,758)
2045	425,923	445,778	(19,855)	400,656	418,308	(17,652)
2050	426,151	445,416	(19,265)	401,699	418,973	(17,274)

The difference between the CDM Smith method applied uniformly to all agencies vs the CDM Smith method plus agency provided forecast is between 4.3 and 4.5 percent by 2050, certainly within the reasonable range of error.

APPENDIX F

AWWA Water Loss Audits

AWWA Free Water Audit Software v5.0

This spreadsheet-based water audit tool is designed to help quantify and track water losses associated with water distribution systems and identify areas for improved efficiency and cost recovery. It provides a "top-down" summary water audit format, and is not meant to take the place of a full-scale, comprehensive water audit format.

Auditors are strongly encouraged to refer to the most current edition of AWWA M36 Manual for Water Audits for detailed guidance on the water auditing process and targetting loss reduction levels

The spreadsheet contains several separate worksheets. Sheets can be accessed using the tabs towards the bottom of the screen, or by clicking the buttons below.

Please begin by providing the following information

Name of Contact Person: Derrick Escobedo
Email Address: descobedo@sealbeachca.gov
Telephone | Ext.: 562-431-2529 | x1409
Name of City / Utility: City of Seal Beach Water Services
City/Town/Municipality: Seal Beach
State / Province: California (CA)
Country: USA
Year: 2014 | Financial Year
Start Date: 07/2013 Enter MM/YYYY numeric format
End Date: 06/2014 Enter MM/YYYY numeric format
Audit Preparation Date:
Volume Reporting Units: Acre-feet
PWSID / Other ID:

The following guidance will help you complete the Audit

All audit data are entered on the ***Reporting Worksheet***

☐ Value can be entered by user
🟨 Value calculated based on input data
🟪 These cells contain recommended default values

Use of Option (Radio) Buttons: Pcnt: 0.25% ● ○ Value:

Select the default percentage by choosing the option button on the left

To enter a value, choose this button and enter a value in the cell to the right

The following worksheets are available by clicking the buttons below or selecting the tabs along the bottom of the page

Instructions
The current sheet. Enter contact information and basic audit details (year, units etc)

Reporting Worksheet
Enter the required data on this worksheet to calculate the water balance and data grading

Comments
Enter comments to explain how values were calculated or to document data sources

Performance Indicators
Review the performance indicators to evaluate the results of the audit

Water Balance
The values entered in the Reporting Worksheet are used to populate the Water Balance

Dashboard
A graphical summary of the water balance and Non-Revenue Water components

Grading Matrix
Presents the possible grading options for each input component of the audit

Service Connection Diagram
Diagrams depicting possible customer service connection line configurations

Definitions
Use this sheet to understand the terms used in the audit process

Loss Control Planning
Use this sheet to interpret the results of the audit validity score and performance indicators

Example Audits
Reporting Worksheet and Performance Indicators examples are shown for two validated audits

Acknowledgements
Acknowledgements for the AWWA Free Water Audit Software v5.0

If you have questions or comments regarding the software please contact us via email at: wlc@awwa.org

AWWA Free Water Audit Software:
Reporting Worksheet

WAS v5.0

? Click to access definition
\+ Click to add a comment

Water Audit Report for: City of Seal Beach Water Services
Reporting Year: 2014 | 7/2013 - 6/2014

Please enter data in the white cells below. Where available, metered values should be used; if metered values are unavailable please estimate a value. Indicate your confidence in the accuracy of the input data by grading each component (n/a or 1-10) using the drop-down list to the left of the input cell. Hover the mouse over the cell to obtain a description of the grades

All volumes to be entered as: ACRE-FEET PER YEAR

To select the correct data grading for each input, determine the highest grade where the utility meets or exceeds all criteria for that grade and all grades below it.

<----------- Enter grading in column 'E' and 'J' ---------->

WATER SUPPLIED

Master Meter and Supply Error Adjustments

	Grade	Value	Unit	Grade	Pcnt:		Value:	Unit
Volume from own sources:	n/a	0.000	acre-ft/yr			● ○		acre-ft/yr
Water imported:	8	3,868.000	acre-ft/yr	8		● ○		acre-ft/yr
Water exported:	n/a	0.000	acre-ft/yr			● ○		acre-ft/yr

Enter negative % or value for under-registration
Enter positive % or value for over-registration

WATER SUPPLIED: 3,868.000 acre-ft/yr

AUTHORIZED CONSUMPTION

Click here: ? for help using option buttons below

	Grade	Value	Unit	Pcnt:		Value:	Unit
Billed metered:	7	3,704.000	acre-ft/yr				
Billed unmetered:	n/a	0.000	acre-ft/yr				
Unbilled metered:	n/a	0.000	acre-ft/yr				
Unbilled unmetered:	6	5.000	acre-ft/yr		○ ●	5.000	acre-ft/yr

Use buttons to select percentage of water supplied
OR
value

AUTHORIZED CONSUMPTION: 3,709.000 acre-ft/yr

WATER LOSSES (Water Supplied - Authorized Consumption)

159.000 acre-ft/yr

Apparent Losses

	Grade	Value	Unit	Pcnt:		Value:	Unit
Unauthorized consumption:		9.670	acre-ft/yr	0.25%	● ○		acre-ft/yr

Default option selected for unauthorized consumption - a grading of 5 is applied but not displayed

	Grade	Value	Unit	Pcnt:		Value:	Unit
Customer metering inaccuracies:	7	114.557	acre-ft/yr	3.00%	● ○		acre-ft/yr
Systematic data handling errors:		9.260	acre-ft/yr	0.25%	● ○		acre-ft/yr

Default option selected for Systematic data handling errors - a grading of 5 is applied but not displayed

Apparent Losses: 133.487 acre-ft/yr

Real Losses (Current Annual Real Losses or CARL)

Real Losses = Water Losses - Apparent Losses: 25.513 acre-ft/yr

WATER LOSSES: 159.000 acre-ft/yr

NON-REVENUE WATER

NON-REVENUE WATER: 164.000 acre-ft/yr

= Water Losses + Unbilled Metered + Unbilled Unmetered

SYSTEM DATA

	Grade	Value	Unit
Length of mains:	8	73.5	miles
Number of active AND inactive service connections:	8	5,677	
Service connection density:		77	conn./mile main

Are customer meters typically located at the curbstop or property line? Yes

Average length of customer service line: (length of service line, beyond the property boundary, that is the responsibility of the utility)

Average length of customer service line has been set to zero and a data grading score of 10 has been applied

Average operating pressure: 8 | 60.0 psi

COST DATA

	Grade	Value	Unit
Total annual cost of operating water system:	7	$4,200,700	$/Year
Customer retail unit cost (applied to Apparent Losses):	7	$1.00	$/100 cubic feet (ccf)
Variable production cost (applied to Real Losses):	8	$864.65	$/acre-ft

☐ Use Customer Retail Unit Cost to value real losses

Retail costs are less than (or equal to) production costs; please review and correct if necessary

---

WATER AUDIT DATA VALIDITY SCORE:

***** YOUR SCORE IS: 73 out of 100 *****

A weighted scale for the components of consumption and water loss is included in the calculation of the Water Audit Data Validity Score

PRIORITY AREAS FOR ATTENTION:

Based on the information provided, audit accuracy can be improved by addressing the following components:

1: Water imported
2: Billed metered
3: Unauthorized consumption

AWWA Free Water Audit Software:
System Attributes and Performance Indicators

WAS v5.0

Water Audit Report for: City of Seal Beach Water Services
Reporting Year: 2014 | 7/2013 - 6/2014

***** YOUR WATER AUDIT DATA VALIDITY SCORE IS: 73 out of 100 *****

System Attributes:

	Apparent Losses:	133.487	acre-ft/yr
+	Real Losses:	25.513	acre-ft/yr
=	**Water Losses:**	**159.000**	acre-ft/yr
?	Unavoidable Annual Real Losses (UARL):	83.96	acre-ft/yr
	Annual cost of Apparent Losses:	$58,147	
	Annual cost of Real Losses:	$22,060	Valued at **Variable Production Cost**

Return to Reporting Worksheet to change this assumpiton

Performance Indicators:

Financial:	Non-revenue water as percent by volume of Water Supplied:	4.2%	
	Non-revenue water as percent by cost of operating system:	2.0%	Real Losses valued at Variable Production Cost
Operational Efficiency:	Apparent Losses per service connection per day:	20.99	gallons/connection/day
	Real Losses per service connection per day:	4.01	gallons/connection/day
	Real Losses per length of main per day*:	N/A	
	Real Losses per service connection per day per psi pressure:	0.07	gallons/connection/day/psi

From Above, Real Losses = Current Annual Real Losses (CARL):	25.51	acre-feet/year
? Infrastructure Leakage Index (ILI) [CARL/UARL]:	0.30	

* This performance indicator applies for systems with a low service connection density of less than 32 service connections/mile of pipeline

AWWA Free Water Audit Software:
User Comments

Use this worksheet to add comments or notes to explain how an input value was calculated, or to document the sources of the information used.

General Comment:	

Audit Item	Comment
Volume from own sources:	
Vol. from own sources: Master meter error adjustment:	
Water imported:	From Water Loss Audit Data request - The City of Seal Beach has purchased 1577.69 acre feet of water from the Metropolitan Water District during the 2013-2014 PLUS 2300 from OCWD
Water imported: master meter error adjustment:	
Water exported:	
Water exported: master meter error adjustment:	
Billed metered:	
Billed unmetered:	Not tracked
Unbilled metered:	

Audit Item	Comment
Unbilled unmetered:	Estimated per email 12/15
Unauthorized consumption:	
Customer metering inaccuracies:	
Systematic data handling errors:	
Length of mains:	The lengths of mains being entered in the reporting worksheet has been determined from information gathered in both the “drinc waterboards” reporting service through the state of California and the City of Seal Beach Annual Masterplan for water infrastructure 2012. Seal Beach owns and operates 73.4 miles of mainline pipe ranging from 4 inch to 20 inch in diameter (Seal Beach Water Master Plan 2012). PLUS 535 ft for longer mains = /.1 mi
Number of active AND inactive service connections:	
Average length of customer service line:	
Average operating pressure:	Is there a SCADA system?
Total annual cost of operating water system:	
Customer retail unit cost (applied to Apparent Losses):	Total biled metered consumption is $1,613,826 / 1,613,572 ccf
Variable production cost (applied to Real Losses):	

AWWA Free Water Audit Software: Water Balance

WAS v5.0

American Water Works Association.

Water Audit Report for: City of Seal Beach Water Services
Reporting Year: 2014 7/2013 - 6/2014
Data Validity Score: 73

Own Sources (Adjusted for known errors) *0.000*	System Input *3,868.000*	Water Exported *0.000*			Billed Water Exported	Revenue Water 0.000
		Water Supplied *3,868.000*	Authorized Consumption *3,709.000*	Billed Authorized Consumption *3,704.000*	Billed Metered Consumption (water exported is removed) *3,704.000*	Revenue Water 3,704.000
					Billed Unmetered Consumption *0.000*	
				Unbilled Authorized Consumption 5.000	Unbilled Metered Consumption *0.000*	Non-Revenue Water (NRW) 164.000
					Unbilled Unmetered Consumption *5.000*	
			Water Losses *159.000*	Apparent Losses *133.487*	Unauthorized Consumption *9.670*	
					Customer Metering Inaccuracies *114.557*	
					Systematic Data Handling Errors *9.260*	
Water Imported *3,868.000*				Real Losses *25.513*	Leakage on Transmission and/or Distribution Mains *Not broken down*	
					Leakage and Overflows at Utility's Storage Tanks *Not broken down*	
					Leakage on Service Connections *Not broken down*	

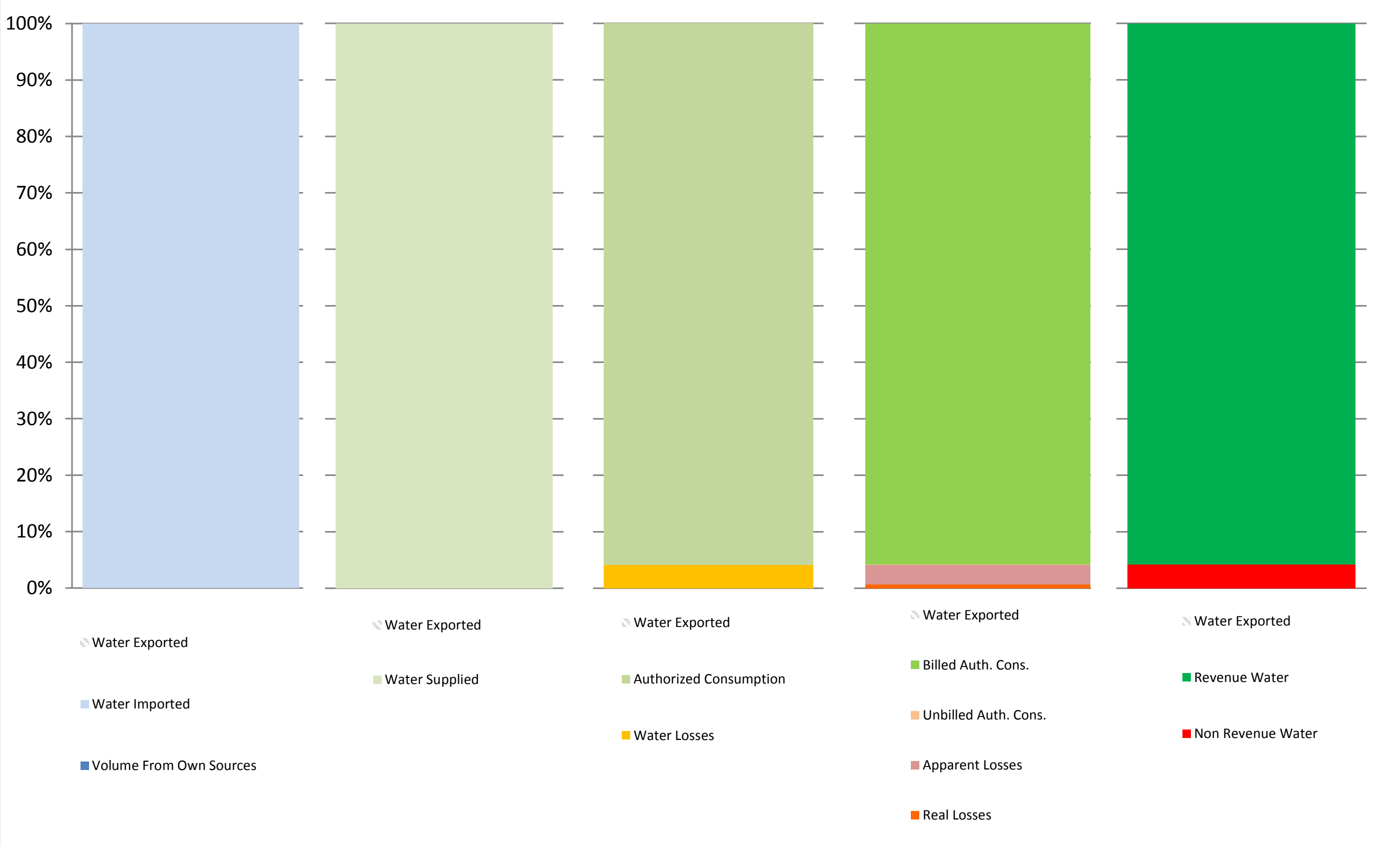
AWWA Free Water Audit Software:
Dashboard

WAS v5.0

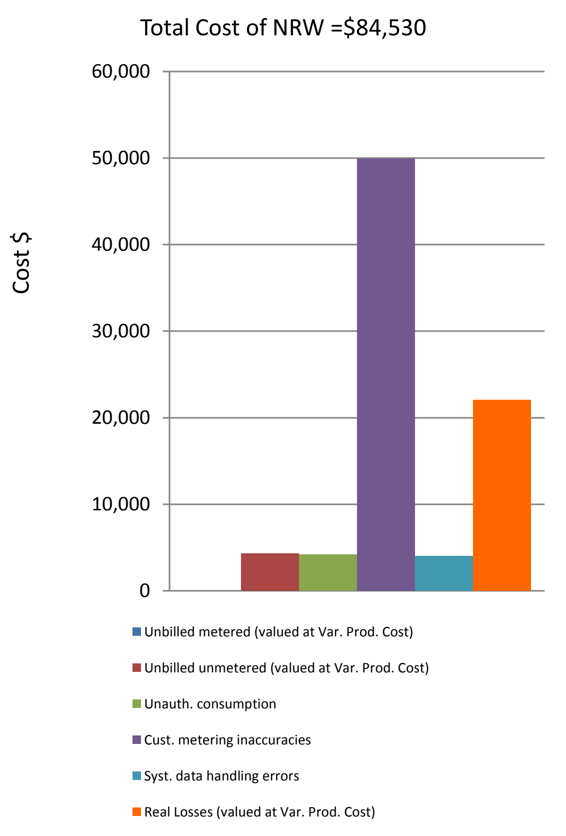
The graphic below is a visual representation of the Water Balance with bar heights propotional to the volume of the audit components

Water Audit Report for: City of Seal Beach Water Services
Reporting Year: 2014 7/2013 - 6/2014
Data Validity Score: 73

○ Show me the VOLUME of Non-Revenue Water
● Show me the COST of Non-Revenue Water



Total Cost of NRW =$84,530



AWWA Free Water Audit Software v5.0

This spreadsheet-based water audit tool is designed to help quantify and track water losses associated with water distribution systems and identify areas for improved efficiency and cost recovery. It provides a "top-down" summary water audit format, and is not meant to take the place of a full-scale, comprehensive water audit format.

Auditors are strongly encouraged to refer to the most current edition of AWWA M36 Manual for Water Audits
for detailed guidance on the water auditing process and targetting loss reduction levels

The spreadsheet contains several separate worksheets. Sheets can be accessed using the tabs towards the bottom of the screen, or by clicking the buttons below.

Please begin by providing the following information

Name of Contact Person: David Spitz
Email Address: Dspitz@sealbeachca.gov
Telephone (incl Ext.): (562)431-2527 Ext. 1331
Name of City / Utility: City of Seal Beach
City/Town/Municipality: Seal Beach
State / Province: California (CA)
Country: USA
Year: 2016 Calendar Year

Audit Preparation Date: 5/1/2017
Volume Reporting Units: Acre-feet
PWSID / Other ID:

The following guidance will help you complete the Audit

All audit data are entered on the ***Reporting Worksheet***

⬜	Value can be entered by user
🟨	Value calculated based on input data
🟪	These cells contain recommended default values

Use of Option (Radio) Buttons: Pcnt: 0.25% ● ○ Value:

Select the default percentage by choosing the option button on the left

To enter a value, choose this button and enter a value in the cell to the right

The following worksheets are available by clicking the buttons below or selecting the tabs along the bottom of the page

Instructions
The current sheet. Enter contact information and basic audit details (year, units etc)

Reporting Worksheet
Enter the required data on this worksheet to calculate the water balance and data grading

Comments
Enter comments to explain how values were calculated or to document data sources

Performance Indicators
Review the performance indicators to evaluate the results of the audit

Water Balance
The values entered in the Reporting Worksheet are used to populate the Water Balance

Dashboard
A graphical summary of the water balance and Non-Revenue Water components

Grading Matrix
Presents the possible grading options for each input component of the audit

Service Connection Diagram
Diagrams depicting possible customer service connection line configurations

Definitions
Use this sheet to understand the terms used in the audit process

Loss Control Planning
Use this sheet to interpret the results of the audit validity score and performance indicators

Example Audits
Reporting Worksheet and Performance Indicators examples are shown for two validated audits

Acknowledgements
Acknowledgements for the AWWA Free Water Audit Software v5.0

If you have questions or comments regarding the software please contact us via email at: wlc@awwa.org

AWWA Free Water Audit Software:
Reporting Worksheet

WAS v5.0

American Water Works Association.

? Click to access definition

\+ Click to add a comment

Water Audit Report for: City of Seal Beach

Reporting Year: 2016 | 1/2016 - 12/2016

Please enter data in the white cells below. Where available, metered values should be used; if metered values are unavailable please estimate a value. Indicate your confidence in the accuracy of the input data by grading each component (n/a or 1-10) using the drop-down list to the left of the input cell. Hover the mouse over the cell to obtain a description of the grades

All volumes to be entered as: ACRE-FEET PER YEAR

To select the correct data grading for each input, determine the highest grade where the utility meets or exceeds all criteria for that grade and all grades below it.

Master Meter and Supply Error Adjustments

WATER SUPPLIED

<----------- Enter grading in column 'E' and 'J' ---------->

				Grade	Pcnt:		Value:	
Volume from own sources:	7	2,293.336	acre-ft/yr	4		○ ●	-17.468	acre-ft/yr
Water imported:	3	1,008.372	acre-ft/yr	3		● ○		acre-ft/yr
Water exported:	n/a	0.000	acre-ft/yr			● ○		acre-ft/yr

Enter negative % or value for under-registration

Enter positive % or value for over-registration

WATER SUPPLIED: **3,319.176** acre-ft/yr

AUTHORIZED CONSUMPTION

Click here: ? for help using option buttons below

				Pcnt:		Value:	
Billed metered:	7	2,935.285	acre-ft/yr				
Billed unmetered:	n/a	0.000	acre-ft/yr				
Unbilled metered:	9	142.514	acre-ft/yr				
Unbilled unmetered:	5	8.298	acre-ft/yr		○ ●	8.298	acre-ft/yr

Use buttons to select percentage of water supplied **OR** value

AUTHORIZED CONSUMPTION: **3,086.097** acre-ft/yr

WATER LOSSES (Water Supplied - Authorized Consumption) **233.079** acre-ft/yr

Apparent Losses

				Pcnt:		Value:	
Unauthorized consumption:		8.298	acre-ft/yr	0.25%	● ○		acre-ft/yr

Default option selected for unauthorized consumption - a grading of 5 is applied but not displayed

Customer metering inaccuracies:	5	21.322	acre-ft/yr		○ ●	21.322	acre-ft/yr
Systematic data handling errors:	5	7.338	acre-ft/yr	0.25%	● ○		acre-ft/yr

Default option selected for Systematic data handling errors - a grading of 5 is applied but not displayed

Apparent Losses: **36.958** acre-ft/yr

Real Losses (Current Annual Real Losses or CARL)

Real Losses = Water Losses - Apparent Losses: **196.120** acre-ft/yr

WATER LOSSES: **233.079** acre-ft/yr

NON-REVENUE WATER

NON-REVENUE WATER: **383.891** acre-ft/yr

= Water Losses + Unbilled Metered + Unbilled Unmetered

SYSTEM DATA

Length of mains:	2	74.8	miles
Number of active AND inactive service connections:	6	5,794	
Service connection density:		77	conn./mile main

Are customer meters typically located at the curbstop or property line? Yes

Average length of customer service line: (length of service line, beyond the property boundary, that is the responsibility of the utility)

Average length of customer service line has been set to zero and a data grading score of 10 has been applied

Average operating pressure: 5 | 65.0 psi

COST DATA

Total annual cost of operating water system:	10	$4,573,300	$/Year
Customer retail unit cost (applied to Apparent Losses):	9	$2.49	$/100 cubic feet (ccf)
Variable production cost (applied to Real Losses):	7	$288.00	$/acre-ft

☐ Use Customer Retail Unit Cost to value real losses

WATER AUDIT DATA VALIDITY SCORE:

***** YOUR SCORE IS: 67 out of 100 *****

A weighted scale for the components of consumption and water loss is included in the calculation of the Water Audit Data Validity Score

PRIORITY AREAS FOR ATTENTION:

Based on the information provided, audit accuracy can be improved by addressing the following components:

1: Water imported

2: Volume from own sources

3: Customer metering inaccuracies

AWWA Free Water Audit Software:
System Attributes and Performance Indicators

Water Audit Report for: City of Seal Beach
Reporting Year: 2016 1/2016 - 12/2016

*** YOUR WATER AUDIT DATA VALIDITY SCORE IS: 67 out of 100 ***

System Attributes:

Apparent Losses:	36.958	acre-ft/yr
+ Real Losses:	196.120	acre-ft/yr
= **Water Losses:**	**233.079**	acre-ft/yr
? Unavoidable Annual Real Losses (UARL):	92.74	acre-ft/yr
Annual cost of Apparent Losses:	$40,128	
Annual cost of Real Losses:	$56,482	Valued at **Variable Production Cost**

Return to Reporting Worksheet to change this assumpiton

Performance Indicators:

Financial:	Non-revenue water as percent by volume of Water Supplied:	11.6%	
	Non-revenue water as percent by cost of operating system:	3.1%	Real Losses valued at Variable Production Cost
Operational Efficiency:	Apparent Losses per service connection per day:	5.69	gallons/connection/day
	Real Losses per service connection per day:	30.22	gallons/connection/day
	Real Losses per length of main per day*:	N/A	
	Real Losses per service connection per day per psi pressure:	0.46	gallons/connection/day/psi
	From Above, Real Losses = Current Annual Real Losses (CARL):	196.12	acre-feet/year
	? Infrastructure Leakage Index (ILI) [CARL/UARL]:	2.11	

* This performance indicator applies for systems with a low service connection density of less than 32 service connections/mile of pipeline

AWWA Free Water Audit Software: Water Balance

WAS v5.0

American Water Works Association.

Water Audit Report for: City of Seal Beach
Reporting Year: 2016 | 1/2016 - 12/2016
Data Validity Score: 67

<table>
<tr><td rowspan="8">Own Sources
(Adjusted for known errors)
2,310.804</td><td>Water Exported
0.000</td><td colspan="4">Billed Water Exported</td></tr>
<tr><td rowspan="10">Water Supplied
3,319.176</td><td rowspan="4">Authorized Consumption
3,086.097</td><td rowspan="2">Billed Authorized Consumption
2,935.285</td><td>Billed Metered Consumption (water exported is removed)
2,935.285</td><td rowspan="2">Revenue Water
2,935.285</td></tr>
<tr><td>Billed Unmetered Consumption
0.000</td></tr>
<tr><td rowspan="2">Unbilled Authorized Consumption
150.812</td><td>Unbilled Metered Consumption
142.514</td><td rowspan="8">Non-Revenue Water (NRW)
383.891</td></tr>
<tr><td>Unbilled Unmetered Consumption
8.298</td></tr>
<tr><td rowspan="6">Water Losses
233.079</td><td rowspan="3">Apparent Losses
36.958</td><td>Unauthorized Consumption
8.298</td></tr>
<tr><td>Customer Metering Inaccuracies
21.322</td></tr>
<tr><td>Systematic Data Handling Errors
7.338</td></tr>
<tr><td rowspan="3">Water Imported
1,008.372</td><td rowspan="3">Real Losses
196.120</td><td>Leakage on Transmission and/or Distribution Mains
Not broken down</td></tr>
<tr><td>Leakage and Overflows at Utility's Storage Tanks
Not broken down</td></tr>
<tr><td>Leakage on Service Connections
Not broken down</td></tr>
</table>

AWWA Free Water Audit Software:
Dashboard

WAS v5.0

American Water Works Association.

The graphic below is a visual representation of the Water Balance with bar heights propotional to the volume of the audit components

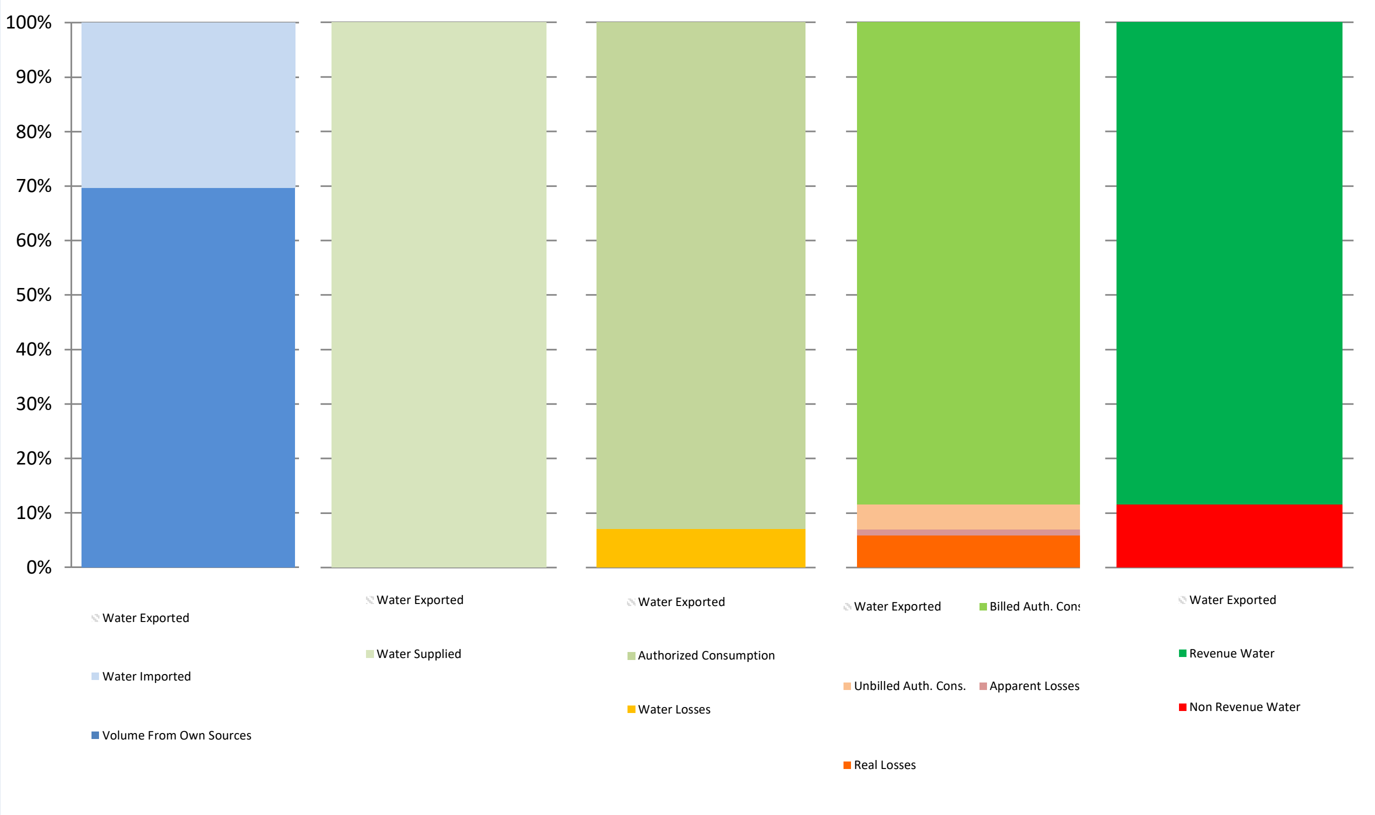
Water Audit Report for: City of Seal Beach

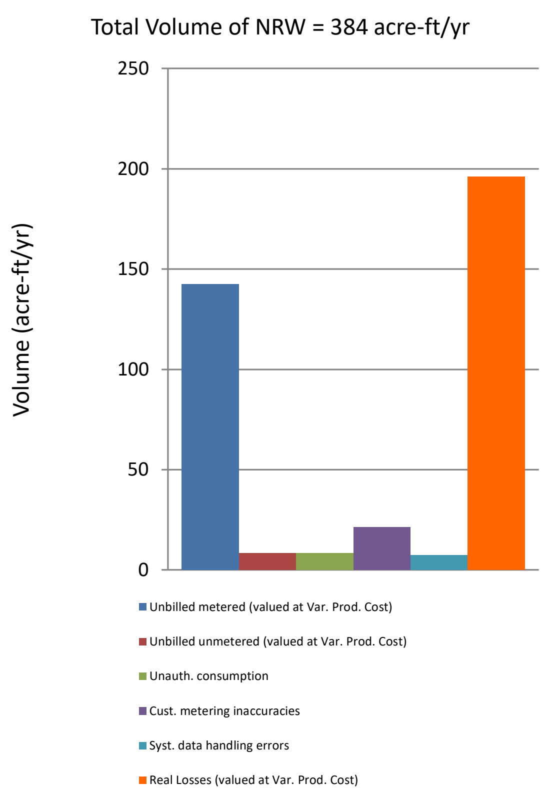
Reporting Year: 2016 1/2016 - 12/2016

Data Validity Score: 67

● Show me the VOLUME of Non-Revenue Water

○ Show me the COST of Non-Revenue Water




Total Volume of NRW = 384 acre-ft/yr

AWWA Free Water Audit Software v5.0

This spreadsheet-based water audit tool is designed to help quantify and track water losses associated with water distribution systems and identify areas for improved efficiency and cost recovery. It provides a "top-down" summary water audit format, and is not meant to take the place of a full-scale, comprehensive water audit format.

Auditors are strongly encouraged to refer to the most current edition of AWWA M36 Manual for Water Audits
for detailed guidance on the water auditing process and targetting loss reduction levels

The spreadsheet contains several separate worksheets. Sheets can be accessed using the tabs towards the bottom of the screen, or by clicking the buttons below.

Please begin by providing the following information

Name of Contact Person: David Spitz
Email Address: Dspitz@sealbeachca.gov
Telephone (incl Ext.): (562)431-2527 Ext. 1331
Name of City / Utility: City of Seal Beach
City/Town/Municipality: Seal Beach
State / Province: California (CA)
Country: USA
Year: 2017 Calendar Year

Audit Preparation Date: 5/1/2017
Volume Reporting Units: Acre-feet
PWSID / Other ID:

The following guidance will help you complete the Audit

All audit data are entered on the ***Reporting Worksheet***

☐	Value can be entered by user
🟨	Value calculated based on input data
🟪	These cells contain recommended default values

Use of Option (Radio) Buttons:

Pcnt:			Value:
0.25%	●	○	

Select the default percentage by choosing the option button

To enter a value, choose this button and enter a value in the cell to the right

The following worksheets are available by clicking the buttons below or selecting the tabs along the bottom of the page

Instructions
The current sheet. Enter contact information and basic audit details (year, units etc)

Reporting Worksheet
Enter the required data on this worksheet to calculate the water balance and data grading

Comments
Enter comments to explain how values were calculated or to document data sources

Performance Indicators
Review the performance indicators to evaluate the results of the audit

Water Balance
The values entered in the Reporting Worksheet are used to populate the Water Balance

Dashboard
A graphical summary of the water balance and Non-Revenue Water components

Grading Matrix
Presents the possible grading options for each input component of the audit

Service Connection Diagram
Diagrams depicting possible customer service connection line configurations

Definitions
Use this sheet to understand the terms used in the audit process

Loss Control Planning
Use this sheet to interpret the results of the audit validity score and performance indicators

Example Audits
Reporting Worksheet and Performance Indicators examples are shown for two validated audits

Acknowledgements
Acknowledgements for the AWWA Free Water Audit Software v5.0

If you have questions or comments regarding the software please contact us via email at: wlc@awwa.org

AWWA Free Water Audit Software:
Reporting Worksheet

WAS v5.0
American Water Works Association.

? Click to access definition
\+ Click to add a comment

Water Audit Report for: City of Seal Beach
Reporting Year: 2017 | 1/2017 - 12/2017

Please enter data in the white cells below. Where available, metered values should be used; if metered values are unavailable please estimate a value. Indicate your confidence in the accuracy of the input data by grading each component (n/a or 1-10) using the drop-down list to the left of the input cell. Hover the mouse over the cell to obtain a description of the grades

All volumes to be entered as: ACRE-FEET PER YEAR

To select the correct data grading for each input, determine the highest grade where the utility meets or exceeds all criteria for that grade and all grades below it.

<----------- Enter grading in column 'E' and 'J' ---------->

Master Meter and Supply Error Adjustments

WATER SUPPLIED

		Grade	Value	Unit		Grade	Pcnt:		Value:	Unit
Volume from own sources:	+ ?	5	1,435.560	acre-ft/yr	+ ?	3		○ ●	-16.403	acre-ft/yr
Water imported:	+ ?	2	1,909.730	acre-ft/yr	+ ?	3		● ○		acre-ft/yr
Water exported:	+ ?	n/a	0.000	acre-ft/yr	+ ?			● ○		acre-ft/yr

Enter negative % or value for under-registration
Enter positive % or value for over-registration

WATER SUPPLIED: 3,361.693 acre-ft/yr

AUTHORIZED CONSUMPTION

Click here: ? for help using option buttons below

		Grade	Value	Unit	Pcnt:		Value:	Unit
Billed metered:	+ ?	7	3,015.932	acre-ft/yr				
Billed unmetered:	+ ?	n/a		acre-ft/yr				
Unbilled metered:	+ ?	9	124.846	acre-ft/yr				
Unbilled unmetered:	+ ?	5	9.104	acre-ft/yr		○ ●	9.104	acre-ft/yr

AUTHORIZED CONSUMPTION: ? 3,149.882 acre-ft/yr

Use buttons to select percentage of water supplied
OR
value

WATER LOSSES (Water Supplied - Authorized Consumption)

211.811 acre-ft/yr

Apparent Losses

		Grade	Value	Unit	Pcnt:		Value:	Unit
Unauthorized consumption:	+ ?		8.404	acre-ft/yr	0.25%	● ○		acre-ft/yr

Default option selected for unauthorized consumption - a grading of 5 is applied but not displayed

		Grade	Value	Unit	Pcnt:		Value:	Unit
Customer metering inaccuracies:	+ ?	5	7.464	acre-ft/yr		○ ●	7.464	acre-ft/yr
Systematic data handling errors:	+ ?	5	7.540	acre-ft/yr	0.25%	● ○		acre-ft/yr

Default option selected for Systematic data handling errors - a grading of 5 is applied but not displayed

Apparent Losses: ? 23.408 acre-ft/yr

Real Losses (Current Annual Real Losses or CARL)

Real Losses = Water Losses - Apparent Losses: ? 188.403 acre-ft/yr

WATER LOSSES: 211.811 acre-ft/yr

NON-REVENUE WATER

NON-REVENUE WATER: ? 345.761 acre-ft/yr

= Water Losses + Unbilled Metered + Unbilled Unmetered

SYSTEM DATA

		Grade	Value	Unit
Length of mains:	+ ?	2	74.8	miles
Number of active AND inactive service connections:	+ ?	9	5,373	
Service connection density:	?		72	conn./mile main

Are customer meters typically located at the curbstop or property line? Yes

Average length of customer service line: + ? (length of service line, beyond the property boundary, that is the responsibility of the utility)

Average length of customer service line has been set to zero and a data grading score of 10 has been applied

		Grade	Value	Unit
Average operating pressure:	+ ?	5	65.0	psi

COST DATA

		Grade	Value	Unit
Total annual cost of operating water system:	+ ?	10	$4,939,764	$/Year
Customer retail unit cost (applied to Apparent Losses):	+ ?	10	$2.35	$/100 cubic feet (ccf)
Variable production cost (applied to Real Losses):	+ ?	5	$692.45	$/acre-ft

☐ Use Customer Retail Unit Cost to value real losses

WATER AUDIT DATA VALIDITY SCORE:

***** YOUR SCORE IS: 58 out of 100 *****

A weighted scale for the components of consumption and water loss is included in the calculation of the Water Audit Data Validity Score

PRIORITY AREAS FOR ATTENTION:

Based on the information provided, audit accuracy can be improved by addressing the following components:

1: Water imported
2: Volume from own sources
3: Customer metering inaccuracies

AWWA Free Water Audit Software:
System Attributes and Performance Indicators

WAS v5.0
American Water Works Association.

Water Audit Report for: City of Seal Beach
Reporting Year: 2017 | 1/2017 - 12/2017

*** YOUR WATER AUDIT DATA VALIDITY SCORE IS: 58 out of 100 ***

System Attributes:

	Apparent Losses:	23.408	acre-ft/yr
+	Real Losses:	188.403	acre-ft/yr
=	**Water Losses:**	**211.811**	acre-ft/yr
?	Unavoidable Annual Real Losses (UARL):	88.14	acre-ft/yr
	Annual cost of Apparent Losses:	$23,962	
	Annual cost of Real Losses:	$130,459	Valued at **Variable Production Cost** Return to Reporting Worksheet to change this assumpiton

Performance Indicators:

Financial:	Non-revenue water as percent by volume of Water Supplied:	10.3%	
	Non-revenue water as percent by cost of operating system:	5.0%	Real Losses valued at Variable Production Cost
Operational	Apparent Losses per service connection per day:	3.89	gallons/connection/day
	Real Losses per service connection per day:	31.30	gallons/connection/day
	Real Losses per length of main per day*:	N/A	
	Real Losses per service connection per day per psi pressure:	0.48	gallons/connection/day/psi
	From Above, Real Losses = Current Annual Real Losses (CARL):	188.40	acre-feet/year
?	Infrastructure Leakage Index (ILI) [CARL/UARL]:	2.14	

* This performance indicator applies for systems with a low service connection density of less than 32 service connections/mile of pipeline

AWWA Free Water Audit Software: Water Balance

WAS v5.0
American Water Works Association.

Water Audit Report for: City of Seal Beach
Reporting Year: 2017 | 1/2017 - 12/2017
Data Validity Score: 58

<table>
<tr><td rowspan="8">Own Sources
(Adjusted for known errors)
1,451.963</td><td>Water Exported
0.000</td><td colspan="4">Billed Water Exported</td></tr>
<tr><td rowspan="10">Water Supplied
3,361.693</td><td rowspan="4">Authorized Consumption
3,149.882</td><td rowspan="2">Billed Authorized Consumption
3,015.932</td><td>Billed Metered Consumption (water exported is removed)
3,015.932</td><td rowspan="2">Revenue Water
3,015.932</td></tr>
<tr><td>Billed Unmetered Consumption
0.000</td></tr>
<tr><td rowspan="2">Unbilled Authorized Consumption
133.950</td><td>Unbilled Metered Consumption
124.846</td><td rowspan="8">Non-Revenue Water (NRW)
345.761</td></tr>
<tr><td>Unbilled Unmetered Consumption
9.104</td></tr>
<tr><td rowspan="6">Water Losses
211.811</td><td rowspan="3">Apparent Losses
23.408</td><td>Unauthorized Consumption
8.404</td></tr>
<tr><td>Customer Metering Inaccuracies
7.464</td></tr>
<tr><td>Systematic Data Handling Errors
7.540</td></tr>
<tr><td rowspan="3">Water Imported
1,909.730</td><td rowspan="3">Real Losses
188.403</td><td>Leakage on Transmission and/or Distribution Mains
Not broken down</td></tr>
<tr><td>Leakage and Overflows at Utility's Storage Tanks
Not broken down</td></tr>
<tr><td>Leakage on Service Connections
Not broken down</td></tr>
</table>

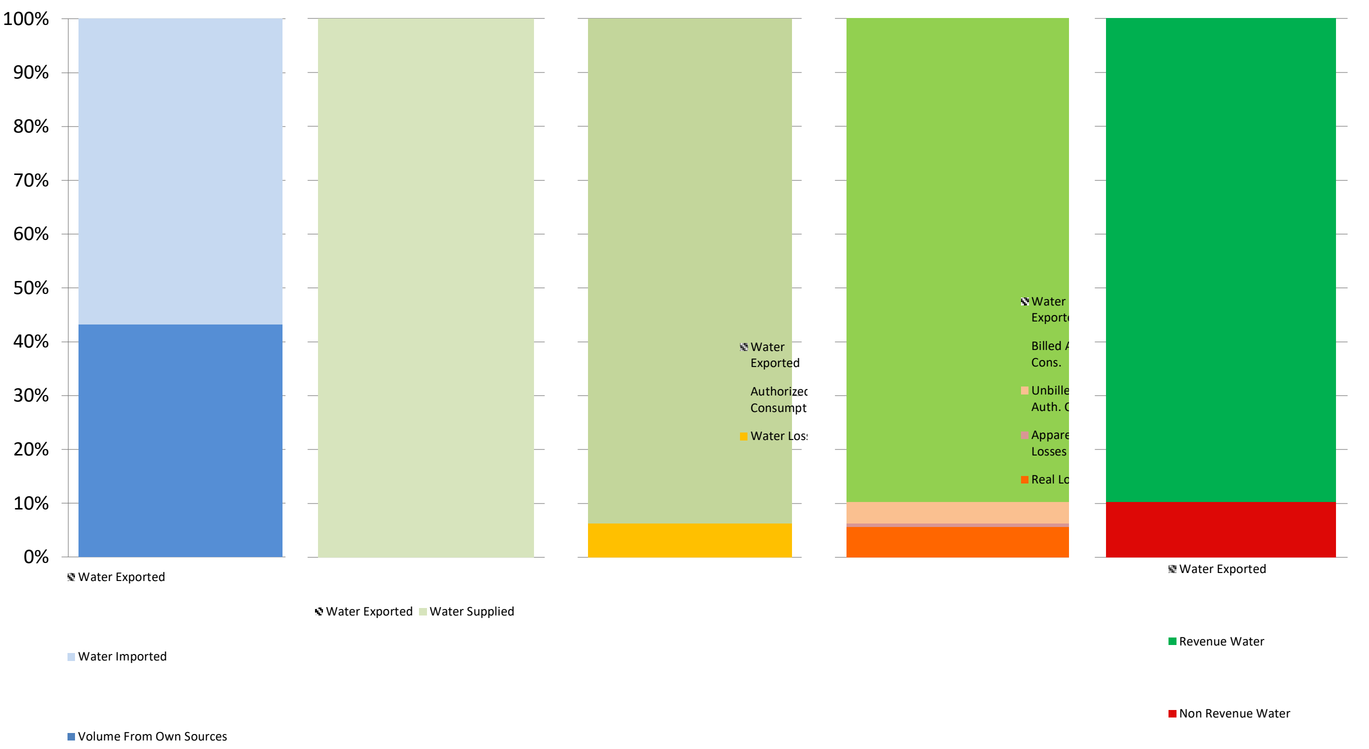
AWWA Free Water Audit Software: Dashboard

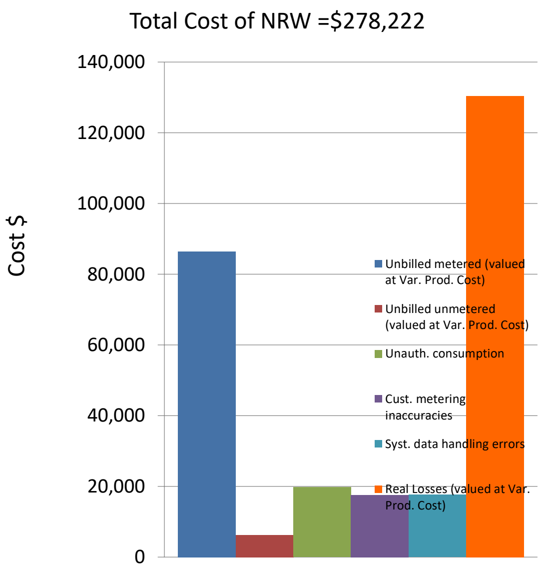
WAS v5.0
American Water Works Association.

The graphic below is a visual representation of the Water Balance with bar heights propotional to the volume of the audit components

Water Audit Report for: City of Seal Beach
Reporting Year: 2017 | 1/2017 - 12/2017
Data Validity Score: 58

○ Show me the VOLUME of Non-Revenue Water
● Show me the COST of Non-Revenue Water





AWWA Free Water Audit Software v5.0

This spreadsheet-based water audit tool is designed to help quantify and track water losses associated with water distribution systems and identify areas for improved efficiency and cost recovery. It provides a "top-down" summary water audit format, and is not meant to take the place of a full-scale, comprehensive water audit format.

Auditors are strongly encouraged to refer to the most current edition of AWWA M36 Manual for Water Audits for detailed guidance on the water auditing process and targetting loss reduction levels

The spreadsheet contains several separate worksheets. Sheets can be accessed using the tabs towards the bottom of the screen, or by clicking the buttons below.

Please begin by providing the following information

Name of Contact Person: David Spitz
Email Address: Dspitz@sealbeachca.gov
Telephone (incl Ext.): (562)431-2527 Ext. 1331
Name of City / Utility: City of Seal Beach
City/Town/Municipality: Seal Beach
State / Province: California (CA)
Country: USA
Year: 2018 Calendar Year

Audit Preparation Date: 5/1/2019
Volume Reporting Units: Acre-feet
PWSID / Other ID:

The following guidance will help you complete the Audit

All audit data are entered on the ***Reporting Worksheet***

☐	Value can be entered by user
🟨	Value calculated based on input data
🟪	These cells contain recommended default values

Use of Option (Radio) Buttons:

Pcnt: 0.25% ● ○ Value:

Select the default percentage by choosing the option button

To enter a value, choose this button and enter a value in the cell to the right

The following worksheets are available by clicking the buttons below or selecting the tabs along the bottom of the page

Instructions
The current sheet. Enter contact information and basic audit details (year, units etc)

Reporting Worksheet
Enter the required data on this worksheet to calculate the water balance and data grading

Comments
Enter comments to explain how values were calculated or to document data sources

Performance Indicators
Review the performance indicators to evaluate the results of the audit

Water Balance
The values entered in the Reporting Worksheet are used to populate the Water Balance

Dashboard
A graphical summary of the water balance and Non-Revenue Water components

Grading Matrix
Presents the possible grading options for each input component of the audit

Service Connection Diagram
Diagrams depicting possible customer service connection line configurations

Definitions
Use this sheet to understand the terms used in the audit process

Loss Control Planning
Use this sheet to interpret the results of the audit validity score and performance indicators

Example Audits
Reporting Worksheet and Performance Indicators examples are shown for two validated audits

Acknowledgements
Acknowledgements for the AWWA Free Water Audit Software v5.0

If you have questions or comments regarding the software please contact us via email at: wlc@awwa.org

AWWA Free Water Audit Software:
Reporting Worksheet

WAS v5.0
American Water Works Association.

? Click to access definition
\+ Click to add a comment

Water Audit Report for: City of Seal Beach
Reporting Year: 2018 1/2018 - 12/2018

Please enter data in the white cells below. Where available, metered values should be used; if metered values are unavailable please estimate a value. Indicate your confidence in the accuracy of the

All volumes to be entered as: ACRE-FEET PER YEAR

To select the correct data grading for each input, determine the highest grade where the utility meets or exceeds all criteria for that grade and all grades below it.

<----------- Enter grading in column 'E' and 'J' ---------->

Master Meter and Supply Error Adjustments

WATER SUPPLIED

	Grade	Value	Unit	Grade	Pcnt:		Value:	Unit
Volume from own sources: + ?	7	2,851.590	acre-ft/yr	+ ? 3		○ ●	-31.574	acre-ft/yr
Water imported: + ?	7	700.840	acre-ft/yr	+ ? 7		● ○		acre-ft/yr
Water exported: + ?	n/a	0.000	acre-ft/yr	+ ?		● ○		acre-ft/yr

Enter negative % or value for under-registration
Enter positive % or value for over-registration

WATER SUPPLIED: 3,584.004 acre-ft/yr

AUTHORIZED CONSUMPTION

Click here: ? for help using option buttons below

	Grade	Value	Unit	Pcnt:		Value:	Unit
Billed metered: + ?	7	3,266.340	acre-ft/yr				
Billed unmetered: + ?	n/a		acre-ft/yr				
Unbilled metered: + ?	9	180.317	acre-ft/yr				
Unbilled unmetered: + ?	8	1.833	acre-ft/yr		○ ●	1.833	acre-ft/yr

Use buttons to select percentage of water supplied
OR
value

AUTHORIZED CONSUMPTION: ? 3,448.490 acre-ft/yr

WATER LOSSES (Water Supplied - Authorized Consumption)

135.514 acre-ft/yr

Apparent Losses

	Grade	Value	Unit	Pcnt:		Value:	Unit
Unauthorized consumption: + ?		8.960	acre-ft/yr	0.25%	● ○		acre-ft/yr

Default option selected for unauthorized consumption - a grading of 5 is applied but not displayed

	Grade	Value	Unit	Pcnt:		Value:	Unit
Customer metering inaccuracies: + ?	5	15.778	acre-ft/yr		○ ●	15.778	acre-ft/yr
Systematic data handling errors: + ?	5	8.166	acre-ft/yr	0.25%	● ○		acre-ft/yr

Default option selected for Systematic data handling errors - a grading of 5 is applied but not displayed

Apparent Losses: ? 32.904 acre-ft/yr

Real Losses (Current Annual Real Losses or CARL)

Real Losses = Water Losses - Apparent Losses: ? 102.610 acre-ft/yr

WATER LOSSES: 135.514 acre-ft/yr

NON-REVENUE WATER

NON-REVENUE WATER: ? 317.664 acre-ft/yr

= Water Losses + Unbilled Metered + Unbilled Unmetered

SYSTEM DATA

	Grade	Value	Unit
Length of mains: + ?	2	74.8	miles
Number of active AND inactive service connections: + ?	9	5,373	
Service connection density: ?		72	conn./mile main

Are customer meters typically located at the curbstop or property line? Yes

Average length of customer service line: + ? (length of service line, beyond the property boundary, that is the responsibility of the utility)

Average length of customer service line has been set to zero and a data grading score of 10 has been applied

	Grade	Value	Unit
Average operating pressure: + ?	5	65.0	psi

COST DATA

	Grade	Value	Unit
Total annual cost of operating water system: + ?	10	$4,504,812	$/Year
Customer retail unit cost (applied to Apparent Losses): + ?	10	$2.29	$/100 cubic feet (ccf)
Variable production cost (applied to Real Losses): + ?	5	$559.94	$/acre-ft

☐ Use Customer Retail Unit Cost to value real losses

WATER AUDIT DATA VALIDITY SCORE:

***** YOUR SCORE IS: 71 out of 100 *****

A weighted scale for the components of consumption and water loss is included in the calculation of the Water Audit Data Validity Score

PRIORITY AREAS FOR ATTENTION:

Based on the information provided, audit accuracy can be improved by addressing the following components:

1: Volume from own sources
2: Customer metering inaccuracies
3: Variable production cost (applied to Real Losses)

AWWA Free Water Audit Software:
System Attributes and Performance Indicators

WAS v5.0
American Water Works Association.

Water Audit Report for: City of Seal Beach
Reporting Year: 2018 1/2018 - 12/2018

***** YOUR WATER AUDIT DATA VALIDITY SCORE IS: 71 out of 100 *****

System Attributes:

	Apparent Losses:	32.904	acre-ft/yr
+	Real Losses:	102.610	acre-ft/yr
=	**Water Losses:**	**135.514**	acre-ft/yr
?	Unavoidable Annual Real Losses (UARL):	88.14	acre-ft/yr
	Annual cost of Apparent Losses:	$32,822	
	Annual cost of Real Losses:	$57,456	Valued at **Variable Production Cost** Return to Reporting Worksheet to change this assumpiton

Performance Indicators:

Financial:	Non-revenue water as percent by volume of Water Supplied:	8.9%	
	Non-revenue water as percent by cost of operating system:	4.3%	Real Losses valued at Variable Production Cost
Operational	Apparent Losses per service connection per day:	5.47	gallons/connection/day
	Real Losses per service connection per day:	17.05	gallons/connection/day
	Real Losses per length of main per day*:	N/A	
	Real Losses per service connection per day per psi pressure:	0.26	gallons/connection/day/psi
	From Above, Real Losses = Current Annual Real Losses (CARL):	102.61	acre-feet/year
?	Infrastructure Leakage Index (ILI) [CARL/UARL]:	1.16	

* This performance indicator applies for systems with a low service connection density of less than 32 service connections/mile of pipeline

AWWA Free Water Audit Software: Water Balance

Water Audit Report for: City of Seal Beach
Reporting Year: 2018 1/2018 - 12/2018
Data Validity Score: 71

	Water Exported *0.000*	Billed Water Exported			
Own Sources (Adjusted for known errors) *2,883.164*	Water Supplied *3,584.004*	Authorized Consumption *3,448.490*	Billed Authorized Consumption *3,266.340*	Billed Metered Consumption (water exported is removed) *3,266.340*	Revenue Water 3,266.340
				Billed Unmetered Consumption *0.000*	
			Unbilled Authorized Consumption *182.150*	Unbilled Metered Consumption *180.317*	Non-Revenue Water (NRW) 317.664
				Unbilled Unmetered Consumption *1.833*	
		Water Losses *135.514*	Apparent Losses *32.904*	Unauthorized Consumption *8.960*	
				Customer Metering Inaccuracies *15.778*	
				Systematic Data Handling Errors *8.166*	
Water Imported *700.840*			Real Losses *102.610*	Leakage on Transmission and/or Distribution Mains *Not broken down*	
				Leakage and Overflows at Utility's Storage Tanks *Not broken down*	
				Leakage on Service Connections *Not broken down*	

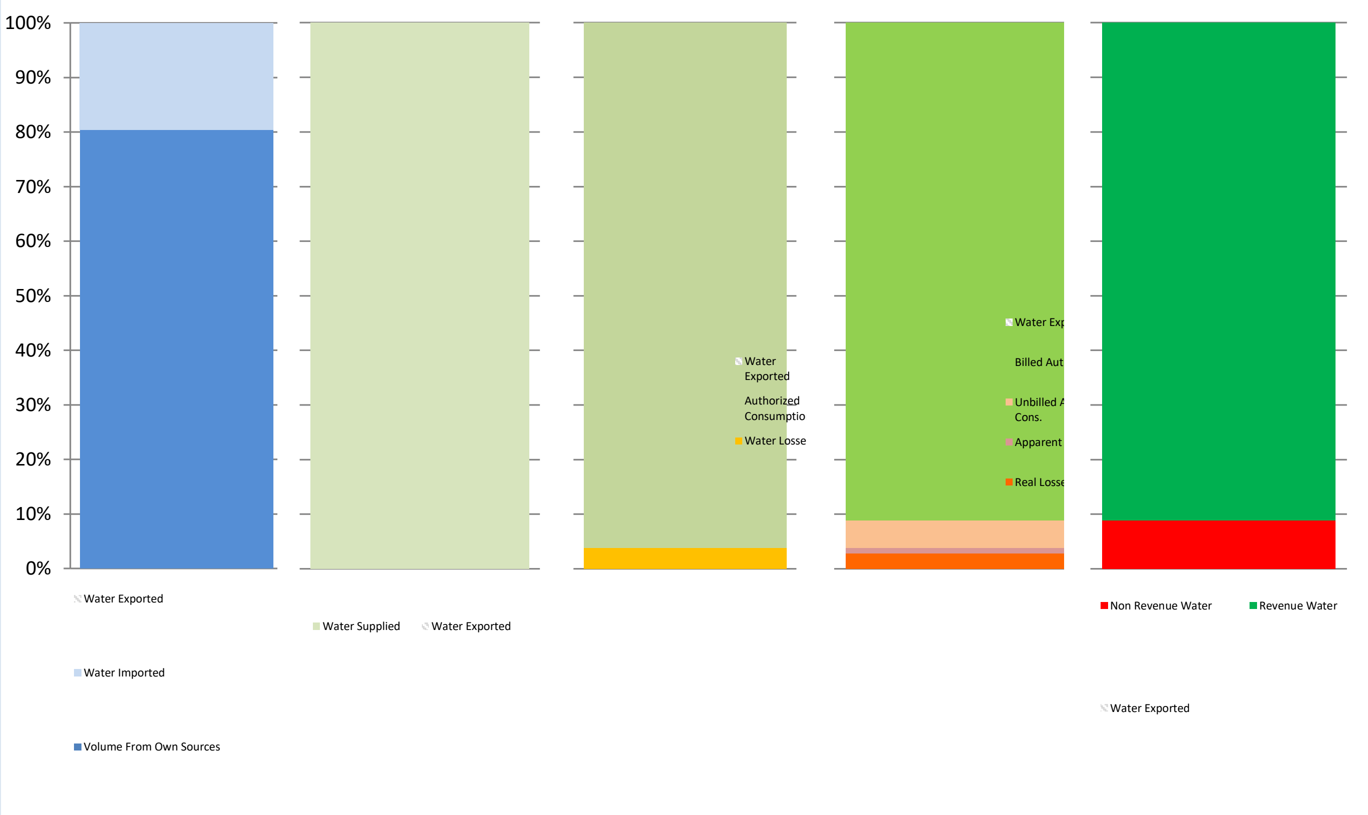
AWWA Free Water Audit Software:
Dashboard

WAS v5.0
American Water Works Association.

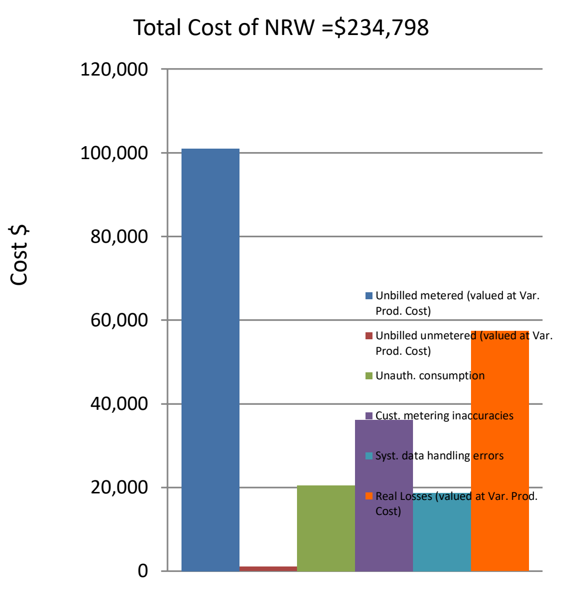
The graphic below is a visual representation of the Water Balance with bar heights propotional to the volume of the audit components

Water Audit Report for:	City of Seal Beach	
Reporting Year:	2018	1/2018 - 12/2018
Data Validity Score:	71	

○ Show me the VOLUME of Non-Revenue Water
● Show me the COST of Non-Revenue Water



Total Cost of NRW =$234,798



AWWA Free Water Audit Software v5.0

This spreadsheet-based water audit tool is designed to help quantify and track water losses associated with water distribution systems and identify areas for improved efficiency and cost recovery. It provides a "top-down" summary water audit format, and is not meant to take the place of a full-scale, comprehensive water audit format.

Auditors are strongly encouraged to refer to the most current edition of AWWA M36 Manual for Water Audits
for detailed guidance on the water auditing process and targetting loss reduction levels

The spreadsheet contains several separate worksheets. Sheets can be accessed using the tabs towards the bottom of the screen, or by clicking the buttons below.

Please begin by providing the following information

Name of Contact Person: David Spitz
Email Address: Dspitz@sealbeachca.gov
Telephone (incl Ext.): (562)431-2527 Ext. 1331
Name of City / Utility: City of Seal Beach
City/Town/Municipality: Seal Beach
State / Province: California (CA)
Country: USA
Year: 2019 Calendar Year

Audit Preparation Date: 8/28/2020
Volume Reporting Units: Acre-feet
PWSID / Other ID: CA3010041

The following guidance will help you complete the Audit

All audit data are entered on the ***Reporting Worksheet***

☐	Value can be entered by user
🟨	Value calculated based on input data
🟪	These cells contain recommended default values

Use of Option (Radio) Buttons:

	Pcnt:			Value:
	0.25%	●	○	

Select the default percentage by choosing the option button

To enter a value, choose this button and enter a value in the cell to the right

The following worksheets are available by clicking the buttons below or selecting the tabs along the bottom of the page

Instructions
The current sheet. Enter contact information and basic audit details (year, units etc)

Reporting Worksheet
Enter the required data on this worksheet to calculate the water balance and data grading

Comments
Enter comments to explain how values were calculated or to document data sources

Performance Indicators
Review the performance indicators to evaluate the results of the audit

Water Balance
The values entered in the Reporting Worksheet are used to populate the Water Balance

Dashboard
A graphical summary of the water balance and Non-Revenue Water components

Grading Matrix
Presents the possible grading options for each input component of the audit

Service Connection Diagram
Diagrams depicting possible customer service connection line configurations

Definitions
Use this sheet to understand the terms used in the audit process

Loss Control Planning
Use this sheet to interpret the results of the audit validity score and performance indicators

Example Audits
Reporting Worksheet and Performance Indicators examples are shown for two validated audits

Acknowledgements
Acknowledgements for the AWWA Free Water Audit Software v5.0

If you have questions or comments regarding the software please contact us via email at: wlc@awwa.org

AWWA Free Water Audit Software:
Reporting Worksheet

WAS v5.0
American Water Works Association.

? Click to access definition
\+ Click to add a comment

Water Audit Report for: City of Seal Beach (CA3010041)
Reporting Year: 2019 | 1/2019 - 12/2019

Please enter data in the white cells below. Where available, metered values should be used; if metered values are unavailable please estimate a value. Indicate your confidence in the accuracy of the

All volumes to be entered as: ACRE-FEET PER YEAR

To select the correct data grading for each input, determine the highest grade where the utility meets or exceeds all criteria for that grade and all grades below it.

<----------- Enter grading in column 'E' and 'J' ---------->

Master Meter and Supply Error Adjustments

WATER SUPPLIED

		Grade	Value	Unit		Grade	Pcnt:		Value:	
Volume from own sources:	+ ?	7	2,043.200	acre-ft/yr	+ ?	3		○ ●	-26.194	acre-ft/yr
Water imported:	+ ?	7	1,182.880	acre-ft/yr	+ ?	9		● ○		acre-ft/yr
Water exported:	+ ?	n/a	0.000	acre-ft/yr	+ ?			● ○		acre-ft/yr

Enter negative % or value for under-registration
Enter positive % or value for over-registration

WATER SUPPLIED:	3,252.274	acre-ft/yr

AUTHORIZED CONSUMPTION

Click here: ? for help using option buttons below

		Grade	Value	Unit	Pcnt:		Value:	
Billed metered:	+ ?	7	2,904.993	acre-ft/yr				
Billed unmetered:	+ ?	9	0.019	acre-ft/yr				
Unbilled metered:	+ ?	9	126.432	acre-ft/yr				
Unbilled unmetered:	+ ?	9	1.317	acre-ft/yr		○ ●	1.317	acre-ft/yr

Use buttons to select percentage of water supplied
OR
value

AUTHORIZED CONSUMPTION:	?	3,032.761	acre-ft/yr

WATER LOSSES (Water Supplied - Authorized Consumption)

WATER LOSSES (Water Supplied - Authorized Consumption)	219.513	acre-ft/yr

Apparent Losses

		Grade	Value	Unit	Pcnt:		Value:	
Unauthorized consumption:	+ ?		8.131	acre-ft/yr	0.25%	● ○		acre-ft/yr

Default option selected for unauthorized consumption - a grading of 5 is applied but not displayed

		Grade	Value	Unit	Pcnt:		Value:	
Customer metering inaccuracies:	+ ?	5	14.299	acre-ft/yr		○ ●	14.299	acre-ft/yr
Systematic data handling errors:	+ ?	5	7.262	acre-ft/yr	0.25%	● ○		acre-ft/yr

Default option selected for Systematic data handling errors - a grading of 5 is applied but not displayed

Apparent Losses:	?	29.692	acre-ft/yr

Real Losses (Current Annual Real Losses or CARL)

Real Losses = Water Losses - Apparent Losses:	?	189.821	acre-ft/yr
WATER LOSSES:		219.513	acre-ft/yr

NON-REVENUE WATER

NON-REVENUE WATER:	?	347.262	acre-ft/yr

= Water Losses + Unbilled Metered + Unbilled Unmetered

SYSTEM DATA

		Grade	Value	Unit
Length of mains:	+ ?	2	74.8	miles
Number of active AND inactive service connections:	+ ?	9	5,428	
Service connection density:	?		73	conn./mile main

Are customer meters typically located at the curbstop or property line? Yes

Average length of customer service line: + ? (length of service line, beyond the property boundary, that is the responsibility of the utility)

Average length of customer service line has been set to zero and a data grading score of 10 has been applied

		Grade	Value	Unit
Average operating pressure:	+ ?	5	65.0	psi

COST DATA

		Grade	Value	Unit
Total annual cost of operating water system:	+ ?	10	$4,927,179	$/Year
Customer retail unit cost (applied to Apparent Losses):	+ ?	10	$2.30	$/100 cubic feet (ccf)
Variable production cost (applied to Real Losses):	+ ?	5	$736.06	$/acre-ft

☐ Use Customer Retail Unit Cost to value real losses

WATER AUDIT DATA VALIDITY SCORE:

***** YOUR SCORE IS: 72 out of 100 *****

A weighted scale for the components of consumption and water loss is included in the calculation of the Water Audit Data Validity Score

PRIORITY AREAS FOR ATTENTION:

Based on the information provided, audit accuracy can be improved by addressing the following components:

1: Volume from own sources
2: Water imported
3: Customer metering inaccuracies

WAS v5.0
American Water Works Association.

AWWA Free Water Audit Software:
System Attributes and Performance Indicators

Water Audit Report for: City of Seal Beach (CA3010041)
Reporting Year: 2019 | 1/2019 - 12/2019

***** YOUR WATER AUDIT DATA VALIDITY SCORE IS: 72 out of 100 *****

System Attributes:

Apparent Losses:	29.692	acre-ft/yr
+ Real Losses:	189.821	acre-ft/yr
= **Water Losses:**	**219.513**	acre-ft/yr
Unavoidable Annual Real Losses (UARL):	88.74	acre-ft/yr
Annual cost of Apparent Losses:	$29,748	
Annual cost of Real Losses:	$139,720	Valued at **Variable Production Cost**

Return to Reporting Worksheet to change this assumpiton

Performance Indicators:

Financial:

Non-revenue water as percent by volume of Water Supplied:	10.7%	
Non-revenue water as percent by cost of operating system:	5.3%	Real Losses valued at Variable Production Cost

Operational

Apparent Losses per service connection per day:	4.88	gallons/connection/day
Real Losses per service connection per day:	31.22	gallons/connection/day
Real Losses per length of main per day*:	N/A	
Real Losses per service connection per day per psi pressure:	0.48	gallons/connection/day/psi

From Above, Real Losses = Current Annual Real Losses (CARL):	189.82	acre-feet/year
Infrastructure Leakage Index (ILI) [CARL/UARL]:	2.14	

* This performance indicator applies for systems with a low service connection density of less than 32 service connections/mile of pipeline

AWWA Free Water Audit Software: Water Balance

WAS

American Water Works Association.

Water Audit Report for: City of Seal Beach (CA3010041)

Reporting Year: 2019 | 1/2019 - 12/2019

Data Validity Score: 72

<table>
<tr><td rowspan="8">Own Sources
(Adjusted for known errors)
2,069.394</td><td>Water Exported
0.000</td><td colspan="4">Billed Water Exported</td></tr>
<tr><td rowspan="10">Water Supplied
3,252.274</td><td rowspan="4">Authorized Consumption
3,032.761</td><td rowspan="2">Billed Authorized Consumption
2,905.012</td><td>Billed Metered Consumption (water exported is removed)
2,904.993</td><td rowspan="2">Revenue Water
2,905.012</td></tr>
<tr><td>Billed Unmetered Consumption
0.019</td></tr>
<tr><td rowspan="2">Unbilled Authorized Consumption
127.749</td><td>Unbilled Metered Consumption
126.432</td><td rowspan="8">Non-Revenue Water (NRW)
347.262</td></tr>
<tr><td>Unbilled Unmetered Consumption
1.317</td></tr>
<tr><td rowspan="6">Water Losses
219.513</td><td rowspan="3">Apparent Losses
29.692</td><td>Unauthorized Consumption
8.131</td></tr>
<tr><td>Customer Metering Inaccuracies
14.299</td></tr>
<tr><td>Systematic Data Handling Errors
7.262</td></tr>
<tr><td rowspan="3">Water Imported
1,182.880</td><td rowspan="3">Real Losses
189.821</td><td>Leakage on Transmission and/or Distribution Mains
Not broken down</td></tr>
<tr><td>Leakage and Overflows at Utility's Storage Tanks
Not broken down</td></tr>
<tr><td>Leakage on Service Connections
Not broken down</td></tr>
</table>

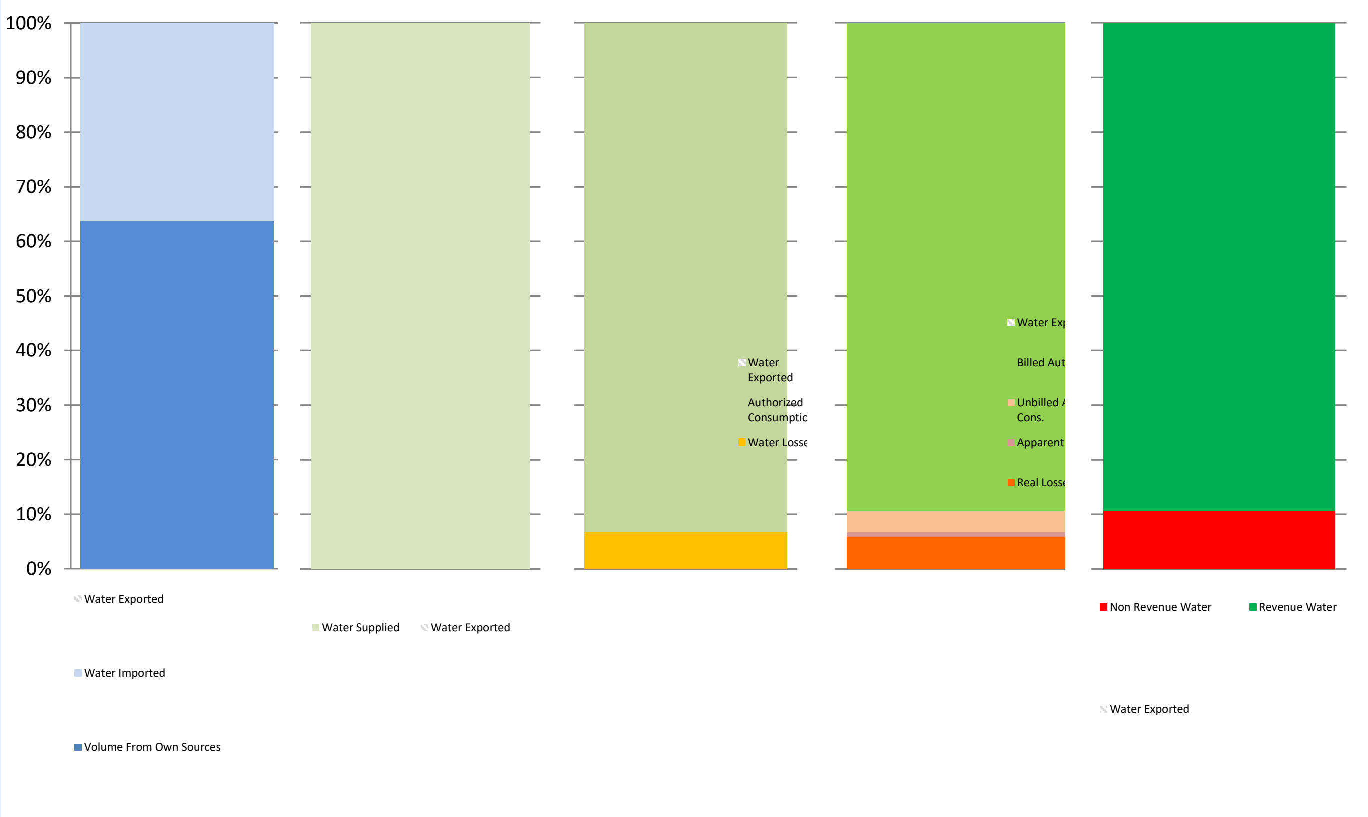
AWWA Free Water Audit Software:
Dashboard

WAS v5.0
American Water Works Association.

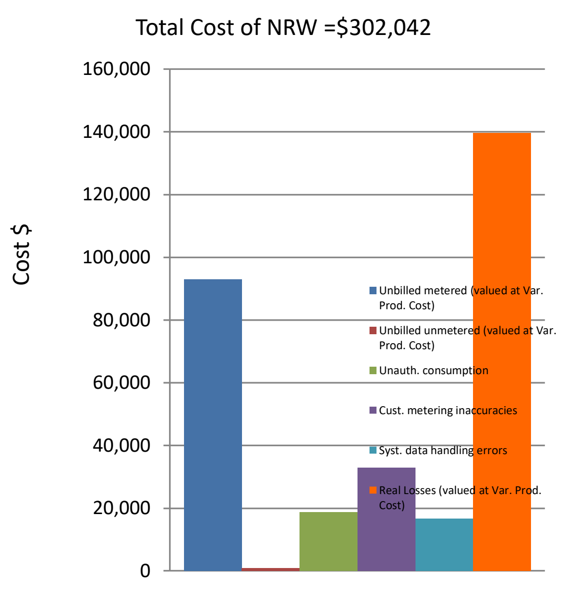
The graphic below is a visual representation of the Water Balance with bar heights propotional to the volume of the audit components

Water Audit Report for: City of Seal Beach (CA3010041)
Reporting Year: 2019 | 1/2019 - 12/2019
Data Validity Score: 72

○ Show me the VOLUME of Non-Revenue Water
● Show me the COST of Non-Revenue Water



Total Cost of NRW =$302,042



APPENDIX G

2017 Basin 8-1 Alternative

Basin 8-1 Alternative

Submitted by: Orange County Water District
City of La Habra
Irvine Ranch Water District

Submitted to: California Department of Water Resources

January 1, 2017

Table of Contents

BASIN 8-1 ALTERNATIVE OVERVIEW

The Sustainable Groundwater Management Act (SGMA) requires all high- and medium-priority basins, as designated by the Department of Water Resources (DWR), be sustainably managed. DWR designated the Coastal Plain of Orange County Groundwater Basin (“Basin 8-1” or “Basin”) as a medium-priority basin, primarily due to heavy reliance on the Basin’s groundwater as a source of water supply.

Compliance with SGMA can be achieved in one of two ways:

1) A Groundwater Sustainability Agency (GSA) is formed and a Groundwater Sustainability Plan (GSP) is adopted, or
2) Special Act Districts created by statute, such as OCWD, and other agencies may prepare and submit an Alternative to a GSP.

The agencies within Basin 8-1 have agreed to collaborate together in order to submit an Alternative to a GSP. Within this document, this Alternative to a GSP will be referred to herein as the “Basin 8-1 Alternative” or “Alternative”. In accordance with Water Code §10733.6(b)(3), this Alternative presents an analysis of basin conditions that demonstrates that the Basin has operated within its sustainable yield over a period of at least 10 years. In addition, the Alternative establishes objectives and criteria for management that would be addressed in a GSP and is designed to be “functionally equivalent” to a GSP. As will be shown in the Basin 8-1 Alternative, Basin 8-1 has been operated within its sustainable yield for more than 10 years without experiencing significant and unreasonable (1) lowering of groundwater levels, (2) reduction in storage, (3) water quality degradation, (4) seawater intrusion, (5) inelastic land subsidence, or (6) depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water. Please note that the boundaries of Basin 8-1 described in this document are based on the scientific boundary modifications as accepted by DWR in 2016 as part of the Basin Boundary Modification Process.

The Basin 8-1 Alternative has been jointly prepared by the Orange County Water District (OCWD), Irvine Ranch Water District (IRWD); and the City of La Habra (collectively the “Submitting Agencies”); pursuant to this Alternative, the Submitting Agencies will ensure the entire Basin 8-1 continues to be sustainably managed and data reported as required by SGMA. Other agencies within Basin 8-1 and at least partially outside of OCWD’s boundaries support submission of the Basin 8-1 Alternative and either have participated in preparing the Alternative and/or reviewed the Alternative. These agencies include the cities of Brea, Corona, and Chino Hills; the Counties of Orange, Riverside, and San Bernardino; Yorba Linda Water District; and El Toro Water District. Pursuant to Water Code §10733.6(b)(3), the Basin 8-1 Alternative has been prepared by or under the direction of a professional geologist or professional engineer.

For the purpose of compliance with the SGMA requirement that the entire basin be covered by this Basin 8-1 Alternative, Submitting Agencies have divided Basin 8-1 into four management areas: La Habra-Brea, OCWD, South East, and Santa Ana Canyon Management Areas, shown in Figure 1-1.

Historically, the majority of Basin 8-1 (90% of the land area) has been managed by OCWD, which includes the land area within the OCWD Management Area and a small portion of the land area within the Santa Ana Canyon Management Area. The percentage of the land area within Basin 8-1 in each of the management areas is shown in Figure 1-2.

Although the land areas outside of OCWD's jurisdiction in the Santa Ana Canyon and South East Management Areas have not been formally "managed" by OCWD, the hydrogeological conditions in these areas are essentially an extension of the managed basin. OCWD has incorporated data, when available, from these areas into the OCWD data base. For example, precipitation runoff from the mountains along the eastern border (in the South East Management Area) is estimated and incorporated into OCWD's basin water budget. The Santa Ana Canyon Management Area, created in this report in order to include land within and outside of OCWD's service area, is upstream of OCWD recharge operations. While OCWD does not have jurisdiction over all the land in this area, OCWD does have the rights to all the water in the Santa Ana River released from Prado Dam. In this respect, OCWD is actively engaged in managing the flow of surface water within the Santa Ana Canyon irrespective of land ownership.

While the four management areas are described separately in this report, it is important to understand that actual "management" is not as distinct, and existing collaborative efforts between agencies in managing groundwater resources will continue. In the case of the La Habra-Brea Management Area, the City of La Habra has already been deemed the exclusive GSA for the La Habra/Brea area and intends to prepare a Groundwater Sustainability Plan (GSP). When La Habra submits a GSP, this Basin 8-1 Alternative will no longer include the La Habra/Brea area within the area designated by the GSP.

As authorized by 23 CCR § 354.20, this Basin 8-1 Alternative describes four management areas as shown in Figure 1. The rationale for designating these management areas within Basin 8-1 is explained as follows:

- La Habra-Brea Management Area includes the northern portion of Basin 8-1 that is located outside of the OCWD service area and is within the cities of La Habra and Brea. The City of La Habra currently manages this portion of Basin 8-1. Although this management area is hydrologically distinct from the OCWD Management Area there is an estimated 1,000 afy of subsurface groundwater flow from the La Habra-Brea Management Area to the OCWD Management Area. Surface water that recharges the OCWD portion of Basin 8-1 does not replenish the La Habra-Brea Management Area.

- The OCWD Management Area includes approximately 89 percent of the land area of Basin 8-1. Ninety-eight percent of all groundwater production within 8-1 occurs in this management area. This area includes the portion of Basin 8-1 that is within OCWD's service area, except for an approximately 7-square mile portion of OCWD's service area that is in the Santa Ana Canyon Management Area. OCWD has been managing the majority of Basin 8-1 since its formation in 1933.

- The South East Management Area includes the southern and southeastern portion of Basin 8-1 that is hydrogeologically connected to the OCWD Management Area but is outside of OCWD's service area. This area consists of several, disconnected, small fringe areas that are within the DWR designated boundary of Basin 8-1. This management area includes areas under the jurisdiction of the IRWD, the El Toro Water District and the City of Orange. The groundwater basin in this area is thin and contains more clay and silt deposits than aquifers in the OCWD Management Area. Groundwater historically has flowed out of this area into the OCWD Management Area. Production has been minimal in this area due to hydrogeological conditions with little potential for significant future increases.

- The Santa Ana Canyon Management Area includes the easternmost section of Basin 8-1. This area includes land under the jurisdiction of several cities, two counties, and two water districts, including a portion that is within the OCWD service area. Groundwater production is relatively minor compared to groundwater production in the OCWD Management Area. The western boundary of this management area is located at Imperial Highway in the city of Anaheim where the basin thickness begins to increase. Imperial Highway crosses the Santa Ana River where OCWD begins to divert river water into the recharge facilities for percolation into the groundwater basin.

The Basin 8-1 Alternative is organized as follows:

- Overview: Provides a map and description of Basin 8-1 and a brief description of the basin management areas.

- Hydrogeology of Basin 8-1: Provides a description of the hydrogeology of Basin 8-1 including a description of the basin, the aquifer systems, fault zones, total basin volume, basin cross-sections, basin characteristics, and general groundwater quality.

- La Habra-Brea Management Area: Provides a description of sustainable management of the La Habra-Brea Management Area

- OCWD Management Area: Provides a description of sustainable management of the OCWD Management Area

- South East Management Area: Provides a description of sustainable management of the South East Management Area

- Santa Ana Canyon Management Area: Provides a description of sustainable management of the Santa Ana Canyon Management Area

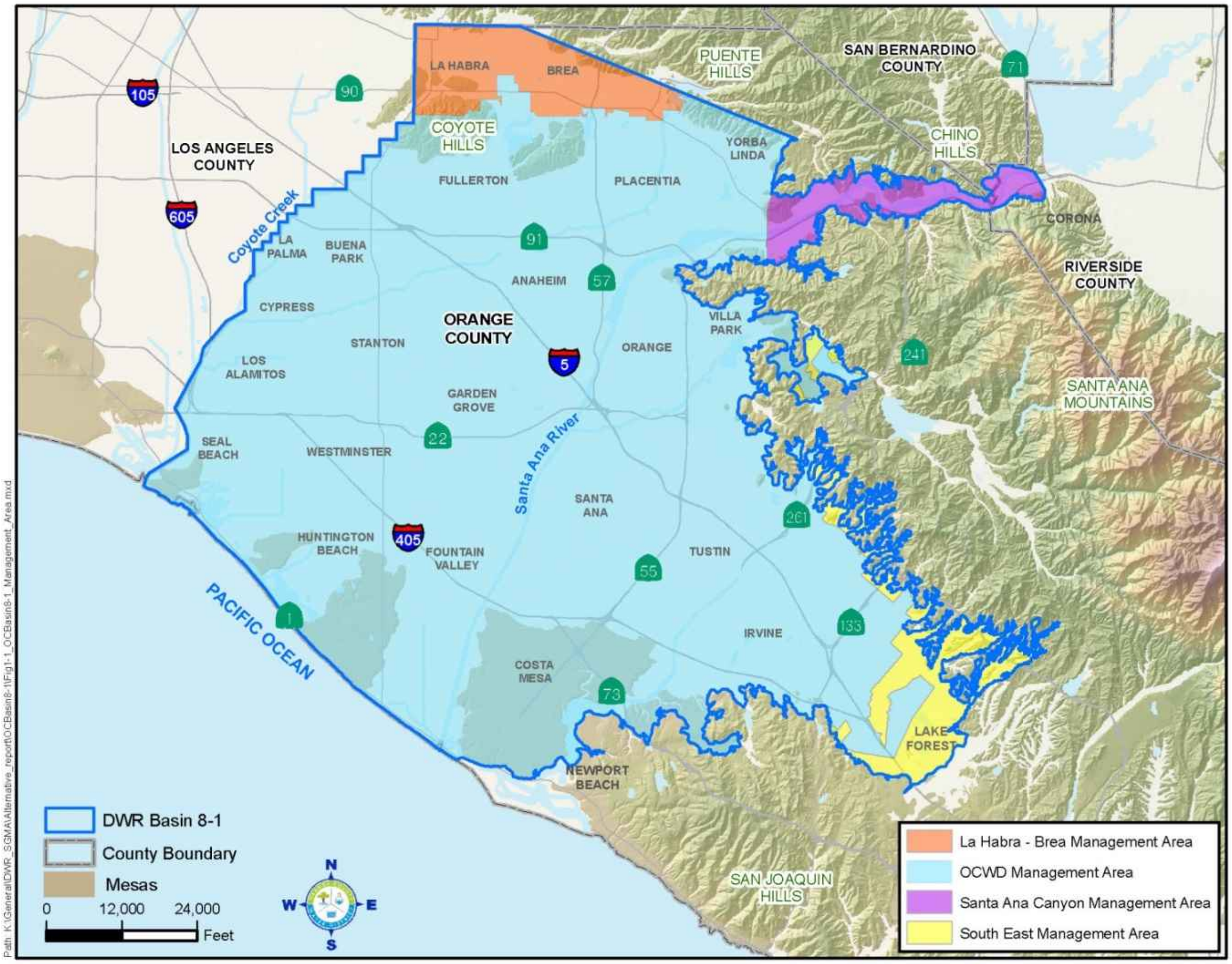


Figure 1-1: Basin 8-1 Management Area Boundaries

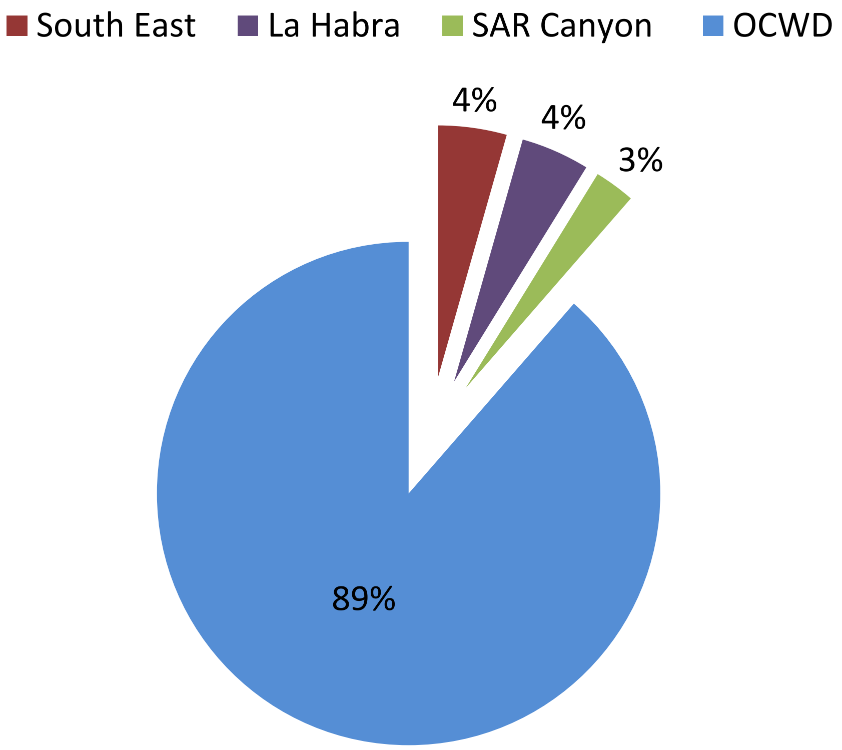


Figure 1-2: Percentage of Land Area in Basin 8-1 within Management Areas

1. LA HABRA-BREA MANAGEMENT AREA

The La Habra-Brea Management area covers the northern portion of Basin 8-1. The City of La Habra has been deemed the exclusive GSA under SGMA for this management area. This management area is part of Basin 8-1, but is hydrogeologically distinct from the OCWD Management Area and is not under the jurisdiction of OCWD. The City adopted a resolution to establish the La Habra Basin as a separate basin from Basin 8-1. OCWD adopted a resolution to support the City's request to DWR for an internal jurisdictional boundary modification in the OC Basin that follows the city limits of La Habra and Brea as is outside of the Orange County Water District's jurisdictional boundary.

The La Habra-Brea Management Area is included with this Alternative to facilitate collaboration among groundwater agencies within Basin 8-1 as required by SGMA. The City of La Habra and portions of the City of Brea comprise the La Habra-Brea Management Area. This area overlies the extents of the proposed La Habra Groundwater Basin, referenced herein.

The La Habra-Brea Management Area is currently monitored for groundwater elevations and for groundwater quality through productions wells and historical data from monitoring wells within the La Habra-Brea Management Area and surrounding area.

As the City of La Habra currently depends on local groundwater to meet approximately 40 percent of its water consumption; preserving the sustainability of the La Habra-Brea Management Area is essential. Currently (and historically), the City of La Habra manages (and has managed) the La Habra-Brea Management Area through management plans and programs for groundwater levels, basin storage, and water quality. By January 2020, the City will manage the La Habra-Brea Management Area through a Groundwater Sustainability Plan under SGMA, which will describe the monitoring program and ensure that no undesirable results occur in the future.

2. OCWD MANAGEMENT AREA

The OCWD Management Area covers an area of approximately 260 square miles within Basin 8-1, which represents approximately 89 percent of the land area of Basin 8-1. Ninety-eight percent of the groundwater production within Basin 8-1 occurs in the OCWD Management Area. Groundwater produced within the OCWD Management Area provides approximately 70 percent of the total water supply for a population of around 2.4 million residents.

Since its formation by the California Legislature in 1933, OCWD has been the managing agency for the majority of Basin 8-1, also referred to as the Coastal Plain of Orange County Groundwater Basin. As a special act district listed in Water Code § 1072(c)(1), OCWD is the exclusive local agency within its jurisdictional boundaries with powers to comply with SGMA.

Water demands within the OCWD Management Area have grown from approximately 150,000 acre-feet per year (afy) in the mid-1950s to a high of approximately 366,000 afy in water year 2007-08. OCWD operates an extensive network of recharge basins to increase recharge of surface water into the groundwater basin to support groundwater production. OCWD monitors the basin by collecting groundwater elevation and quality data from nearly 700 wells, including over 400 OCWD-owned monitoring wells, manages an electronic database that stores water elevation, water quality, production, recharge and other data on over 2,000 wells and facilities within and outside OCWD boundaries.

An OCWD-operated water recycling plant provides up to 100 million gallons per day of advanced tertiary-treated wastewater that supplies recharge operations and a seawater intrusion barrier operated to protect the basin’s water quality. OCWD manages groundwater storage and water levels within an established operating range which has resulted in sustainable conditions with no unreasonable and significant undesirable results.

The Sustainability Goal for the OCWD Management Area is to continue to sustainably manage the groundwater basin to prevent conditions that would lead to significant and unreasonable (1) lowering of groundwater levels, (2) reduction in storage, (3) water quality degradation, (4) seawater intrusion, (5) inelastic land subsidence and (6) adverse impacts on hydrologically connected surface water.

3. SOUTH EAST MANAGEMENT AREA

The South East Management Area contains portions of Irvine Ranch Water District (IRWD), El Toro Water District (ETWD), and the City of Orange. The area covered this management area is essentially an extension of the main basin and was formed to comply with the requirement that the entirety of Basin 8-1 be covered by a responsible agency.

There is relatively little existing, or potential, groundwater development within the South East Management Area. What pumping does occur is less than 200 acre-feet-per-year (afy), which is much less than the total recharge to the area. Water levels and storage levels are steady.

The Sustainability Goal for the South East Management Area is to recognize it is a small part of the larger groundwater basin that is managed by OCWD. Nevertheless, groundwater levels and water quality will be monitored to assure that conditions do not lead to significant and unreasonable (1) lowering of groundwater levels, (2) reduction in storage, (3) water quality degradation, (4) inelastic land subsidence, (5) unreasonable adverse effect on surface water resources, and (6) adverse impacts on hydrologically connected surface water.

4. SANTA ANA CANYON MANAGEMENT AREA

The Santa Ana Canyon Management Area covers the easternmost extent of Basin 8-1. The water resources in the Santa Ana Canyon Management Area include the Santa Ana River and groundwater. Groundwater is primarily located in a thin alluvial aquifer that is 90 to 100 feet thick and is a combination of infiltrated surface water and groundwater inflow from the adjacent foothills.

Groundwater pumping in this management area is primarily used for irrigation with a minimal amount used for potable purposes. The amount of groundwater pumping is small relative to the large volumes of flow in the canyon provided by the Santa Ana River and monitoring indicates there are no depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water. There are no groundwater withdrawals within the areas covered by the Cities of Anaheim, Chino Hills, and Yorba Linda; Riverside County; and Yorba Linda Water District.

OCWD has water rights to all Santa Ana River flows released through Prado Dam. For the area within its boundary, OCWD has the legal authority through the OCWD Act to require reporting of groundwater production and to charge groundwater pumping assessments for groundwater production. OCWD also monitors surface water flow and quality as well as groundwater levels and quality throughout the Santa Ana Canyon Management Area.

The Sustainability Goal for the Santa Ana Canyon Management Area is to continue monitoring sustainable conditions and monitor to ensure that no significant and unreasonable results occur in the future.

ABBREVIATIONS AND ACRONYMS

afy	acre-feet per year
AWPF	Advanced Water Purification Facility
basin	Orange County groundwater basin
Basin Model	OCWD groundwater model
BEA	Basin Equity Assessment
BPP	Basin Production Percentage
CDPH	California Department of Public Health
cfs	cubic feet per second
DATS	Deep Aquifer Treatment System
DOC	dissolved organic compound
DWR	Department of Water Resources
DWSAP	Drinking Water Source Assessment and Protection
EDCs	Endocrine Disrupting Compounds
EIR	Environmental Impact Report
EPA	U.S. Environmental Protection Agency
FY	fiscal year
GAC	granular activated carbon
GIS	geographic information system
GWRS	Groundwater Replenishment System
IAP	Independent Advisory Panel
IRWD	Irvine Ranch Water District
LACDWP	Los Angeles County Department of Public Works
maf	million acre feet
MCAS	Marine Corps Air Station
MCL	maximum contaminant level
MF	microfiltration
MODFLOW	Computer modeling program developed by USGS
mgd	million gallons per day
mg/L	milligrams per liter
MTBE	methyl tertiary-butyl ether
MWD	Metropolitan Water District of Southern California
MWDOC	Municipal Water District of Orange County
NDMA	n-Nitrosodimethylamine
NF	nanofiltration
ng/L	nanograms per liter
NBGPP	North Basin Groundwater Protection Program
NO_2	nitrite
NO_3^-	nitrate
NPDES	National Pollution Discharge Elimination System
NWRI	National Water Research Institute

ABBREVIATIONS AND ACRONYMS

O&M	operations and maintenance
OCHCA	Orange County Health Care Agency
OCSD	Orange County Sanitation District
OC Survey	Orange County Survey
OCWD	Orange County Water District
PCE	perchloroethylene
PPCPs	pharmaceuticals and personal care products
Producers	Orange County groundwater producers
RA	replenishment assessment
RO	reverse osmosis
Regional Water Board	Regional Water Quality Control Board
SARI	Santa Ana River Interceptor
SARMON	Santa Ana River Monitoring Program
SARWQH	Santa Ana River Water Quality and Health
SAWPA	Santa Ana Watershed Project Authority
SBGPP	South Basin Groundwater Protection Program
SDWA	Safe Drinking Water Act
SOCs	synthetic organic chemicals
SWP	State Water Project
SWRCB	State Water Resources Control Board
TCE	trichloroethylene
TDS	total dissolved solids
TIN	total inorganic nitrogen
µg/L	micrograms per liter
USFWS	U.S. Fish & Wildlife Service
USGS	U.S. Geological Survey
UV	ultraviolet light
VOCs	volatile organic compounds
WACO	Water Advisory Committee of Orange County
WEI	Wildermuth Environmental Inc.
WF-21	Water Factory 21
WLAM	Waste Load Allocation Model
WRD	Water Replenishment District of Southern California
WRMS	Water Resources Management System

ORANGE COUNTY WATER DISTRICT

CITY OF LA HABRA

Irvine Ranch WATER DISTRICT

Hydrogeology of Basin 8-1

January 1, 2017

Basin 8-1 Alternative

Hydrogeology of Basin 8-1

PROFESSIONAL GEOLOGIST
ROY L. HERNDON
P.G. No. 4817
CERTIFIED HYDROGEOLOGIST
No. 113
EXP. 8/31/18
STATE OF CALIFORNIA

Roy Herndon, P.G., C.Hg.

Chief Hydrogeologist
Orange County Water District
18700 Ward Street
Fountain Valley, CA 92708

Prepared for the Department of Water Resources, pursuant to Water Code §10733.6(b)(3)

January 1, 2017

Table of Contents

Table

SECTION 1 INTRODUCTION

The Coastal Plain of Orange County Groundwater Basin (Basin 8-1) underlies a coastal alluvial plain in the northwestern portion of Orange County with a small portion in Riverside and San Bernardino counties at the easternmost edge. The basin is designated as Basin 8-1 in the Department of Water Resources Bulletin 118. The basin is bounded by consolidated sedimentary rocks exposed on the north in the Puente Hills and Chino Hills, on the east in the Santa Ana Mountains, and on the south in the San Joaquin Hills. The basin is bounded by the Pacific Ocean on the southwest and by a low topographic divide approximated by the Orange County-Los Angeles County line on the northwest. The basin underlies the lower Santa Ana River watershed and a portion of the Coyote Creek Watershed (Coyote Creek is a tributary to the San Gabriel River).

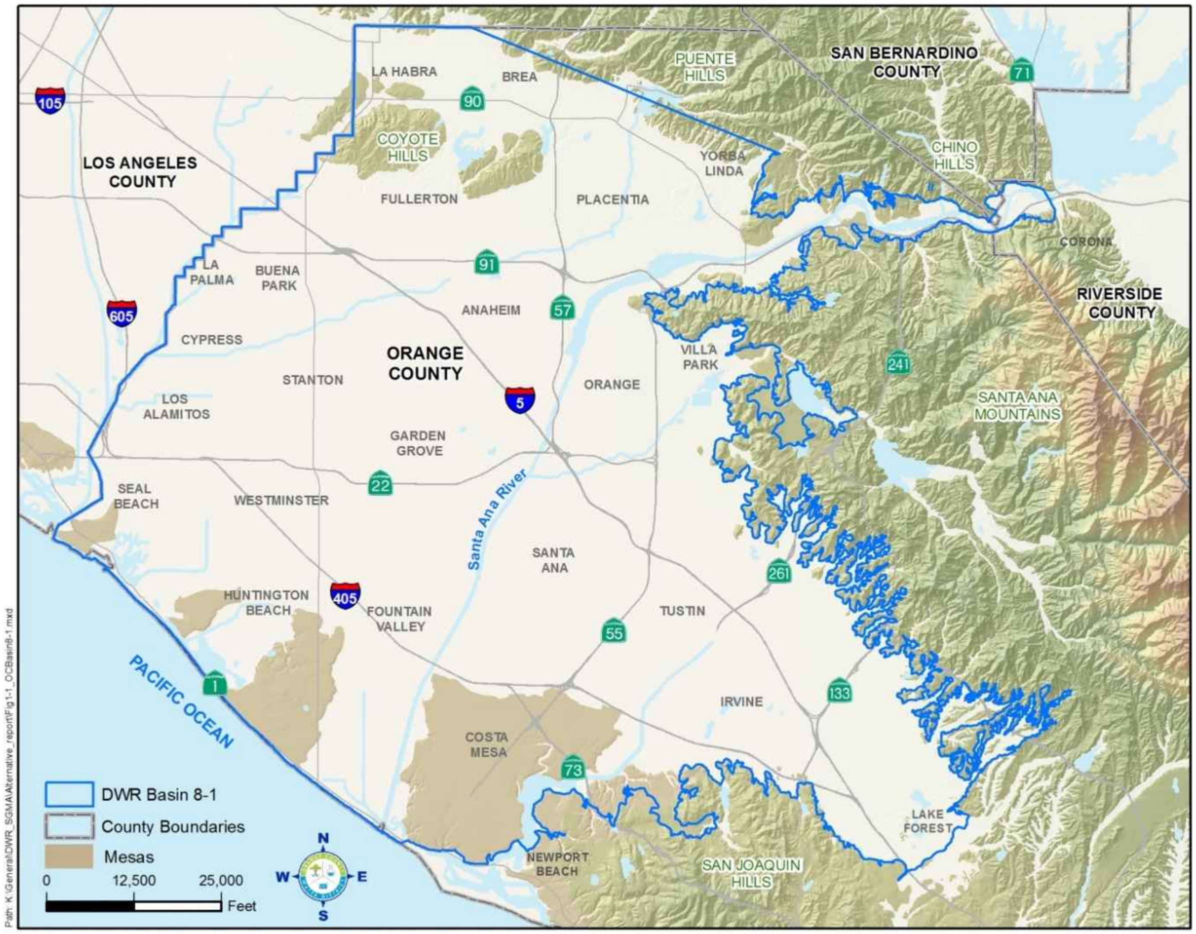


Figure 1-1: Coastal Plain of Orange County Groundwater Basin, Basin 8-1

SECTION 2 BASIN HYDROGEOLOGY

2.1 BASIN DESCRIPTION

Basin 8-1 underlies north and central Orange County beneath broad lowlands known as the Tustin and Downey plains. The basin covers an area of approximately 350 square miles, bordered by the Puente Hills and Chino Hills to the north, the Santa Ana Mountains to the northeast, and the Pacific Ocean to the southwest. The basin boundary extends to the Orange-Los Angeles county line to the northwest, where groundwater flow between Basin 8-1 and the Central Basin (Basin 4-11.04) is unrestricted. The Newport-Inglewood fault zone forms the southwestern boundary of all fresh water-bearing zones but the Shallow Aquifer, which extends to the ocean in coastal erosional gaps between the mesas.

The groundwater basin formed in a synclinal, northwest-trending trough that deepens as it continues beyond the Orange-Los Angeles county line. The Newport-Inglewood fault zone, San Joaquin Hills, Puente Hills, and Santa Ana Mountains form the uplifted margins of the syncline. The total thickness of sedimentary rocks in the basin surpasses 20,000 feet, of which only the upper 2,000 to 4,000 feet contain fresh water. In the southeastern area underlying the city of Irvine and along the basin margins, the thickness of fresh water-bearing sediments is less than 1,000 feet (Herndon and Bonsangue, 2006).

Basin 8-1 includes the La Habra Groundwater Basin which is separated from the rest of Basin 8-1 by the Coyote Hills. The La Habra Groundwater Basin lies in the synclinal trough between the Puente Hills and the Santa Fe Springs - Coyote Hills uplift. The Whittier fault, located in the Puente Hills, forms the northern limit of the La Habra syncline.

Structural folding and faulting along the basin margins, together with down warping and deposition within the basin, have occurred since Oligocene time (last 23 million years). The Newport-Inglewood fault zone, comprising the most significant structural feature in the basin from a hydrogeologic standpoint, consists of a series of faulted blocks which are generally up thrown on the southwest side. Folding and faulting along the Newport-Inglewood fault zone have created a natural restriction to seawater intrusion into the groundwater basin (Herndon and Bonsangue, 2006).

Formations of Miocene or older age constitute the base of water-bearing strata, as they are consolidated units with minimal water transmissive capacity. The tops of Miocene-aged units, including the non-marine Sespe formation, marine Vaqueros formation, and Monterey shale, form the base of water bearing sediments in the coastal and Irvine areas of the basin, whereas the tops of the Miocene-aged marine Puente and Topanga formations and El Modeno volcanics define the base of permeable sediments along inland boundary of the basin from the city of La Habra to the city of Villa Park.

Fresh water-bearing formations within the groundwater basin are comprised of Pliocene or younger (last 5 million years), semi-consolidated to unconsolidated sedimentary units. The upper Pliocene-aged Pico formation is reportedly present throughout much of the basin, and is significant in that the base of its upper unit is reported to form the base of the fresh water aquifer system where it exists. Other Pliocene-aged sediments, including the Fernando and Repetto formations, are believed to contain producible quantities of fresh water; however, they are relatively untapped in the center of the basin, as they fall below economically viable depths to which to construct water wells (>2,000 feet).

Unconsolidated sands and gravels of the Pleistocene-aged San Pedro, Lakewood, and La Habra formations, and to a lesser extent, the Coyote Hills formation and Palos Verdes sand, constitute the primary production aquifers within the groundwater basin. The non-marine Coyote Hills and La Habra formations underlie the Fullerton and Anaheim areas, whereas the marine Lakewood and San Pedro formations underlie the majority of the central and coastal portions of the basin. The Coyote Hills and La Habra formations are present in the La Habra Basin portion of Basin 8-1 and are underlain by the San Pedro formation. These marine and non-marine formations are time correlative and are thought to interfinger throughout the basin. Total depths of the base of these formations range from approximately 500 to 2,000 feet.

Overlying the Pleistocene deposits are younger, Recent-aged alluvial sediments that range from less than 50 feet to approximately 300 feet thick. These sediments include coarse-grained channel deposits laid down by the Santa Ana River, which has flowed into the Pacific Ocean as far north as the present-day San Gabriel River mouth and as far south as Newport Bay. It is these channel deposits, which have not been substantially offset by the Newport-Inglewood fault zone, that provide the conduits for seawater to migrate inland toward groundwater pumping depressions.

Pleistocene or younger aquifers within the basin form a complex series of interconnected sand and gravel deposits. In coastal and central portions of the basin, these deposits are extensively separated by lower-permeability clay and silt deposits or aquitards. In the inland areas, the clay and silt deposits become thinner and more discontinuous, allowing larger quantities of groundwater to flow more easily between shallow and deeper aquifers (DWR, 1967).

2.2 AQUIFER SYSTEMS

The current “conceptual model’ of the basin is based on studies by the DWR in the mid-1960s which described the existence of three major aquifer systems. In OCWD’s management of the groundwater basin, these aquifer systems are referred to as the Shallow, Principal, and Deep Aquifers (see Figure 2-1).

Because of the groundwater basin’s synclinal and faulted structure, the Shallow Aquifer system extends over a larger area than the underlying Principal and Deep aquifer systems. Potentiometric head differences measured in over 60 multi-depth, discretely-screened monitoring wells have been the primary means by which the vertical delineation of these aquifer systems has been interpreted. These head differences range from negligible to several tens of feet depending on the degree of hydraulic continuity and local pumping and recharge. Generally, aquifers in the “Forebay area” have a higher degree of vertical hydraulic continuity than aquifers in the “Pressure area” (see Section 2.4). This is due to thinner and less laterally extensive low-permeability sediments in the Forebay area as compared to the Pressure area.

The Shallow Aquifer system overlies the entire basin and includes the transmissive Talbert Aquifer, which covers an approximate three-mile wide swath along today's Santa Ana River. It generally occurs from the surface to approximately 200 feet below ground surface. The majority of groundwater from the Shallow Aquifer is pumped by small water systems for industrial and agricultural use, although the cities of Garden Grove and Newport Beach, and the Yorba Linda Water District, operate wells that pump from the Shallow Aquifer for municipal use.

Over 90 percent of groundwater production occurs from wells that are screened within the Principal Aquifer system at depths between 200 and 1,300 feet, which underlies the Shallow Aquifer system and is up to 2,000 feet deep in the center of the basin. Underlying the Principal Aquifer System is the Deep Aquifer system, which reaches depths of up to 4,000 feet. The depth and presence of amber colored groundwater in some coastal areas hinders production from the Deep Aquifer system.

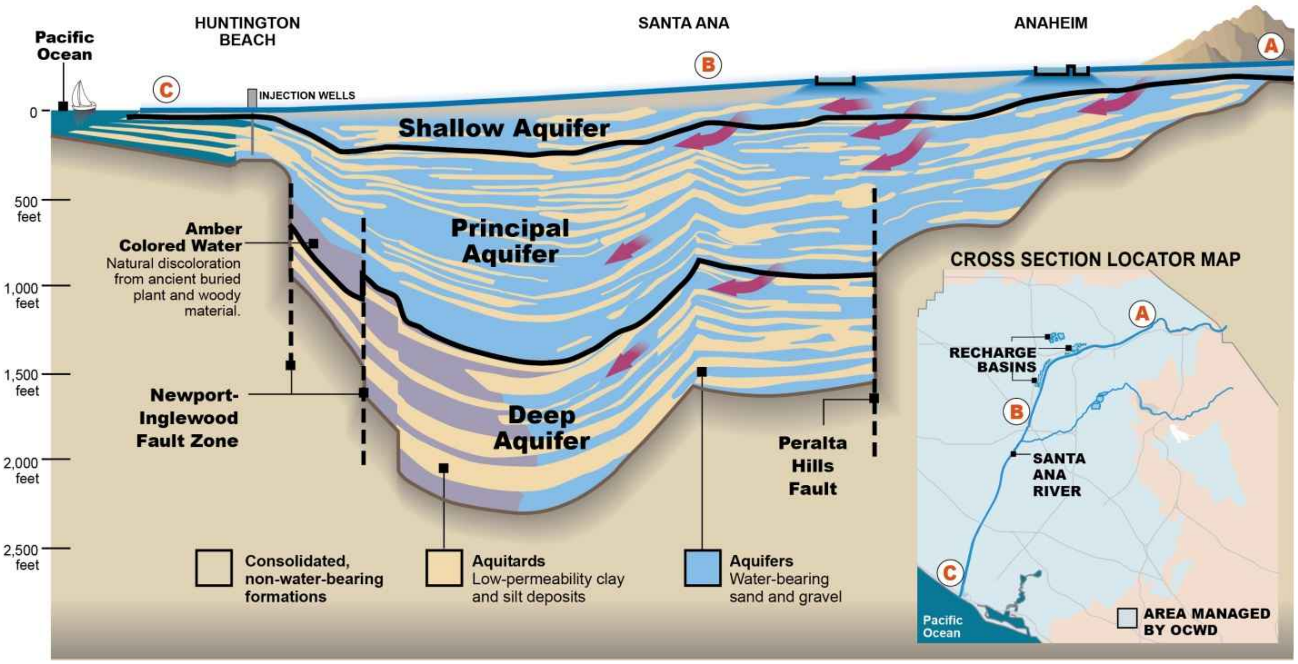


Figure 2-1: Basin 8-1 Aquifer Systems

The La Habra Groundwater Basin was studied by the DWR in the mid-1930s (DWR, 1934) and mid-1940s (DWR, 1947). It has been characterized as a layered aquifer system consisting of the near-surface alluvium, the La Habra Aquifer, and the San Pedro Aquifer (Montgomery, 1977; Geoscience, 2009).

The alluvial aquifer is typically about 100 feet thick. The older alluvium covers most of the surface of the eastern La Habra Groundwater Basin with younger alluvium deposited in Coyote Creek and Brea Creek stream channels. The La Habra aquifer is composed of nonmarine pebbly sandstones within the La Habra formation and underlying the Coyote Hills formation. This aquifer can reach a thickness of 1,200 feet near the center of the basin. Underlying the Coyote Hills formation is the San Pedro formation which contains the San Pedro aquifer, representing the most productive aquifer in the La Habra Groundwater Basin. This confined aquifer is thickest along the axis of the syncline in the basin.

2.3 FAULT ZONES AND GROUNDWATER FLOW

The following is a description of the fault zones in Basin 8-1 from Bulletin 118 (DWR, 2003):

> There are three fault zones within this basin that impede groundwater flow (DWR 1967). The most prominent is the Newport-Inglewood fault zone, which trends northwest and is responsible for formation of the Newport Inglewood uplift. This fault zone forms a barrier to groundwater flow to the southwest and marks the southwest edge of the thick aquifer materials important for groundwater production in the basin (DWR 1967). This barrier is breached by erosional channels filled with alluvium at the Alamitos and Talbert Gaps. Another northwest-trending system is the Whittier fault zone which forms the northeastern boundary of the basin along the Puente Hills. This fault forms a groundwater barrier except where it is breached by recent alluvial channels (DWR 1967). The Norwalk fault trends eastward along the southern edge of the Coyote Hills and is responsible for a lower groundwater level to the south (DWR 1967).

Figure 2-2 shows the major fault zones in Basin 8-1. Because of its variable stratigraphy, large thickness, and annual recharge and production volume, Basin 8-1 possesses a complex subsurface flow regime. Groundwater generally flows in a southwesterly direction from the Forebay recharge areas toward coastal pumping depressions.

The Peralta Hills fault follows a northwest trend crossing the Santa Ana River just north of Lincoln Avenue in the city of Anaheim. This fault has been mapped along the southern flank of the Peralta Hills, and its extension across the Santa Ana River has been inferred from a perennial steep potentiometric gradient in the vicinity of Lincoln Avenue. The fault is believed to partially restrict groundwater flow in this area (OCWD, 1991).

OCWD prepares a groundwater elevation contour map for each of the Shallow, Principal and Deep aquifers within the basin on an annual basis. These maps are useful in assessing the direction of lateral groundwater flow and annual change in groundwater storage in the basin. Data from over 60 depth-specific monitoring wells throughout the basin are used to determine the vertical hydraulic gradients between aquifers as well as temporal changes in groundwater elevation within each of the three major aquifers.

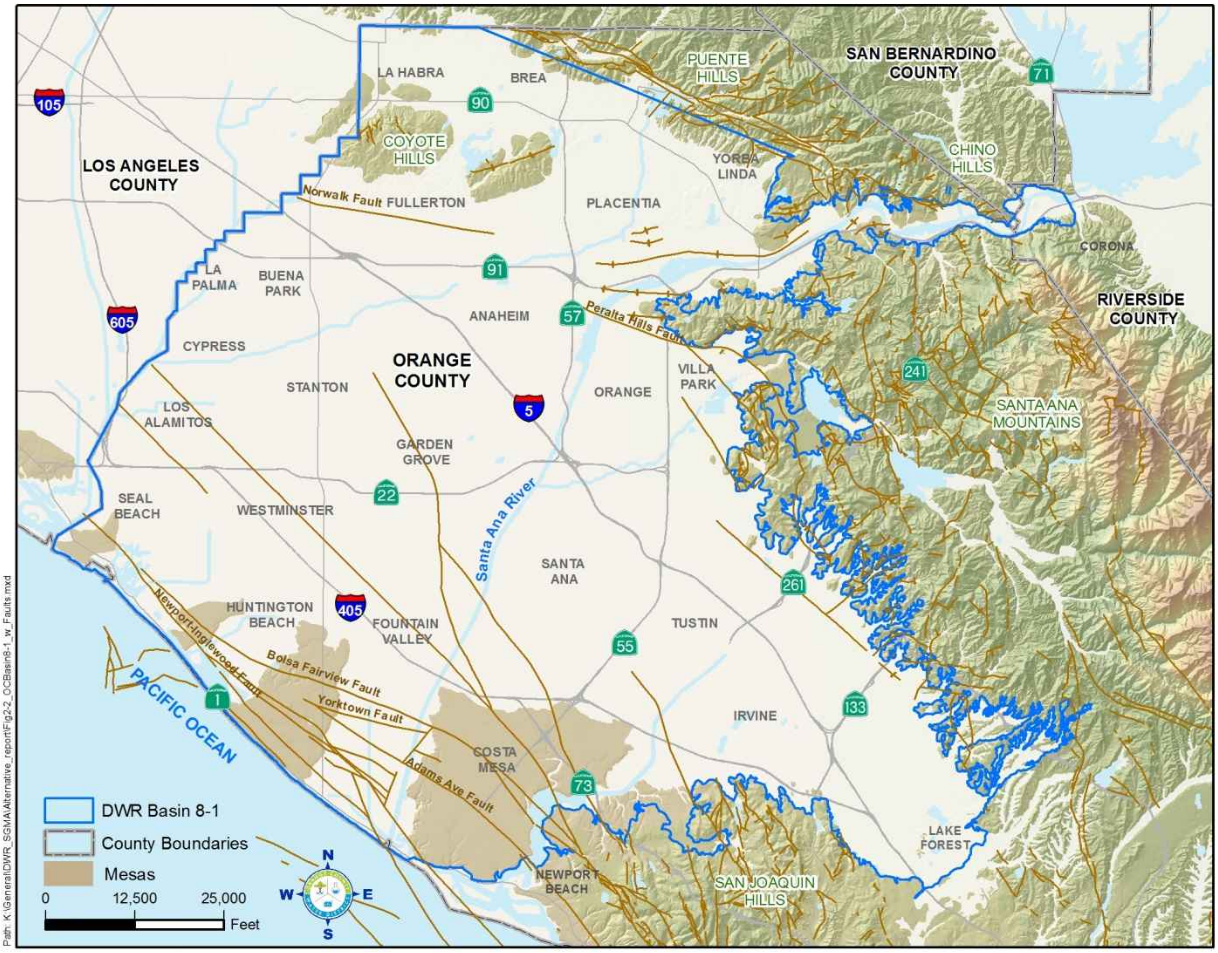


Figure 2-2: Fault Zones

2.4 FOREBAY AND PRESSURE AREAS

The Department of Water Resources (DWR, 1934) divided the basin into two primary hydrologic divisions, the Forebay and Pressure areas, as shown in Figure 2-3. The Forebay/Pressure area boundary generally delineates the areas where surface water or shallow groundwater can or cannot move downward to the first producible aquifer in quantities significant from a water supply perspective. From a water quality perspective, the amount of vertical flow to deeper aquifers from surface water or shallow groundwater may be significant in terms of impacts of past agricultural or industrial land uses (e.g., fertilizer application and leaky underground storage tanks).

The Forebay refers to the area of intake or recharge where the major basin aquifers are replenished by either direct percolation from surface water or downward groundwater flow from overlying, hydraulically-connected aquifers. The area is characterized by a stratigraphic sequence of relatively coarse-grained deposits of sands and gravels with occasional lenses of clay and silt. These clay and silt lenses do not generally impede groundwater flow from one aquifer to another. In fact, it is the lack of continuous aquitards which make aquifer delineation and correlation in the Forebay extremely difficult. Aquifers within the Forebay typically exhibit unconfined to semiconfined conditions. The Forebay area encompasses most of the cities of Anaheim, Fullerton, and Villa Park and portions of the cities of Orange and Yorba Linda.

The Pressure Area is generally defined as the area of the basin where large quantities of surface water and near-surface groundwater are impeded from percolating into the major producible aquifers by clay and silt layers at shallow depths (upper 50 feet). This area is characterized by semi-perched groundwater at depths of less than 50 feet, with substantially clayey or silty sediments in the shallow subsurface. Piezometric head differentials of 50 to 100 feet are common between the shallow-most aquifers and underlying production aquifers in the Pressure Area. The main production aquifers in the Pressure Area, generally at depths between 300 and 1,500 feet, behave as confined or "pressure" aquifers, with seasonal piezometric level fluctuations of several tens of feet between pumping and non-pumping conditions. Most of the central and coastal portions of the basin fall within the Pressure Area.

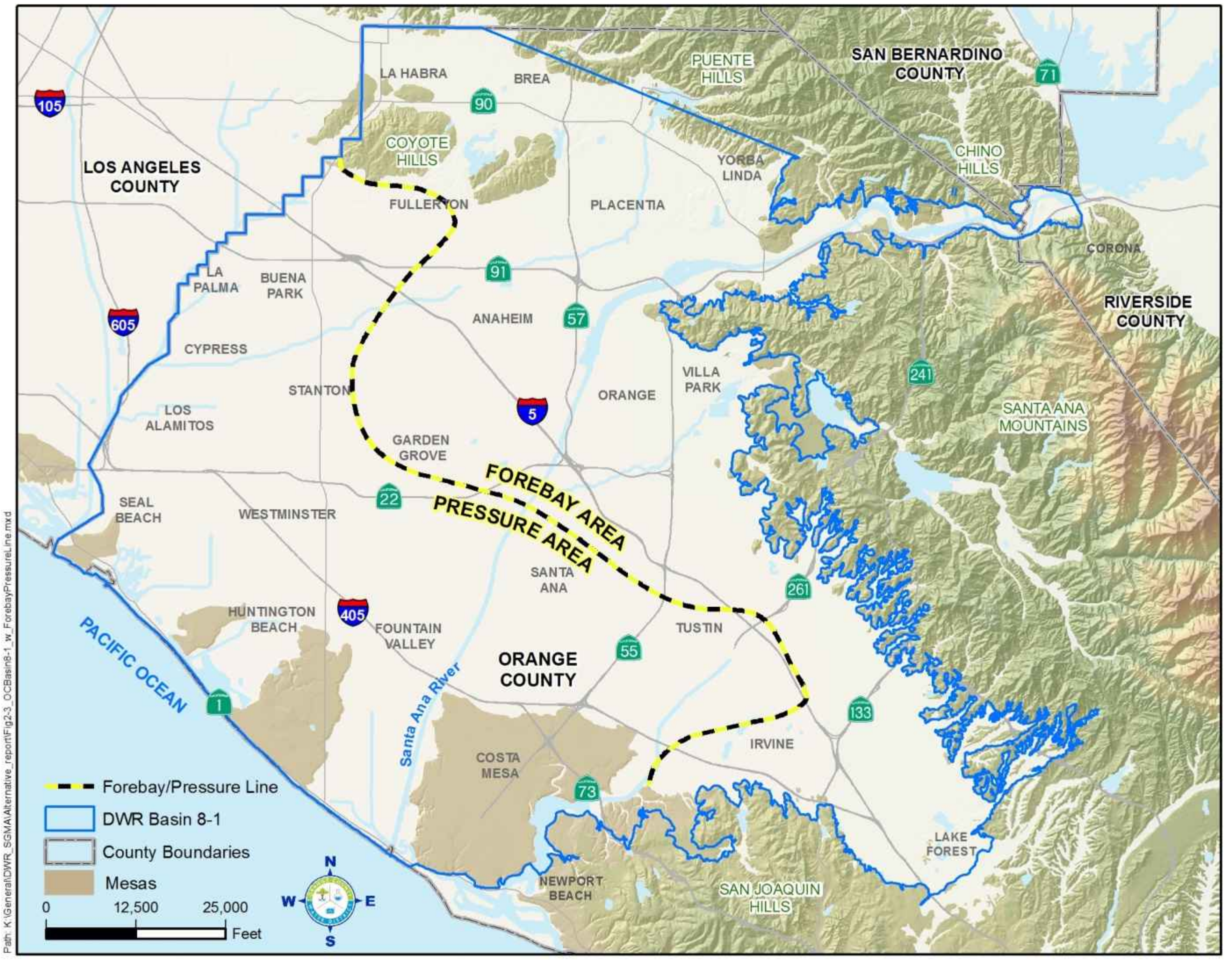


Figure 2-3: Basin 8-1 Forebay and Pressure Areas and Mesas

2.5 COASTAL AREAS

Four relatively flat elevated areas, known as mesas, occur along the coastal boundary of the basin. These mesas, shown in Figure 2-3, were formed by ground surface uplift along the Newport Inglewood Fault Zone. Concurrent with the coastal uplift, alternating courses of the ancient Santa Ana River carved notches through the uplifted area and left behind sand- and gravel-filled deposits beneath the lowland areas between the mesas, known as gaps (Poland et al., 1956).

2.6 TOTAL BASIN VOLUME

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

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

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

2.7 BASIN CROSS SECTIONS

Figure 2-1 shows a schematic basin cross-section prepared by OCWD that shows a representation of the aquifer zones, bottom of basin, and general configuration of aquifers and aquitards. OCWD has developed a series of cross-sections depicting major stratigraphic and structural features in the basin. The twenty-six cross-section profile lines are shown in Figure 2-4. Three representative cross-sections are shown in Figures 2-5 to 2-7.

Table 2-1: Estimated Basin Groundwater Storage by Hydrogeologic Unit
(Volumes in Acre-feet)

HYDROGEOLOGIC UNIT	PRESSURE AREA	FOREBAY	TOTAL
Shallow Aquifer System	3,800,000	1,200,000	5,000,000
Aquitard	900,000	200,000	1,100,000
Principal Aquifer System	24,300,000	8,600,000	32,900,000
Aquitard	1,600,000	300,000	1,900,000
Deep Aquifer System	18,800,000	6,300,000	25,100,000
TOTAL	49,400,000	16,600,000	66,000,000

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

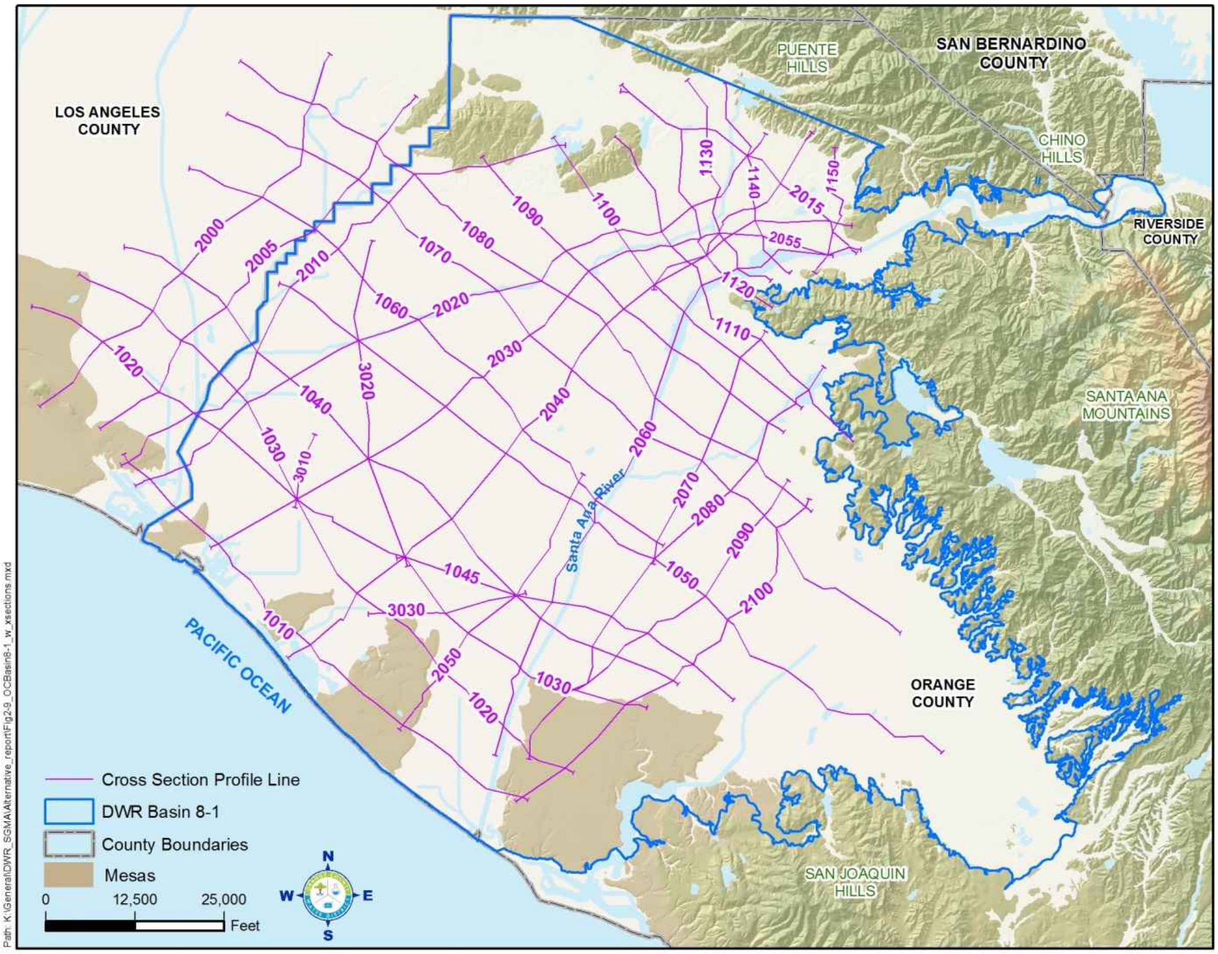
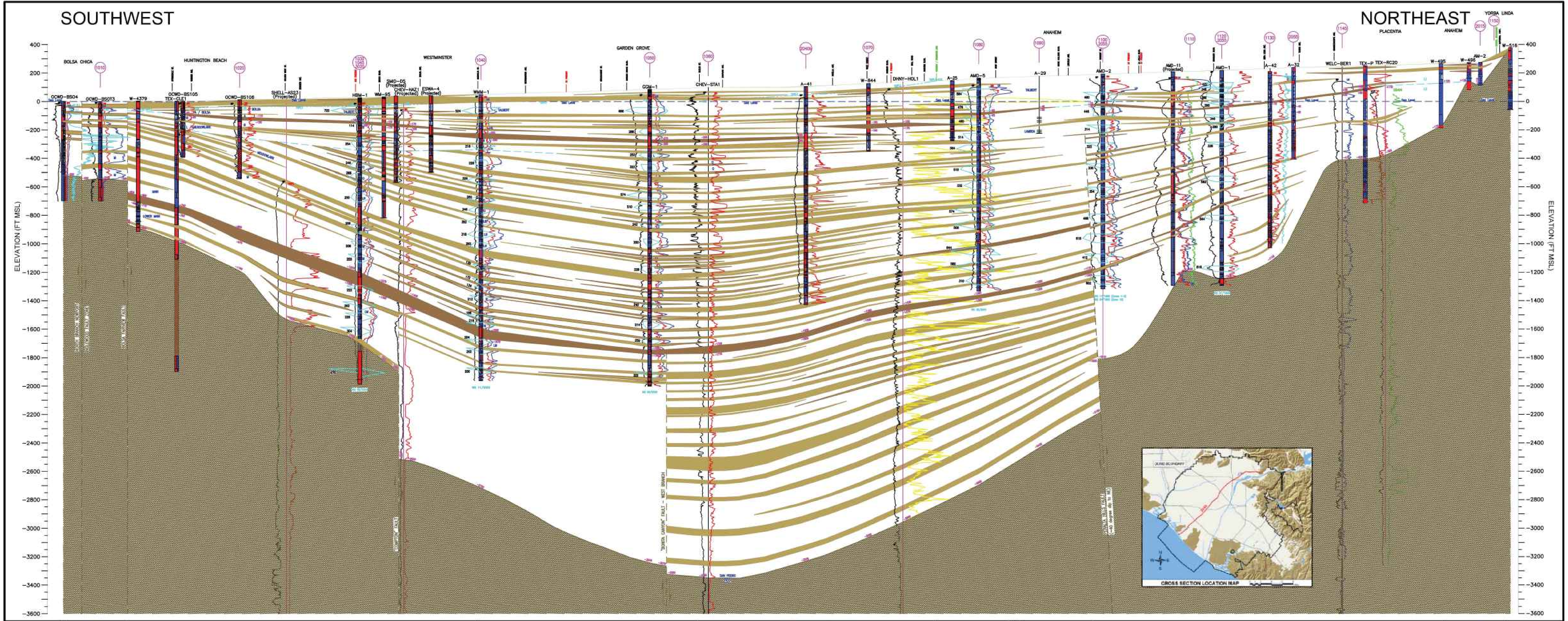


Figure 2-4: Groundwater Basin Cross-Sections



CROSS SECTION ID:

2040

GEOLOGIC CROSS SECTION FOR 3-LAYER BASIN MODEL

☐	High Permeability Sediments
▨	Low Permeability Sediments
▨	Low Permeability Sediments & Piezometric System Break
▨	Consolidated Low Permeability Sediments
☐	Area Of Interpreted Colored Water (> 15 cu)
	Top Of Model Layer 1
	Model Layer Boundary
	Unconformity

Intersection With Numbered Cross Section

WELL NAME

Well with Screened Intervals, Electric Log, Aquifer Designations, Color Water Values (Color Units) and Depths of Layer Boundaries (feet mean sea level)

▨	100% Gravel
▨	75% Gravel, 25% Sand
▨	50% Sand, 50% Silt
▨	75% Silt, 25% Clay
▨	100% Clay
▨	100% Sand With Shells
▨	100% Sand With Wood

Revisions

Revised By	Date	Description	Checked By	Approved By
AAC	[illegible]	PROFILE DRAWN	[illegible]	[illegible]
AAC	[illegible]	PARTIAL CORRELATION SKETCHED	[illegible]	[illegible]
TS	[illegible]	[illegible]	[illegible]	[illegible]
JR	[illegible]	[illegible]	[illegible]	[illegible]
JR	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
JR	[illegible]	[illegible]	[illegible]	[illegible]

FILE LOCATION: [illegible]

Figure 2-5: Cross Section 2040

CROSS SECTION ID:

2040

CROSS SECTION ID:

1050

GEOLOGIC CROSS SECTION FOR 3-LAYER BASIN MODEL

0 2000 4000 6000 8000

HORIZONTAL SCALE (FEET)

- ☐ High Permeability Sediments
- 🟫 Low Permeability Sediments
- 🟫 Low Permeability Sediments & Piezometric System Break
- ▨ Consolidated Low-Permeability Sediments
- ☐ Area Of Interpreted Colored Water (> 15 cu)
- Top Of Model Layer 1
- Model Layer Boundary
- Unconformity

(1050) Intersection With Numbered Cross Section

WELL NAME

SP

MAIN

40

Well with Screened Intervals, Electric Logs, Aquifer Designations, Color Water Values (Color Units) and Depths of Layer Boundaries (feet mean sea level)

TDS Na + K Cl Ca HCO3 Mg SO4

10 0 10

meq / liter

- 100% Gravel
- 75% Gravel, 25% Sand
- 50% Sand, 50% Silt
- 75% Silt, 25% Clay
- 100% Clay
- 100% Sand With Shells
- 100% Sand With Wood

Revisions

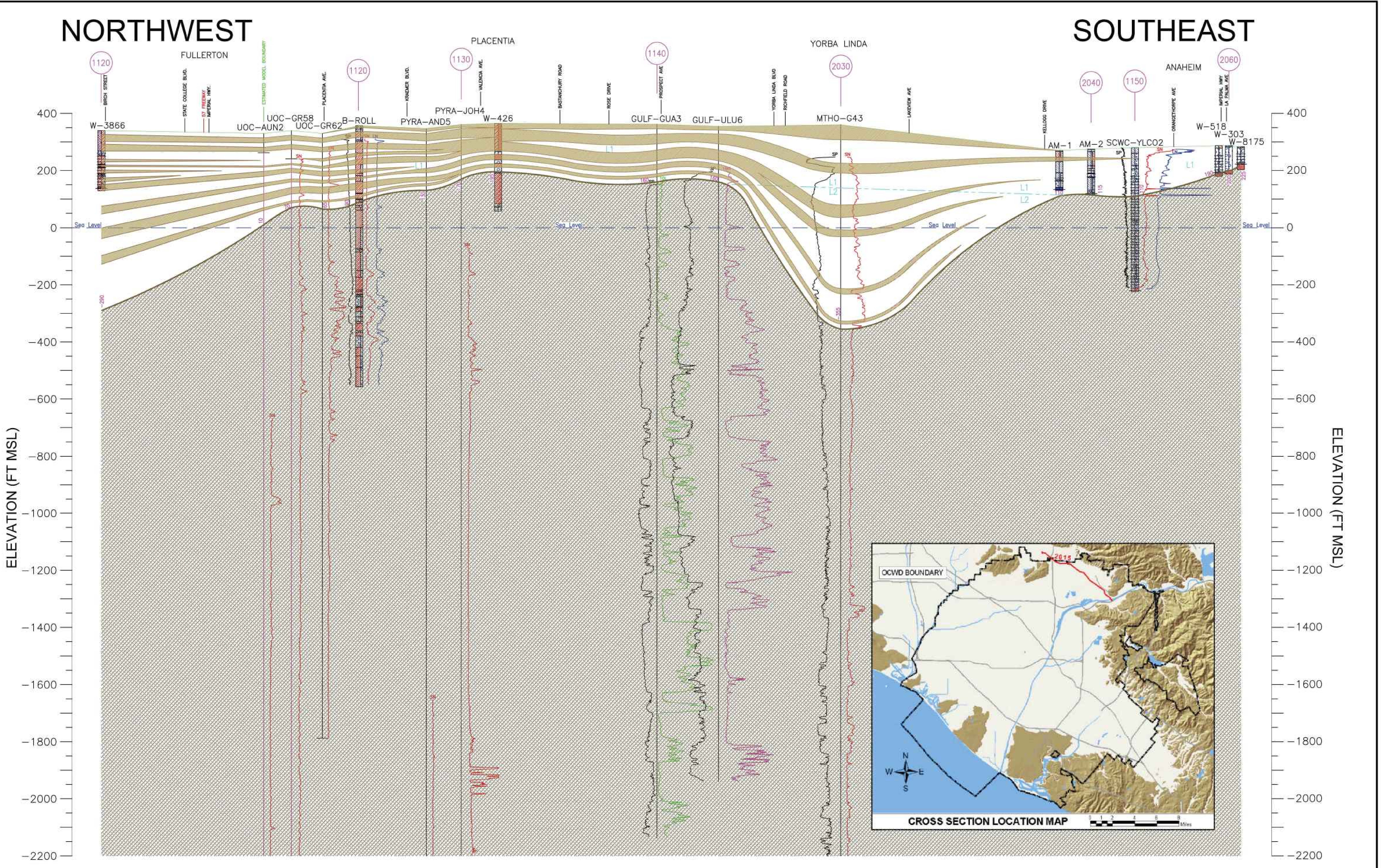
Revised By	Date	Description	Checked By	Approved By
AC	06/20/96	CORRELATION DRAWN	RH	RH
JR	08/05/97	CORRELATION UPDATED	RH	RH
TS	FALL 1999	MODEL ID REVISIONS DRAWN	TS	RH
JR	01/02/02	MODEL ID REVISIONS UPDATED	TS	RH
DF	01/02/03	STIFF DIAGRAMS REVISED	JR	RH
JR	01/09/04	ADDED MAP, LEGEND AND BORDER / UPDATED HATCH AND COLORS	TS	RH

FILE LOCATION : B:\ BASINMOD \ XSC \ XSC-1050.DWG

Figure 2-6: Cross Section 1050

CROSS SECTION ID:

1050



ORANGE COUNTY WATER DISTRICT

SINCE 1933

GEOLOGIC CROSS SECTION FOR 3-LAYER BASIN MODEL

0 2000 4000 6000 8000

HORIZONTAL SCALE (FEET)

☐ High Permeability Sediments

▨ Low Permeability Sediments

■ Low Permeability Sediments & Piezometric System Break

▨ Consolidated Low Permeability Sediments

⁙ Area Of Interpreted Colored Water (> 15 cu)

TL1 TOPL1 Top Of Model Layer 1

L1/L2 Model Layer Boundary

Unconformity

(1050) Intersection With Numbered Cross Section

WELL NAME

SP SN MAIN 45 -150

Well with Screened Intervals, Electric Logs, Aquifer Designations, Color Water Values (Color Units) and Depths of Layer Boundaries (feet mean sea level)

TDS Na + K Ca Mg Cl HCO3 SO4

10 0 10

meq./ liter

▨ 100% Gravel

▨ 75% Gravel, 25% Sand

▨ 50% Sand, 50% Silt

▨ 75% Silt, 25% Clay

▨ 100% Clay

▨ 100% Sand With Shells

▨ 100% Sand With Wood

Revisions

Revised By	Date	Description	Checked By	Approved By
AJC	10/28/94	PROFILE DRAWN	TS	RH
JR	05/30/97	BOTTOM OF 3D MODEL DRAWN	TS	RH
JR	10/23/03	CORRELATION DIGITIZED	TS	RH
JR	02/26/04	ADDED MAP, LEGEND AND BORDER / UPDATED HATCH AND COLORS	TS	RH

FILE LOCATION: S:/ BASINMOD / XSC / XSC-2015.DWG

Figure 2-7: Cross Section 2015

CROSS SECTION ID:

2015

2.8 BASIN CHARACTERISTICS

Physiographic characteristics of Basin 8-1 are shown in Figures 2-8 to 2-11. These figures show the USGS topographic information, surface soil characteristics, recharge areas and surface water bodies that are significant to the management of the basin, and surficial geology.

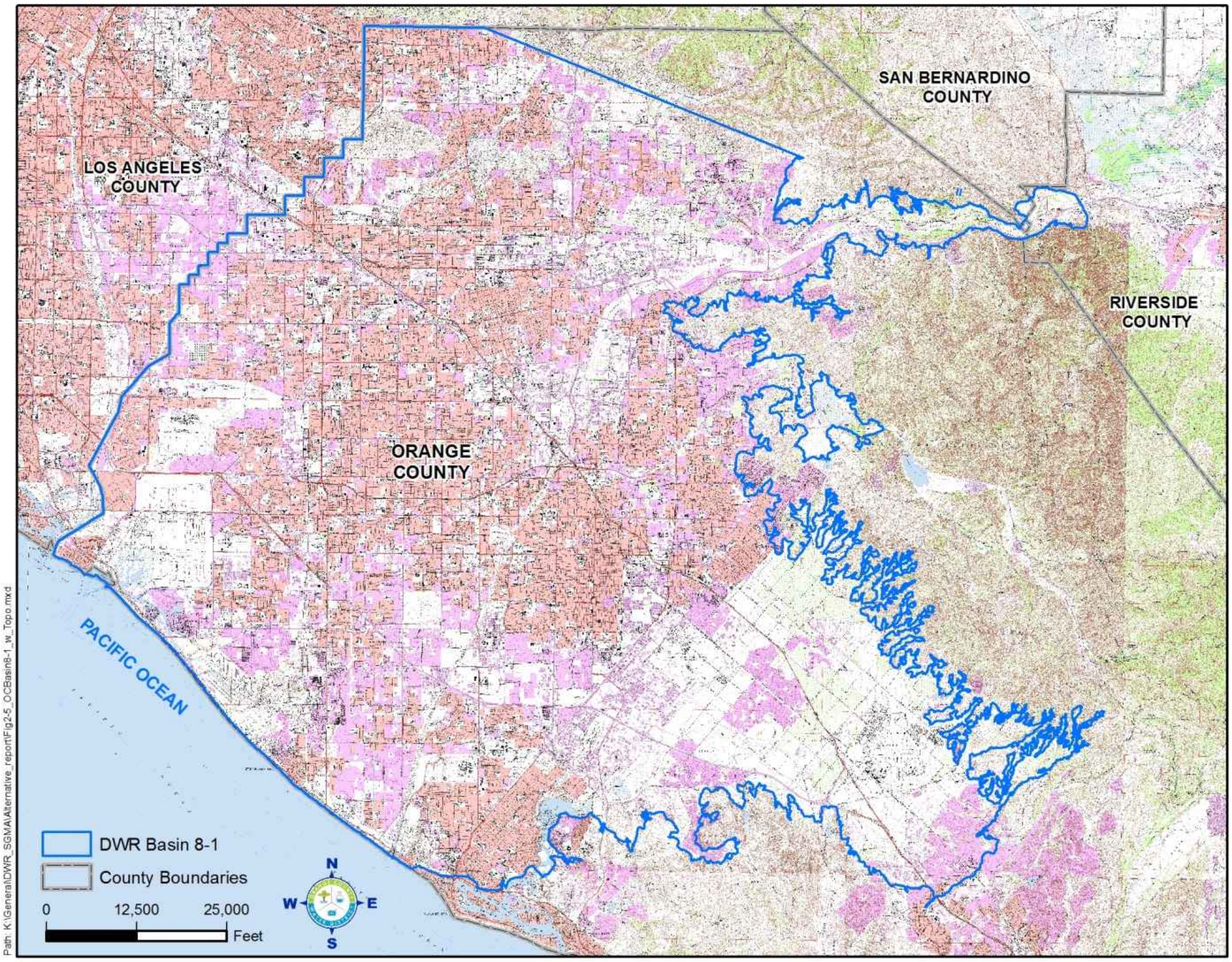


Figure 2-8: United States Geological Survey Topographic Map

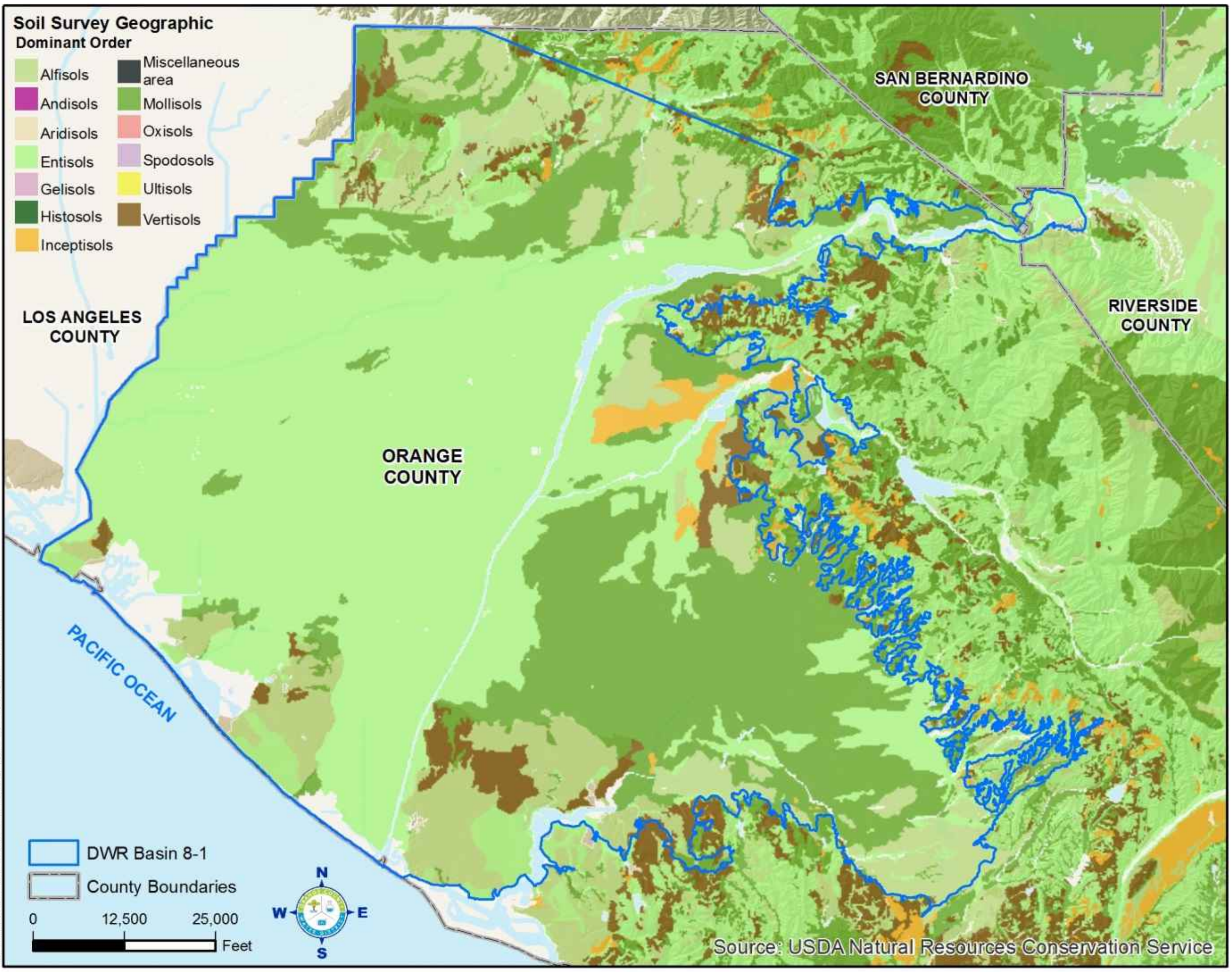


Figure 2-9**:** Surficial Soil Characteristics

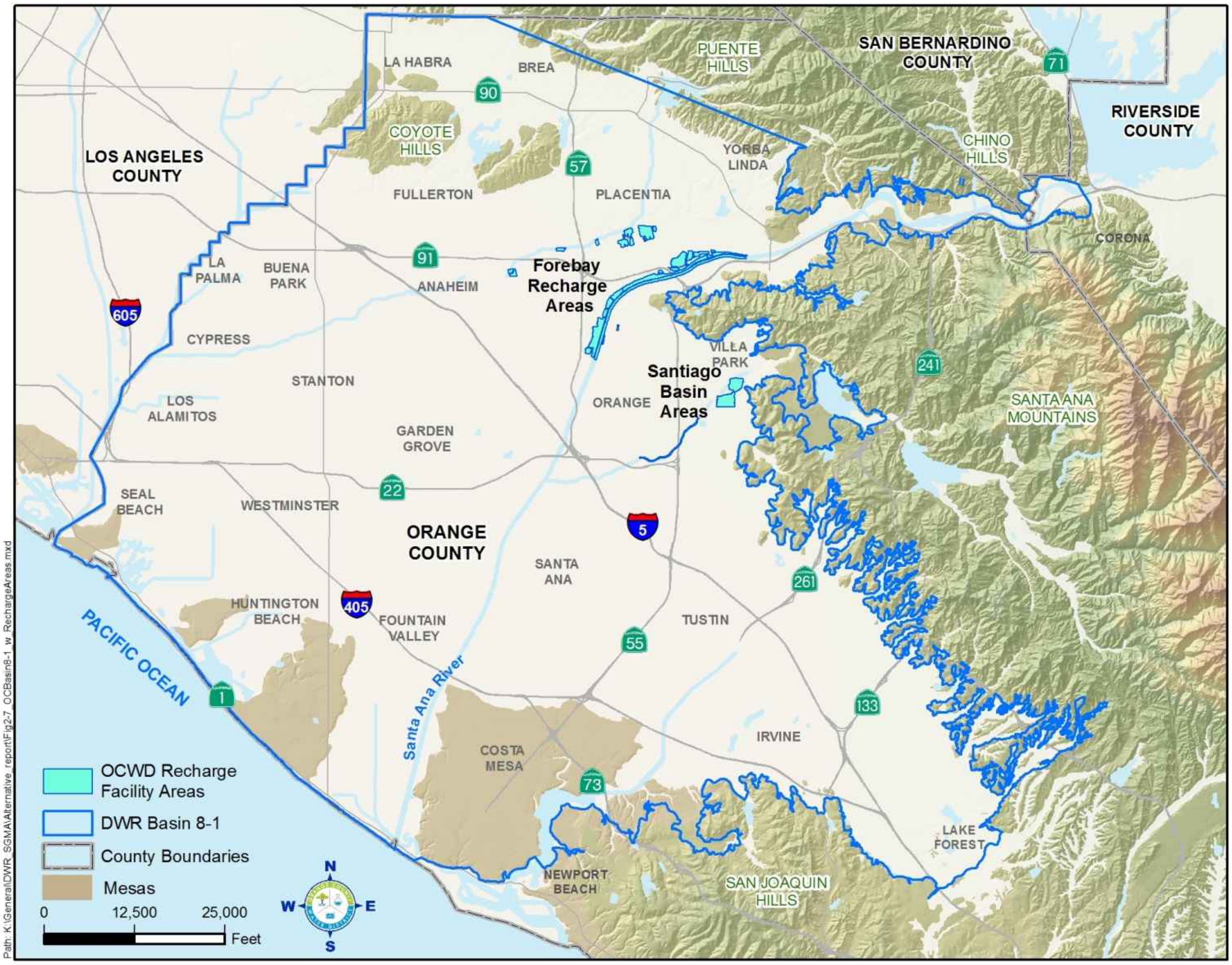


Figure 2-10**:** Recharge Areas

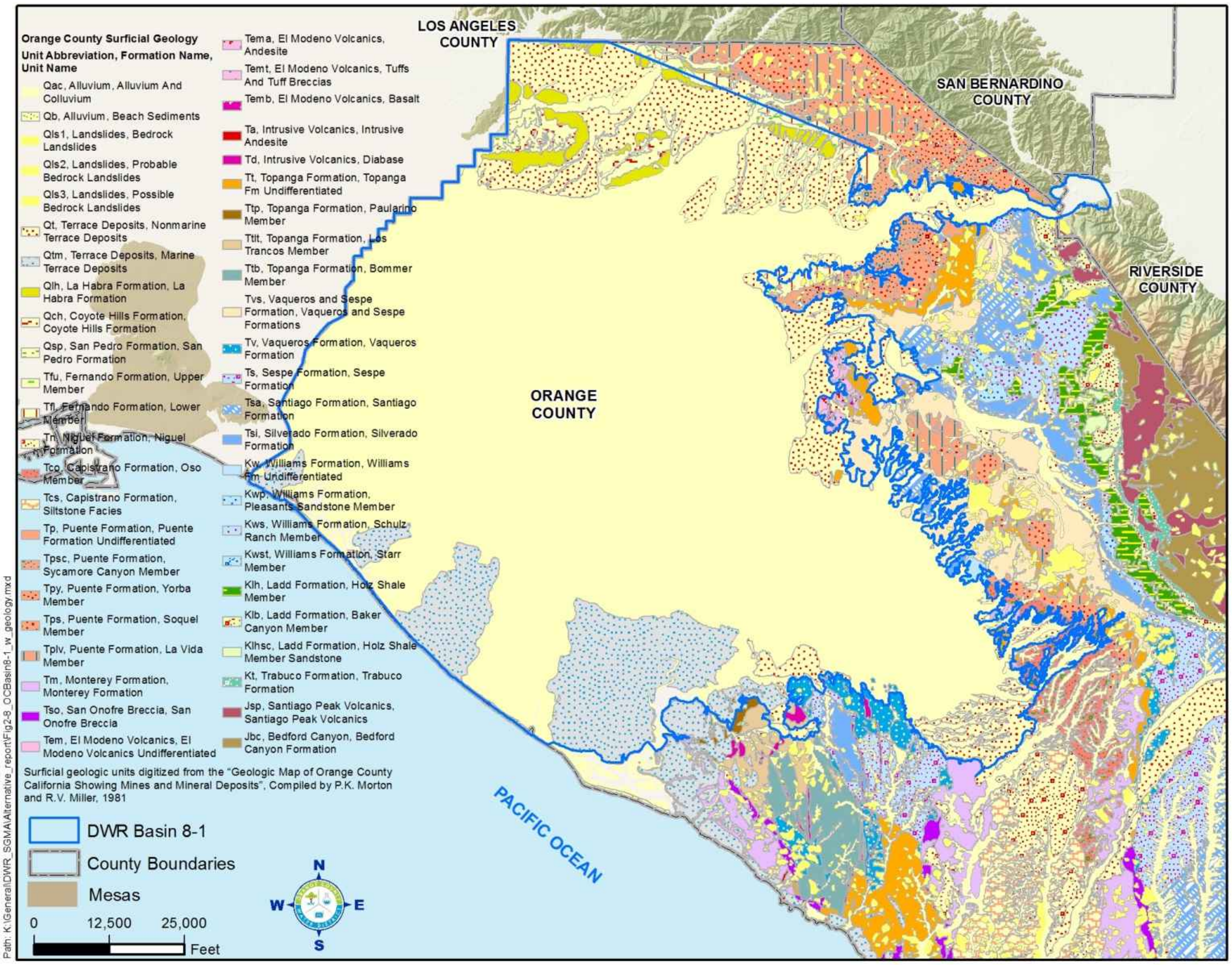


Figure 2-11: Surficial Geology

SECTION 3 BENEFICIAL USES AND BASIN WATER QUALITY

3.1 BASIN PLAN

The State Water Resources Control Board (State Board) and nine Regional Water Quality Control Boards have responsibility to protect the quality of California's waters. Basin 8-1 is under the jurisdiction of the Santa Ana Regional Board (Regional Water Board). The Regional Water Board first adopted, in 1975, the Water Quality Control Plan (Basin Plan) for the Santa Ana Region. The Santa Ana Region, shown in Figure 3-1, includes the area drained by the Santa Ana River and a portion of the Coyote Creek Watershed drained by the San Gabriel River.

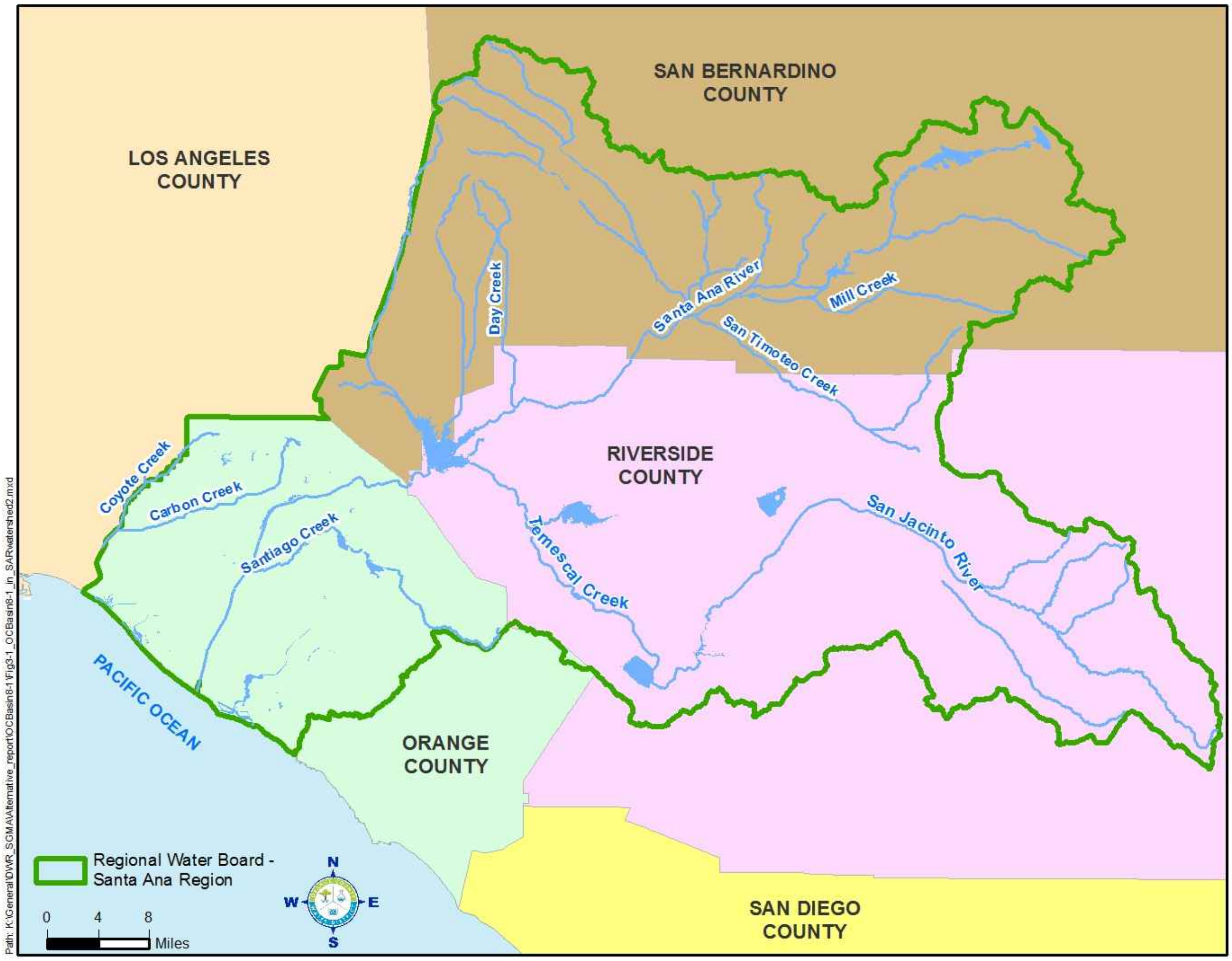


Figure 3-1: Regional Water Quality Control Board, Santa Ana Region

The Santa Ana River begins in the San Bernardino Mountains, flows through parts of Riverside and San Bernardino Counties and discharges to the Pacific Ocean in Orange County. Since the initial adoption of the Basin Plan, it has been periodically updated. The Basin Plan is the basis for the Regional Water Board's regulatory programs and salt and nutrient management programs. It establishes beneficial uses and water quality standards for surface water and groundwater in the region and a wasteload allocation for discharges to the Santa Ana River and its tributaries for total dissolved solids and nitrate.

3.2 BENEFICIAL USE DESIGNATIONS

Groundwater Management Zones established by the Regional Board in Basin 8-1 are shown in Figure 3-2. Beneficial uses designated for Groundwater Management Zones within Basin 8-1 are shown in Table 3-1.

Figures 3-3 and 3-4 show the surface water body designations for water bodies within the Santa Ana Region. Beneficial Uses designated for surface water bodies that may influence the quality of groundwater in Basin 8-1 are shown in Table 3-4.

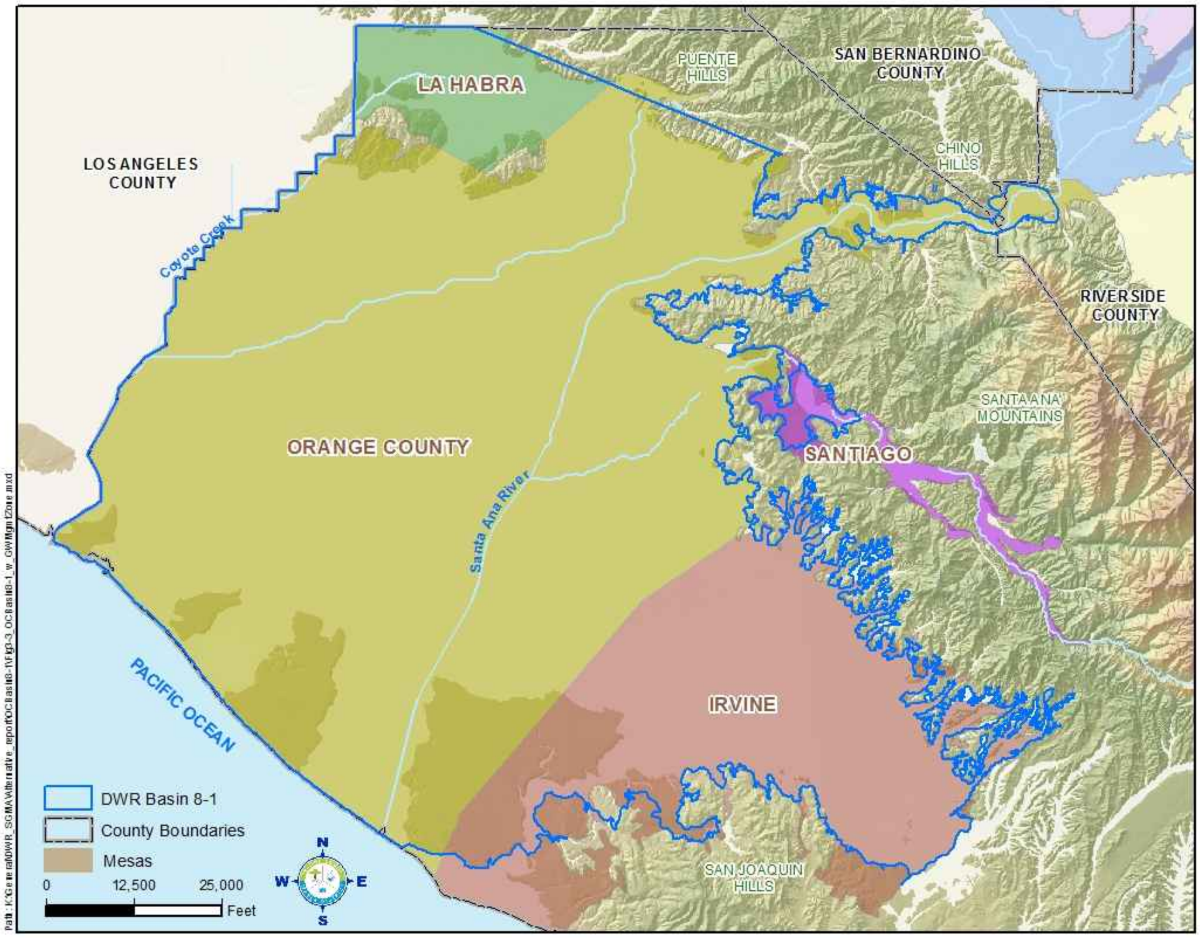


Figure 3-2: Basin 8-1 Groundwater Management Zones

Table 3-1: Beneficial Use Designations for Groundwater Management Zones

Groundwater Management Zone	Existing or Potential Beneficial Use			
	Municipal and Domestic Supply	Agricultural Supply	Industrial Service Supply	Industrial Process Supply
La Habra	X	X		
Santiago	X	X		
Orange	X	X	X	X
Irvine	X	X	X	X

Source: Santa Ana Basin Plan X= existing or potential Beneficial Use

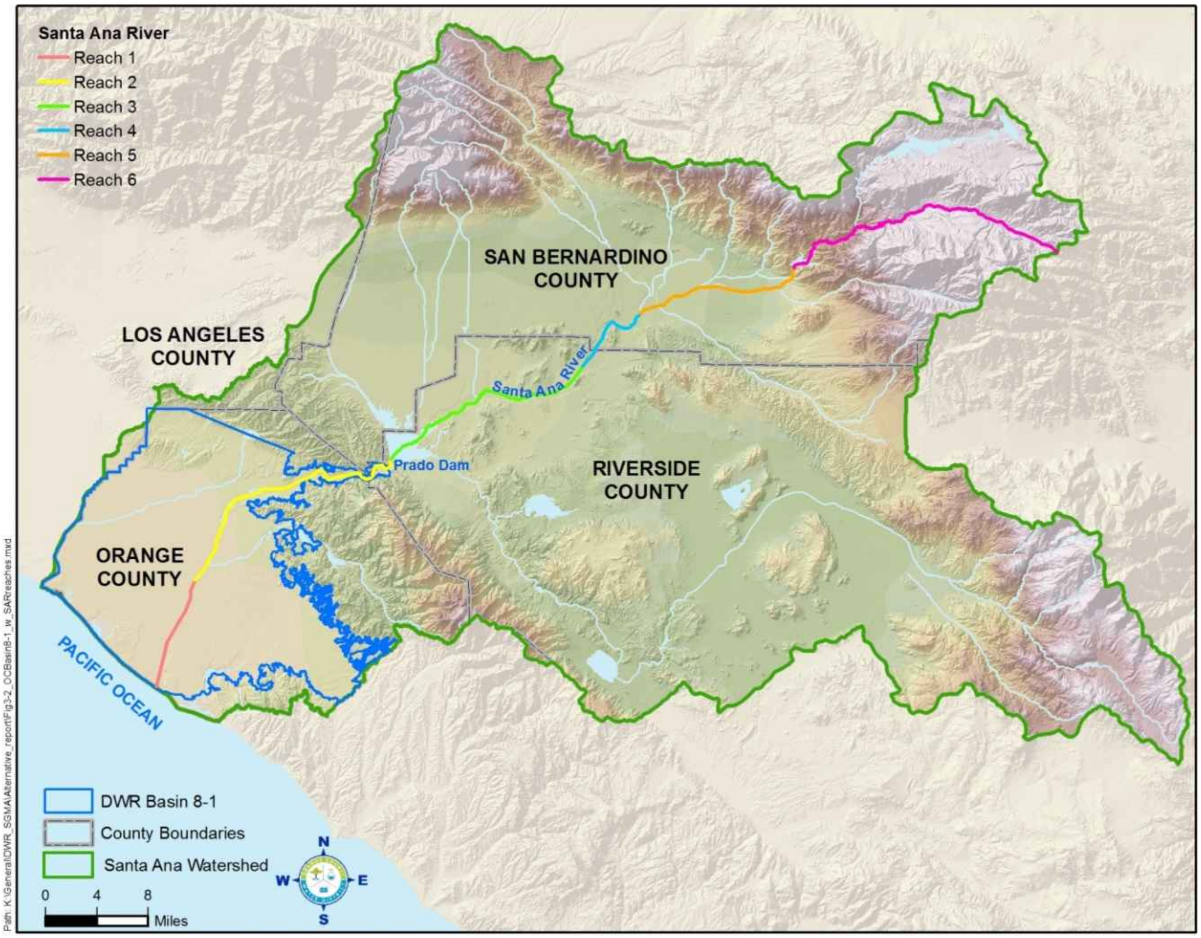


Figure 3-3: Santa Ana River Reaches

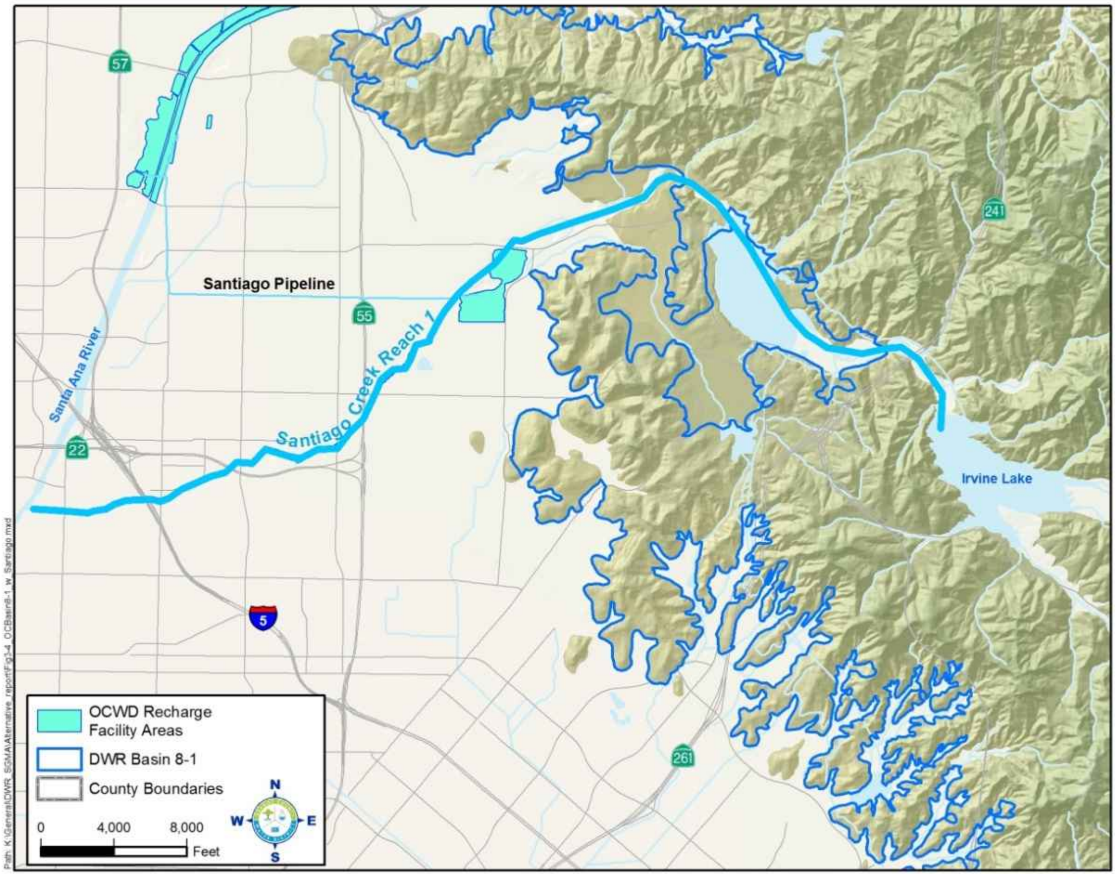


Figure 3-4: Santiago Creek and Santiago Basins

Table 3-2: Beneficial Use Designations for Surface Water Bodies

Surface Water Body	Existing or Potential Beneficial Use*							
	MUN	AGR	GWR	REC 1	REC 2	WARM	WILD	RARE
Santa Ana River, Reach 2- 17th Street in Santa Ana to Prado Dam		X	X	X	X	X	X	X
Santiago Creek, Reach 1- below Irvine Lake	X		X	X	X	X	X	
Coyote Creek (within Santa Ana Regional Boundary)	X			X	X	X	X	

*MUN- municipal and domestic supply; AGR-agricultural supply; GWR-groundwater recharge; REC 1-water contact recreation; REC 2-non-contact water recreation; WARM-warm freshwater habitat; WILD-wildlife habitat; RARE-rare, threatened, or endangered species

Source: Santa Ana Basin Plan X= Existing or Potential Beneficial Use

3.3 WATER QUALITY OBJECTIVES

3.3.1 Regulation of Groundwater Quality

The 1975 Basin Plan established groundwater subbasin boundaries in the Santa Ana Region for the purpose of designating water quality objectives for specified geographic areas. These subbasin boundaries were revised with the creation of Management Zones by amendments to the Basin Plan in 2004. The new Management Zones were defined on the basis of separation by impervious rock formations or other groundwater barriers, distinct flow systems defined by consistent hydraulic gradients that prevent widespread intermixing, and distinct differences in water quality.

Along with the creation of Management Zones, the Regional Water Board adopted water quality objectives for total dissolved solids (TDS) and nitrate-nitrogen for a majority of the management zones. The water quality objectives were based on historical concentrations of TDS and nitrate-nitrogen from 1954 to 1973. In Basin 8-1, the Regional Board established four management zones: La Habra, Santiago, Orange County, and Irvine (see Figure 3-2). For La Habra and Santiago Management Zones, the Regional Water Board did not established numeric objectives. For these two management zones, water quality is regulated by narrative objectives in the Basin Plan. For Orange County and Irvine Management Zones, numeric water quality objectives were adopted for TDS and nitrate-nitrogen (as N), as shown in Table 3-3.

Table 3-3: Groundwater Water Quality Objectives

MANAGEMENT ZONE	**WATER QUALITY OBJECTIVE**	
	Total Dissolved Solids (TDS)	**Nitrate-nitrogen (as N)**
La Habra*	---	---
Santiago*	---	---
Orange County	580 mg/L	3.4 mg/L
Irvine	910 mg/L	5.9 mg/L

* Numeric objectives not established; narrative objectives apply
Source: Regional Board, 2008

3.3.2 Regulation of Surface Water Quality

Water quality objectives for the Santa Ana River are a significant part of the Basin Plan, in part because the river water is a major source of groundwater recharge for Basin 8-1.

The Regional Water Board divides the Santa Ana River into five reaches (see Figure 3-3). The dividing line between Reaches 2 and 3 of the river, and between the upper and lower Santa Ana Basins, is Prado Dam, a flood control facility built and operated by the U.S. Army Corps of Engineers. The dam includes a subsurface groundwater barrier, and as a result all ground and surface waters from the upper basin are forced to pass through the dam (or over the spillway).

The quality of the Santa Ana River is a function of the quantity and quality of the base flows and storm flows. The base flow is primarily comprised of wastewater discharges. OCWD captures and recharges nearly all of the base flow and a portion of the storm flow in the river that is released through Prado Dam.

OCWD also recharges surface water within the Santiago Creek bed and in recharge basins located adjacent to the creek. Santiago Creek is the primary drainage for the northwest portion of the Santa Ana Mountains and ultimately drains into the Santa Ana River. Water from Santiago Creek is impounded by Santiago Dam, creating Irvine Lake, which is owned by the Irvine Ranch Water District and Serrano Water District. Downstream of Santiago Dam is Villa Park Dam, which is a flood-control facility owned and operated by the Orange County Flood Control District. OCWD owns and operates recharge basins downstream of Villa Park Dam.

The water quality objectives established in the Basin Plan for Santa Ana River, Reach 2 and Santiago Creek, Reach 1, are shown in Table 3-4. The Regional Board has not established numeric objectives for the portion of Coyote Creek within the Santa Ana Basin boundary.

Table 3-4: Surface Water Quality Objectives

SURFACE WATER BODY	WATER QUALITY OBJECTIVES Total Dissolved Solids (mg/L)
Santa Ana River, Reach 2	650 (5-year moving average)
Santiago Creek, Reach 1- below Irvine Lake	600
Coyote Creek (within Santa Ana Regional Boundary)	*

*Numeric objectives not established; narrative objectives apply

3.4 GENERAL WATER QUALITY OF THE PRINCIPAL AQUIFER

TDS concentrations in the Principal Aquifer in the OCWD Management Zone of Basin 8-1 generally range from 300 to 400 mg/L in the Pressure Area and from 500 to 700 mg/L in the Forebay Area. In the Irvine Management Zone, TDS concentrations range from approximately 400 mg/L west of Culver Drive to 1,000 mg/L in the area northeast of Interstate 5.

Nitrate (as N) concentrations in the OCWD Management Zone of Basin 8-1 generally range from less than 1 to 4 mg/L in the Pressure Area and from 4 to 7 mg/L in the Forebay Area. In the Irvine Management Zone, nitrate (as N) concentrations are generally less than 1 mg/L in the area west of Culver Drive and increase to 10 to 25 mg/L in the area northeast of Interstate 5.

The Regional Water Board requires that the ambient quality of groundwater in each of the Management Zones be recomputed every three years for TDS and nitrate. The most recent re-computation was completed in 2014 for the period ending in 2012. Ambient water quality concentrations for the Basin 8-1 Management Zones are shown in Table 3-5

Table 3-5: Ambient Water Quality

MANAGEMENT ZONE	AMBIENT WATER QUALITY	
	Total Dissolved Solids (TDS)	Nitrate-nitrogen (as N)
Orange County	610 mg/L	2.9 mg/L
Irvine	940 mg/L	6.7 mg/L
La Habra	963 mg/L	2 mg/L

Source: Wildermuth Environmental, Inc. 2014; City of La Habra

SECTION 4 REFERENCES

California Department of Public Works, Division of Water Resources, 1934, *South Coastal Basin Investigation, Geology and Ground Water Storage Capacity of Valley Fill*, Bulletin No. 45.

California Department of Water Resources, 1934. Bulletin No. 45 South Coastal Basin Investigation; Geology and Ground Water Storage Capacity of Valley Fill. State of California, Department of Public Works, Division of Water Resources.

***** 1947. Bulletin No. 53 South Coastal Basin Investigation; Overdraft on Ground Water Basins. State of California, Department of Public Works, Division of Water Resources.

***** 1967, *Progress Report on the Ground Water Geology of the Coastal Plain of Orange County*.

***** 1989, Southern District, *Analysis of Aquifer-System Compaction in the Orange County Ground Water Basin*, prepared for Orange County Water District.

***** 2003, *California's Groundwater* Bulletin No. 118

California Regional Water Quality Control Board, Santa Ana Region, 2008, Water Quality Control Plan, Santa Ana River Basin (8)

Geoscience, 2009. Draft Preliminary Geohydrologic Evaluation of the La Habra Basin. Prepared for City of La Habra, April 2, 2009.

Herndon, R. L., and J. D. Bonsangue, 2006, *Hydrology of the Orange County Groundwater Basin – An Updated Overview, Annual Field Trip Guide No. 33*, South Coast Geological Society, Inc.

Montgomery, 1977. La Habra Basin Ground Water Study. Prepared for City of La Habra, November 1977. James M. Montgomery Consulting Engineers, Inc.

Orange County Water District, 1991. *Santiago Creek Recharge Project, Phase 1 Hydrogeologic Investigation.*

***** 1994, *Hydrogeology and Groundwater Production Potential in the Vicinity of Brea Creek at Bastanchury Road, Fullerton, California*.

Poland, J.F. et al., 1956. Ground Water Geology of the Coastal Zone Long Beach-Santa Ana Area, California, USGS Water Supply Paper 1109.

Yerkes, R.F. 1972. Geology and Oil Resources of the Western Puente Hills Area, Southern California. Geological Survey Professional Paper 420-C.

Wildermuth Environmental, Inc., 2014, *Recomputation of Ambient Water Quality in the Santa Ana Watershed for the Period 1993 to 2012, Technical Memorandum,* Prepared for Santa Ana Watershed Project Authority Basin Monitoring Program Task Force.

Basin 8-1 Alternative

La Habra-Brea Management Area

Submitted by: City of La Habra
On behalf of: City of La Habra
City of Brea

January 1, 2017

Basin 8-1 Alternative

La Habra-Brea Management Area

JEFFREY D. HELSLEY
No. 39599
Exp. 12-31-2017

Jeffrey D. Helsley, P.E.

Stetson Engineers, Inc.
861 S. Village Oaks Drive, Suite 100
Covina, CA 91724

Prepared for the Department of Water Resources, pursuant to Water Code §10733.6(b)(3)

January 1, 2017

Section **Page**

Figure

Table

SECTION 1. EXECUTIVE SUMMARY

The La Habra-Brea Management area covers the northern corner of the Department of Water Resources (DWR) Basin 8-1, Coastal Plain of Orange County Groundwater Basin. The City of La Habra is established as the GSA under SGMA for the La Habra-Brea Management Area. This management area is part of Basin 8-1, but is hydrogeologically distinct from the OCWD Management Area and is not under the jurisdiction of OCWD. The City of La Habra adopted a resolution to establish the La Habra Groundwater Basin as a separate basin from Basin 8-1. OCWD adopted a resolution to support the City's request to DWR for an internal jurisdictional boundary modification in the OC Basin that follows the city limits of La Habra and Brea and is outside of the Orange County Water District's jurisdictional boundary. .

The La Habra-Brea Management Area is included with this Basin 8-1 Alternative to facilitate collaboration among groundwater agencies within Basin 8-1 as required by SGMA. The City of La Habra and portions of the City of Brea comprise the La Habra-Brea Management Area. This management area overlies the extents of the proposed La Habra Groundwater Basin, referenced herein. Figure 1-1 shows the extent of the La Habra Groundwater Basin and the cities (La Habra and Brea) with jurisdiction in the La Habra-Brea Management Area.

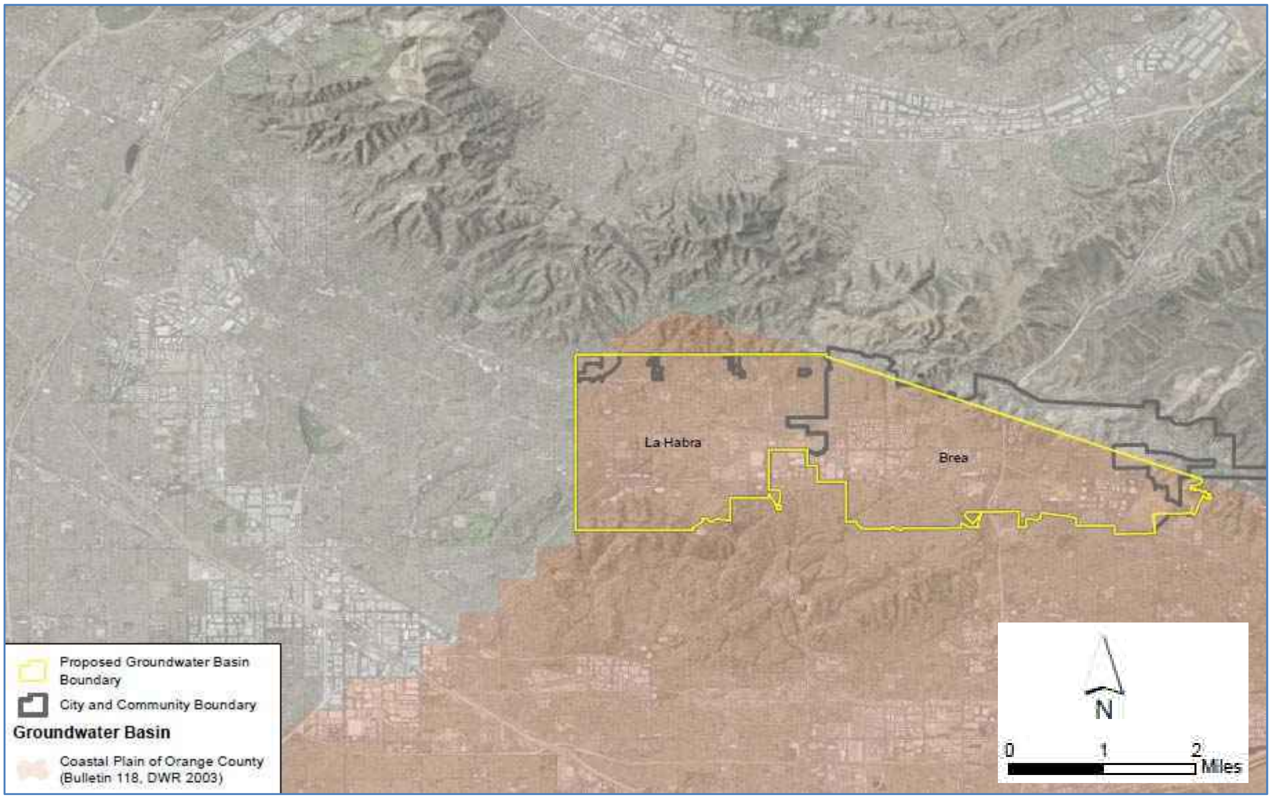


Figure 1-1: La Habra Groundwater Basin

The geologic structure of the La Habra Groundwater Basin is dominated by the La Habra Syncline, a northwest trending, U-shaped down-fold. The syncline is deepest in the Brea area and becomes increasingly shallower towards the City of Whittier and is bounded by the Whittier Fault within the Puente Hills to the north and the Coyote Hills to the south (Montgomery, 1977). The La Habra Syncline produces the La Habra Valley, a naturally-occurring valley, where significant amounts of groundwater have accumulated over the past 150,000 years (Malcolm Pirnie, 2011a).

Groundwater within the La Habra Groundwater Basin generally flows from the Puente Hills in a south or southwesterly direction. A groundwater level hydrograph for a well completed in the Alluvium shows water levels declining to their lowest level in the 1950s, and recovering during the 1970s. More recent data from a nearby well shows a leveling off of water levels through the 1990s. Wells completed in the San Pedro Formation show rising groundwater levels. The lowest groundwater levels in this aquifer were observed during the 1930s and 1940s, with water levels recovering about 60 feet through 1972. More recent data show an overall rising trend of 50 to 60 feet in groundwater levels from 1970 through 2007 and a slight decline during the last three years of data.

The City of La Habra pumps local groundwater from the La Habra Groundwater Basin from three production wells: the Idaho Street Well, the La Bonita Well, and the Portola Well. The City of Brea owns and operates one non-potable groundwater well used for irrigation at Brea Creek Golf Course.

The La Habra Groundwater Basin is currently monitored for groundwater elevations and for groundwater quality through productions wells and historical data from monitoring wells within the La Habra Groundwater Basin and surrounding area.

Groundwater resources protection is considered a critical component for safeguarding the long-term sustainability of the La Habra Groundwater Basin. Groundwater resources protection includes water resources planning as well as groundwater protection programs including well construction, abandonment, and destruction policies, wellhead protection, and the control of the migration and remediation of contaminated, poor quality, or saline water.

As the City of La Habra currently depends on local groundwater to meet approximately 40 percent of its water consumption, preserving the sustainability of the La Habra Groundwater Basin is essential for the well-being of the City. Currently (and historically), the City of La Habra manages (and has managed) the La Habra Groundwater Basin through management plans and programs for groundwater levels, basin storage, and water quality. By January 2020, the City will manage the La Habra Groundwater Basin through a Groundwater Sustainability Plan (“GSP”) under SGMA, which will describe the City’s monitoring program and ensure that no undesirable results occur in the future.

SECTION 2. AGENCY INFORMATION

2.1 HISTORY OF AGENCIES IN LA HABRA GROUNDWATER BASIN

Two cities overly the La Habra Groundwater Basin within Basin 8-1: the City of La Habra and the City of Brea, which are the only groundwater producers in the La Habra Groundwater Basin. See Figure 2-1.

The City of La Habra is located in the northwestern corner of Orange County. The City of La Habra serves a population of approximately 63,000 throughout its 7.3 square-mile service area. Los Angeles County borders the City of La Habra on the north and west, the City of Brea on the east, and the City of Fullerton on the south and southeast.

The City of Brea is located in the northwestern corner of Orange County. The City of Brea serves a population of approximately 40,377 throughout its 10.7 square-mile service area. Los Angeles County borders the City of La Habra on the north and west, the City of Brea on the east, and the City of Fullerton on the south and southeast.

Historically, the Cities of La Habra and Brea have managed the groundwater resources in the La Habra Groundwater Basin.

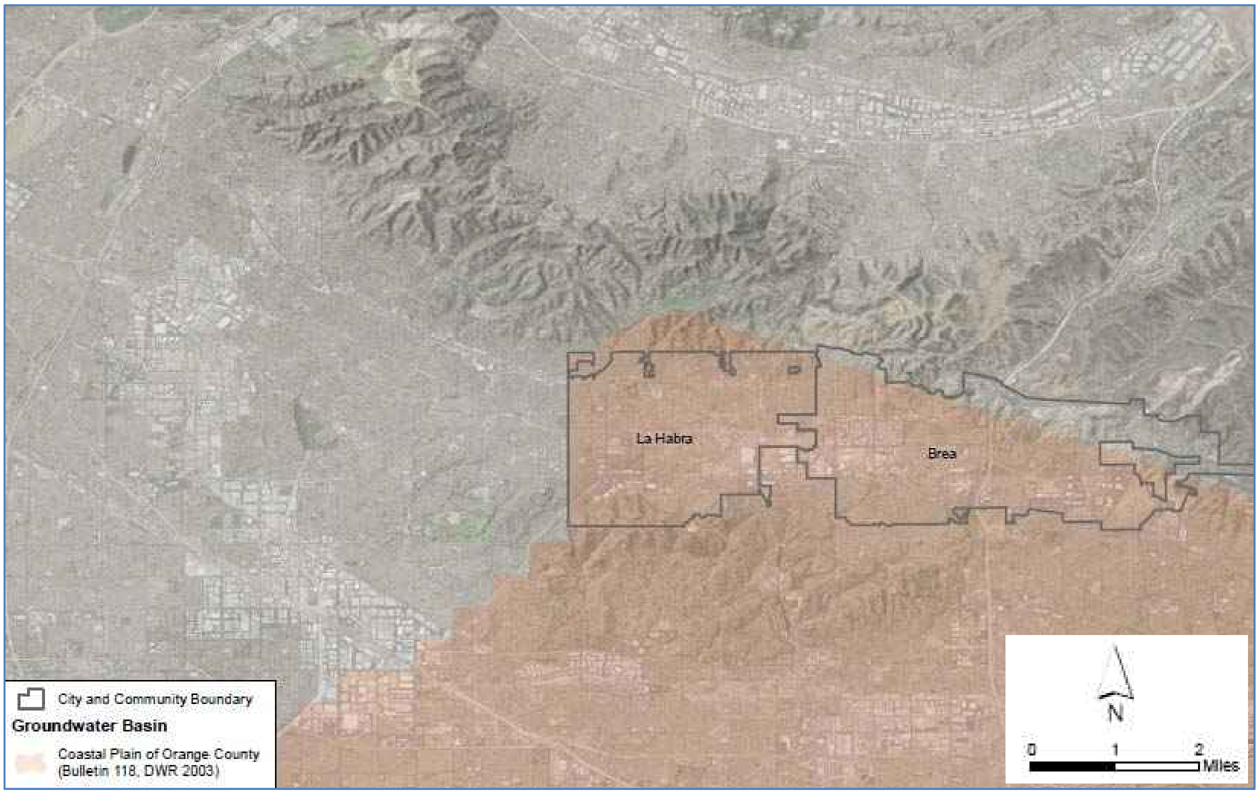


Figure 2-1: Cities of La Habra and Brea within Basin 8-1

2.2 GOVERNANCE AND MANAGEMENT STRUCTURE

Pursuant to California Water Code 10723 of the Sustainable Groundwater Management Act (SGMA), the City of La Habra, under a memorandum of agreement with the City of Brea, has been established as the Groundwater Sustainability Agency (GSA) for the La Habra Groundwater Basin. On December 21, 2015, the La Habra City Council adopted Resolution No. 5714 to establish La Habra as a GSA and formally notified the Department of Water Resources on May 11, 2016. The Department of Water Resources has listed the La Habra GSA as an "exclusive" GSA within the areas of the Basin identified in La Habra's GSA notification, meaning the 90 day notice period has expired and La Habra is the exclusive GSA for that portion of the basin, i.e. the La Habra-Brea Management Area.

2.3 LEGAL AUTHORITY

Apart from SGMA, the Cities of La Habra and Brea have the legal authority to make and enforce ordinances and regulations not in conflict with general laws within their jurisdictions, pursuant to California Constitution Article XI Section 7; and to establish ordinances not in conflict with the Constitution and State and Federal laws, pursuant to Government Code Title 4 Division 3 Part 2 Chapter 3 Section 37100. Pursuant to both Article XI, Section 7 and Article X, Section 2, the City of La Habra adopted Ordinance No. 1767 to prohibit extraction and exportation of groundwater underlying the City for use outside of the City.

As local government, the Cities can establish, purchase, and operate public works, including water services, pursuant to California Constitution Article XI Section 9. Likewise, Government Code Title 4 Division 3 Part 2 Chapter 10 Article 5 Section 38730 grants cities legal authority to acquire water, water rights, and all suitable water infrastructure to supply water to the City and its inhabitants.

As discussed in Section 2.2, the City of La Habra has been established as the GSA for the portions of the Cities of La Habra and Brea within a portion of Basin 8-1 that is outside of OCWD's jurisdiction, i.e. the La Habra-Brea Management Area.

Therefore, the Cities of La Habra and Brea have the authority independently, as Cities, and through the memorandum of agreement and establishment of the GSA, to manage the groundwater resources in the La Habra-Brea Management Area.

2.4 BUDGET

The costs for managing groundwater within the La Habra-Brea Management Area are for data collection and reporting. The budget for costs required to comply with this plan have not been estimated due to the minimal nature of the effort to collect and report groundwater production, level and water quality data.

The following funding sources are available to the La Habra GSA to finance groundwater projects. These sources are briefly described below.

- Grants and Loans from State and Federal Agencies: La Habra GSA has the option to pursue funding opportunities from DWR and other governmental agencies.
- Local Groundwater Assistance Program: Under AB 303 (the Local Groundwater Assistance Program), grants are awarded to public agencies with up to $250,000 to conduct groundwater studies or carry out groundwater monitoring and management programs.
- Capital Improvement Fees: La Habra GSA has the authority to collect repayment charges from beneficial parties of capital improvement projects such as a groundwater recharge or banking project.
- Water User Fees and Assessments: La Habra GSA has the authority to fund groundwater projects through water use fees and assessments collected regularly from City residents and businesses.

SECTION 3. MANAGEMENT AREA DESCRIPTION

3.1 LA HABRA GROUNDWATER BASIN SERVICE AREA

The La Habra-Brea Management Area refers to the northwestern portion of Basin 8-1, as defined by DWR Bulletin 118, overlying the La Habra Groundwater Basin. This management area is outside of the jurisdiction of OCWD. As discussed in Section 2.2, the City of La Habra adopted a resolution establishing it as a GSA, under a memorandum of agreement with the City of Brea, for management of the La Habra Groundwater Basin underlying the two cities. The City adopted a second resolution to establish the La Habra Basin as a separate basin from Basin 8-1. OCWD adopted a resolution to support the City's establishment of the La Habra Basin.

3.1.1 Jurisdictional Boundaries

The historical La Habra Groundwater Basin as described in DWR Bulletin 45 (1934) and Bulletin 53 (1947) is located in both Los Angeles (western basin) and Orange Counties (eastern basin) (see Figure 3-1). The majority of the historical La Habra Basin located in Los Angeles County is within Basin 4-11, the Coastal Plain of Los Angeles, as depicted in DWR Bulletin 118 (2003 update); the entirety of the La Habra Basin located in Los Angeles County is within the area subject to the terms of the Central Basin Adjudication. The majority of the historical La Habra Basin located in Orange County is within Basin 8-1, the Coastal Plain of Orange County as depicted in DWR Bulletin 118. Only a small portion of the historical La Habra Basin in Orange County is within the boundaries of the Orange County Water District.

The Cities of La Habra and Brea overlie a portion of the La Habra Groundwater Basin that is not within the area subject to the terms of the Central Basin Adjudication, nor within the boundaries of the Orange County Water District. The La Habra Groundwater Basin referred to herein, includes all of the City of La Habra and the portion of the City of Brea within Basin 8-1 but not within the jurisdiction of Orange County Water District, overlying the historical La Habra Groundwater Basin (see Figure 3-2).

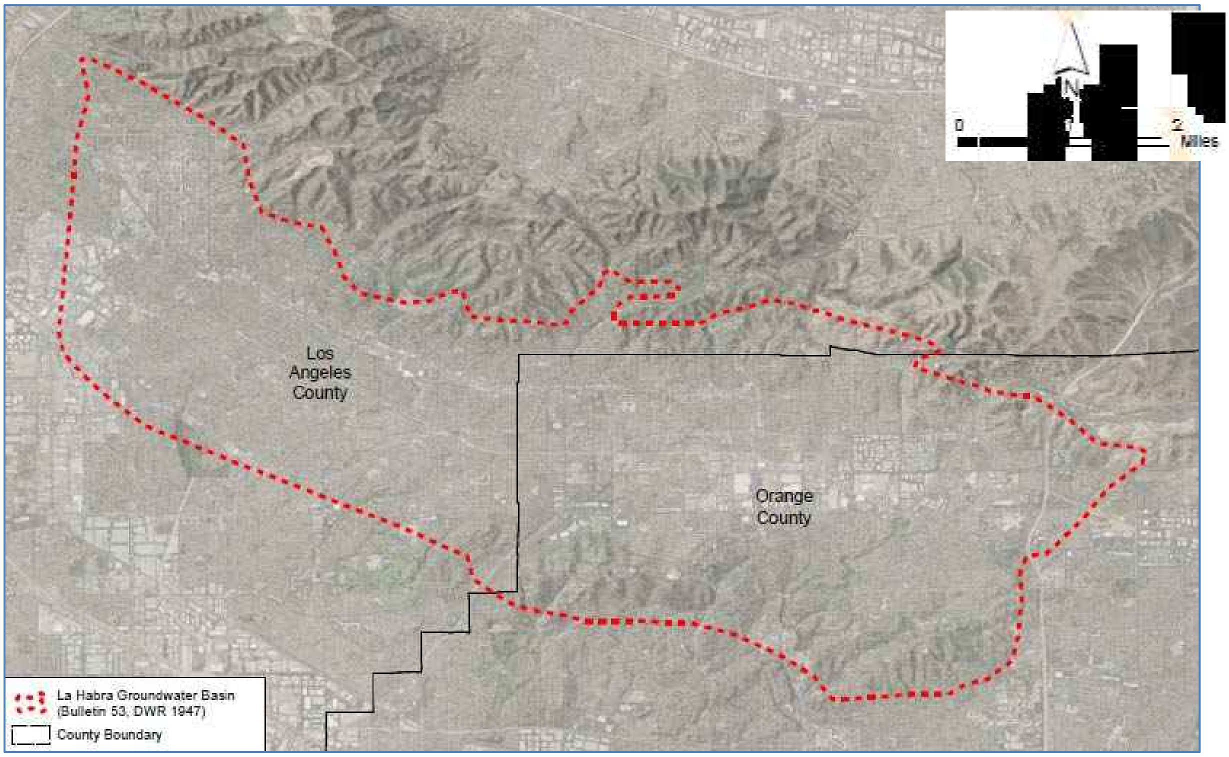


Figure 3-1: Historical La Habra Groundwater Basin (DWR, 1934. DWR, 1937)

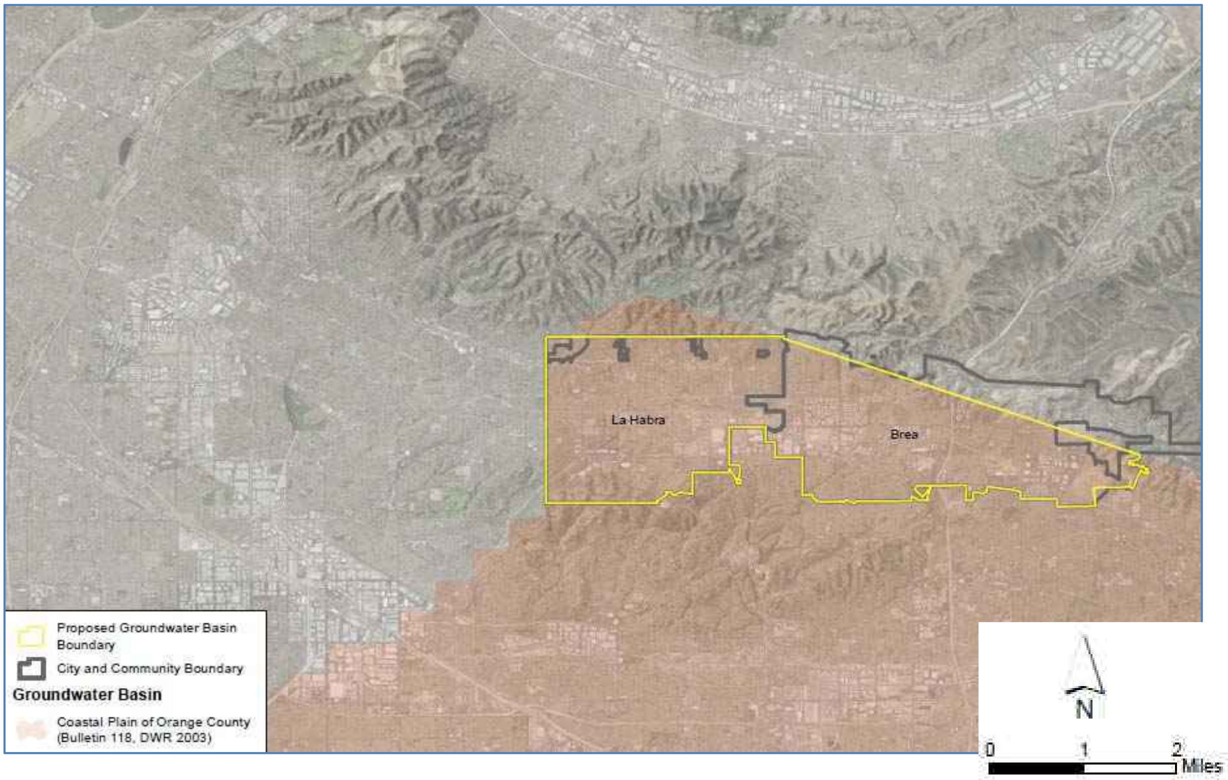


Figure 3-2 La Habra Groundwater Basin

3.1.2 Existing Land Use Designations

The major land use within the City of La Habra is low-density residential with pockets of medium-density residential areas. Portions of La Habra consist of commercial and light industrial land uses. Likewise, land use within the City of Brea is primarily residential with sections of commercial and industrial facilities.

3.2 GROUNDWATER CONDITIONS

The geologic structure of the La Habra Groundwater Basin is dominated by the La Habra Syncline, a northwest trending, U-shaped down-fold. The syncline is deepest in the Brea area and becomes increasingly shallower the west and is bounded by the Whittier Fault within the Puente Hills to the north and the Coyote Hills to the south (Montgomery, 1977). The La Habra Syncline produces the La Habra Valley, a naturally-occurring valley, where significant amounts of groundwater have accumulated over the past 150,000 years (Malcolm Pirnie, 2011a).

3.2.1 Groundwater Elevation

Groundwater within the La Habra Groundwater Basin generally flows from the Puente Hills in a south or southwesterly direction. Subsurface flow out of the basin occurs near Coyote and La Mirada Creeks into the Coastal Plain of Los Angeles and at the gap between the East and West Coyote Hills into the Coastal Plain of Orange County (Stetson, 2014).

A groundwater level hydrograph for a well completed in the Alluvium shows water levels declining to their lowest level in the 1950s, and recovering during the 1970s. More recent data from a nearby well shows a leveling off of water levels through the 1990s. Two other wells completed in the alluvium also show relatively flat water levels from the 1970s through the 1990s (Stetson, 2014).

Wells completed in the San Pedro Formation show rising groundwater levels. The lowest groundwater levels in this aquifer were observed during the 1930s and 1940s, with water levels recovering about 60 feet through 1972. This corresponds to DWR Bulletin No. 53 (1947) stating that the La Habra Groundwater Basin was in overdraft. More recent data show an overall rising trend of 50 to 60 feet in groundwater levels from 1970 through 2007 and a slight decline during the last three years of data. There were no water levels available for the La Habra Formation. See Section 3.2.3 for more information.

3.2.2 Regional Pumping Patterns

The transmissivity of a groundwater basin is the rate at which groundwater flows horizontally through the aquifer. Based on Montgomery (1977), the following are the estimated transmissivities in gallons per day per foot (gpd/ft) for each of the water-bearing zones of the La Habra Groundwater Basin.

- Alluvium: 200 gpd/ft to 10,000 gpd/ft

- La Habra Formation: 25,000 gpd/ft
- San Pedro Formation: 60,000 gpd/ft

Historically, all three water-bearing zones of the La Habra Groundwater Basin were developed for domestic and irrigation purposes, with most wells drilled between 1916 and 1940. The City of La Habra originally drilled three production wells in the deeper aquifers. Groundwater production in these wells ceased in 1968 (Montgomery, 1977). Based on Montgomery (1979), the Alluvium and La Habra Formations are not considered to have groundwater development potential for the following reasons: the Alluvium is limited in thickness and extent, has low permeability characteristics, and is of poor water quality while the La Habra Formation's permeable sand and gravel zones are thin and discontinuous. Groundwater production in the San Pedro Formation continues to this day. Based on Montgomery (1977), the following are expected well yields for each of the water-bearing zones of the La Habra Groundwater Basin.

- Alluvium: 200 gpm
- La Habra Formation: 100 gpm to 400 gpm
- San Pedro Formation: 300 gpm to 800 gpm

The City of La Habra pumps local groundwater from the La Habra Groundwater Basin from three production wells: the Idaho Street Well, the La Bonita Well, and the Portola Well. The Idaho Street Well has a capacity of 2,000 gpm but is regulated at 1,500 gpm. Water pumped from the Idaho Street Well requires treatment before entering into the distribution system. This treatment consists of chlorination, air-stripping to remove ammonia and hydrogen sulfide, and the addition of sodium hexametaphosphate to sequester iron and manganese (Malcolm Pirnie, 2011a). The capacity of La Bonita Well and Portola Well is 850 gpm and 1,200 gpm, respectively.

The City of Brea owns and operates one non-potable groundwater well used for irrigation at Brea Creek Golf Course (Brea, Water Master Plan Update, November 2009). The maximum capacity of this well is 450 gpm.

Table 3-1: Groundwater Production in La Habra Groundwater Basin (afy)

City	2011	2012	2013	2014	2015
City of La Habra	1,849	1,865	3,073	4,094	3,630
City of Brea	76	86	82	121	50
TOTAL	1,925	1,951	3,155	4,215	3,680

Source: 2015 Urban Water Management Plans (Arcadis, 2016).

Table 3-2: La Habra Groundwater Basin Wells

Well Owner	Well Name	Well Use	Well Depth (ft)	Well Capacity (gpm)
City of La Habra	Idaho Street	Potable	970	2,000
City of La Habra	La Bonita	Potable	890	850
City of La Habra	Portola	Potable	1,010	1,200
City of Brea	Irrigation Well	Irrigation	--	450

3.2.3 Long-Term Groundwater Elevation Hydrograph

Groundwater level data were compiled from DWR's Water Data Library for eight wells with sufficient data to analyze trends within the La Habra Groundwater Basin. The DWR groundwater data were available for 1970 through 2010. Montgomery's hydrographs from 1922 through 1975 are also included to capture earlier groundwater trends when there was more agricultural groundwater pumping for crop irrigation. Five of the ten monitoring wells had accompanying well logs to determine which aquifer was represented by the data. Figure 3-3 shows the location of these wells and the inferred direction of groundwater flow based on the groundwater level data (Stetson, 2014).

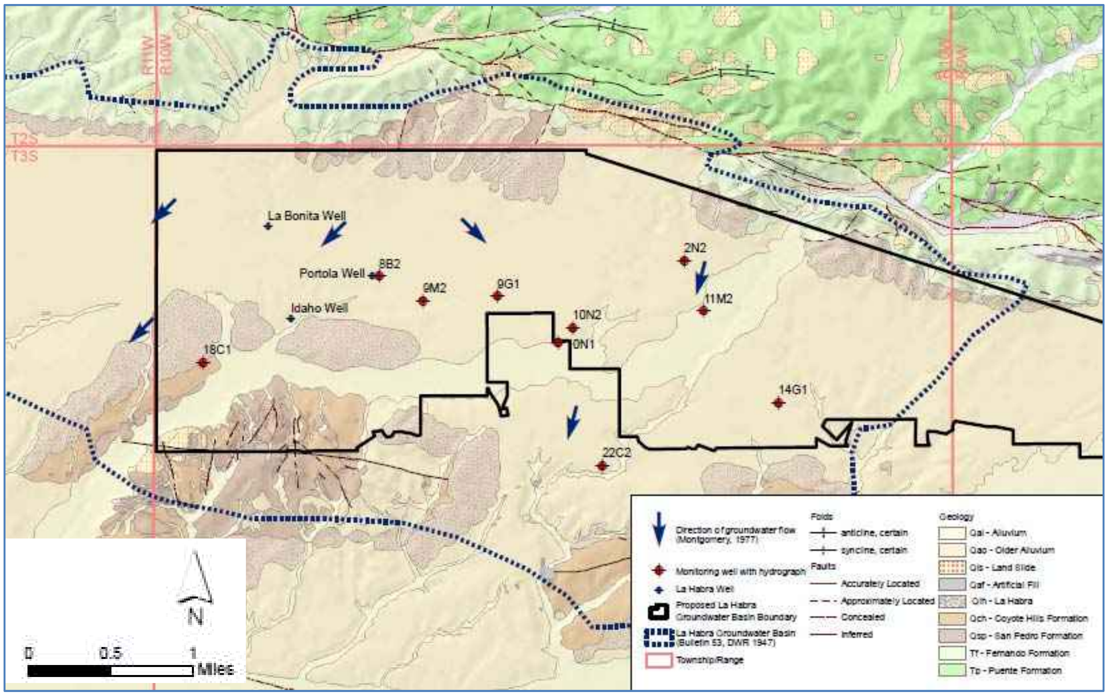


Figure 3-3: Groundwater Elevation Monitoring Wells

The groundwater level hydrograph for a well completed in the alluvial aquifer (Figure 3-4; T3/R10-10N1) shows water levels declining to their lowest level in the 1950s, and recovering during the 1970s. More recent data from a nearby well (Figure 3-5; T3/R10-10N2) shows a leveling off of water levels through the 1990s. Two other wells completed in the alluvium (T3/R10-2N2 and -9M2) also show relatively flat water levels from the 1970s through the 1990s, (Stetson, 2014).

Wells completed in the San Pedro aquifer show rising groundwater levels. The lowest groundwater levels in this aquifer were observed during the 1930s and 1940s, with water levels recovering about 60 feet through 1972 at well T3/R10-14G1. This corresponds to DWR Bulletin No. 53 (1947) stating that the La Habra Groundwater Basin was in overdraft. More recent data from well T3/R10-18C1 show an overall rising trend of 50 to 60 feet in groundwater levels from 1970 through 2007 and a slight decline during the last three years of data. There were no water levels available for the La Habra aquifer (Stetson, 2014).

Recent data showing the depth to groundwater are presented in Figure 3-6. Wells T3/R10-9G1 and -8B2 show a similar pattern of rising groundwater levels through 2007 as seen at well T3/R10-18C1 completed in the San Pedro aquifer. The alluvial aquifer well data present a relatively flat groundwater level from 10 to 40 feet below land surface. The depth to groundwater graph shows groundwater levels in the San Pedro Aquifer recovering to levels observed in the alluvial aquifer (Stetson, 2014).

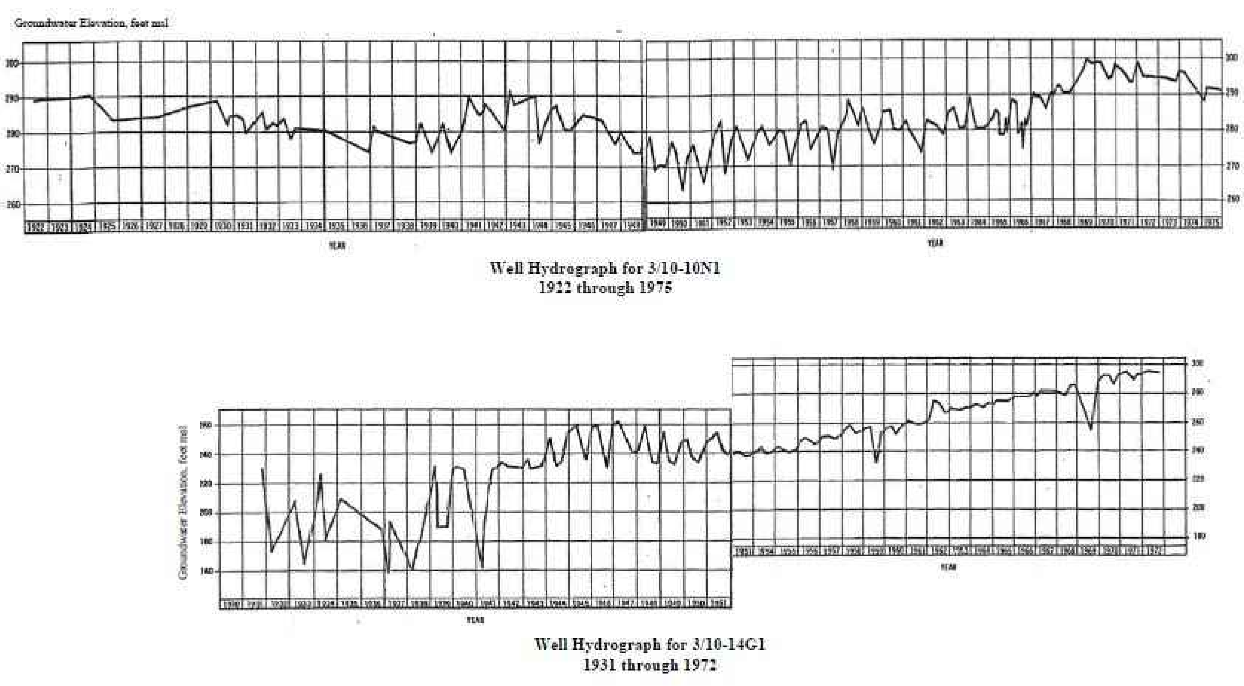
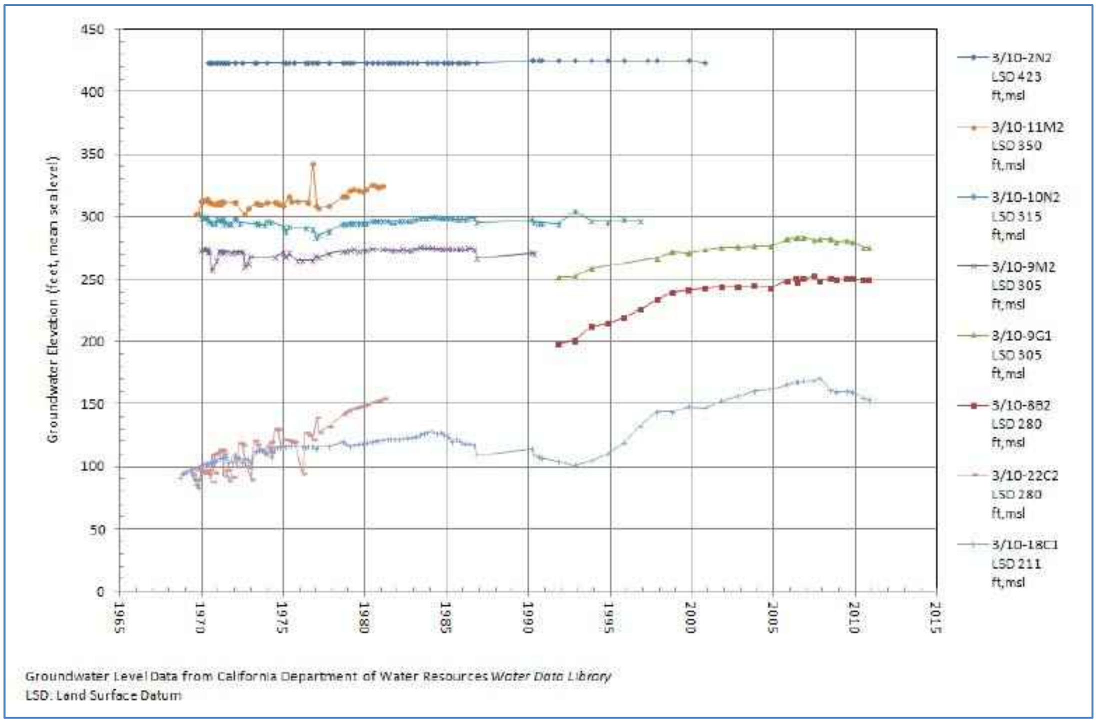


Figure 3-4: Early Well Hydrograph (1922-1975)

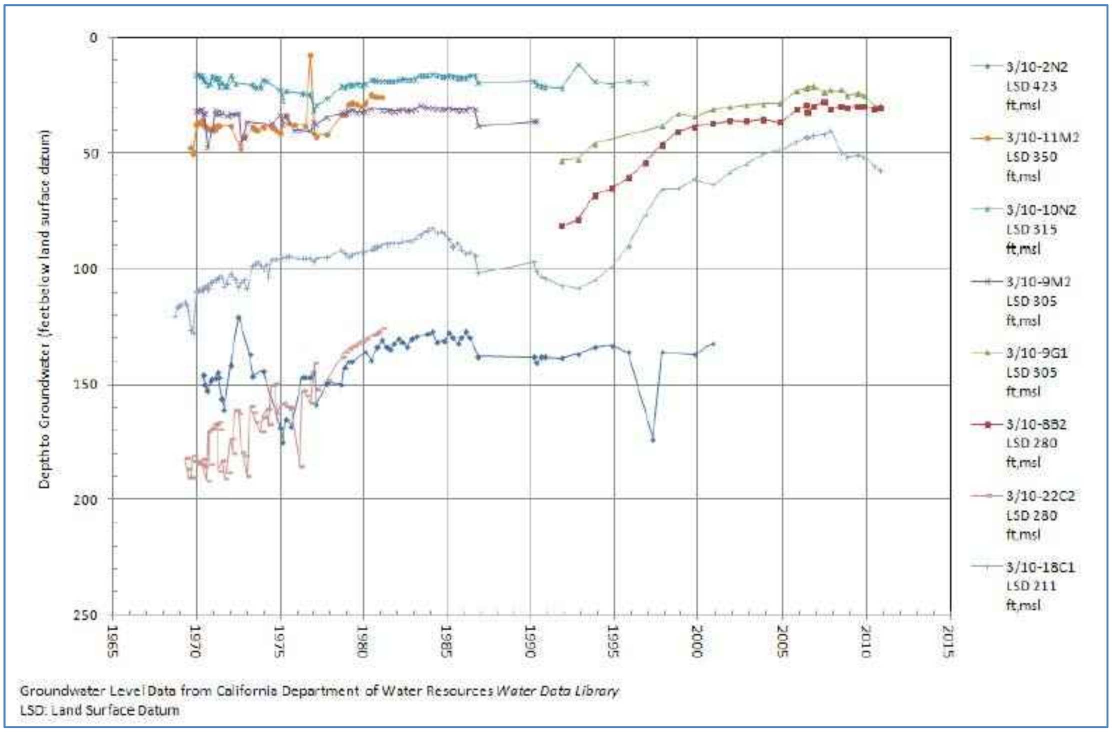
Source: Montgomery, 1977.



Groundwater Level Data from California Department of Water Resources *Water Data Library*
LSD: Land Surface Datum

Figure 3-5: Groundwater Level Hydrographs

Source: Stetson, 2014.



Groundwater Level Data from California Department of Water Resources *Water Data Library*
LSD: Land Surface Datum

Figure 3-6: Depth to Groundwater

Source: Stetson, 2014.

3.2.4 Groundwater Storage Data

According to the DWR Bulletin 45 (1934), the storage capacity of the historical La Habra Groundwater Basin is approximately 153,000 acre-feet. Approximately 57 percent of the historical La Habra Groundwater Basin is in the eastern portion of the basin which is now designated within Basin 8-1. The Cities of La Habra and Brea overlie approximately 60 percent of the eastern portion of the historical La Habra Groundwater Basin (Stetson, 2014). Accordingly, the storage capacity of the current La Habra Groundwater Basin is approximately 55,000 acre-feet.

3.2.5 Groundwater Quality Conditions

Previous investigations of water quality within the La Habra Basin determined that the quality is extremely variable. It was shown that shallow regions within the central portion of the basin as well as areas recharged by surface water along the basin boundary are of a bicarbonate and chloride character. Sulfate concentration increased with depth in the La Habra and San Pedro water-bearing zones. The historical data also shows that total dissolved solids (TDS) concentrations have remained relatively stable (Montgomery, 1977). The current TDS concentration in La Habra wells is approximately 960 mg/L. Overall, groundwater from the San Pedro Aquifer is considered to be of fair to good quality (Montgomery, 1979).

Water from the La Bonita and Portola Wells is chlorinated and then blended with water purchased from the California Domestic Water Company in a 250,000-gallon forebay to reduce the concentration of minerals prior to entering the City of La Habra’s distribution system (La Habra, 2014).

The City of Brea’s non-potable well is strictly used for irrigation purposes as the groundwater beneath the city has poor water quality and would require extensive treatment and blending with higher quality water to meet public health standards (Malcolm Pirnie, 2011).

Table 3-3: Historical Constituent Concentrations (1927-1977)

Constituent	Minimum	Maximum	Average
Specific Conductance	255	2,235	1,324
Total Dissolved Solids	269	1,696	943
Sulfate	0	672	174
Chloride	18	460	161
Nitrate	0	185	44
Fluoride	0	1.6	0.44
Total Hardness	75	931	489

Source: Montgomery, 1977.

3.2.6 Land Subsidence

Based on Orange County Water District’s 2015 Update to its Groundwater Management Plan, there is no evidence that the observed minimal land surface changes in portions of Orange County has caused, or are likely to cause, any structural damage within the area (OCWD, 2015). As long as groundwater elevations and storage within the basin are maintained within their historical operating ranges, the potential for problematic land subsidence is reduced.

Additionally, the United States Geological Survey (USGS) does not show the La Habra Groundwater Basin as an area where there have been historical or current subsidence recorded due to either groundwater pumping, loss of peat, or oil extraction (USGS, 2016).

3.2.7 Groundwater and Surface Water Interactions and Groundwater Dependent Ecosystems

The La Habra Groundwater Basin lies entirely within the Coyote Creek Watershed (see Figure 3-7). The Coyote Creek Watershed drains approximately 165 square miles of densely populated areas of residential, commercial, and industrial areas as well as areas of open space (Atkins, 2012). Coyote Creek is a tributary to the San Gabriel River. Major Creeks within the watershed are: Coyote Creek, Brea Creek, Fullerton Creek, Carbon Creek, Moody Creek, and Los Alamitos Channel.

Coyote Creek, Brea Creek, and La Mirada Creek (a non-major creek) all flow into and drain out of the La Habra Valley. The total drainage area of these three creeks within the valley is approximately 12,950 acres (Stetson, 2013). Coyote Creek and La Mirada Creek are surface waters flowing through the boundaries of the City of La Habra. Montgomery (1977) determined that about 30% of the runoff available in an average rainfall year percolates to the aquifers underlying the La Habra Valley.

Within the La Habra Valley, direct percolation of precipitation also occurs. The 40-year average rainfall (14 inches) results in a water supply from precipitation within the 10,160-acre drainage area of approximately 11,870 AFY (Stetson, 2013).

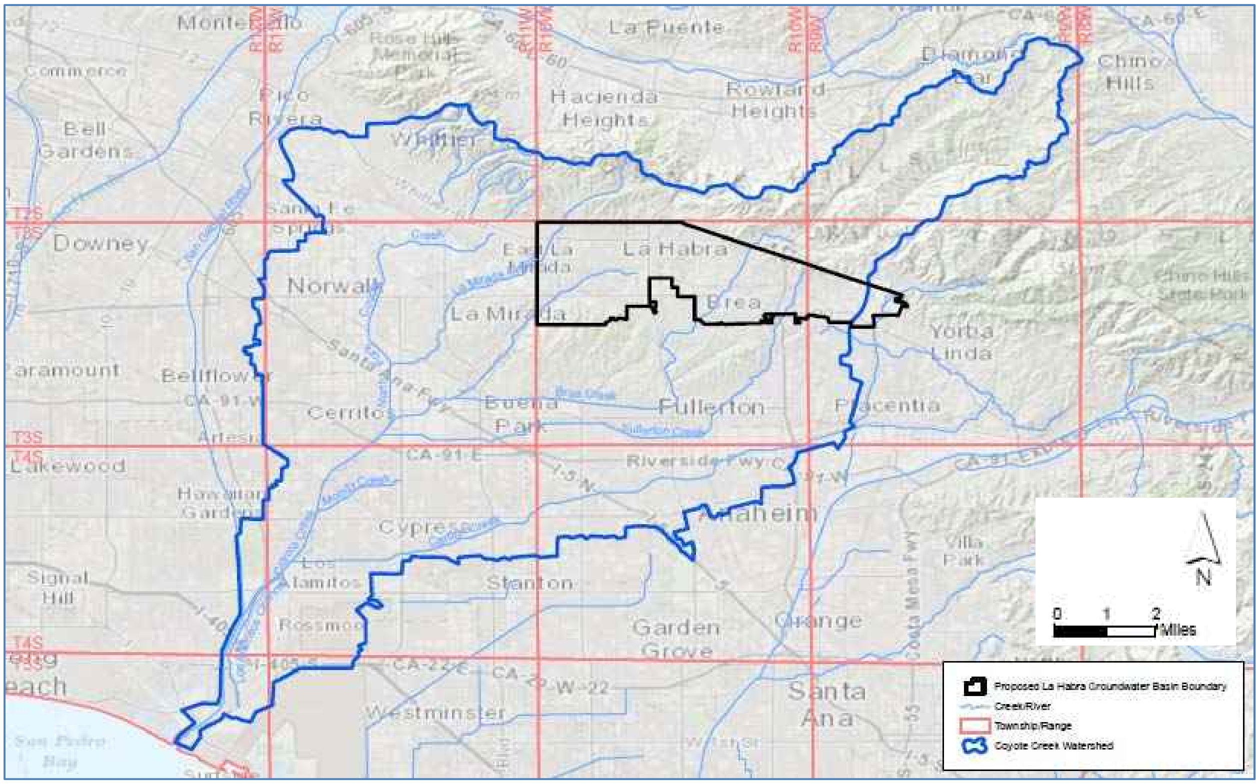


Figure 3-7: Coyote Creek Watershed

SECTION 4. WATER BUDGET

4.1 BUDGET COMPONENTS

The components of the water budget generally include recharge from precipitation and runoff, recharge from subsurface inflow, subsurface outflow, and groundwater production.

Groundwater production in the La Habra Groundwater Basin has ranged from approximately 2,000 AFY to 4,200 AFY in recent years (See Table 3-1). Subsurface flow out of the groundwater basin occurs near Coyote and La Mirada Creeks into the Coastal Plain of Los Angeles, and at the gap between the East and West Coyote Hills into the Coastal Plain of Orange County (Stetson, 2014). The remaining breakdown of the water budget components in the La Habra Groundwater Basin is not well known; therefore, a formal water budget has not been established but will be established in accordance with DWR regulations as part of the GSP development that is anticipated to occur within the La Habra-Brea Management Area before 2020.

As discussed in the section below, based on water level measurements the water budget appears to be in balance over the past ten years. Changes in groundwater storage are monitored through the monitoring of groundwater elevations and have shown rising trends since the 1970s.

4.2 ESTIMATE OF SUSTAINABLE YIELD

In 1977, Montgomery Engineers completed a groundwater study for the City of La Habra and estimated the “probable long-term groundwater basin yield” of the La Habra Groundwater Basin. Stetson conducted a re-evaluation of Montgomery’s 1977 safe yield analysis in 2013. The average of these two methods results in an approximate safe yield of 4,500 AFY.

The City of La Habra has been producing groundwater since the late 1990s and monitoring non-pumping and pumping groundwater elevations since 2008. Previous investigations into groundwater levels and the safe yield have been used to manage the La Habra Groundwater Basin for over 10 years.

Groundwater production within the La Habra-Brea Management Area will be managed by the establishment of the safe yield so that the groundwater levels and storage capacity in the La Habra Groundwater Basin will be maintained.

SECTION 5. WATER RESOURCE MONITORING PROGRAMS

5.1 OVERVIEW

The La Habra Groundwater Basin is currently monitored for groundwater elevations and for groundwater quality through productions wells and monitoring wells within the City of La Habra. Surface water is currently not monitored in the Cities of La Habra and Brea overlying the La Habra Groundwater Basin. Recycled water is not used within the La Habra-Brea Management Area. Imported surface water and groundwater are used within the La Habra-Brea Management Area for potable supply. These potable water sources are monitored prior to delivery and not directly monitored by the Cities of La Habra and Brea.

5.2 GROUNDWATER MONITORING PROGRAMS

Groundwater Elevations

Since 2008, the City of La Habra has measured non-pumping and pumping groundwater elevations at its production wells to review general trends in groundwater elevations in the Basin.

The City of La Habra will supplement its existing groundwater elevation monitoring program by including water level measurements reported by DWR for three monitoring wells in the La Habra Basin. Groundwater elevations are reported by DWR for wells 3/10-9G1, 3/10-8B2, and 3/10-18C1. By January 2020, the City’s monitoring program will be governed by its GSP under SGMA.

Groundwater Quality

Currently, the City samples for constituents at its production wells pursuant to Title 22 of the California Code of Regulations (Title 22). Under Title 22, the City monitors and reports groundwater quality for constituents that are regulated by the State Water Resources Control Board Division of Drinking Water pertaining to maximum contaminant levels (MCLs). The City of La Habra also monitors areas of contamination, as described in its Drinking Water Source Assessments provided to the Division of Drinking Water for its production wells. The City of La Habra plans to continue to review and comment on documents regarding these areas within the City limits as well as be aware of any areas outside of its jurisdiction that may affect the water quality of the Basin through surface or subsurface flow.

The City of La Habra plans to continue its existing groundwater water quality monitoring program and will evaluate the need for additional monitoring above its current program in accordance with DWR GSP regulations.

5.3 OTHER MONITORING PROGRAMS

Currently the City of La Habra does not perform any surface water quality monitoring; however, the City of La Habra will investigate any existing programs for the Coyote Creek Watershed including monitoring programs being developed in response to regulations set forth for the watershed by the local Regional Water Quality Control Board (Coyote Creek is shown on the Clean Water Act's 303(d) list of impaired waters). The City of La Habra will consider developing and implementing its own surface and subsurface inflow quality monitoring programs for the local watershed in accordance with DWR GSP regulations.

Likewise, the City of La Habra does not monitor land subsidence within the La Habra-Brea Management Area. However, the City may develop a program to monitor and measure the rate of land surface subsidence in accordance with DWR GSP regulations.

SECTION 6. WATER RESOURCE MANAGEMENT PROGRAMS

Groundwater resources protection is considered a critical component for safeguarding the long-term sustainability of the La Habra Groundwater Basin. Groundwater resources protection includes water resources planning and an ordinance to prohibit the extraction and exportation of groundwater underlying the City for use outside the City as well as groundwater protection programs including well construction, abandonment, and destruction policies, wellhead protection, and the control of the migration and remediation of contaminated, poor quality, or saline water.

6.1 LAND USE ELEMENTS RELATED TO BASIN MANAGEMENT

The Cities of Brea and La Habra participate in two water resources management planning documents: the Integrated Regional Water Management Plan, and the Urban Water Management Plan.

Integrated Regional Water Management Plan

Integrated Regional Water Management (IRWM) is a collaborative approach of implementing water management solutions on a regional scale in order to address water resources needs. The Greater Los County Region has been designated as an IRWM region and is comprised of the following subregions: North Santa Monica Bay, South Bay, Upper Los Angeles River, Upper San Gabriel and Rio Hondo Rivers, and Lower San Gabriel and Los Angeles Rivers. The Coyote Creek watershed, which overlies the La Habra Groundwater Basin, is within the Lower San Gabriel and Los Angeles Rivers IRWM subregion. The La Habra Groundwater Basin contributes a small portion of the groundwater produced within the subregion.

Urban Water Management Plan

Water Code Sections 10610 through 10656 of the Urban Water Management Planning Act require every urban water supplier providing water for municipal purposes to more than 3,000 customers or supplying more than 3,000 acre-feet (AF) of water annually to prepare, adopt, and file an Urban Water Management Plan (UWMP) with the California Department of Water Resources (DWR). The Cities of Brea and La Habra both are required to file an UWMP every five years with DWR. The UWMP is a management tool that provides water planning and identifies water supplies needed to meet existing and future water demands.

6.2 GROUNDWATER WATER QUALITY PROTECTION AND MANAGEMENT

Well Construction, Abandonment, and Destruction Policies

The policies that govern well construction, abandonment, and destruction are designed specifically to protect groundwater quality. The administration of these policies has been delegated to individual counties by California legislature. As stated in Orange County Ordinance No. 2607, all well activity within Orange County will comply with the standards set in DWR Bulletin 74, Chapter 2. These standards are enforced by the Orange County Health Care Agency. The Cities of La Habra and Brea properly construct and abandon wells pursuant to Orange County Ordnance No. 2607.

Wellhead Protection Measures

Wellhead protection is a way to prevent drinking water from being contaminated by managing sources of potential contamination within the vicinity of a production well. Surface contaminants can enter a well through the outside edge of the well casing or directly through opening in the well head. These contaminants can travel in two directions: to the groundwater aquifer or to the distribution system. As defined in the Safe Drinking Water Act Amendments of 1986, a wellhead protection area is “the surface and subsurface area surrounding a water well or well field supplying a public water system, through which contaminants are reasonably likely to move toward and reach such water well or well field.”

The Cities of La Habra and Brea design and construct wells in accordance with the measures described in DWR Bulletin 74 so that the wellhead is protected from contamination. Important wellhead protection measures described in Bulletin 74 include: methods for sealing the well from intrusion from surface contaminants, site grading to assure drainage is away from the wellhead, and set-back requirements from known pollution sources.

Control of Migration and Remediation of Contaminated Groundwater

Groundwater can become contaminated naturally or through human activity. Based on a 2010 drinking water assessment performed by the City of La Habra, sources of potential groundwater contamination to the La Habra Basin include: car repair and bodywork shops, gas stations, machine and metalwork shops, and sewer collection systems (La Habra, 2013).

The City of La Habra has previously taken the position that oil and gas mining operations in or up gradient of the basin have the potential to release chemicals that could contaminate groundwater, particularly during fracking activities.

The Cities of La Habra and Brea will monitor the migration of contaminants through its water quality monitoring program and will also monitor nearby oil and gas mining operations. This will allow the point and non-point pollution sources to be identified. If contamination becomes a concern in the future, an approach to address the problem will be developed.

Control of Saline Water Intrusion

Raised salinity is a significant water quality problem in many parts of the southwestern United States and southern California, including Orange County. Elevated salinity is of concern as it can limit the implementation of recycling water projects and potentially require water purveyors to perform additional treatment on their water supplies.

The level of salinity is sometimes measured based on Total Dissolved Solids (TDS) concentrations. The TDS concentrations in the La Habra Basin are naturally occurring and it is not believed that current activities in the basin significantly contribute to the TDS loading in the basin. The TDS concentrations are not a result of saline water intrusion. The TDS concentrations in the City of La Habra's wells are below the secondary Maximum Contaminant Level (MCL) of 1,000 mg/L. TDS is listed as a secondary constituent as it does not directly cause harm to consumers but can affect the aesthetic quality of the water, including taste.

6.3 GROUNDWATER EXPORT PROHIBITION

The protection of the health, welfare, and safety of the residents and economy of the City of La Habra require that the groundwater resources of the City be protected for present and future municipal, industrial, and domestic beneficial uses within the City. The sustainable yield of the portion of the La Habra Basin underlying the City is not sufficient to serve beneficial uses in addition to the beneficial municipal, industrial and domestic uses currently served through the City municipal water system. The best interest of the present and future inhabitants of the City is served by the prohibition against the extraction and exportation of groundwater produced from within the City's jurisdictional boundaries. Accordingly, on December 21, 2015, the City of La Habra adopted Ordinance No. 1767 to prohibit the extraction and exportation of groundwater underlying the City for use outside of the City.

SECTION 7. NOTICE AND COMMUNICATION

7.1 INTRODUCTION

The Cities of La Habra and Brea overlie the La Habra Groundwater Basin and are the only producers of groundwater within the basin. Potential agencies that may additionally have a stake in the successful management of the basin include:

- Central Basin Watermaster (DWR): adjudicated Central Basin (Los Angeles)
- OCWD: actively manages Orange County portion
- City of Fullerton: included in OCWD’s service area

7.2 GROUNDWATER PRODUCERS

As the City of Brea is a direct stakeholder in the Orange County portion of the La Habra Basin outside of OCWD’s service area, Brea was included in the preparation of this plan.

While the Central Basin Watermaster, OCWD, and the City of Fullerton do not have a direct stake in the Orange County portion of the La Habra Basin outside of OCWD’s service area that is the focus of this Plan, the portions of the historical La Habra Basin underlying these entities are hydrologically connected to the portion of the basin that is the subject of this Plan. As such these entities were informed that OCWD was preparing this Plan and the planned management of the basin was discussed with them.

7.3 PUBLIC PARTICIPATION

The City of La Habra has invited the public to participate in City Council meetings where management of the La Habra Basin and future actions have been discussed and presented. On December 21, 2015, La Habra held a public hearing to establish La Habra as a GSA for the La Habra Basin and to establish the La Habra Basin as a separate basin from Basin 8-1. Notice for the public hearing was posted in the Orange County Register in accordance with Government Code Section 6066. The City Council also approved the readings of an ordinance to prohibit the extraction and exportation of groundwater underlying La Habra for use outside of the city on December 21, 2015 and January 19, 2016. This ordinance took effect on February 18, 2016.

The La Habra GSA will strive to involve the public in groundwater management decisions regarding the La Habra-Brea Management Area. In the future, the La Habra GSA plans to provide copies of the periodic groundwater reports that will be prepared to the public at their request and publish information on groundwater management accomplishments on the City’s website. The La Habra GSA will also comply with the public participation requirements under SGMA.

7.4 COMMUNICATION PLAN

The La Habra GSA plans to prepare a summary report of the current conditions of the La Habra Groundwater Basin ideally every two to five years using the results from the monitoring program (see Section 5.0). These informative reports will be used to plan future groundwater projects, develop new groundwater policies, and identify any new concerns with the basin.

SECTION 8. SUSTAINABLE MANAGEMENT APPROACH

As the City of La Habra currently depends on local groundwater to meet approximately 40 percent of its water consumption and the City of Brea uses groundwater to meet irrigation needs, preserving the sustainability of the La Habra Groundwater Basin is essential for the well-being of the two cities. Currently (and historically), the City of La Habra manages (and has managed) the La Habra Groundwater Basin through management plans and programs for groundwater levels, basin storage, water quality, groundwater export prohibition, and groundwater-surface water interactions, discussed below in Sections 9, 10, 11, and 14, respectively. Seawater intrusion and land subsidence are not occurring in the La Habra-Brea Management Area and therefore are not actively managed at this time, but will be monitored under the La Habra GSP. By January 2020, the La Habra GSA will manage the La Habra- Brea Management Area through its GSP, which will describe the City's monitoring program and ensure that no undesirable results occur in the future.

As a key component of sustainable management, the Cities of La Habra and Brea strongly promote conservation as a means to preserve water supplies. Both cities have sections on their websites dedicated to water conservation in addition to including conservation guidance in their annual Consumer Confidence Reports distributed to residents.

SECTION 9. SUSTAINABLE MANAGEMENT RELATED TO GROUNDWATER LEVELS

A solid understanding of groundwater elevations, seasonal fluctuations and response to pumping, existing basin yield, and how groundwater is stored and transmitted through the basin is critical for sustainably managing the La Habra-Brea Management Area.

9.1 HISTORY OF BASIN CONDITIONS AND MANAGEMENT ACTIONS

As shown on Figures 3-4, 3-5, and 3-6, groundwater levels in the La Habra-Brea Management Area have recovered from lows in the 1930 to 1950s and have experienced a general rising trend and leveling off since the 1970s. Given consistent groundwater production within the estimated safe yield of the basin, groundwater levels are expected to remain steady in the future.

9.2 MONITORING OF GROUNDWATER LEVELS

As discussed in Section 5.2, the La Habra GSA has measured non-pumping and pumping groundwater elevations at its production wells since 2008. In addition, DWR reports water level measurements for some monitoring wells in the La Habra Groundwater Basin. Groundwater levels reported by DWR for wells 3/10-9G1, 3/10-8B2, and 3/10-18C1 will be included in the periodic reviews of the condition of the basin.

In accordance with DWR GSP regulations, the City of La Habra will evaluate the need for additional monitoring above its current groundwater elevation monitoring program. The need for standard and multi-level monitoring wells to monitor the three aquifers of the basin will be investigated. Characterization of the conditions of the basin using the City’s existing groundwater elevation data from its production wells may not reflect steady state conditions because the wells pump frequently and groundwater within the well does not have enough time to fully recover to obtain a static elevation before the well is put into production once more. Static elevations may be recorded through the use of monitoring wells where no pumping is performed and the well is constantly in a static condition.

If the City constructs a monitoring or production well in the future, the City will perform aquifer tests to determine the hydrologic properties of each aquifer.

9.3 DEFINITION OF SIGNIFICANT AND UNREASONABLE LOWERING OF GROUNDWATER LEVELS

The definition of significant and unreasonable lowering of groundwater levels in the La Habra Management Area is a lowering of groundwater levels such that a significant loss of well production capacity or a significant degradation of water quality occurs which would impact the intended use of the groundwater.

9.4 DETERMINATION OF MINIMUM THRESHOLDS

There are no minimum thresholds established for groundwater levels in the La Habra Groundwater Basin because the basin is currently not in overdraft and is managed within the safe yield of the basin. If chronic or significant lowering of groundwater levels are observed through groundwater level monitoring, the La Habra GSA will evaluate its operations, re-evaluate the safe yield and establish minimum thresholds, where appropriate, and in accordance with SGMA.

SECTION 10. SUSTAINABLE MANAGEMENT RELATED TO BASIN STORAGE

10.1 HISTORY

As discussed in Section 9.1, groundwater levels in the La Habra Groundwater Basin have recovered from lows in the 1930 to 1950s and have experienced a general rising trend and leveling off since the 1970s. Given steady groundwater production within the estimated safe yield of the basin, groundwater levels are expected to remain steady in the future.

10.2 MONITORING STORAGE LEVELS

The monitoring of storage levels is indirectly monitored through the groundwater level monitoring program described in Section 9.2.

10.3 MANAGEMENT PROGRAMS

10.3.1 Establishment of Safe Yield

A “safe yield” is used for ongoing management and future planning of a groundwater basin for sustained beneficial use. It is generally defined as the volume of groundwater that can be pumped annually without depleting the aquifer beyond its ability to recover through natural recharge over a reasonable hydrologic period. In 1977, Montgomery Engineers completed a groundwater study for the City of La Habra and estimated the “probable long-term groundwater basin yield” of the La Habra Groundwater Basin. Stetson conducted a re-evaluation of Montgomery’s 1977 safe yield analysis in 2013. The average of these two methods results in an approximate safe yield of 4,500 AFY.

Based on a review of groundwater elevations performed in January 2014, groundwater elevations in the San Pedro aquifer of the La Habra Basin appear to have risen about 100 feet from the 1940s to the present with an overall rising trend of 50 to 60 feet between 1970 and 2007 (Stetson, 2014). Therefore, it appears that the basin is not currently in an overdraft condition.

The City of La Habra can maintain sustainable groundwater production by maintaining and coordinating groundwater production within the estimated safe yield of the La Habra Groundwater Basin.

10.3.2 Review and Evaluation of Groundwater Levels

The condition of the basin can be verified through a periodic review of groundwater elevations within the basin. The City can utilize and supplement its existing groundwater elevation monitoring program to review general trends in groundwater elevations in the Basin.

In accordance with DWR GSP regulations, the City will evaluate the need for additional monitoring above its current groundwater elevation program. If the City of La Habra chooses to expand its groundwater monitoring program in the future, the City will prepare basin management reports on a periodic basis (every two to five years) using the results of the monitoring program. These informative reports will be used to review whether groundwater production is within the safe yield of the basin, plan future groundwater projects, develop new groundwater policies, and identify any new concerns within the La Habra-Brea Management Area.

10.3.3 Groundwater Recharge of Storage Projects

The City of La Habra currently does not operate any groundwater recharge or storage projects. In the future, the City may perform a basin replenishment study that identifies potential recharge areas and measures to protect these areas. Two areas where a groundwater recharge project could be studied for implementation are shown in Figure 10-1 The San Pedro Formation is naturally recharged directly through aquifer outcrops (exposed formation sediments) in the Los Coyote Hills (south of the intersection of Beach Boulevard and Imperial Highway) and in the Puente Hills (along the foothills north of Whittier Boulevard) [Montgomery, 1977]. The San Pedro Formation could also be indirectly recharged through the uplifted and exposed San Pedro beds that lie just below a thin layer of alluvium along the Coyote Creek valley (Montgomery, 1977).

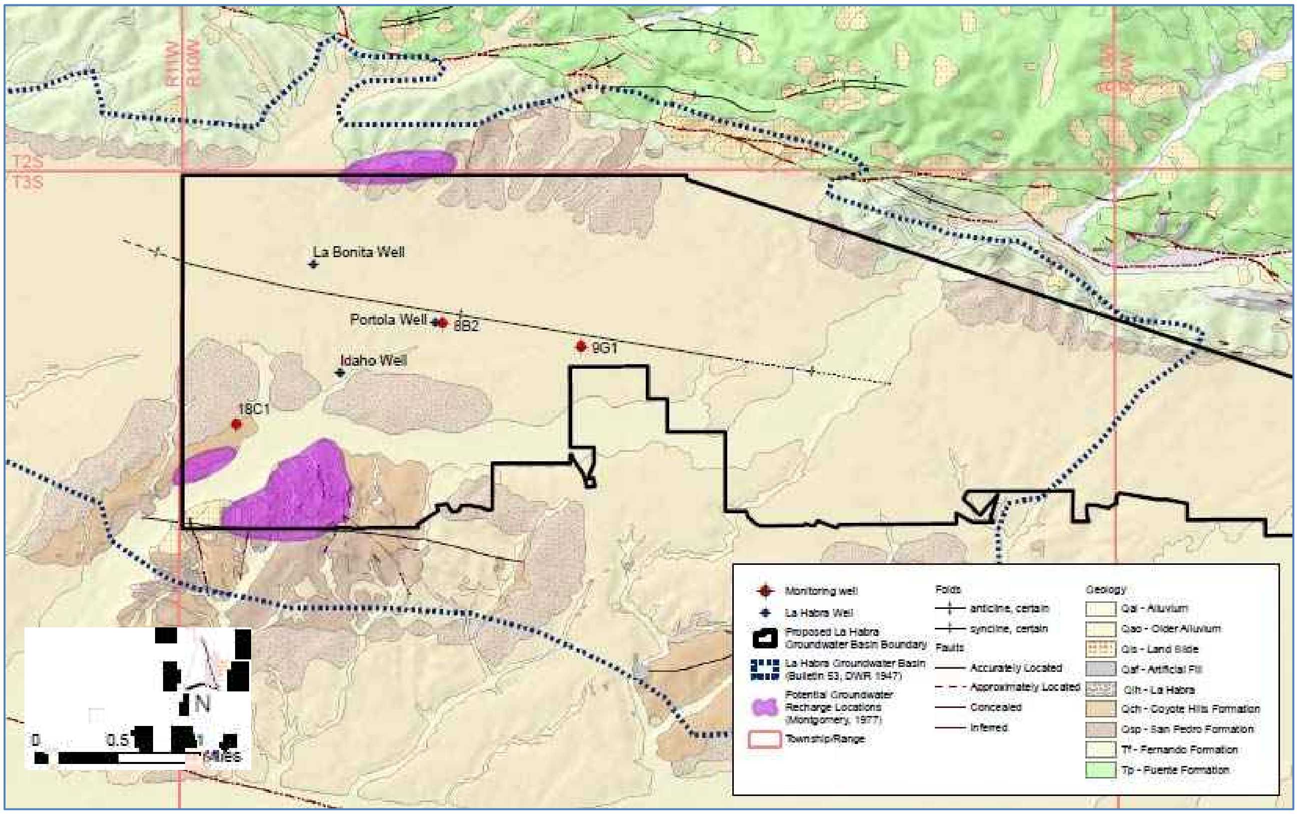


Figure 10-1: Potential Groundwater Recharge Locations

As discussed in Section 2.2, the City of La Habra is located in the Coyote Creek Watershed. The Coyote Creek Watershed is included in the Municipal Separate Storm Sewer System (MS4) Permit for the Orange County Santa Ana Region. The City is implementing new water quality control programs to meet the requirements of the MS4 permit for discharges from storm drains. The programs include Low Impact Development measures to address water quality on residential and commercial properties, new inspection activities, and potential retention and recharge of stormwater runoff. Recharge activities associated with MS4 compliance are anticipated to occur outside of the City of La Habra.

The City of La Habra currently does not operate any conjunctive use projects. The City may study the feasibility of conjunctive use projects in the future.

10.3.4 Potential Management Programs

No known desktop flow model exists for the La Habra Basin. As such, the La Habra GSA will consider developing a desktop flow model for the La Habra-Brea Management Area in the future once a sufficient amount of data are collected (as additional monitoring wells are constructed and monitored, for example). Groundwater models are used to represent natural flow conditions of an aquifer and can predict the effects of hydrological changes (such as pumping and replenishment) on the behavior of the aquifer.

10.4 DEFINITION OF SIGNIFICANT AND UNREASONABLE REDUCTION IN STORAGE

As with groundwater levels, the definition of significant and unreasonable reduction in groundwater storage in the La Habra-Brea Management Area is a lowering of groundwater levels such that a significant loss of well production capacity or a significant degradation of water quality occurs which would impact the intended use of the groundwater.

10.5 DETERMINATION OF MINIMUM THRESHOLDS

As with groundwater levels, minimum thresholds have not been established for changes in groundwater storage. If chronic or significant lowering of groundwater levels is observed through groundwater level monitoring, the La Habra GSA will evaluate its operations, re-evaluate the safe yield and establish minimum thresholds, where appropriate, and in accordance with SGMA.

SECTION 11. SUSTAINABLE MANAGEMENT RELATED TO WATER QUALITY

It is the intent of the La Habra GSA to protect and enhance the groundwater quality in the La Habra-Brea Management Area. This can be achieved through groundwater quality programs, understanding the quality of surface waters and subsurface water that naturally recharge the basin, and implementing measures to protect potential recharge areas.

11.1 HISTORY

Previous investigations of water quality within the La Habra Groundwater Basin determined that the quality is extremely variable. Overall, groundwater from the San Pedro Aquifer is considered to be of fair to good quality (Montgomery, 1979).

11.2 SUMMARY OF GROUNDWATER QUALITY ISSUES

As discussed in Section 3.2.5, Water from the La Bonita and Portola Wells is chlorinated and then blended with water purchased from the California Domestic Water Company in a 250,000-gallon forebay to reduce the concentration of minerals prior to entering the City of La Habra’s distribution system (La Habra, 2014).

The City of Brea’s non-potable well is strictly used for irrigation purposes as the groundwater beneath the city has poor water quality and would require extensive treatment and blending with higher quality water to meet public health standards (Malcolm Pirnie, 2011).

11.3 MONITORING OF GROUNDWATER QUALITY

The La Habra GSA will continue the City of La Habra’s existing water quality monitoring program, described in Section 5.2, and supplement the program as required by SGMA. If the La Habra GSA were to choose to construct monitoring wells for groundwater elevations, these wells can also be sampled for water quality.

The La Habra Basin is recharged through surface runoff and streamflow recharge as well as mountain front recharge (Stetson, 2013). Understanding the quality of the surface and subsurface water that recharges the La Habra Basin is important in protecting and enhancing the water quality of the groundwater basin as the groundwater within the basin originates from these waters. Although the City currently does not have a surface water quality monitoring program for the Coyote Creek Watershed, the La Habra GSA will investigate any existing programs for the watershed including regulations set forth for the watershed by the local Regional Water Quality Control Board (Coyote Creek is shown on the Clean Water Act’s 303(d) list of impaired waters). The La Habra GSA will consider developing and implementing its own surface and subsurface inflow quality monitoring programs for the local watershed in the future.

To protect the water quality of the Basin, the La Habra GSA will continue to monitor and review areas of contamination within the La Habra-Brea Management Area, as described in its Drinking Water Source Assessments provided to the California Department of Public Health (CDPH) for its production wells. The La Habra GSA will continue to review and comment on documents within the La Habra-Brea Management Area as well as be aware of any areas outside of its jurisdiction that may affect the water quality of the La Habra-Brea Management Area through surface or subsurface flow.

11.4 DESCRIPTION OF MANAGEMENT PROGRAMS

The management programs intended to protect the water quality of the La Habra-Brea Management Area include well construction, abandonment, and destruction policies, wellhead protection measures, control of migration and remediation of contaminated water, and control of saline water. See Section 6.

11.5 DEFINITION OF SIGNIFICANT AND UNREASONABLE DEGRADATION OF WATER QUALITY

The definition of significant and unreasonable degradation of water quality is a reduction of water quality in the La Habra-Brea Management Area such that the groundwater can no longer be used for the intended purposes even with the implementation of reasonable mitigation measures. Currently, the City of Brea only uses groundwater produced from the La Habra Groundwater Basin for irrigation; however, the City of La Habra uses groundwater for its potable supply, thus requiring a higher level of quality.

11.6 DETERMINATION OF MINIMUM THREHOLDS

Because groundwater from the La Habra Groundwater Basin is used as a potable source, the minimum thresholds for groundwater quality are exceedances of Maximum Contaminant Levels (MCLs) or other applicable regulatory limits that are directly attributable to groundwater management actions in the La Habra-Brea Management Area that prevents the use of groundwater for its intended purpose.

SECTION 12. SUSTAINABLE MANAGEMENT RELATED TO SEAWATER INTRUSION

The La Habra Groundwater Basin is not located near the ocean. Accordingly, there is no need to manage or consider the potential impact of seawater intrusion in the La Habra-Brea Management Area.

SECTION 13. SUSTAINABLE MANAGEMENT RELATED TO LAND SUBSIDENCE

As discussed in Section 3.2.6, there is no evidence that land subsidence is, or will likely become, problematic within the La Habra-Brea Management Area. However, the City of La Habra may develop a program to monitor and measure the rate of land surface subsidence within the La Habra-Brea Management Area in accordance with DWR GSP regulations. The need for land surface subsidence monitoring will be considered on an annual basis.

SECTION 14. SUSTAINABLE MANAGEMENT RELATED TO GROUNDWATER DEPLETIONS IMPACTING SURFACE WATER

As discussed in Section 3.2.7, the La Habra Groundwater Basin lies within the Coyote Creek Watershed with the major creeks in the watershed being Coyote Creek, Brea Creek, Fullerton Creek, Carbon Creek, Moody Creek, and Los Alamitos Channel. The watershed is highly urbanized with densely populated areas of residential, commercial, and industrial areas, as well as open space. Montgomery (1977) determined that about 30% of the runoff available in an average rainfall year percolates to the aquifers underlying the La Habra Valley.

In recent years, the depth to groundwater from the ground surface is approximately 30 feet (see Figure 3-6. However, groundwater production occurs within the confined San Pedro aquifer which is significantly deeper than the perched alluvial aquifer with a depth to groundwater of approximately 140 feet in the year 2000 (see Figure 3-6). Thus, groundwater production is not anticipated impact surface waters and local habitats.

SECTION 15. PROTOCOLS FOR MODIFYING MONITORING PROGRAMS

A Groundwater Advisory Committee will be established by the La Habra GSA which will be responsible for monitoring the progress in implementing the sustainable management strategies and programs of this plan. The Committee will meet once every five years to evaluate and discuss the current conditions of the La Habra-Brea Management Area and the effectiveness of the current programs. This plan will be amended to reflect any new policies or practices relevant to the management of the La Habra-Brea Management Area. It will also be updated to reflect changes in groundwater conditions as necessary.

Monitoring protocols are necessary to ensure consistency and accuracy in monitoring efforts and are required for monitoring assessments to be valid. Consistency should be reflected in factors such as the locations of the sampling points, frequency and seasonality of measurements, sampling procedures, and testing procedures. Accordingly, the La Habra GSA will undertake uniform data gathering procedures to ensure comparable measurements of groundwater are taken.

15.1 ESTABLISHMENT OF PROTOCOLS FOR WATER QUALITY

The following protocols will be followed for future groundwater elevation measurements:

- Annual sampling should be performed at the same time each year.
- Sampling should be performed during periods of both low and high groundwater production from the basin.
- Pump the well for an adequate period of time prior to sampling and document the stabilized parameters.
- Use proper containers, preservatives, and holding times.
- Use proper handling procedures (gloves, ice coolers, etc.).
- Document the time, date, location, and name of the technician on each sample container.
- Document any field notes regarding the condition of the well, sample, etc. if necessary.
- Use secure chain-of-custody procedures.
- Use the same laboratory for all testing, when possible. Select a laboratory that is accredited and state-certified that use proper quality control and quality assurance procedures.
- Include spiked, duplicates, and field-blank samples for comparison to genuine samples.

15.2 ESTABLISHMENT OF PROTOCOLS FOR GROUNDWATER ELEVATION/STORAGE

The following protocols will be followed for future groundwater elevation measurements:

- Document the time, date, location, and name of the technician for each measurement.
- Document the reference point, measuring device, and calibration date for the measuring device for each measurement.
- Annual measurements should be performed at the same time each year.
- When taking measurements for multiple wells, measurements should be taken in as short a period as possible.
- Measure the groundwater elevation twice, or more if necessary, until consistent results are obtained.
- If groundwater contamination is suspected, decontaminate the measuring equipment. In general, measurements should be performed from the least contaminated to most contaminated wells.

SECTION 16. PROCESS TO EVALUATE NEW PROJECTS

The La Habra GSA will evaluate any proposed actions for the La Habra-Brea Management Area pursuant to this Basin 8-1 Alternative in cooperation with the City of Brea. However, if there is a conflict between this Alternative and La Habra GSA's GSP, the GSP will control. Additionally, new projects would be evaluated through the CEQA process (i.e. by reviewing and commenting on draft CEQA documents). Likewise, OCWD would have an opportunity to comment on projects proposed within the La Habra-Brea Management Area, but OCWD has no authority under this Plan to obstruct any action taken by the La Habra GSA regarding the La Habra-Brea Management Area.

SECTION 17. LIST OF REFERENCES AND TECHNICAL STUDIES

Arcadis. 2016. 2015 Urban Water Management Plan, City of La Habra.

Arcadis. 2016. Draft 2015 Urban Water Management Plan, City of Brea.

Atkins, 2012. City of La Habra General Plan Update. Technical Background Report.

California Department of Water Resources (DWR). 1934. South Coastal Basin Investigation: Geology and Ground Water Storage Capacity of Valley Fill. Bulletin No. 45. Written while DWR was the California Department of Public Works.

DWR. 1947. South Coastal Basin Investigation: Overdraft on Ground Water Basins. Bulletin No. 53. Written while DWR was the California Division of Water Resources.

Geoscience. 2009. Draft Preliminary Geohydrologic Evaluation of the La Habra Basin. Prepared for City of La Habra, April 2, 2009.

Malcolm Pirnie, 2011. Final 2010 Urban Water Management Plan. City of La Habra.

Montgomery, Consulting Engineers Inc. (Montgomery). 1977, November. La Habra Basin Groundwater Study.

Montgomery, 1979, July. Exploratory Drilling in the La Habra Groundwater Basin, Summary Report and Evaluation.

Orange County Water District (OCWD). 2015. Groundwater Management Plan 2105 Update, Orange County Water District. .

Stetson Engineers Inc. August, 2013. Draft Technical Report: Task 1 Re-Evaluation of Basin Safe Yield.

Stetson Engineers, Inc. 2014. Task 3 Hydrogeologic Investigation of the La Habra Groundwater Basin. Technical Memorandum.

United States Geological Survey (USGS). Areas of Land Subsidence in California. Accessed October 5, 2016. http://ca.water.usgs.gov/land_subsidence/california-subsidence-areas.html

Yerkes, R.F. 1972. Geology and Oil Resources of the Western Puente Hills Area, Southern California. Geology of the Eastern Los Angeles Basins, Southern California. Geological Survey Professional Paper 420-C; A study of the stratigraphy, structure, and oil resources of the La Habra and Whittier quadrangles.

Basin 8-1 Alternative

OCWD Management Area

Prepared by: Orange County Water District

January 1, 2017

Basin 8-1 Alternative

OCWD Management Area

PROFESSIONAL GEOLOGIST
ROY L. HERNDON
P.G. No. 4817
CERTIFIED HYDROGEOLOGIST
No. 113
Exp. 8/31/18
STATE OF CALIFORNIA

Roy Herndon, P.G., C.Hg.

Chief Hydrogeologist
Orange County Water District
18700 Ward Street
Fountain Valley, CA 92708

Prepared for the Department of Water Resources, pursuant to Water Code §10733.6(b)(3)

January 1, 2017

Table of Contents

Table of Contents

Table of Contents

Figure

Table

Appendices

SECTION 1 EXECUTIVE SUMMARY

The Orange County Water District (OCWD) is a special district formed in 1933 by an act of the California Legislature, the “OCWD Act”. OCWD manages the groundwater basin that underlies north and central Orange County pursuant to the OCWD Act. Water produced from the basin is the primary water supply for approximately 2.4 million residents living within the service area boundaries. The mission of OCWD includes sustainably managing the Orange County Groundwater Basin, Basin 8-1, over the long-term. Additionally, as a special act district listed in Water Code § 10723 (c)(1), OCWD is the exclusive local agency within its jurisdictional boundaries with powers to comply with SGMA via a groundwater sustainability plan (“GSP”) or via an Alternative prepared in accordance with Water Code § 10733.6.

The OCWD Management Area includes 89 percent of the area designated by the Department of Water Resources (DWR) as Basin 8-1, the “Coastal Plain of Orange County Groundwater Basin” in Bulletin 118 (DWR, 2003). The OCWD Management Area includes the same land area as the OCWD service area within Basin 8-1 except for a small 6.7-square mile area in the northeast corner of the basin that is part of the Santa Ana Canyon Management Area. The boundaries of Basin 8-1, the OCWD service area and the OCWD Management Area are shown in Figure 1-1.

1.1 GROUNDWATER BASIN CONDITIONS

GROUNDWATER ELEVATIONS

OCWD prepares groundwater elevation contour maps for each of the three major aquifer systems (Shallow, Principal, and Deep) annually. In addition to illustrating regional groundwater gradients, the maps are used to prepare water level change maps and to calculate the amount of groundwater in storage and the annual storage change. OCWD’s basin-wide network of monitoring wells is used to monitor groundwater levels and quality, assess effects of pumping and recharge, estimate groundwater storage, characterize basin hydrogeology, and develop and calibrate a numerical flow model of the basin. Groundwater elevation contours in the Principal Aquifer as of June 2016 are shown in Figure 1-2.

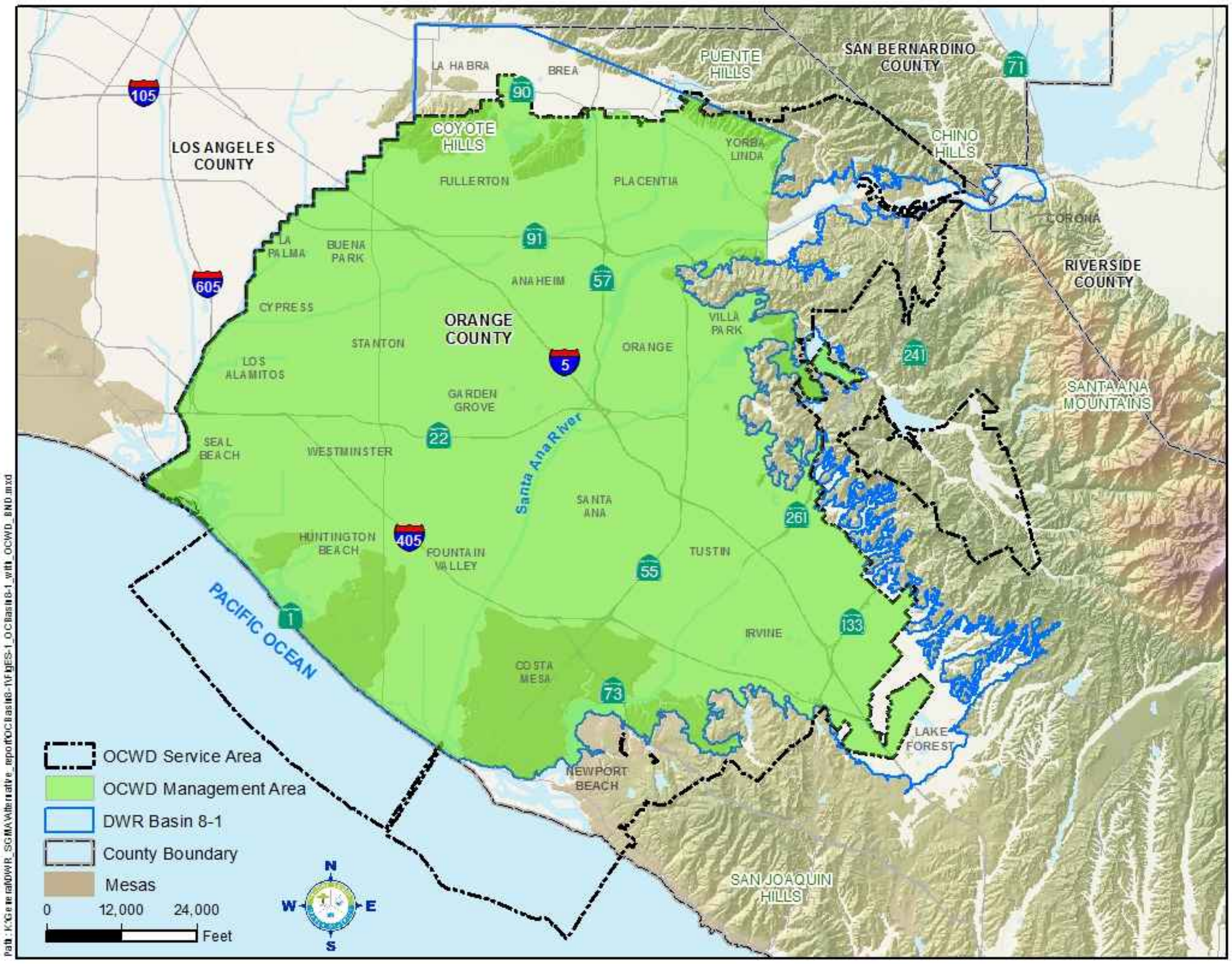


Figure 1-1: Basin 8-1, OCWD Service Area and OCWD Management Area

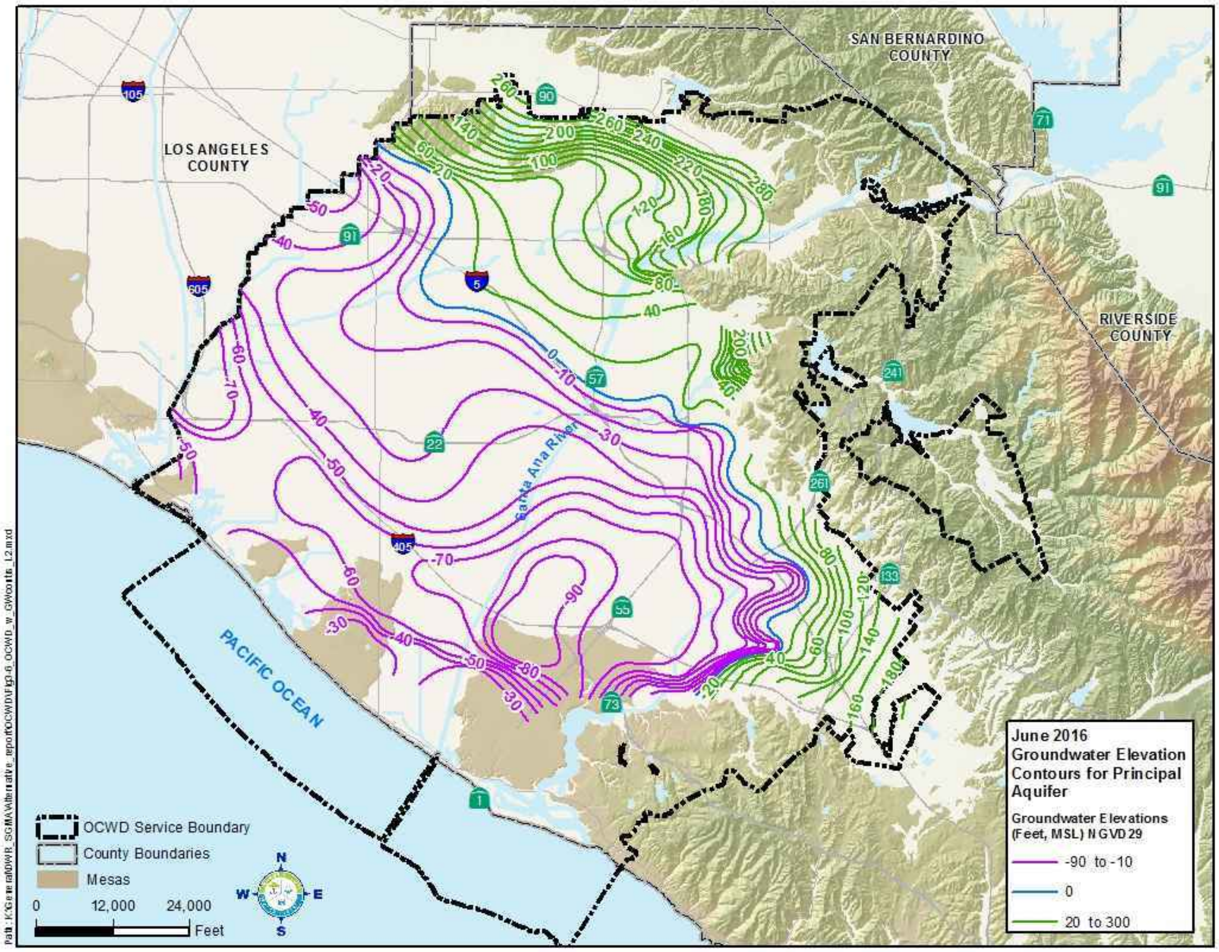


Figure 1-2: Groundwater Elevation Contours for the Principal Aquifer, June 2016

GROUNDWATER STORAGE

The groundwater basin contains an estimated 66 million acre-feet when full. However, OCWD manages the basin within an established operating range of up to 500,000 acre-feet below full condition. This operating range was established to designate the levels of groundwater storage within which the basin that can be maintained without causing adverse impacts. In order to manage the basin within this operating range, OCWD calculates the amount of groundwater in storage on an annual basis. Long-term groundwater storage levels based on OCWD’s water year (July 1 to June 30) are shown in Figure 1-3.

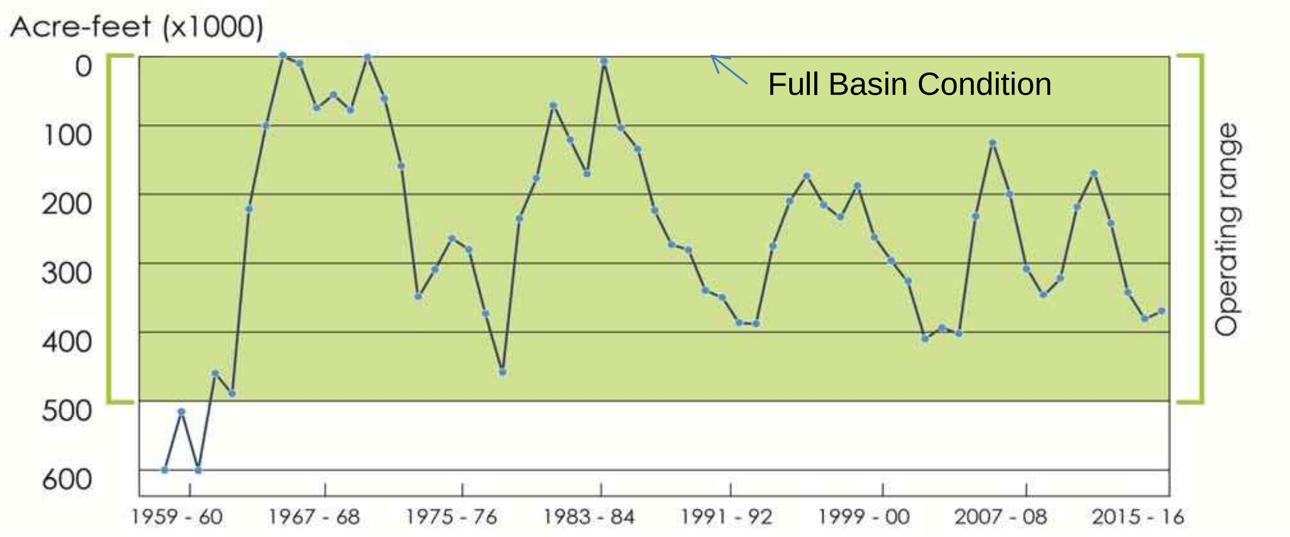


Figure 1-3: Available Basin Storage WY 1958-59 to WY 2015-16

WATER QUALITY

The California Regional Water Quality Control Board, Santa Ana Region (Regional Water Board) is responsible for protection and enhancement of the quality of waters in the watershed, which includes surface water and groundwater in the OCWD Management Area. The watershed's salinity management program, overseen by the Regional Water Board, is managed by the Basin Monitoring Program Task Force. Water quality objectives for total dissolved solids (TDS) and nitrate-nitrogen in groundwater management zones were adopted by the Regional Water Board based on historical water quality data. Every three years the Task Force calculates the current ambient water quality for each groundwater management zone. The most recent recalculation for the groundwater basin was completed in 2014.

There are several regional groundwater contamination plumes within the OCWD Management Area, all of which are under active remediation. The U.S. EPA is the lead agency in remediation of the plume in the North Basin area. Remediation for individual sites within the South Basin area is within the jurisdiction of either the California Department of Toxic Substances Control or the Regional Water Board. The U.S. Navy is taking the lead in remediation of plumes from the former El Toro and Tustin Marine Corps Air Stations and the Naval Weapons Station Seal Beach.

LAND SUBSIDENCE

Land subsidence due to changes in groundwater conditions in the OCWD Management Area is variable and does not show a pattern of widespread, permanent lowering of the ground surface. There is no evidence of permanent, inelastic land subsidence within the OCWD Management Area.

1.2 WATER BUDGET

OCWD developed a hydrologic budget for the purpose of constructing a basin-wide numerical groundwater flow model and for evaluating basin production capacity and recharge requirements. The key components of the budget include measured and unmeasured (estimated) recharge, groundwater production and subsurface outflows.

The groundwater basin is not operated on an annual safe-yield basis. The net change in storage in any given year may be positive or negative; however, over a period of several years, the basin is maintained in an approximate balance. Amounts of total basin production and total water recharged from water year 1999-2000 to 2015-16 are shown in Figure 1-4.

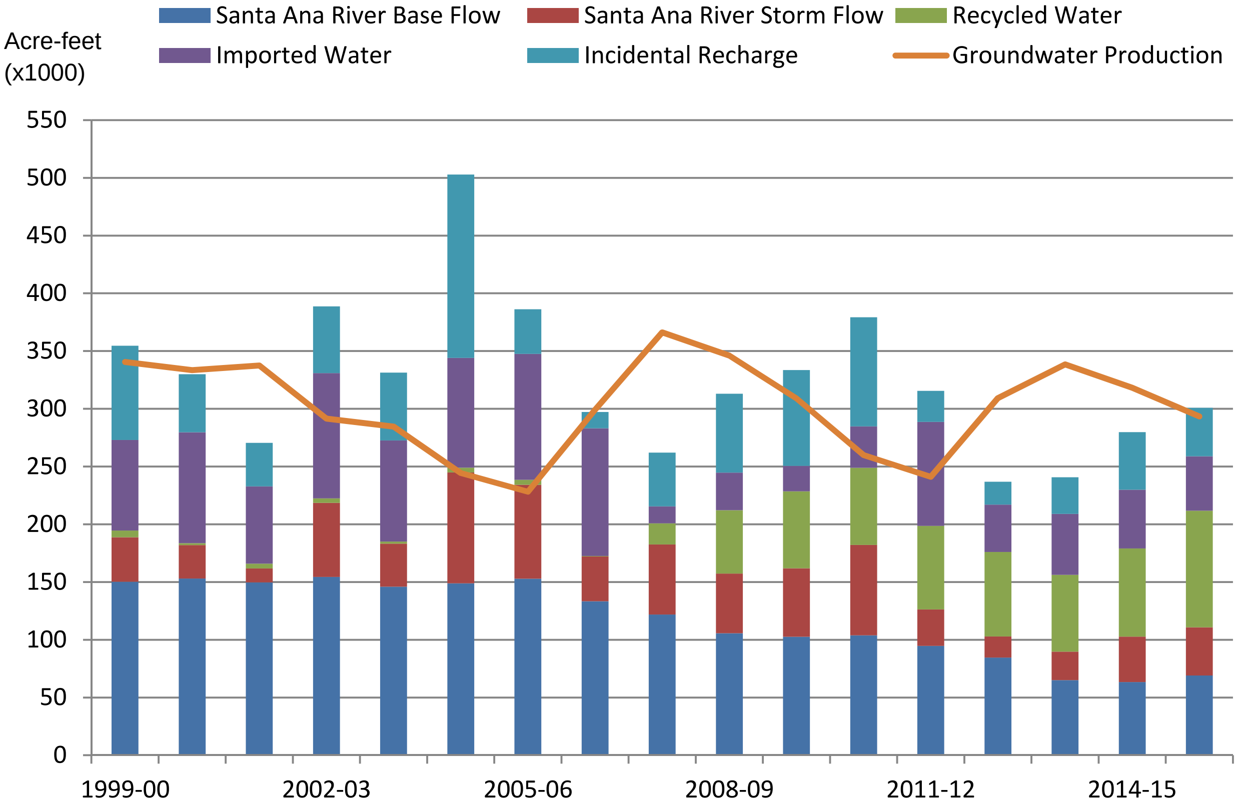


Figure 1-4: Basin Production and Recharge Sources, WY 1999-2000 to WY 2015-16

1.3 WATER RESOURCE MONITORING PROGRAMS

Water resource monitoring programs for groundwater, surface water, recycled water, and imported water are summarized in Table 1-1.

Table 1-1: OCWD Monitoring Programs

MONITORING PROGRAM	PURPOSE
Groundwater Production	Manage basin storage; collect revenues based on production
Groundwater Elevation	Manage basin storage; prepare groundwater level contour maps; manage seawater intrusion barrier injection rates
CA Statewide Groundwater Elevation Monitoring (CASGEM) Program	Compliance with state CASGEM program
Title 22 Water Quality Program	Compliance with CA SWRCB Division of Drinking Water, Title 22 Monitoring for more than 100 regulated and unregulated chemicals at approximately 200 large- and small-system drinking water wells
Groundwater Contamination Plumes	Monitor location of contamination plumes and levels of contamination to protect drinking water wells and basin water quality
Seawater Intrusion	Monitor effectiveness of existing seawater intrusion barriers
Santa Ana River Monitoring Program	Annual review to affirm that OCWD recharge practices are protective of public health
Basin Monitoring Program Task Force	Annual report prepared to comply with Regional Water Board Basin Plan
Santa Ana River Watermaster Monitoring	Determine annual Santa Ana River baseflow and stormflow and TDS at two locations to comply with the 1969 judgment on Santa Ana River water rights
Prado Wetlands	Evaluate changes in water quality and effectiveness of wetlands treatment of surface water used for groundwater recharge
Emerging Constituents	Compliance with federal and state regulations
Recycled Water	Monitor quality of water produced by GWRS
Imported Water	Monitor water quality of supply used for groundwater recharge

1.4 GROUNDWATER MANAGEMENT PROGRAMS

LAND USE

The OCWD Management Area is highly urbanized. As such, OCWD monitors, reviews and comments on local land use plans, environmental documents, and proposed regulatory agency permits to provide input to land use planning agencies regarding proposed projects and programs that could cause short- or long-term water quality impacts to the groundwater basin.

DEMAND MANAGEMENT

Water demands within the OCWD Management Area for water year (WY) 2015-16 totaled approximately 364,000 acre-feet. It is noted that water demands in WY 2015-16 reflect mandatory demand reductions imposed by the State Water Board in response to an extended drought. Between WY1996-97 to present, water demands have ranged between 413,000 afy to 515,000 afy but have generally decreased, as shown in Figure 1-5. OCWD strives to sustainably maximize both production from the basin and recharge of the groundwater basin. Total water demands in the management area are met by a combination of groundwater and imported water.

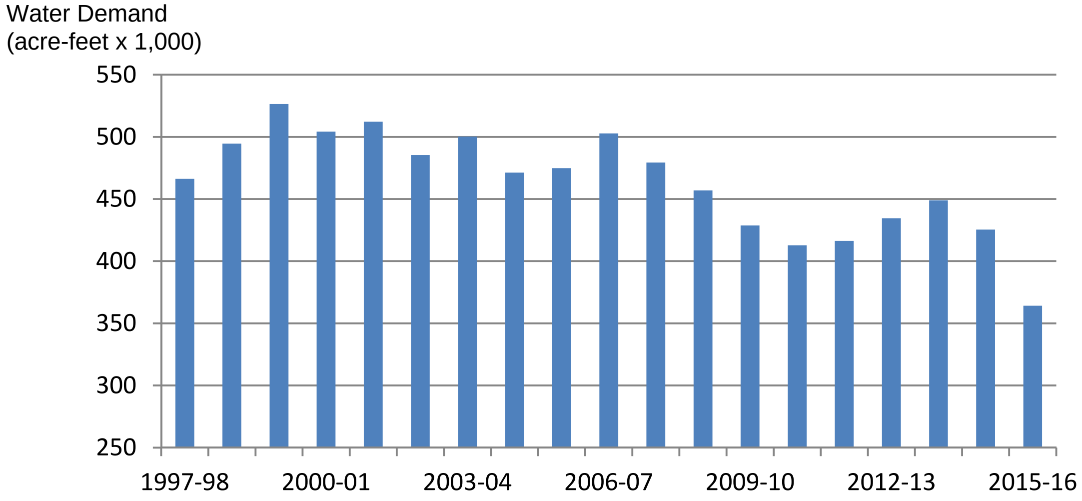


Figure 1-5: Total Water Demands within OCWD, WY 1997-98 to WY 2015-16

GROUNDWATER QUALITY PROTECTION AND MANAGEMENT

OCWD adopted a Groundwater Quality Protection Policy in 1987 and updated it in 2014. This policy guides the actions of OCWD to maintain groundwater quality suitable for all existing and potential beneficial uses; prevent degradation of groundwater quality and protect groundwater from contamination; maintain surface water and groundwater quality monitoring programs, a monitoring well network and data management system; and assist regulatory agencies in remediating contaminated sites.

Salinity Management Programs within the OCWD Management Area include:

- Operation of two seawater intrusion barriers along the coast;
- The Coastal Pumping Transfer Program, a voluntary program that shifts pumping from coastal to inland areas to lessen the potential for seawater intrusion;
- Production of recycled water at OCWD's Groundwater Replenishment System (GWRS) that is used for groundwater recharge and operation of the seawater intrusion barrier;
- Operation of groundwater desalters in Orange, Riverside and San Bernardino Counties to reduce salt buildup in groundwater basins as well as surface water that is used to recharge the Orange County groundwater basin;
- The salt and nutrient management program managed by the Regional Water Board; and
- Removal of nitrates through operation of the city of Tustin's Main Street and 17th Street treatment plants, IRWD's Irvine Desalter and Well 21/22 projects and OCWD's 465-acre Prado Constructed Wetlands.

RECYCLED WATER PRODUCTION

The GWRS produces up to 100 million gallons per day (mgd) of highly treated recycled water. Plans are underway to expand the plant to 130 mgd. GWRS product water is recharged into the groundwater basin and is the primary source of water for the Talbert Seawater Barrier. OCWD also operates the Green Acres Project, a non-potable recycled water supply for irrigation and industrial water users.

CONJUNCTIVE USE PROGRAMS

Recharge water sources include water from the Santa Ana River and tributaries, imported water, and recycled water supplied by the GWRS as well as incidental recharge from precipitation and subsurface inflow. OCWD's conjunctive use program includes over 1,500 acres of land on which there are 1,067 wetted acres of recharge facilities. This network of 25 facilities recharges an average of over 250,000 afy.

MANAGEMENT OF SEAWATER INTRUSION

The Alamitos and Talbert Seawater Intrusion Barriers control seawater intrusion through the Alamitos and Talbert Gaps by injecting fresh water into susceptible aquifers through a series of injection wells to create a hydraulic barrier.

1.5 NOTICE AND COMMUNICATION

The local agencies that produce the majority of the groundwater from the basin include 19 cities, water districts, and water companies. OCWD staff holds monthly meetings with this group to provide information and seek input on issues related to groundwater management. OCWD has a proactive community outreach program that includes conducting an annual Children's Water Education Festival attended by over 7,000 elementary school students and a monthly electronic newsletter with approximately 5,700 subscribers.

1.6 SUSTAINABLE BASIN MANAGEMENT

The sustainability goal for the OCWD Management Area is to:

> Continue to manage the groundwater basin to prevent basin conditions that would lead to significant and unreasonable (1) lowering of groundwater levels, (2) reduction in storage, (3) water quality degradation, (4) seawater intrusion, (5) land subsidence and (6) depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water.

Existing monitoring and management programs in place today enable OCWD to sustainably manage the groundwater basin. Since its founding in 1933, OCWD has developed a managed aquifer recharge program, constructed hundreds of monitoring wells, developed an extensive water quality monitoring program, installed seawater intrusion barriers, and doubled the volume of groundwater production while protecting the long-term sustainability of the groundwater resource. OCWD's management of the OCWD Management Area will continue to provide long-term sustainable basin management that is able to adapt to changing conditions affecting the groundwater basin.

1.6.1 Sustainable Management: Water Levels

OCWD manages the basin for long-term sustainability by maximizing groundwater recharge and managing basin production within sustainable levels. Long-term data trends demonstrate that groundwater elevations in the basin have not been in the condition of chronic lowering. The undesirable result of "chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply" is not present and is not anticipated to occur in the future in the OCWD Management Area due to OCWD's management programs. Hydrographs representative of long-term water levels in the basin are shown in Figure 1-6. These hydrographs demonstrate that groundwater levels in the OCWD Management Area are being managed at long-term sustainable levels.

1.6.2 Sustainable Management: Basin Storage

OCWD manages the basin within an established operating range of groundwater in storage of up to 500,000 acre-feet below full condition. Maintaining basin storage within this range protects the basin from detrimental impacts such as land subsidence, chronic lowering of groundwater levels and chronic reduction in storage. OCWD manages groundwater pumping such that it is sustainable over the long-term; however, in any given year pumping may exceed recharge or vice versa. Thus, the amount of groundwater stored in or withdrawn from the basin varies from year to year and often goes through multi-year cycles of emptying and filling, which typically correlates with state-wide and/or local precipitation patterns and other factors.

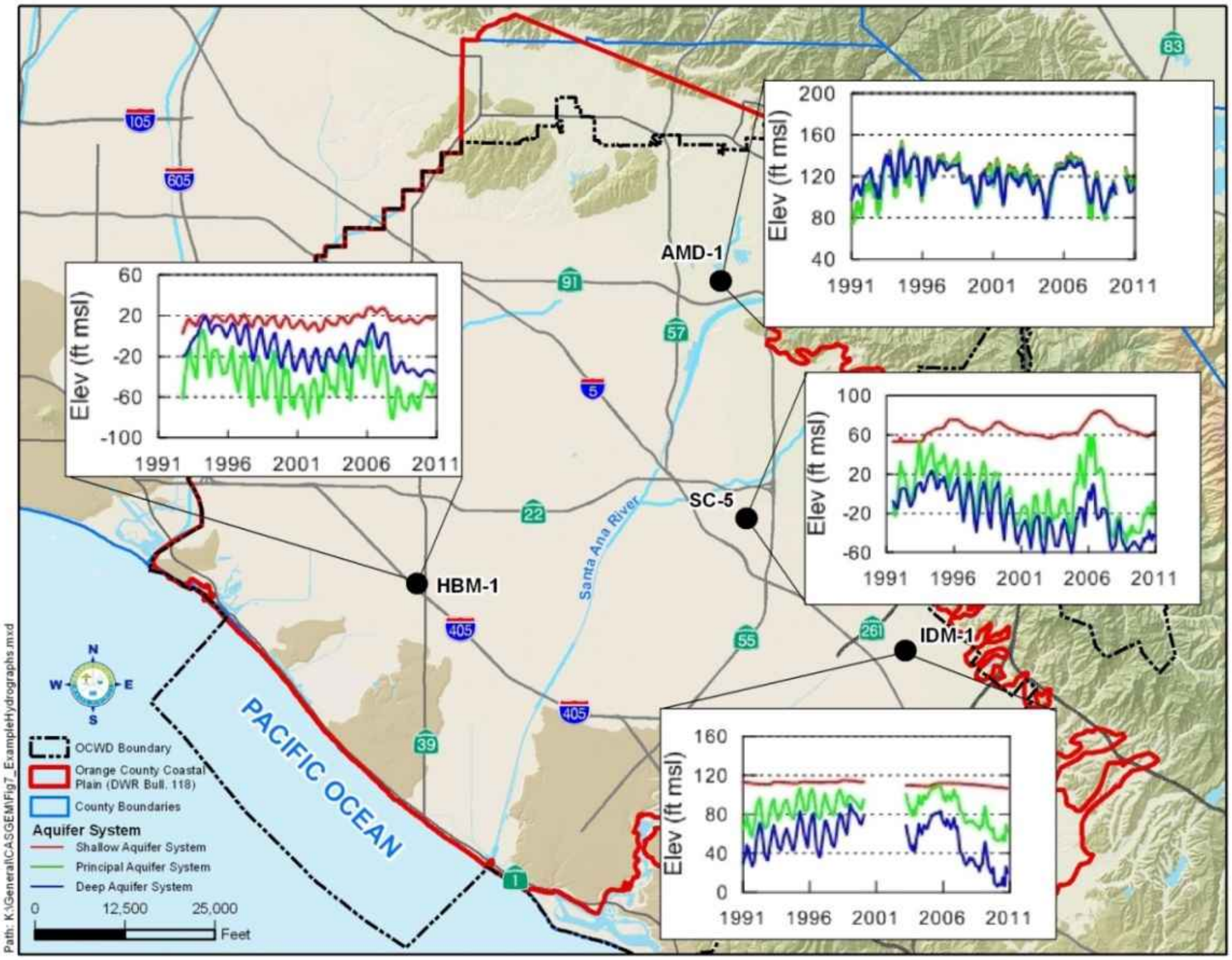


Figure 1-6: Example Hydrographs

Each year OCWD calculates the volume of groundwater storage change from a theoretical “full” benchmark condition based on a calculation using changes in groundwater elevations in each of the three major aquifer systems and aquifer storage coefficients. This calculation is checked against an annual water budget that accounts for all production, measured recharge and estimated unmeasured recharge. The amount of available or unfilled storage from the theoretical full condition is graphed on Figure 1-3. Maintaining the basin storage condition on a long-term basis within the established operating range allows for long-term sustainable management of the basin without experiencing undesirable effects. Therefore, the undesirable result of “significant and unreasonable reduction of groundwater storage” is not present and is not anticipated to occur in the OCWD Management Area in the future due to OCWD’s management programs.

1.6.3 Sustainable Management: Water Quality

OCWD has extensive monitoring and management programs in place to monitor and protect the water quality of the groundwater basin. OCWD's network of approximately 400 monitoring wells is generally distributed throughout the basin. Water quality in these wells is tested on a regular basis for a large number of parameters. OCWD also conducts groundwater quality sampling of approximately 200 production wells on behalf of groundwater producers to comply with Title 22 requirements. An additional approximately 200 private, domestic, and irrigation production wells area also sampled periodically.

OCWD has a sampling protocol in place that includes standards for increased monitoring of individual wells. In cases where there is a detection of an organic compound for the first time, for example, OCWD will resample that well and if the detection is confirmed will increase the sampling frequency of that well. Another example is an increased frequency for monitoring when there is a detection of nitrate at 50% of the MCL. These sampling protocols are designed to detect water quality problems at the earliest possible stage. The undesirable result of "significant and unreasonable degradation of water quality including migration of contaminant plumes that impair water supplies" is not present and is not anticipated to occur in the future in the OCWD Management Area due to OCWD's management programs.

1.6.4 Sustainable Management: Seawater Intrusion

OCWD's management of seawater intrusion is implemented through a comprehensive program that includes operating seawater intrusion barriers, monitoring and evaluating barrier performance, monitoring and evaluating susceptible coastal areas, and coastal groundwater management. These programs enable OCWD to sustainably manage groundwater conditions in the basin by preventing significant and unreasonable seawater intrusion.

The Alamitos Seawater Intrusion Barrier manages seawater intrusion in the Alamitos Gap. The Talbert Seawater Intrusion Barrier manages seawater intrusion in the Talbert Gap. The Alamitos Barrier groundwater model is being used to evaluate seawater intrusion in the area of the Sunset Gap.

Monitoring and evaluating barrier performance and potential seawater intrusion consists of sampling monitoring wells semi-annually, measuring water levels at least quarterly, installing monitoring wells when needed to fill data gaps, and conducting other management activities to reduce potential for seawater intrusion, such as construction of additional injection wells and the Coastal Pumping Transfer Program.

The undesirable result of "significant and unreasonable seawater intrusion" is not present and is not anticipated to occur in the future in the OCWD Management Area due to OCWD's management programs.

1.6.5 Sustainable Management: Land Subsidence

Management of the groundwater basin by maintaining storage levels within the established operating range has prevented the undesirable result in the OCWD Management Area of significant and unreasonable land subsidence that substantially interferes with surface uses. Within the OCWD Management Area there is no evidence of long-term inelastic land subsidence, nor any land subsidence that has interfered with surface uses. Therefore, the undesirable result of “significant and unreasonable land subsidence that substantially interferes with surface uses” is not present and is not anticipated to occur in the OCWD Management Area in the future due to OCWD’s management programs.

1.6.6 Sustainable Management: Depletion of Interconnected Surface Waters

There are no surface water bodies within the OCWD Management Area that are interconnected with groundwater in which the groundwater connection to the surface water provides surface water flow to sustain beneficial uses in a surface water body. Therefore, the undesirable result of “depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water due to groundwater conditions occurring throughout the basin” is not present and in the future is not anticipated to occur in the OCWD Management Area due to OCWD’s management programs.

1.7 PROTOCOLS FOR MODIFYING MONITORING PROGRAMS

Protocols that trigger a change in a monitoring program include a change in regulations, a first time detection of a constituent in a water sample, an increase in a constituent in a water sample that approaches or exceeds a regulatory limit or Maximum Contaminant Level, an indication of an adverse water quality trend or water level, a special study, or a recommendation from OCWD’s Independent Expert Panel.

1.8 EVALUATION OF POTENTIAL PROJECTS

OCWD regularly evaluates potential projects and conducts studies to improve existing operations. This may include:

- Increasing the capacity of existing recharge basins;
- Constructing new recharge facilities;
- Constructing new production wells
- Improving seawater intrusion barriers; and
- Constructing water quality improvement projects.

1.9 CONCLUSION

OCWD has been managing the OCWD Management Area since formation of OCWD by the State Legislature in 1933. Monitoring and management programs described in this Alternative, submitted in compliance with CA Code of Regulations (Title 23, Division 2, Chapter 1.5, Subchapter 2) demonstrate that the groundwater basin has been and will continue to be sustainably managed. This report demonstrates that the OCWD Management Area has operated within its sustainable yield over a period of at least 10 years, as required by CCR Title 23, Division 2, Chapter 1.5, Subchapter 2, Article 9, Section 358.2 (c)(3).

SECTION 2 AGENCY INFORMATION

2.1 HISTORY OF OCWD

The Orange County Water District (OCWD) is a special district formed in 1933 by an act of the California Legislature, the OCWD Act. Additionally, as a special act district listed in Water Code § 10723 (c)(1), OCWD is the exclusive local agency within its jurisdictional boundaries with powers to comply with SGMA via a groundwater sustainability plan (“GSP”) or via an Alternative prepared in accordance with Water Code § 10733.6.

OCWD manages the groundwater basin that underlies north and central Orange County. Water produced from the basin is the primary water supply for approximately 2.4 million residents living within OCWD’s boundaries. With passage of the Sustainable Groundwater Management Act (SGMA) (Water Code §10723(c)) in 2014, OCWD was designated the exclusive local agency within its jurisdictional boundaries with powers to comply with SGMA.

Nineteen major groundwater producers, including cities, water districts, and a private water company, pump groundwater from about 200 large-capacity wells for retail water use. There are also approximately 200 small-capacity wells that pump water from the basin. OCWD protects and manages the groundwater resource for long-term sustainability, while meeting approximately 70 to 75 percent of the water demand within its service area.

Since its founding, OCWD has grown in area from 162,676 to 243,968 acres and has experienced an increase in population from approximately 120,000 to 2.4 million people. OCWD has employed groundwater management techniques to increase the annual yield from the basin including operating over 1,500 acres of recharge basins in the cities of Anaheim, Orange, and unincorporated areas of Orange County. Annual water production increased from approximately 150,000 acre-feet per year (afy) in the mid-1950s to a high of over 366,000 afy in water year 2007-08.

OCWD has managed the basin to provide a reliable supply of relatively low-cost water, accommodating rapid population growth while at the same time avoiding the costly and time-consuming adjudication of water rights experienced in many other major groundwater basins in Southern California. Facing the challenge of increasing demand for water has fostered a history of innovation and creativity that has enabled OCWD to increase available groundwater supply while ensuring the long-term sustainability of the groundwater basin.

A brief history of OCWD is provided in the following timeline:

June 14, 1933: California Legislature creates the Orange County Water District by special act to protect surface water rights and manage the groundwater basin. The new district joins the Irvine Company’s lawsuit.

1930s: Groundwater pumping in Orange County exceeds the rate of recharge resulting in groundwater levels dropping. OCWD begins actively recharging the groundwater basin by infiltrating Santa Ana River flows and looking for additional water supplies.

1936: OCWD begins purchasing portions of the Santa Ana River channel with the first purchase of 26 acres.

1941: U.S. Army Corps of Engineers completes construction of Prado Dam.

1949: OCWD begins purchasing imported water from the Colorado River Aqueduct for groundwater recharge.

1951: OCWD initiates legal action against cities upstream of Orange County to protect rights to Santa Ana River flow. Settlement of the suit in 1957 limits use of river water to the amount used in 1946.

1954: The District Act is amended giving OCWD authority to collect groundwater production records and a Replenishment Assessment (RA) from groundwater pumpers to purchase imported water for groundwater recharge. The amendments also enlarged OCWD boundaries, and required the publication of an annual engineer's report on groundwater production and basin conditions.

1956: Groundwater levels drop as much as 40 feet below sea level and seawater intrudes 3½ miles inland. Plans begin to construct seawater intrusion barriers in two areas – Alamitos Gap at the mouth of the San Gabriel River at the Orange County/Los Angeles County border and the Talbert Gap at the mouth of the Santa Ana River in Fountain Valley.

1957: OCWD purchases land and constructs Anaheim Lake, OCWD's first off-river recharge basin.

1963: OCWD files a lawsuit against all upper watershed entities above Prado Dam to ensure a minimum amount of Santa Ana River water for Orange County.

1965: OCWD partners with the Los Angeles County Flood Control District to begin injecting fresh water into the Alamitos Gap to prevent saltwater intrusion.

1968: OCWD purchases land and water rights owned by Anaheim Union Water Company and the Santa Ana Valley Irrigation Company, which includes land upstream of Prado Dam that was acquired to protect Orange County's interest in Santa Ana River water.

1969: The lawsuit against upper watershed entities is settled. (Orange County Water District v. City of Chino, et al., Case no. 117628 – County of Orange). Large water districts agree to deliver at least 42,000 acre-feet of Santa Ana River baseflow to Orange County, and OCWD gains the rights to all stormflows reaching Prado Dam. Parties to the judgment include Western Municipal Water District, San Bernardino Valley Municipal Water District and the Inland Empire Utilities Agency.

1969: The Basin Production Percentage and the Basin Equity Assessment are established.

1973: First water quality laboratory is constructed to analyze samples from the Santa Ana River and to begin analysis of demonstration injection wells for the planned construction of Water Factory 21.

1975: Talbert Seawater Intrusion Barrier begins operation. Control of seawater intrusion in the Talbert Gap requires six times the amount of water needed for the Alamitos Gap. Water Factory 21 is built to supply recycled water to the Talbert Seawater Intrusion Barrier. Secondary-treated wastewater from the Orange County Sanitation District receives advanced treatment and is blended with potable water to produce a safe, reliable supply for barrier operations – the first project of its kind permitted in the United States.

1991: Santiago Creek recharge project is completed, including purchase and development of Santiago Basins along Santiago Creek, a pump station at Burris Basin, and a pipeline to convey water back and forth from recharge basins along the Santa Ana River and Santiago Basins. Two rubber dams are installed on the Santa Ana River, allowing for more efficient diversion of river water to the downstream recharge facilities.

2008: The Groundwater Replenishment System (GWRS) begins operation, replacing Water Factory 21. The largest of its kind in the world, the GWRS is capable of producing up to 72 mgd of purified recycled water for use in Talbert Barrier operations and for groundwater recharge.

2009: New Advanced Water Quality Assurance Laboratory opens to handle over 400,000 analyses of nearly 20,000 water samples each year.

2015: GWRS Initial Expansion is completed, expanding plant capacity from 72 mgd to 100 mgd of product water.

2.2 GOVERNANCE AND MANAGEMENT STRUCTURE

The Orange County Water District was created by the OCWD Act for the purpose of:

> “providing for the importation of water into said district and preventing waste of water in or exportation of water from said district and providing for reclamation of drainage, storm, flood and other water for beneficial use in said district and for the conservation and control of storm and flood water flowing into said district; providing for the organization and management of said district and establishing the boundaries and divisions thereof and defining the powers of the district, including the right of the district to sue and be sued, and the powers and duties of the officers thereof; providing for the construction of works and acquisition of property by the district to carry out the purposes of this act; authorizing the incurring of indebtedness and the voting, issuing and selling of bonds and the levying and collecting of assessments by said district; and providing for the inclusion of additional lands therein and exclusion of lands therefrom.”
> (Stats.1933, c. 924, p. 2400)

OCWD is divided into 10 divisions as specified in the District Act. One director is elected or appointed from each division. The cities of Anaheim, Fullerton, and Santa Ana appoint one member each to serve on the Board. The other seven Board members are elected by voters in the respective divisions. Boundaries of the 10 divisions are shown in Figure 2-1. Appointed members of the Board serve a four-year term and may be removed at any time by a majority vote of the appointing governing body. Elected members of the board serve four-year terms and may be re-elected without limits.

The full Board of Directors meets twice a month, normally on the first and third Wednesdays of the month. Board committees also meet on a monthly basis. These committees include the Water Issues, Communication/Legislation, Administration/Finance, Property Management and Retirement.

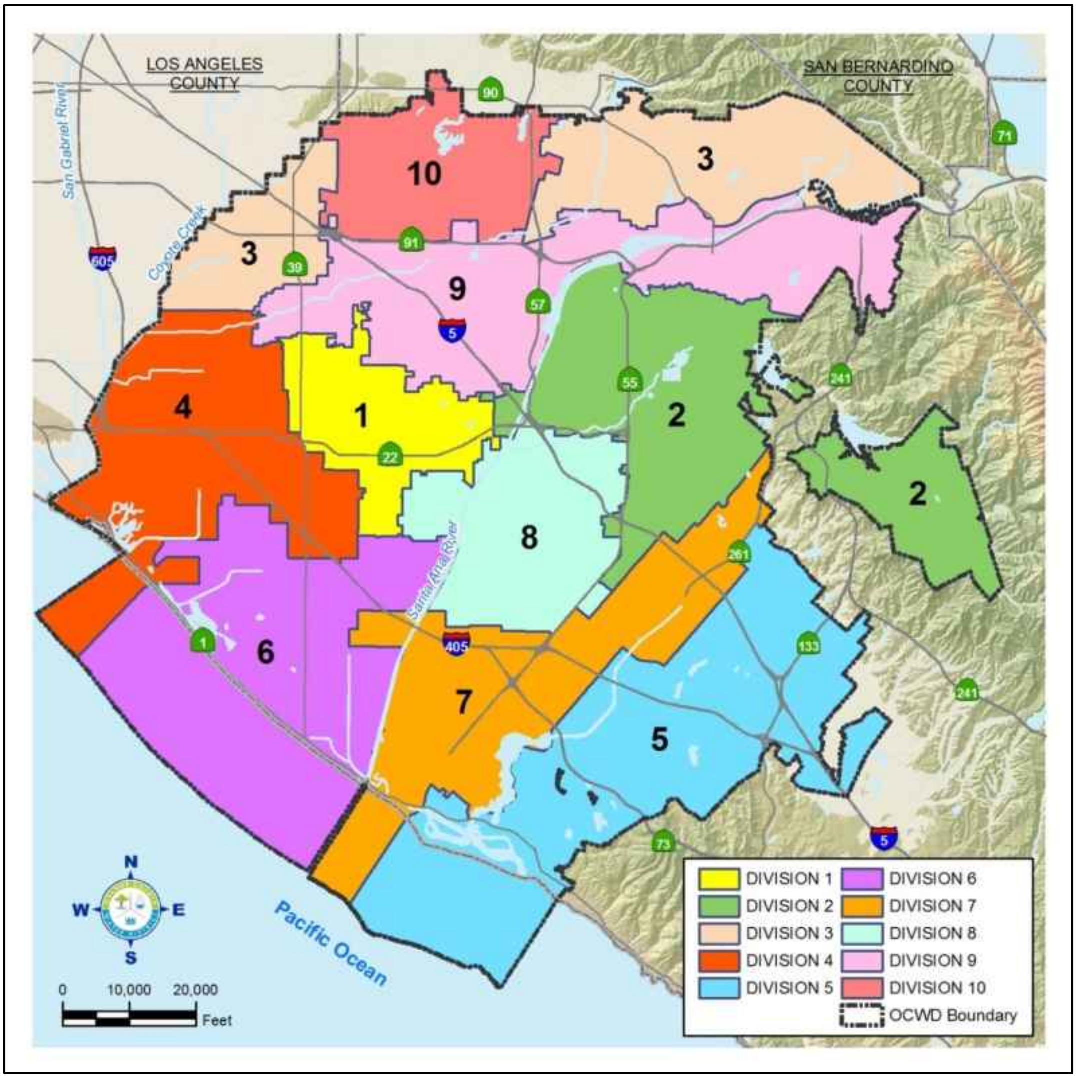


Figure 2-1: Orange County Water District Divisions

The ten divisions are comprised of the following areas:

Division One:	Garden Grove, Stanton, Westminster
Division Two:	Orange, Villa Park, and parts of Tustin
Division Three:	Buena Park, La Palma, Placentia, Yorba Linda, and parts of Cypress

Division Four:	Los Alamitos, Seal Beach, and parts of Buena Park, Cypress, Garden Grove, Huntington Beach, Stanton, and Westminster
Division Five:	Parts of Irvine and Newport Beach
Division Six:	Parts of Fountain Valley and Huntington Beach
Division Seven:	Costa Mesa and parts of Fountain Valley, Irvine, Newport Beach and Tustin
Division Eight:	Santa Ana
Division Nine:	Anaheim
Division Ten:	Fullerton

The nineteen major groundwater producers meet on a monthly basis with OCWD staff to consult with and provide advice on basin management issues. This group is described in more detail in Section 7.1

2.3 LEGAL AUTHORITY

Section 2 of the District Act grants powers to OCWD including, but not limited to:

- To construct, purchase, lease, or otherwise acquire, and to operate and maintain necessary waterworks, water rights, spreading grounds, lands, and rights necessary to replenish the groundwater basin and augment and protect the water quality of the common water supplies of the District;
- Provide for the conjunctive use of groundwater and surface water resources within the district area;
- Store and replenish water in underground basins or reservoirs within or outside the District;
- Regulate and control the storage of water and the use of groundwater basin storage space in the basin;
- Purchase and import water into the District;
- Transport, reclaim, purify, treat, inject, extract, or otherwise manage and control water for the beneficial use of persons or property within the District and to improve and protect the quality of the groundwater supplies;
- Determine the operational range in which groundwater levels may decline or recover during a given water year within the District’s boundaries by determining the amount and percentage of water that may be produced by pumpers from the Groundwater Basin within the district in proportion to the total amount of water used within the District (from all sources) by all persons and operators, e.g., setting of a Basin Production Percentage, or “BPP”;
- Require groundwater producers who produce more of their total water needs from the groundwater within the District than the basin production percentage (“BPP”) determined

annually by the District Board of Directors permits to pay a surcharge, the "Basin Equity Assessment" or "BEA", that removes any financial incentive for over-production from the Basin beyond that set by the OCWD Board each year;

- Provide for the protection and enhancement of the environment within and outside the District in connection with the water activities of the District; and
- To commence, maintain, intervene in, defend, and compromise, and assume the costs and expenses of all actions to prevent interference with water or water rights used within the District or diminution of the quality or pollution or contamination of the water supply of the District.

A copy of the OCWD Act, which has been the basis for OCWD's sustainable management of its portion of the Basin over many years, can be found at:

http://www.ocwd.com/media/2681/ocwddistrictact_201501.pdf

2.4 BUDGET

The mission of OCWD is to provide a reliable, high quality water supply in a cost-effective and environmentally responsible manner and to manage the Orange County groundwater basin in a sustainable manner over the long-term. For the purposes of this report, the District's entire budget is the cost to sustainably manage the basin.

OCWD's fiscal year (FY) begins on July 1 and ends on June 30. The annual operating budget and expected revenues for 2016-17 totaled approximately $158.2 million.

2.4.1 Operating Expenses

OCWD's budgeted operating expenses for FY 2016-17 are summarized in Table 2-1 and described as follows.

Table 2-1: FY 2016-17 Budget Operating Expenses

EXPENSES	Total (in millions)
General Fund	$64.4
Total Debt Service	36.6
Water Purchases	34.7
Capital Projects	6.6
Retiree Health Trust	1.3
Refurbishment and Replacement Transfer	14.6
Total	$158.2

General Fund

The general fund account primarily allows OCWD to operate the recharge facilities in the cities of Anaheim and Orange, GWRS, the Talbert and Alamitos Seawater Intrusion Barriers, the Green Acres Project, and the Prado Wetlands. In addition, the Advanced Water Quality Assurance Laboratory, groundwater monitoring programs, watershed management, planning, and other basin management activities are funded by this account.

Debt Service

The debt service budget provides for repayment of OCWD's debt from issues of previous bonds. OCWD has a comprehensive long-range debt program, which provides for the funding of projects necessary to increase basin production and protect water quality, while providing predictable impacts to the RA. OCWD holds very high credit ratings of AAA from Standard & Poor's, AAA from Fitch, along with an Aa1 rating from Moody's. Because of these excellent credit ratings, OCWD is able to borrow money at a substantially reduced cost.

Water Purchases

The District Act authorizes OCWD to purchase imported water for groundwater recharge to sustain groundwater pumping levels and refill the basin. Imported water is purchased from MWD for basin replenishment. This fund provides the flexibility to purchase water when such supplies are available. The Board of Directors can allocate funds to the Water Reserve Fund so that funds may accumulate in reserve in preparation for water purchases in future years.

New Capital Equipment

This category includes equipment items such as laboratory equipment, vehicles, heavy equipment, tools, computers, and software. These items are expensed and funded using current revenues.

Refurbishment and Replacement Fund

OCWD has over $908 million invested in existing plant and fixed assets. These facilities were constructed to provide a safe and reliable water supply. The Replacement and Refurbishment Fund was established to ensure that sufficient funds are available to repair and replace existing infrastructure, such as pumps, heavy equipment, injection and monitoring wells and water recycling facilities.

2.4.2 Operating Revenues

Expected operating revenues for FY 2016-17 are shown in Table 2-2 and described below.

Table 2-2: FY 2016-17 Operating Revenues

REVENUES	Total (in millions)
Replenishment Assessments	$117.8
Basin Equity Assessments	1.8
Property Taxes	22.9
Investment Revenues	1.6
Gap Sales and LRP Revenues	9.6
Miscellaneous Revenue	4.5
Total	$158.2

Replenishment Assessments

The Replenishment Assessment (RA) is paid for water pumped out of the basin. OCWD invoices Groundwater Producers for their production in July and January. The amount of revenue generated by the RA is directly related to the amount of groundwater production.

Basin Equity Assessment

The Basin Equity Assessment (BEA), as previously referenced, is paid by Producers for groundwater production above the BPP and is one of the primary tools OCWD uses to ensure groundwater levels remain within the pre-established operational range set by the District. This charge is assessed annually in September. The BPP is a percentage of each Producer's water supply that comes from groundwater pumped from the basin (see Section 10.3).

Property Taxes

OCWD receives a small percentage of property taxes, also referred to as ad valorem taxes, collected in the service area. The County of Orange assesses and collects these taxes and transmits them to OCWD at various times during the year. This revenue source has been dedicated to the annual debt service expense.

Investment Revenue

Investment Revenue is generated from OCWD's cash reserves.

GAP Sales and LRP Revenues

OCWD operates the Green Acres Project (GAP), which provides recycled water to customers who purchase the water for landscape irrigation. OCWD receives a subsidy for operation of the Groundwater Replenishment System and the GAP from the Metropolitan Water District of Southern California (MWD) through the Local Resources Program (LRP).

Miscellaneous Revenues

Miscellaneous revenues include annexation fees, producer well loan repayments, and rents and leases.

2.4.3 Reserves

OCWD maintains cash reserves to ensure its financial integrity so that the basin can be successfully managed and protected. Cash reserves ensure that:

- OCWD has sufficient funds for cash flow purposes;
- Funds are available for unexpected events such as contamination issues;
- Funds are available to make necessary replacements and repairs to infrastructure;
- OCWD has access to debt programs with low interest cost;
- A financial hedge is available to manage variable rate debt; and
- Funds are available to purchase MWD water when available.

Reserve Policies

OCWD has reserve policies, which establish reserves in the following categories:

- Operating reserves
- The Replacement and Refurbishment Program
- The Toxic Cleanup Reserve
- Contingencies required by the District Act
- Bond reserve covenants

Operating Reserves

This reserve category helps maintain sufficient funds for cash flow purposes and helps sustain the District’s excellent credit rating. Maintaining this reserve, which is set at 15 percent of the operating budget, is particularly important because the principal source of revenue, the RA, is only collected twice a year. Payments for significant activities, such as replenishment water purchases, are typically required on a monthly basis. The reserve provides the financial “bridge” to meet the District’s financial obligations on a monthly basis.

Replacement and Refurbishment Program

OCWD maintains a Replacement and Refurbishment Fund to provide the financial resources for replacement and/or repair of the District capital assets. These assets include treatment facilities, monitoring and injection wells, and treatment facilities.

Toxic Cleanup Reserve

Funds are reserved in this account to be used in the event that a portion of the basin becomes threatened by contamination. Over two million residents rely on the basin as their primary source of water. This reserve fund allows OCWD to respond, immediately, to contamination threats in the basin.

General Contingencies

Section 17.1 of the District Act requires the allocation of funds to cover annual expenditures that have not been provided for or that have been insufficiently provided for and for unappropriated requirements.

Debt Service Account

Restricted funds in this account have been set aside by the bonding institutions as a requirement to ensure financial solvency and to help guarantee repayment of any debt issuances. These funds cannot be used for any other purpose. The requirement varies from year to year depending on the OCWD's debt issuance and outstanding state loans.

Capital Improvement Projects

OCWD prepares a Capital Improvements Project budget to support basin production by increasing recharge capacity and operational flexibility, protecting the coastal portion of the basin, and providing water quality improvement.

SECTION 3 MANAGEMENT AREA DESCRIPTION

3.1 OCWD MANAGEMENT AREA

OCWD’s service area covers approximately 430 square miles and is co-extensive with the OCWD Management Area for purposes of this Basin 8-1 Alternative, except as identified below. The OCWD service area includes 76 percent of the area designated by the Department of Water Resources (DWR) as Basin 8-1, the “Coastal Plain of Orange County Groundwater Basin” in Bulletin 118 (DWR, 2003). For the purposes of this Basin 8-1 Alternative, the OCWD Management Area contains the same geographical area as the portion of the OCWD service area within Basin 8-1 except for a small 6.7-square mile area in the northeast corner of the basin that is part of the Santa Ana Canyon Management Area. The boundaries of Basin 8-1, the OCWD service area and the OCWD Management Area are shown in Figure 3-1.

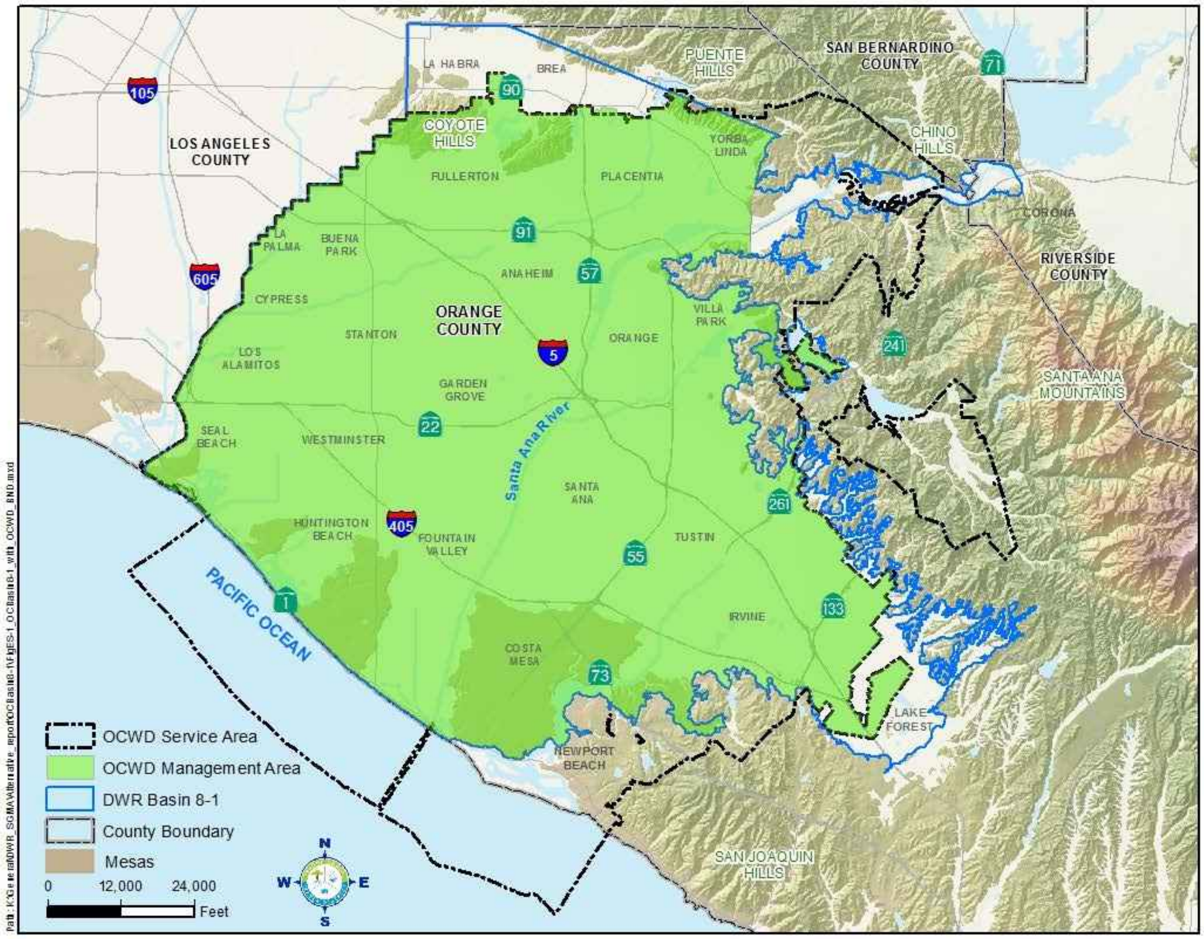


Figure 3-1: Basin 8-1, OCWD Service Area and OCWD Management Area

Jurisdictional Areas within OCWD Management Area

Federal and state lands within the OCWD Management Area as well as city boundaries are shown in Figure 3-2. Retail water providers within OCWD's service area are shown in Figure 3-3. The OCWD Management Area with a population of approximately 2.4 million is highly urbanized, as shown in Figure 3-4. Each of the 22 cities within OCWD's jurisdiction has an adopted general plan. There are no federally recognized tribes with land and there are no adjudicated areas within the OCWD Management Area. The unincorporated areas are managed by the County of Orange. Groundwater supplies are managed as a single, shared resource with no separate water use sectors.

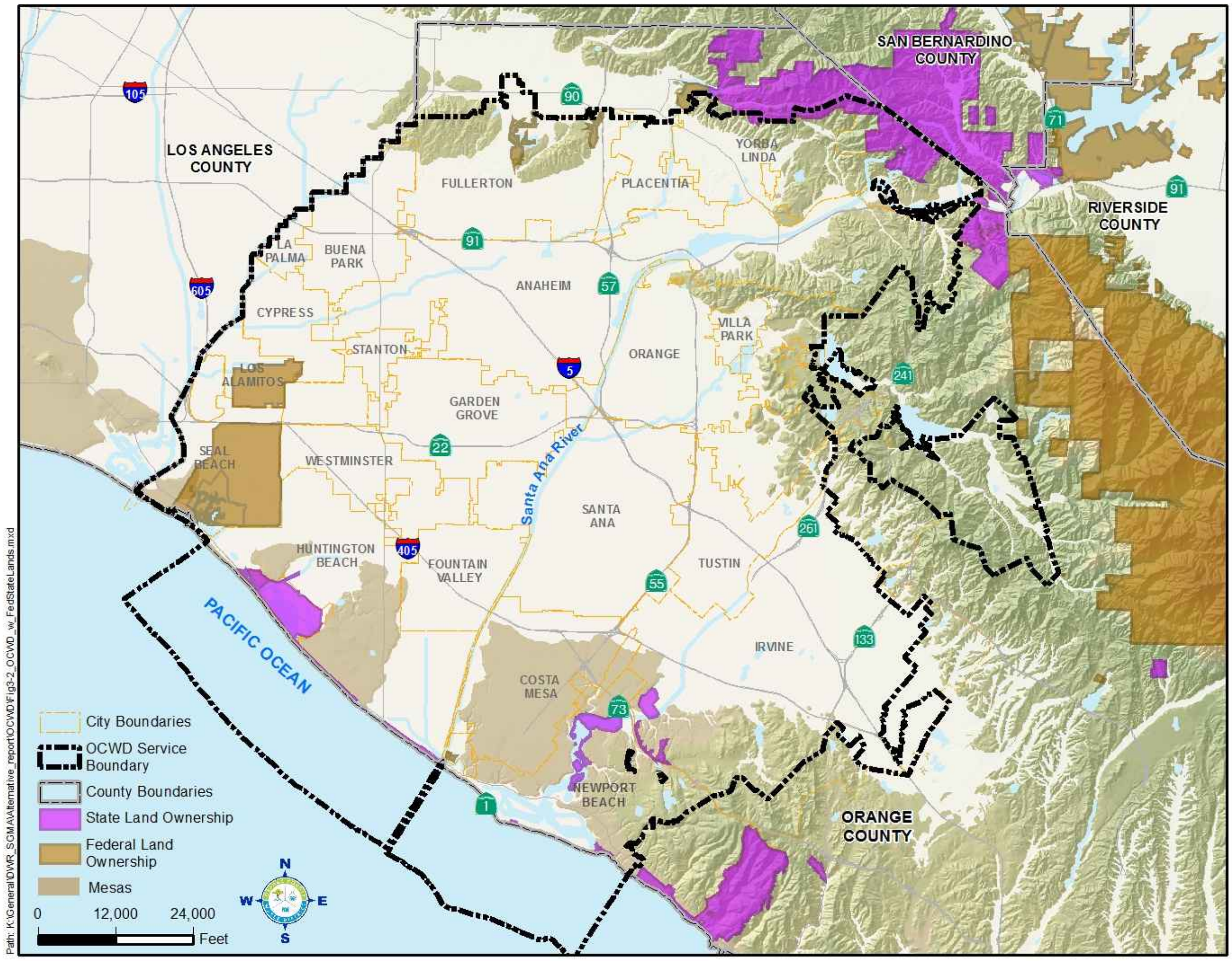


Figure 3-2: Federal and State Lands

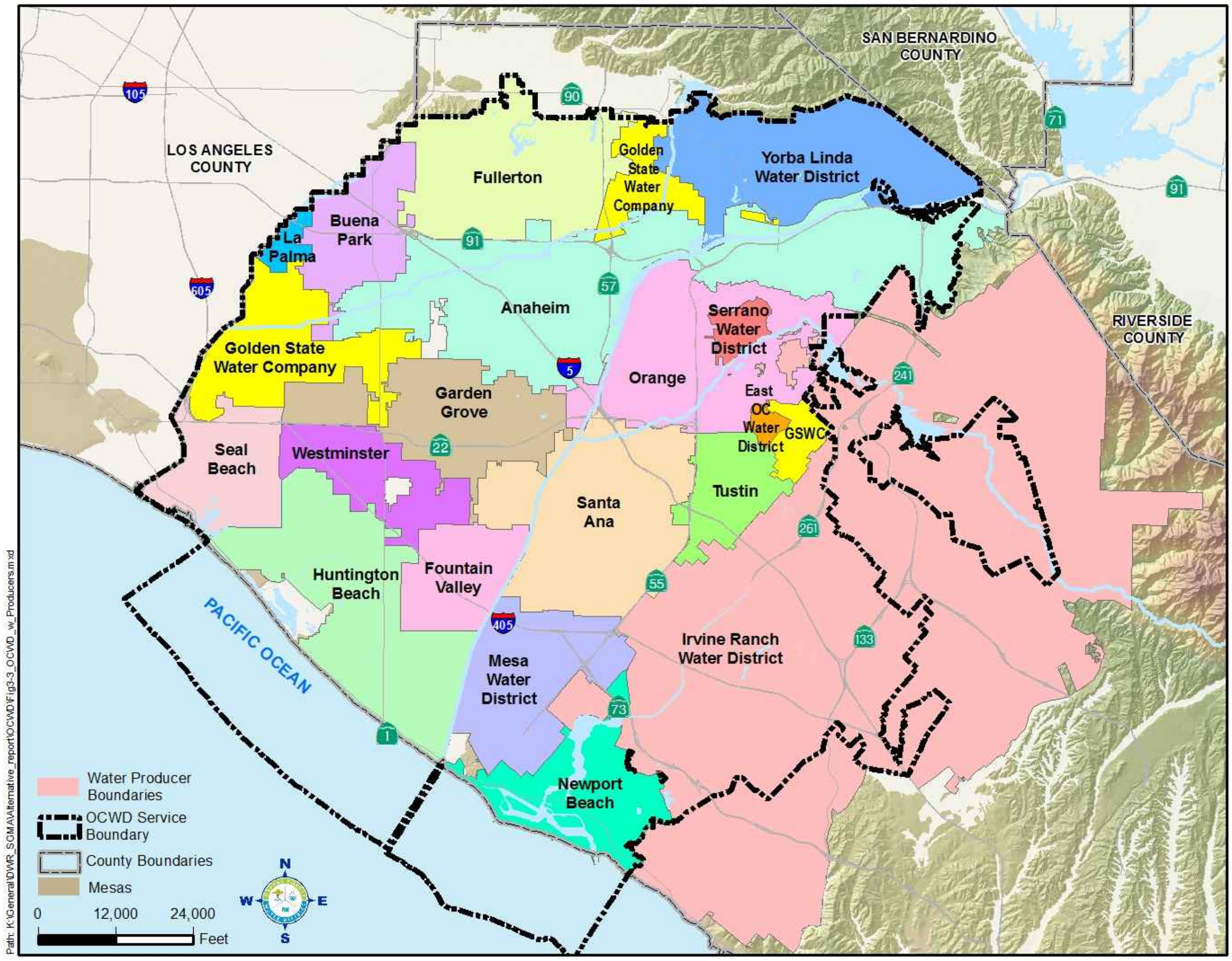


Figure 3-3: Retail Water Supply Agencies

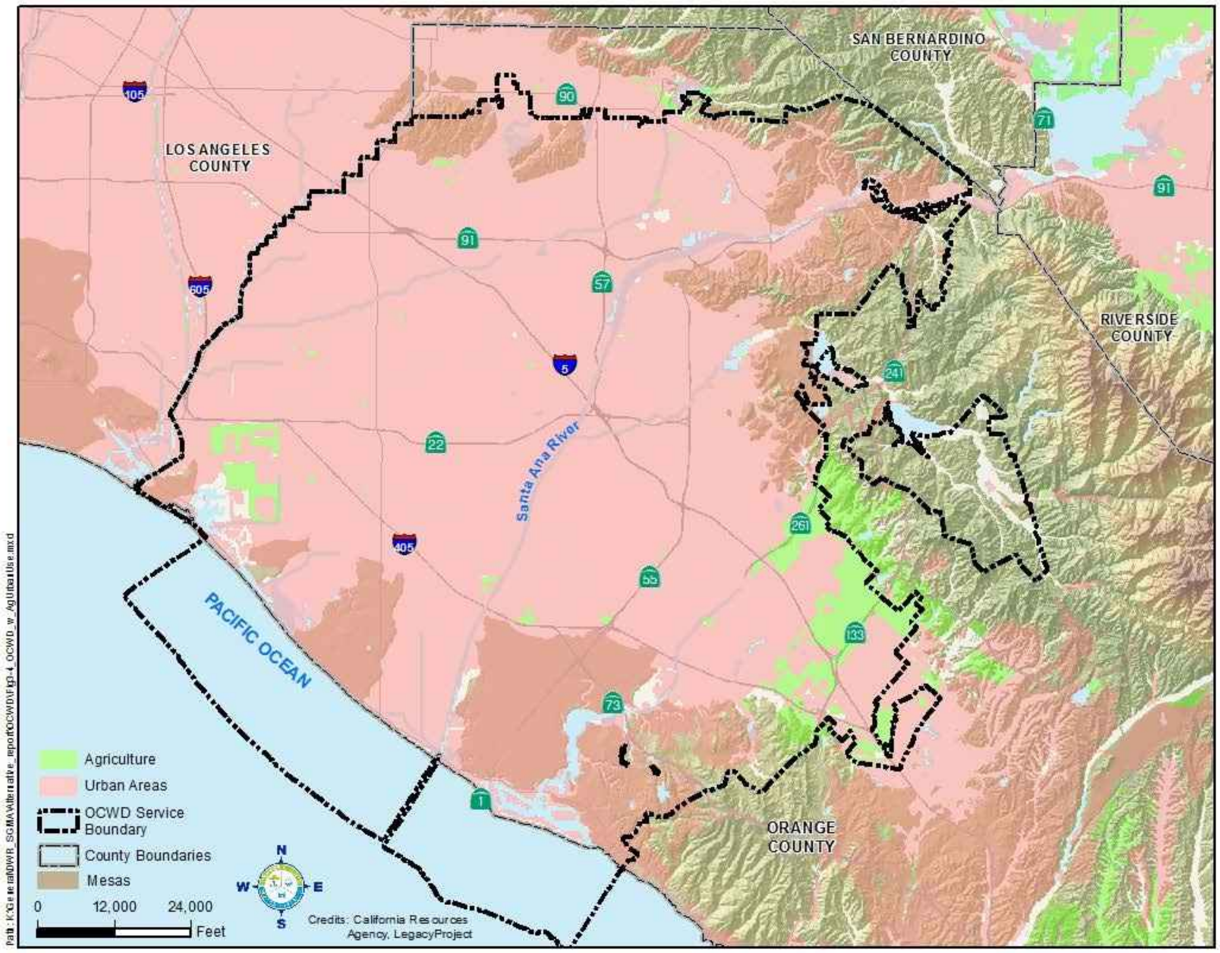


Figure 3-4: Land Uses

3.2 GROUNDWATER CONDITIONS

This section describes the groundwater conditions within the OCWD Management Area. The description includes current and historic groundwater elevation, pumping patterns, storage levels, groundwater quality, historical information concerning land subsidence, seawater intrusion, and interactions between surface water and groundwater. All elevations in this report are in units of feet above mean sea level referenced to vertical datum NGVD29, which can be converted to NAVD88. Geographic locations are reported in GPS State Plane coordinates referenced to NAD83.

3.2.1 Groundwater Elevation Contours

Figures 3-5, 3-6 and 3-7 show the contoured water levels for the Shallow, Principal and Deep Aquifers in June 2016. The contour maps for each of the three aquifer systems are prepared annually. The maps area used to prepare water level change maps for the three major aquifer systems and to calculate the amount of groundwater in storage and the annual storage change.

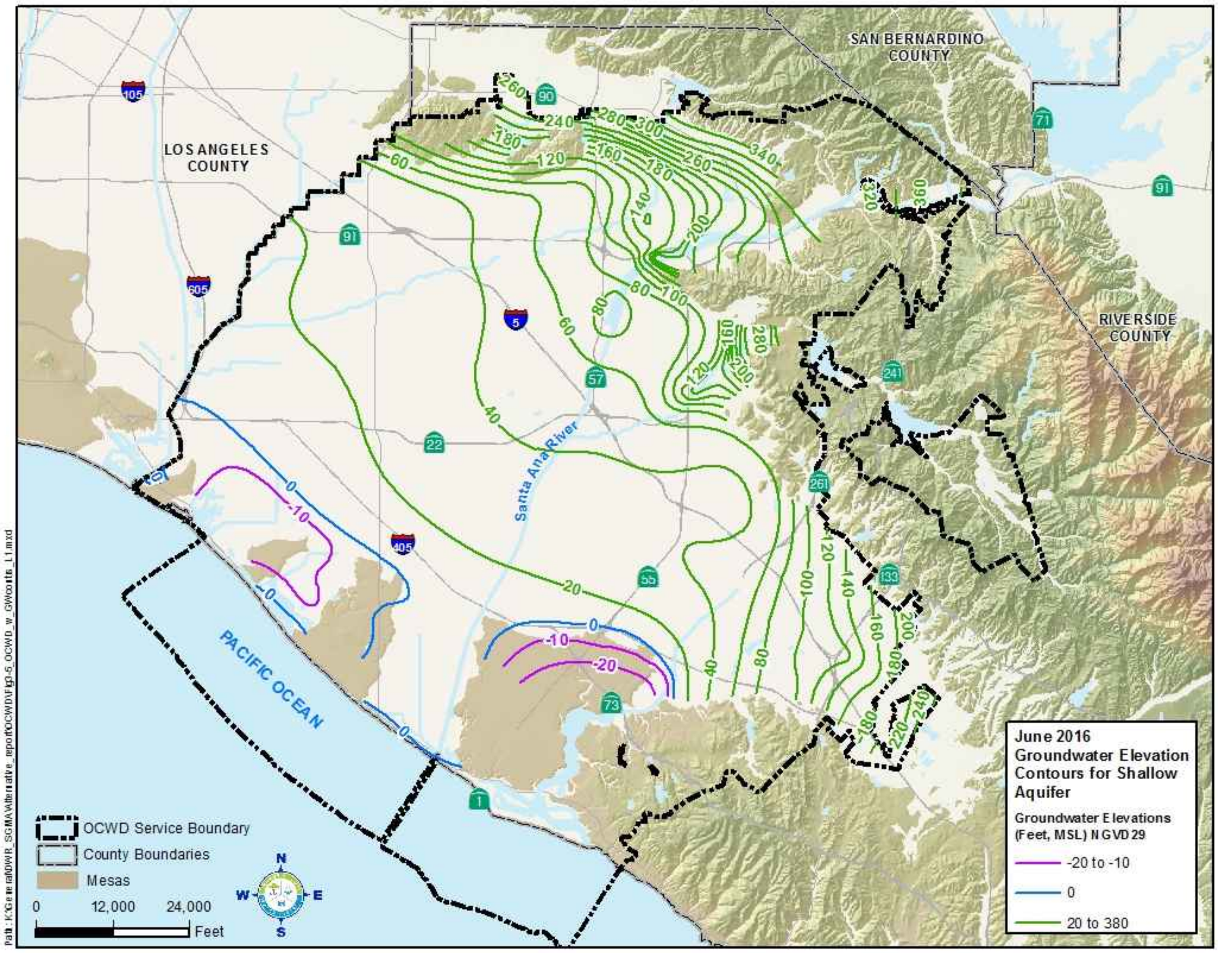


Figure 3-5: Groundwater Elevation Contours for the Shallow Aquifer June 2016

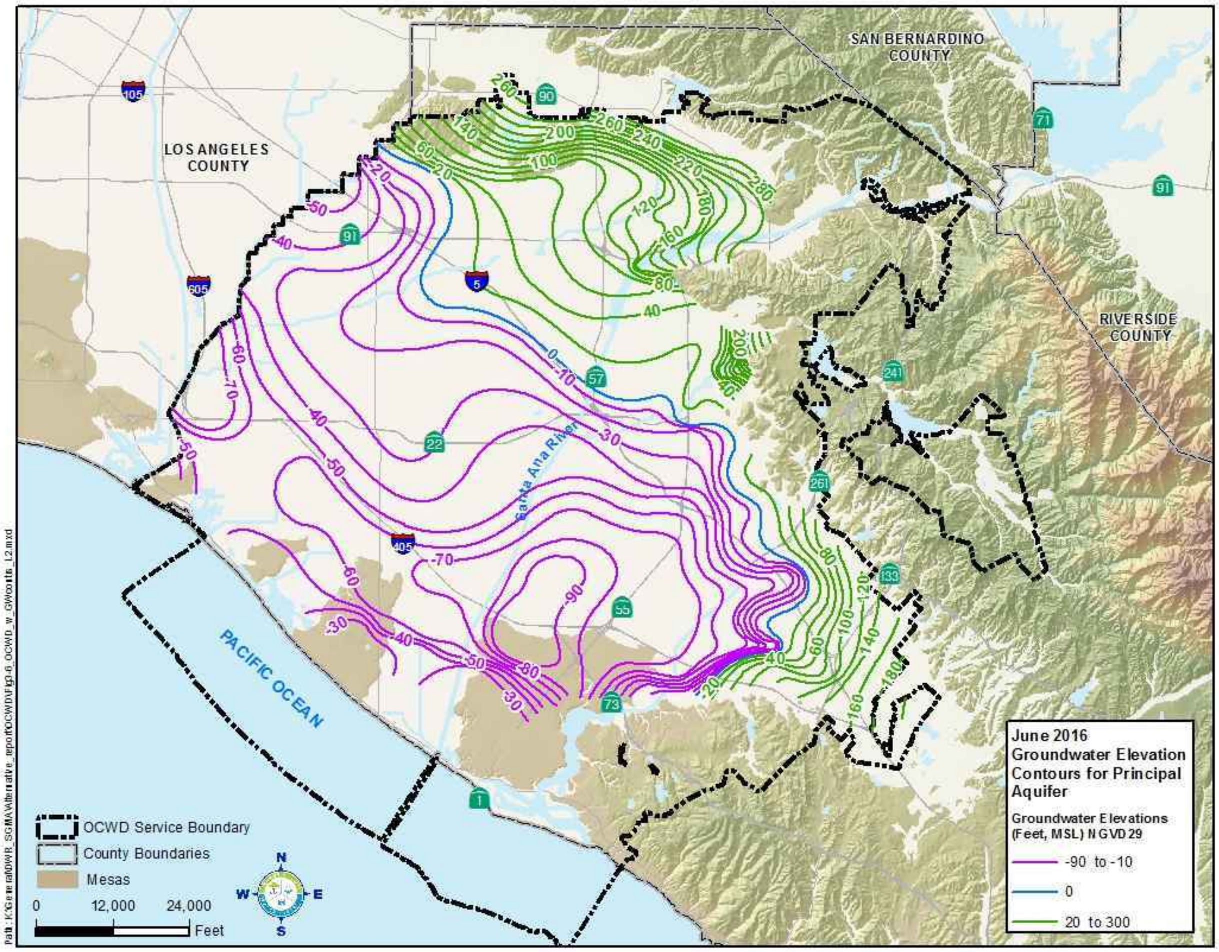


Figure 3-6: Groundwater Elevation Contours for the Principal Aquifer June 2016

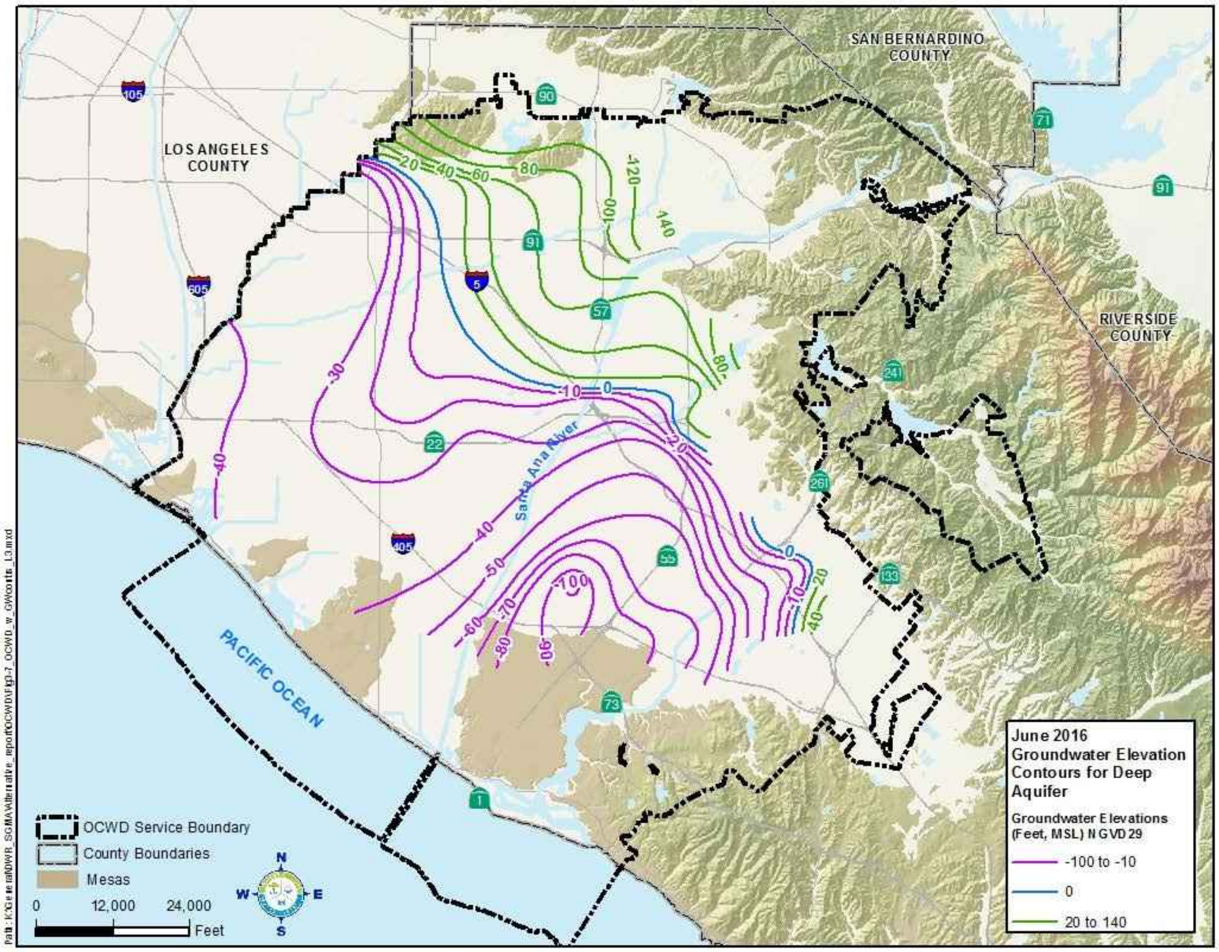


Figure 3-7: Groundwater Elevation Contours for the Deep Aquifer June 2016

3.2.2 Regional Pumping Patterns

Active wells pumping water from the basin are shown in Figure 3-8. The approximately 200 large-system wells account for an estimated 97 percent of the total basin production. The remaining three percent of total basin production includes agricultural and industrial producers, small mutual water companies, domestic well producers, and production from privately-owned wells. As can be seen in Figure 3-8, groundwater production is distributed throughout the productive areas of the basin.

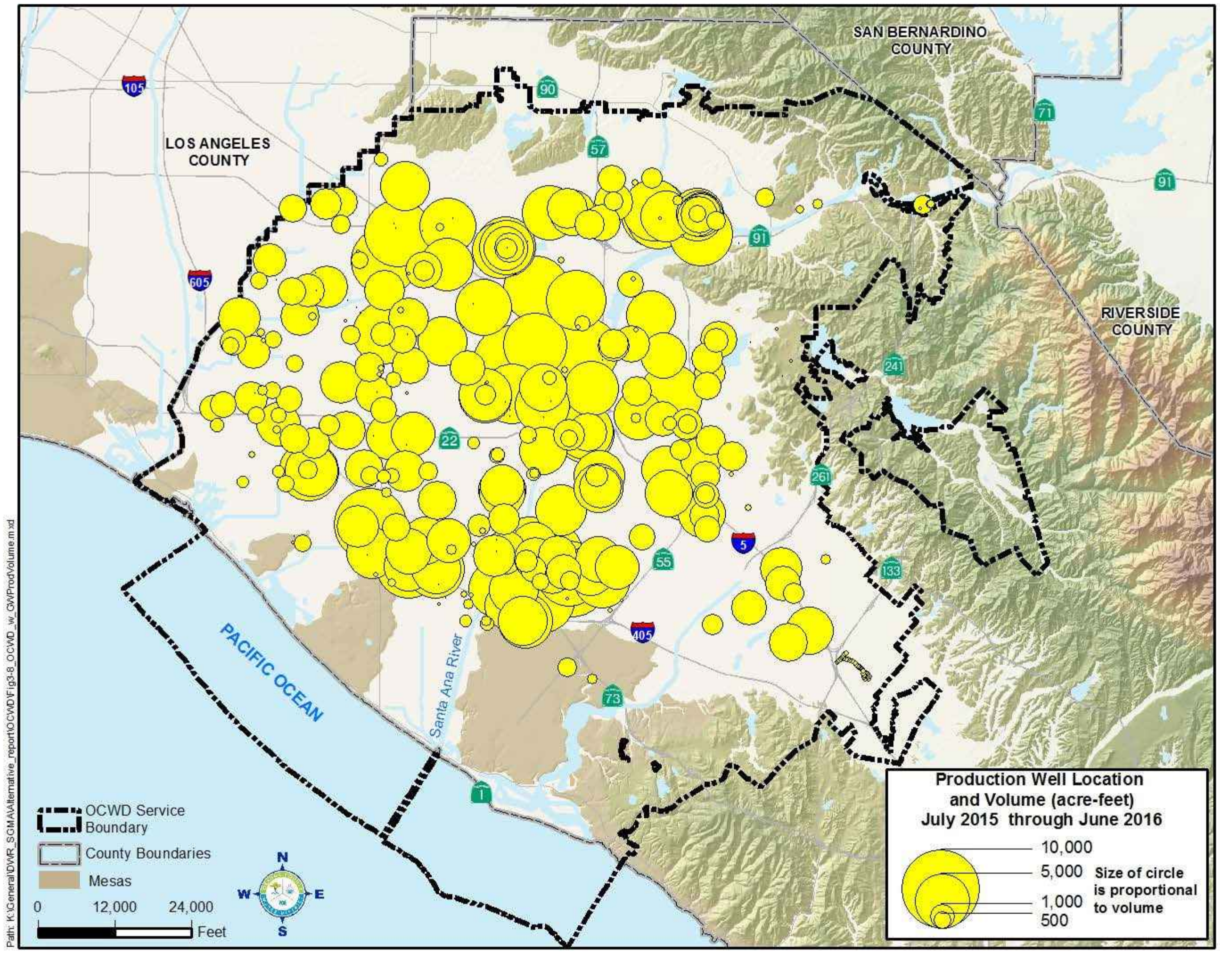


Figure 3-8: Groundwater Production, July 2015 to June 2016

3.2.3 Long-Term Groundwater Elevation Hydrograph

Historical groundwater elevation data within the Orange County groundwater basin dates to the turn of the 20th century and, until the 1980s, is largely derived from measurements of long-screened agricultural and municipal production wells. In the 1950s and 1960s, the United States Geological Survey and DWR conducted focused investigations of seawater intrusion along the coast. These investigations included construction of monitoring wells, some of which are still used today. In 1988, OCWD initiated construction of a basin-wide network of multi-depth monitoring wells which are used to monitor groundwater levels and quality, assess effects of pumping and recharge, estimate groundwater storage, characterize basin hydrogeology, and develop and calibrate a numerical flow model of the basin.

Groundwater elevation trends exhibit both short-term (seasonal) and long-term fluctuations. Seasonal elevation changes reflect short-term variations in pumping and recharge, while multi-year trends reflect the effects of extended periods of above- or below-average precipitation and/or availability of imported water.

OCWD measures elevations in three principal aquifer systems. In general, groundwater elevations in the Shallow Aquifer system show less amplitude than those in the underlying Principal and Deep Aquifer systems due to the higher degree of pumping and confinement of the Principal and Deep Aquifer systems. Because approximately 95 percent of all production occurs from wells screened within the Principal Aquifer system, groundwater elevations within this system are typically lower than those in the overlying Shallow Aquifer system and, in some areas, the underlying Deep Aquifer system. As a result, vertical gradients created by pumping and recharge drive groundwater into the Principal Aquifer system from the overlying Shallow aquifer system and, to a lesser extent, from the Deep Aquifer system.

The groundwater elevation profile for the Principal Aquifer following the Santa Ana River from the ocean to the Forebay in Anaheim, for 1969, 2013, and the theoretical full basin condition are shown in Figure 3-9. A comparison of these profiles shows that groundwater elevations in the Forebay recharge area for all three conditions are similar while in the central and coastal areas of the basin elevations in 2013 are significantly lower. The lowering of coastal area groundwater levels relative to groundwater levels further inland in the Forebay reflects the changes in basin pumping and storage between 1969 and 2013. It also translates into a steeper hydraulic gradient, which drives greater flow from the Forebay to the coastal areas.

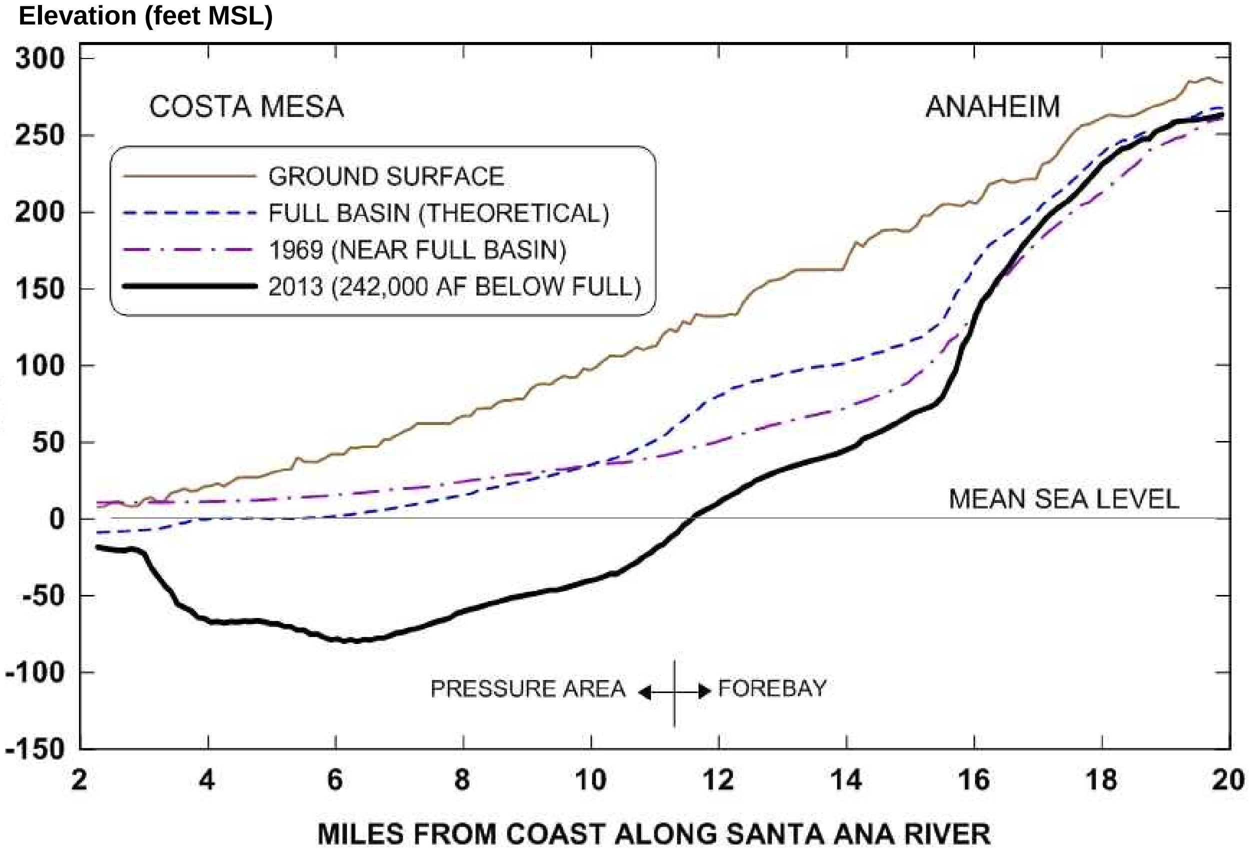


Figure 3-9: Principal Aquifer Groundwater Elevation Profiles, 1969 and 2013

Groundwater elevation trends can be examined using seven wells with long-term groundwater level data, the locations of which are shown in Figure 3-10. Figures 3-11 and 3-12 show water level hydrographs for wells SA-21 and GG-16 representing historical conditions in the Pressure area and well A-27 representing historical conditions in the Forebay. Water level data for well A-27 near Anaheim Lake dates back to 1932 and indicate that the historic low water level in this area occurred in 1951-52. The subsequent replenishment of Colorado River water essentially refilled the basin by 1965. Water levels in this well reached a historic high in 1994 and have generally remained high as recharge has been nearly continuous at Anaheim Lake since the late 1950s.

The hydrograph for well SA-21 indicates that water levels in this area have decreased since 1970. Also noteworthy is the large range of water level fluctuations from the early 1990s to early 2000s. The increased water level fluctuations during this period were due to a combination seasonal water demand-driven pumping and participation in the MWD Short-Term Seasonal Storage Program by local Producers (Boyle Engineering and OCWD, 1997), which encouraged increased pumping from the groundwater basin during summer months when MWD was experiencing high demand for imported water. Although this program did not increase the amount of pumping from the basin on an annual basis, it did result in greater water level declines during the summer during the period of 1989 to 2002 when the program was active.

Figure 3-13 presents water level hydrographs of two OCWD multi-depth monitoring wells, SAR-1 and OCWD-CTG1, showing the relationship between water level elevations in aquifer zones at different depths. The hydrograph of well SAR-1 in the Forebay exhibits a similarity in water levels between shallow and deep aquifers, which indicates the high degree of hydraulic interconnection between aquifers characteristic of much of the Forebay.

The hydrograph of well OCWD-CTG1 is typical of the Pressure Area in that there are large differences in water levels in different aquifers, indicating a reduced level of hydraulic interconnectivity between shallow and deep aquifers caused by fine-grained layers that restrict vertical groundwater flow. Water levels in the deepest aquifer zone at well OCWD-CTG1 are higher than overlying aquifers, in part, because few wells directly produce water from these zones. The lack of production from the deepest aquifers is due to the presences of amber-colored water, the cost to construct very deep wells, and the fact that sufficient high-quality groundwater is readily available within the overlying Principal aquifer.

Two additional hydrographs for wells HBM-1 and IDM-1 show multi-depth water levels representative of the coastal area and the southwestern portion of the management area. The downward trend in water levels at well IDM-1 shows the effects of a water quality improvement project known as the Irvine Desalter Project. This joint project between OCWD and IRWD, in collaboration with the U.S. Department of Navy, went on line in 2006 and consists of production wells, pipelines, and treatment facilities to remove, treat, and put to beneficial use groundwater that contains elevated TDS, nitrate, and/or trichloroethylene. To provide the intended hydraulic containment of this impacted groundwater, lowered groundwater levels in the Irvine area were necessary and expected based on model projections.

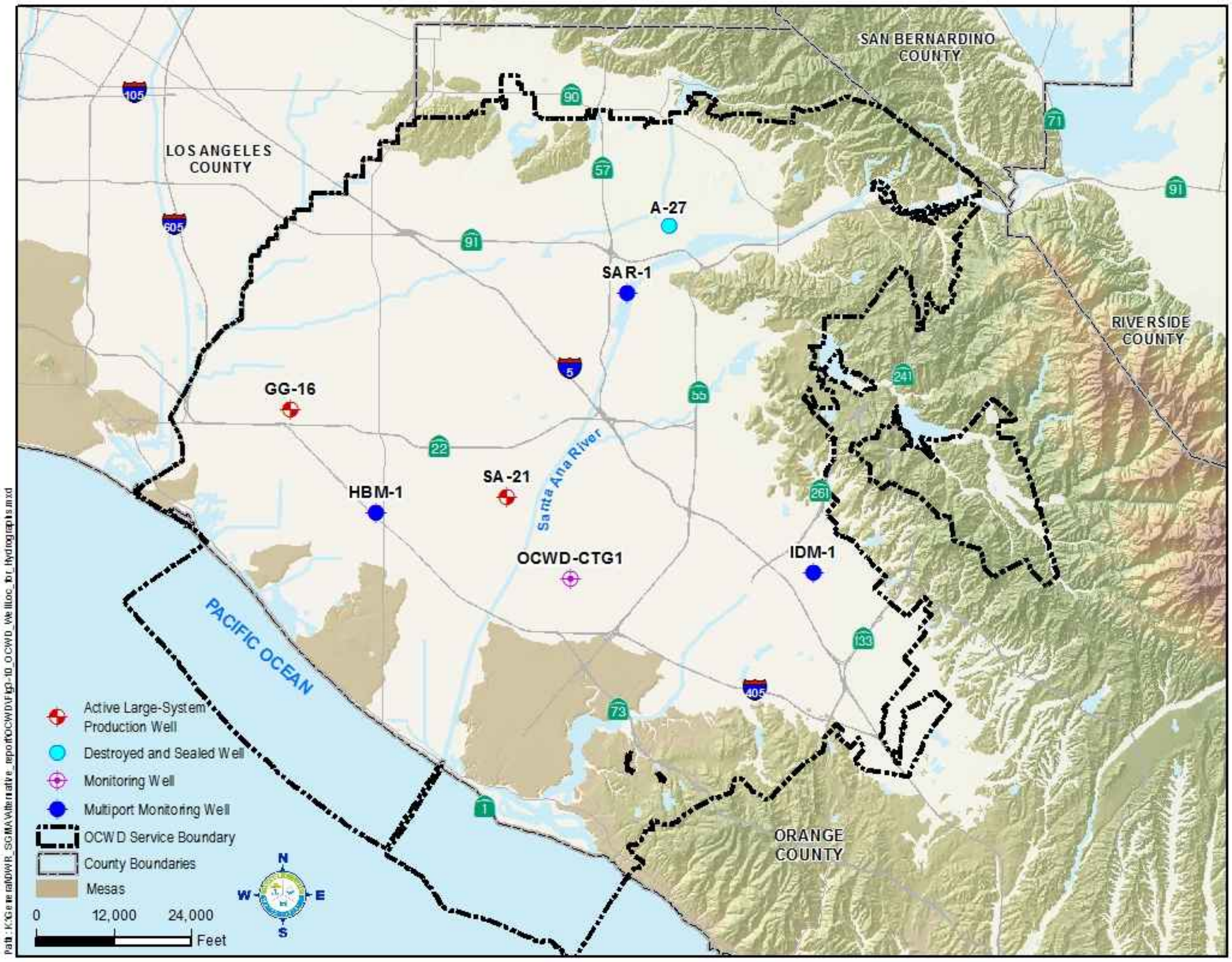
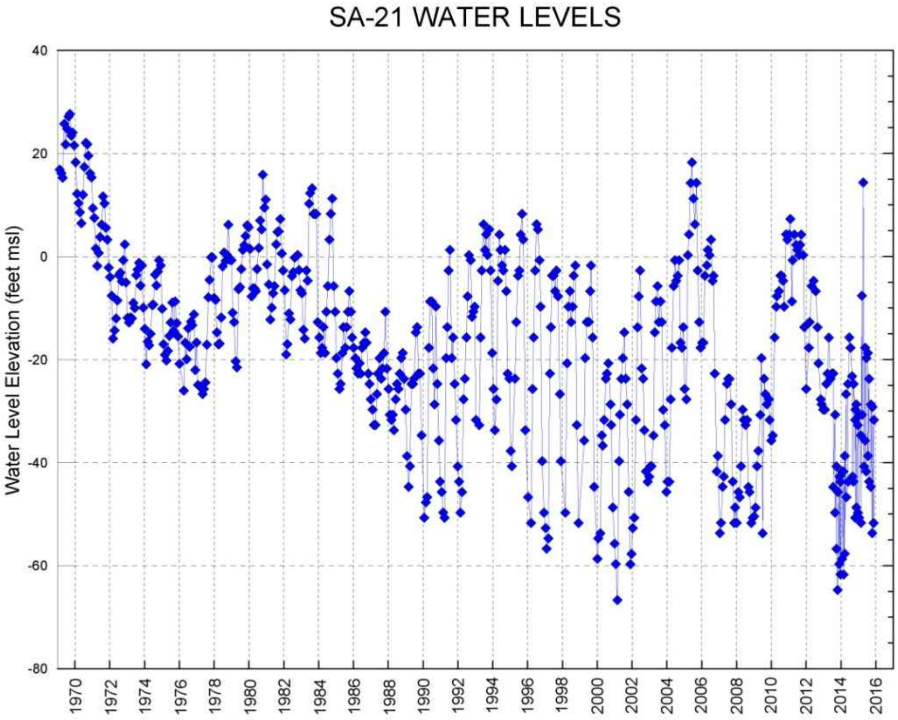


Figure 3-10: Location of Long-Term Groundwater Elevation Hydrographs



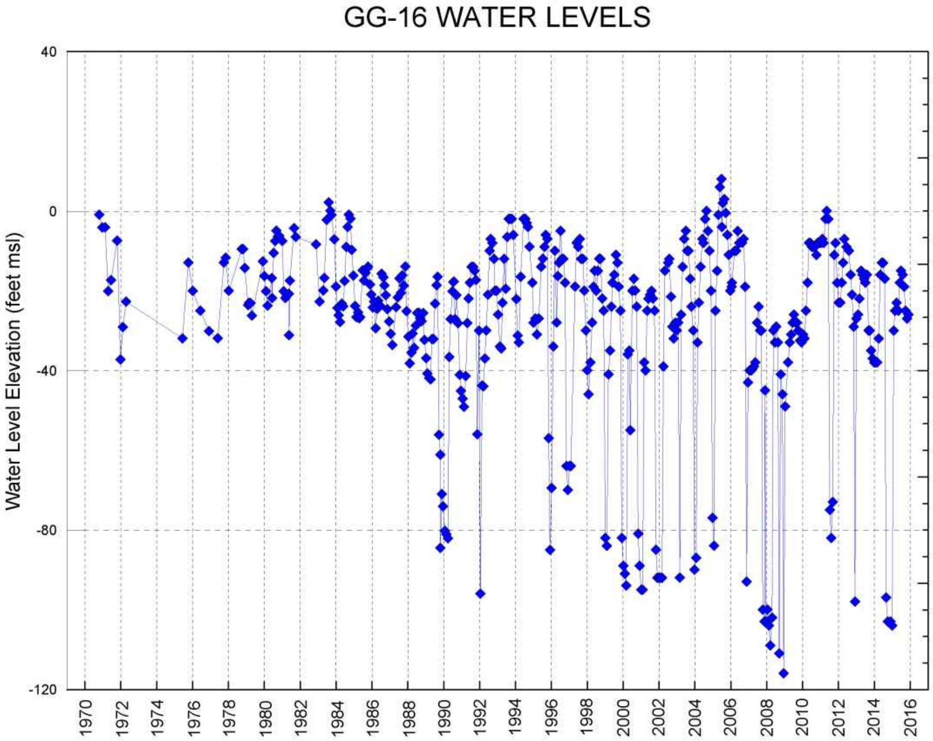


Figure 3-11: Water Level Hydrographs of Wells SA-21 and GG-16 in Pressure Area

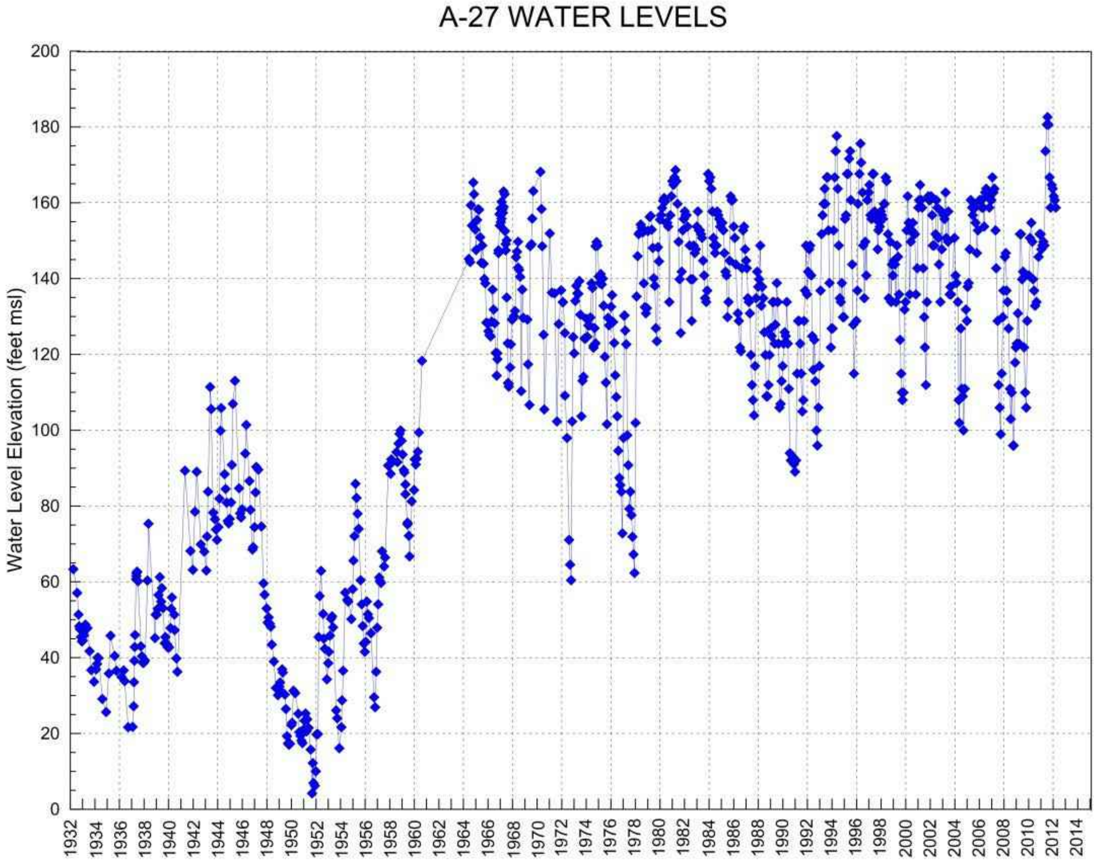


Figure 3-12: Water Level Hydrograph of Well A-27 in Forebay Area

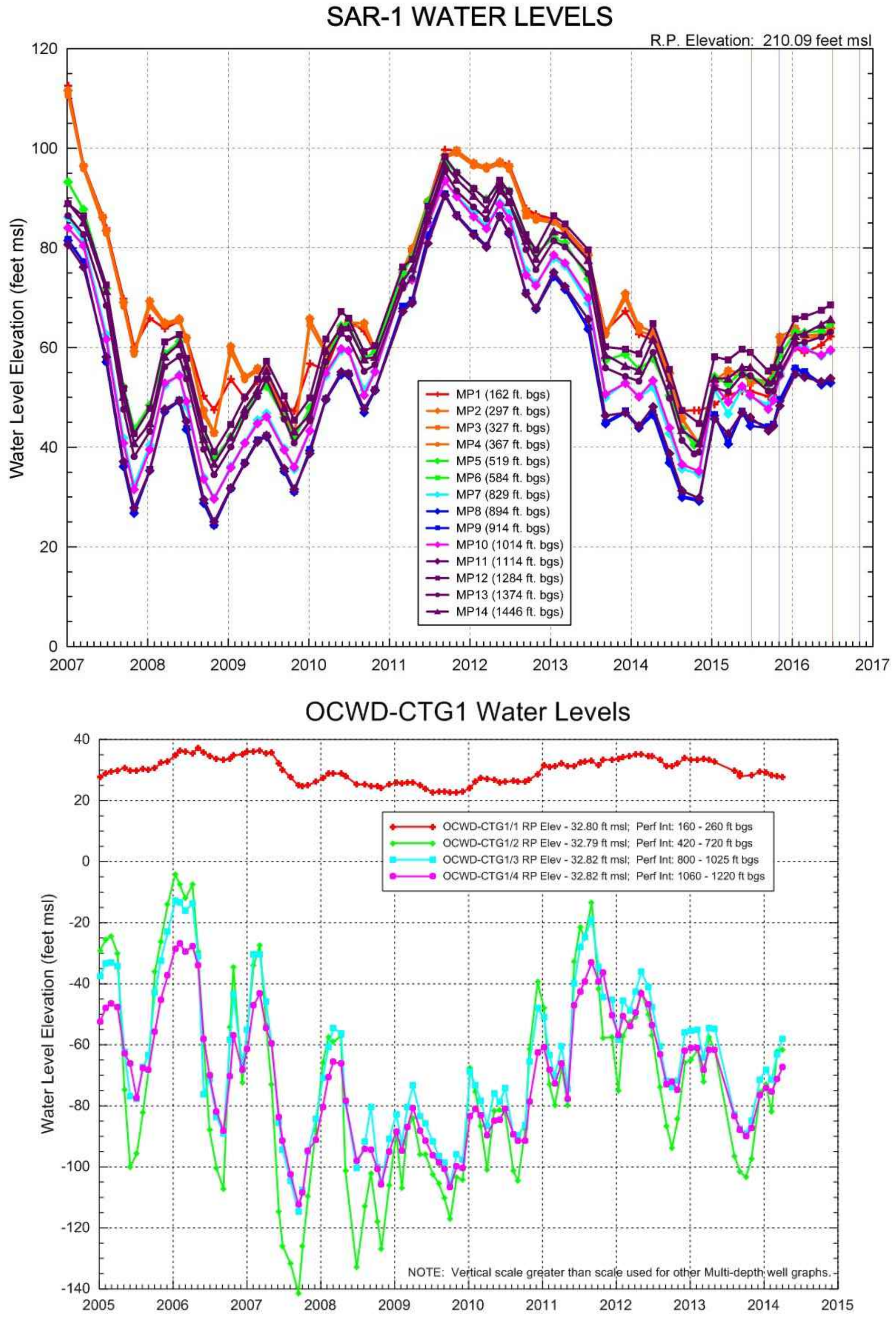


Figure 3-13: Water Level Hydrographs of Wells SAR-1 and OCWD-CTG1

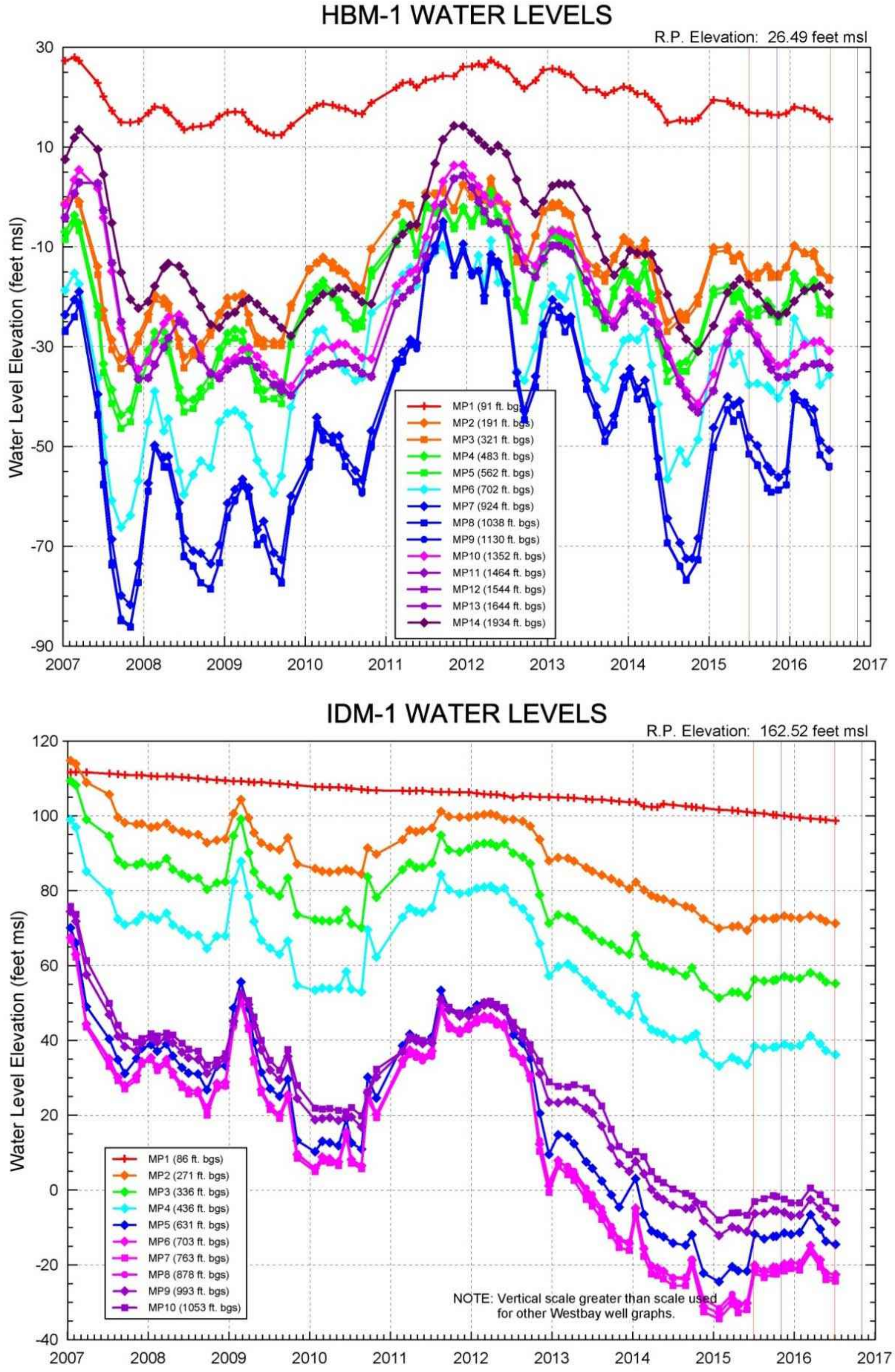


Figure 3-14: Water Level Hydrographs of Wells HBM-1 and IDM-1

3.2.4 Groundwater Storage Data

OCWD operates the basin within an operating range from a full condition to approximately 500,000 acre-feet below full to protect against seawater intrusion, inelastic land subsidence, and other potential undesirable results. On a short-term basis, the basin can be operated at an even lower storage level in an emergency.

In order to manage the basin within this operating range, OCWD calculates the change in storage relative to a full basin condition on an annual basis for the three aquifer layers, an example of which is shown in Figure 3-15. This figure indicates an increase in groundwater in storage from 381,000 acre-feet below full condition in June 2015 to 379,000 acre-feet below full condition in June 2016. In essence, basin storage in June 2015 and June 2016 was almost unchanged, indicating inflows and outflows during that period were virtually balanced, which is not often the case nor necessarily OCWD's goal in any particular year. It is noteworthy that the increase in storage of 2,000 acre-feet is not evenly divided between aquifer layers.

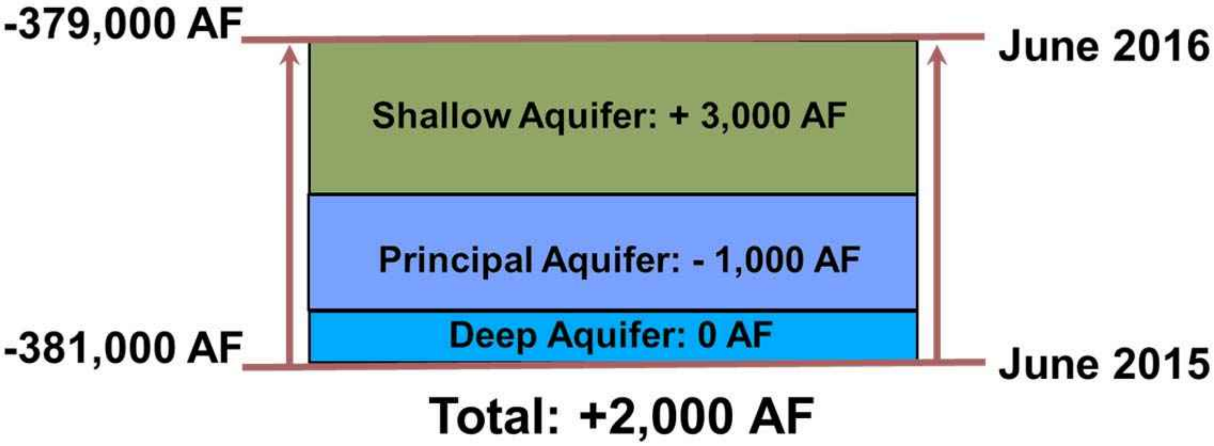


Figure 3-15: Groundwater Storage Level Change, June 2015 to June 2016

3.3 BASIN MODEL

OCWD's basin model encompasses most of Basin 8-1 and extends approximately three miles into the Central Basin in Los Angeles County to provide for more accurate model results than if the model boundary stopped at the county line (see Figure 3-16). The county line is not a hydrogeologic boundary, and groundwater freely flows through aquifers that have been correlated across the county line. The model provides a tool to supplement the storage change calculations that are done each year with actual groundwater elevation data. The model also provides a tool to conduct a wide range of evaluations of proposed projects and operating scenarios.

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

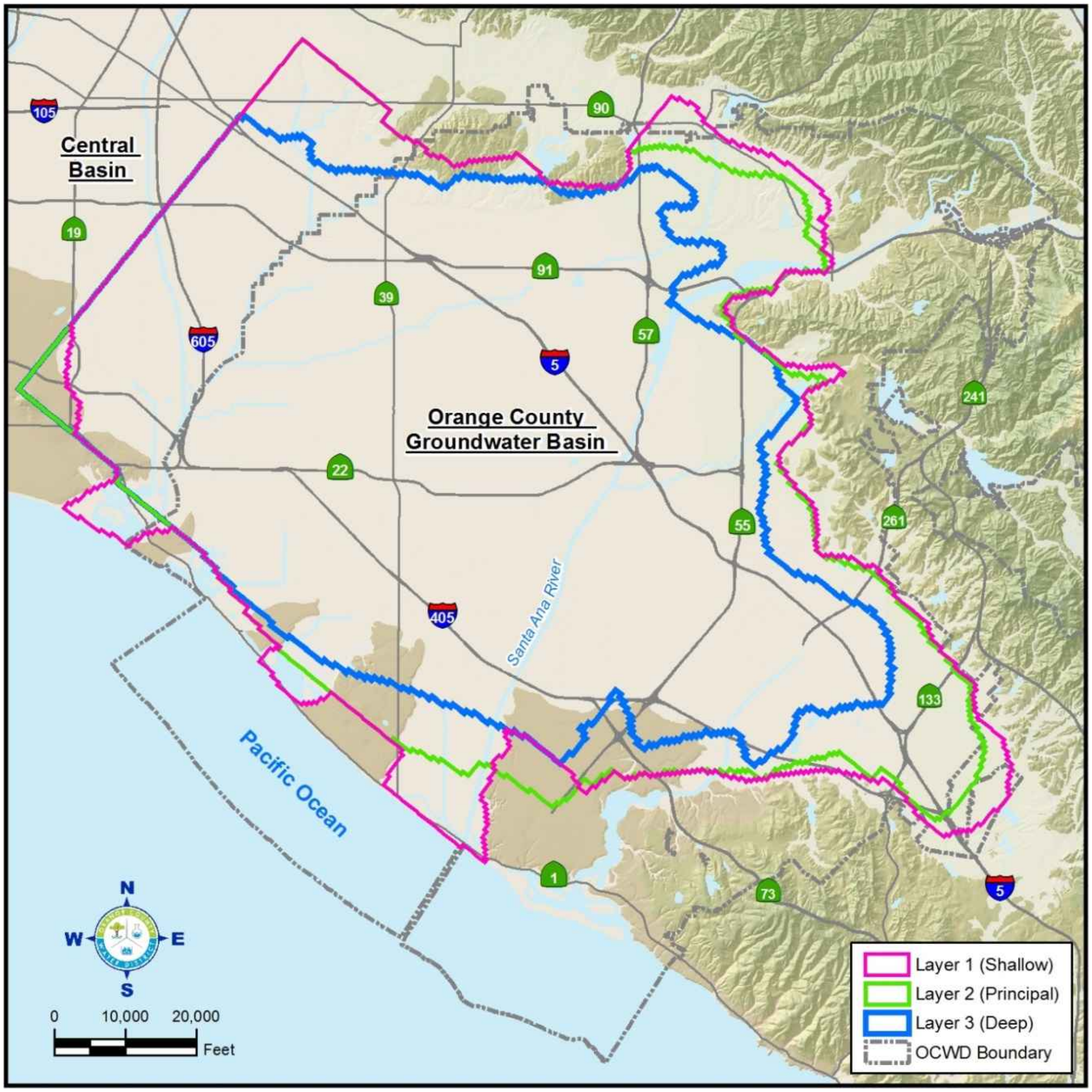


Figure 3-16: Basin Model

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

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

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

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

Typical transient model output consists of water level elevations at each grid cell that can be plotted as a contour map for one point in time or as a time-series graph at a single location. Post-processing of model results into usable graphics is performed using a combination of semi-automated GIS and database program applications. Figure 3-17 presents a simplified schematic of the modeling process.

Model construction, calibration, and operation were built upon 12 years of effort by OCWD staff to collect, compile, digitize, and interpret hundreds of borehole geologic and geophysical logs, water level hydrographs, and water quality analyses. The process was composed of 10 main tasks comprising over 120 subtasks. The major tasks are summarized as follows:

- Finalize conceptual hydrogeologic model layers and program GIS/database applications to create properly formatted MODFLOW input data files. Over 40 geologic cross sections were used to form the basis of the vertical and lateral aquifer boundaries.
- Define model layer boundaries. The top and bottom elevations of the three aquifer system layers and intervening aquitards were hand-contoured, digitized, and overlain on the model grid to populate the model input arrays with a top and bottom elevation for each layer at every grid cell location. Model layer thickness values were then calculated using GIS.

- Develop model layer hydraulic conductivity (K) grids. Estimates of K for each layer were based on (in order of importance): available aquifer test data, well-specific capacity data, and lithologic data. In the absence of reliable aquifer test or specific capacity data for areas in Layers 1 and 3, lithology-based K estimates were calculated by assigning literature values of K to each lithology type (e.g., sand, gravel, clay) within a model layer and then calculating an effective K value for the entire layer at that well location. Layer 2 had the most available aquifer test and specific capacity data. Therefore, a Layer 2 transmissivity contour map was prepared and digitized, and GIS was used to calculate a K surface by dividing the transmissivity grid by the aquifer thickness grid. Initial values of K were adjusted during model calibration to achieve a better match of model results with known groundwater elevations.
- Develop layer production factors for active production wells simulated in the model. Many production wells had long screened intervals that spanned at least two of the three model layers. Therefore, groundwater production for each of these wells had to be divided among each layer screened by use of layer production factors. These factors were calculated using both the relative length of screen within each model layer and the hydraulic conductivity of each layer. Well production was then multiplied by the layer factors for each individual well. For example, if a well had a screened interval equally divided across Layers 1 and 2, but the hydraulic conductivity of Layer 1 was twice that of Layer 2, then the calculated Layer 1 and 2 production factors for that well would have been one-third and two-thirds, respectively, such that when multiplied by the total production for this well, the production assigned to Layer 1 would have been twice that of Layer 2. For the current three-layer model, approximately 25 percent of the production wells in the model were screened across more than one model layer. In this context, further vertical refinement of the model (more model layers) may better represent the aquifer architecture in certain areas but may also increase the uncertainty and potential error involved in the amount of production assigned to each model layer.
- Develop basin model water budget input parameters, including groundwater production, artificial recharge, and unmeasured recharge. Groundwater production and artificial recharge volumes were applied to grid cells in which production wells or recharge facilities were located. The most uncertain component of the water budget – unmeasured or incidental recharge – was applied to the model as an average monthly volume based on estimates calculated annually for the OCWD *Engineer's Report*. Unmeasured recharge was distributed to cells throughout the model, but was mostly applied to cells along margins of the basin at the base of the hills and mountains. The underflow component of the incidental recharge represents the amount of groundwater flowing into and out of the model along open boundaries. Prescribed groundwater elevations were assigned to open boundaries along the northwest model boundary in Los Angeles County; the ocean at the Alamitos, Bolsa, and Talbert Gaps; the mouth of the Santa Ana Canyon; and the mouth of Santiago Creek Canyon. Groundwater elevations for the boundaries other than the ocean boundaries were based on historical groundwater elevation data from nearby wells. The model automatically calculated the dynamic flow across these open boundaries as part of the overall water budget.
- Develop model layer storage coefficients. Storage coefficient values for portions of model layers representing confined aquifer conditions were prepared based on available aquifer test data and were adjusted within reasonable limits based on calibration results.
- Develop vertical leakage parameters between model layers. Vertical groundwater flow between aquifer systems in the basin is generally not directly measured, yet it is one of the critically-important factors in the model's ability to represent actual basin hydraulic processes. Using geologic cross-sections and

depth-specific water level and water quality data from the OCWD multi-depth monitoring well network, staff identified areas where vertical groundwater flow between the modeled aquifer systems is either likely to occur or be significantly impeded, depending on the relative abundance and continuity of lower-permeability aquitards between model layers. During model calibration, the initial parameter estimates for vertical leakage were adjusted to achieve closer matches to known vertical groundwater gradients.

- Develop groundwater contour maps for each model layer to be used for starting conditions and for visual comparison of water level patterns during calibration. Staff used observed water level data from multi-depth and other wells to prepare contour maps of each layer for November 1990 as a starting point for the calibration period. Care was taken to use wells screened within the appropriate vertical interval representing each model layer. The hand-drawn contour maps were then digitized and used as model input to represent starting conditions.
- Perform transient calibration runs. The nine-year period of November 1990 to November 1999 was selected for transient calibration, as it represented the period corresponding to the most detailed set of groundwater elevation, production, and recharge data. The transient calibration process and results are described in the next section.
- Perform various basin production and recharge scenarios using the calibrated model. Criteria for pumping and recharge, including facility locations and quantities, were developed for each scenario and input for each model run.

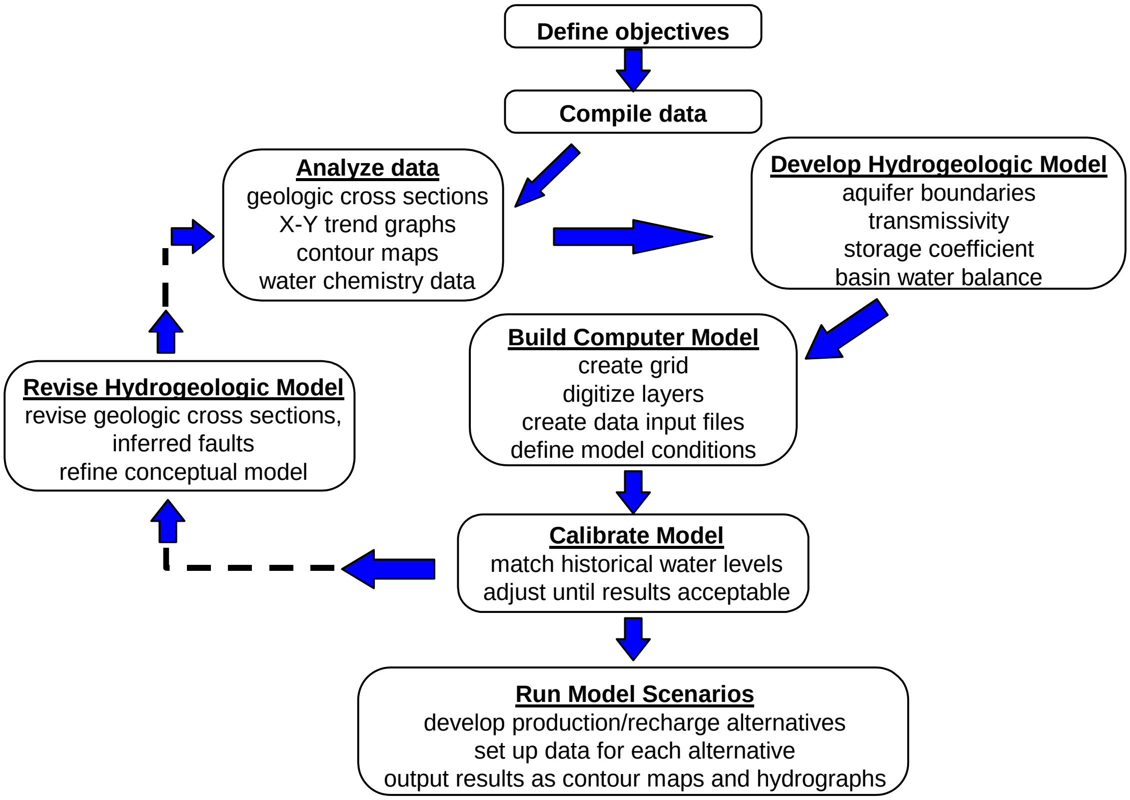


Figure 3-17: Model Development Flowchart

Model Calibration

Calibration of the transient basin model involved a series of simulations of the period 1990 to 1999, using monthly flow and water level data. The time period selected for calibration represents a period during which basic data required for monthly transient calibration were essentially complete (compared to pre-1990 historical records). The calibration period spans at least one “wet/dry” rainfall cycle. Monthly water level data from almost 250 target locations were used to determine if the simulated water levels adequately matched observed water levels. As shown in Figure 3-18, the calibration target points were densely distributed throughout the basin and also covered all three model layers.

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

November 1997 observed data were contoured for all three layers, the contour maps for Layers 1 and 3 were somewhat more generalized than for Layer 2 due to a lower density of data points (wells) in these two layers.

Depending on the results of each calibration run, model input parameters were adjusted, including hydraulic conductivity, storage coefficient, boundary conditions, and recharge distribution. Time-varying head boundaries along the Orange County/Los Angeles County line were found to be extremely useful in obtaining a close fit with observed historical water levels in the northwestern portion of the model.

Fifty calibration runs were required to reach an acceptable level of calibration in which model-generated water levels were within reasonable limits of observed water level elevations during the calibration period. Figures 3-19 through 3-21 show examples of hydrographs of observed versus simulated water levels for three wells used as calibration targets.

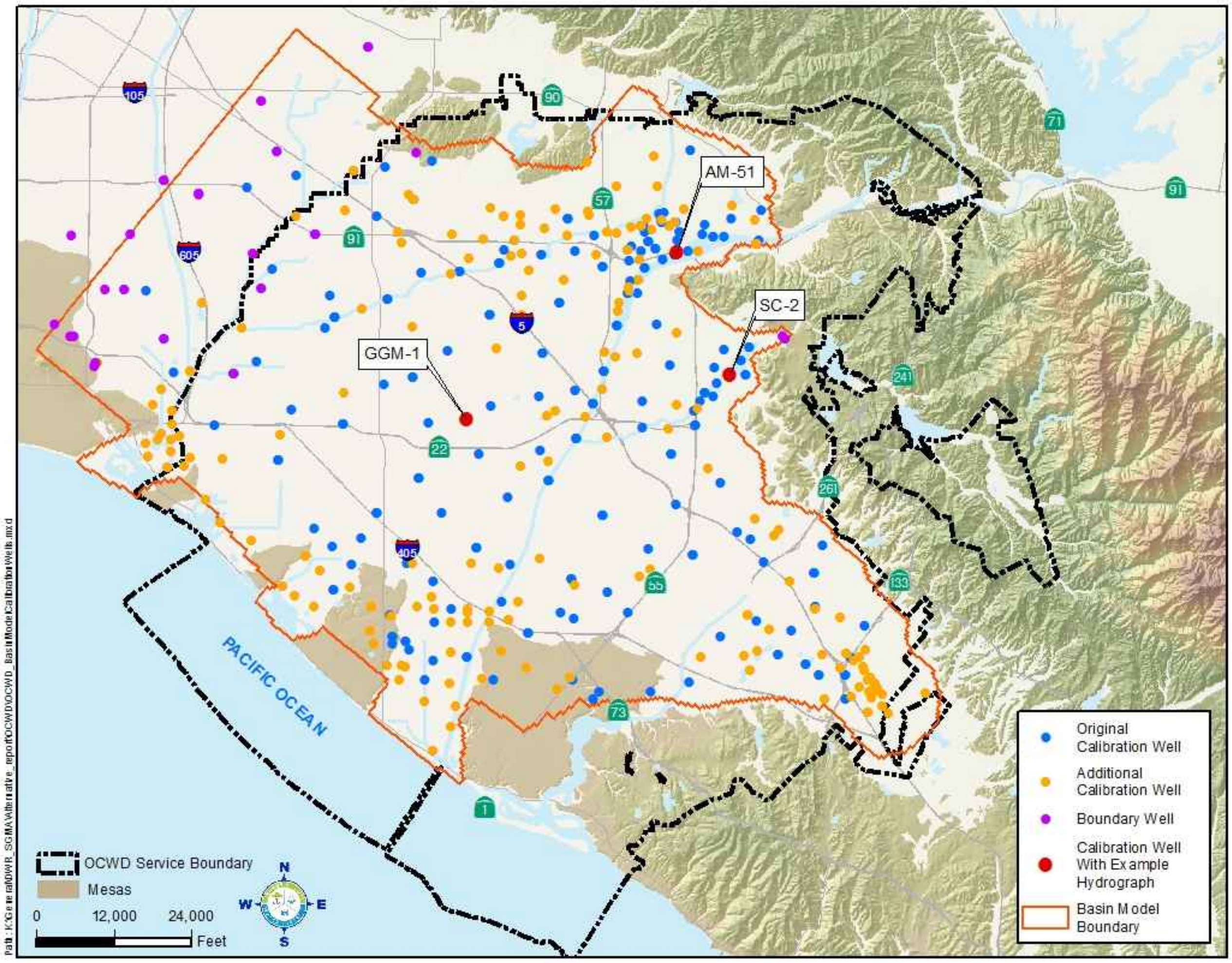


Figure 3-18: Basin Model Calibration Wells

Noteworthy findings of the model calibration process are summarized below:

- The model was most sensitive to adjustments to hydraulic conductivity and recharge distribution. In other words, minor variations in these input parameters caused significant changes in the model water level output.
- The model was less sensitive to changes in storage coefficient, requiring order-of-magnitude changes in this parameter to cause significant changes in simulated water levels, primarily affecting the amplitude of seasonal water level variations.
- The vast amount of observed historical water level data made it readily evident when the model was closely matching observed conditions.
- Incidental (unmeasured) recharge averaging approximately 70,000 afy during the 1990-1999 period appeared to be reasonable, as the model was fairly sensitive to variations in this recharge amount.
- Groundwater outflow to Los Angeles County was estimated to range between 5,000 and 12,000 afy between 1990 and 1999, most of this occurring in Layers 1 and 3.
- Groundwater flow at the Talbert Gap was inland during the entire model calibration period, indicating moderate seawater intrusion conditions. Model-derived seawater inflow ranged from 500 to 2,700 afy in the Talbert Gap and is consistent with chloride concentration trends during the calibration period that indicated inland movement of saline groundwater in these areas.
- Model-derived groundwater inflow from the ocean at Bolsa Gap was only 100-200 afy due to the Newport-Inglewood Fault zone, which offsets the Bolsa aquifer and significantly restricts the inland migration of saline water across the fault.
- Model adjustments (mainly hydraulic conductivity and recharge) in the Santiago Basins area in Orange significantly affected simulated water levels in the coastal areas.
- Model reductions to the hydraulic conductivity of Layer 2 (Principal Aquifer) along the Peralta Hills Fault in Anaheim/Orange had the desired effect of steepening the gradient and restricting groundwater flow across the fault into the Orange area. These simulation results were consistent with observed hydrogeologic data indicating that the Peralta Hills Fault acts as a partial groundwater barrier.
- Potential unmapped faults immediately downgradient from the Santiago Basins appear to restrict groundwater flow in the Principal Aquifer, as evidenced by observed steep gradients in that area, which were reproduced by the model. As with the Peralta Hills Fault, an approximate order-of-magnitude reduction in hydraulic conductivity along these suspected faults achieved the desired effect of reproducing observed water levels with the model.

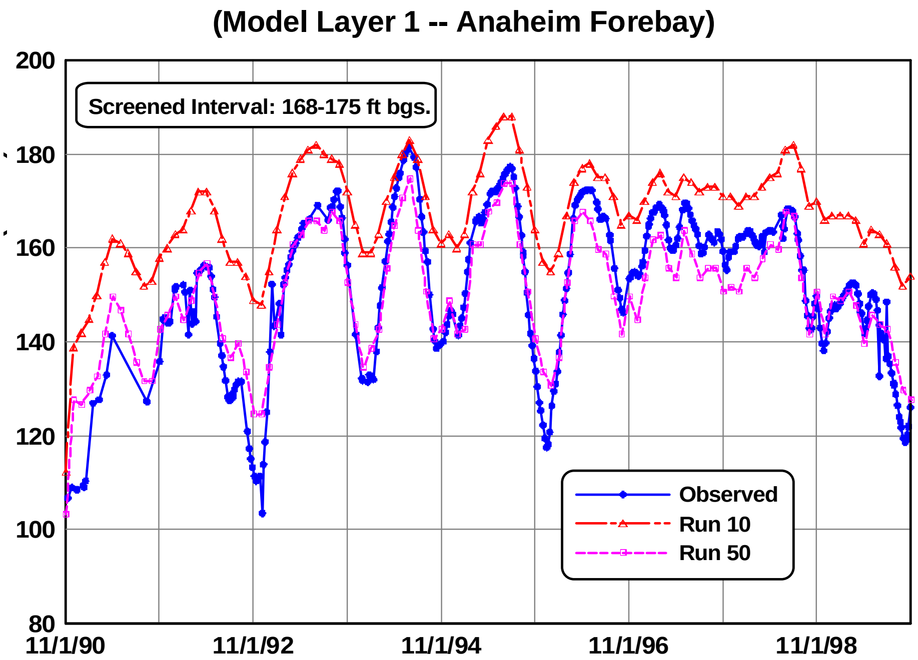


Figure 3-19: Calibration Hydrograph of Monitoring Well AM-5A

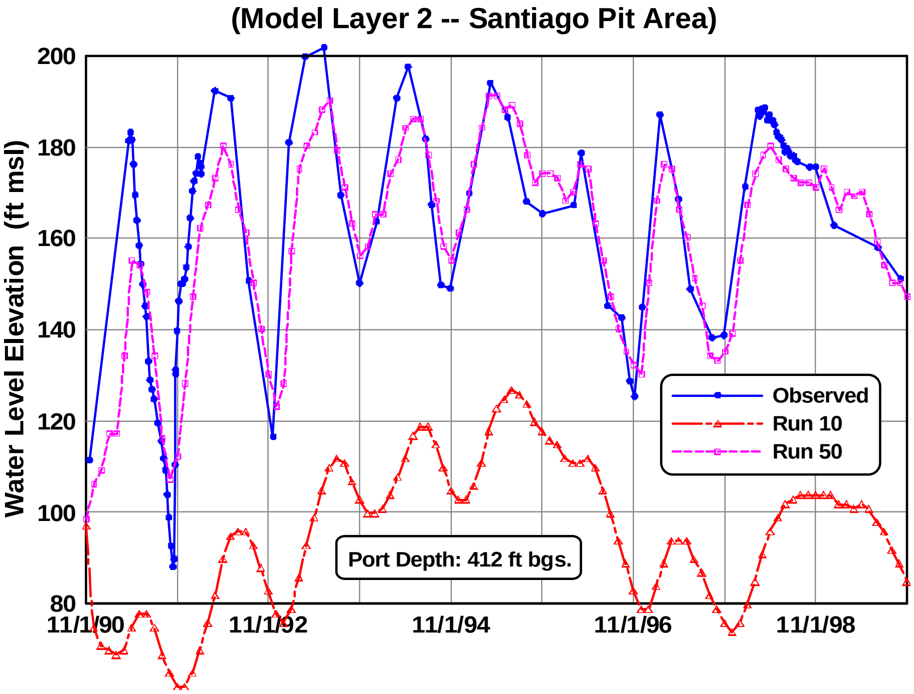


Figure 3-20: Calibration Hydrograph for Monitoring Well SC-2

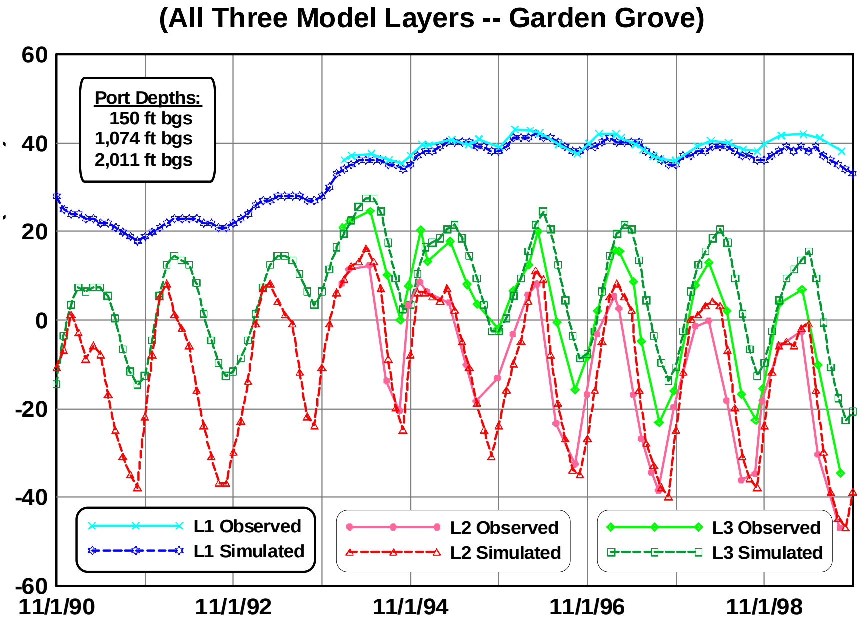


Figure 3-21: Calibration Hydrograph for Monitoring Well GGM-1

Groundwater Model Update and Applications

OCWD staff update the basin groundwater model approximately every three to five years, guided by new information, e.g. new wells in critical areas, warranting the effort or by needed model evaluations using the most recent years, e.g., estimating the groundwater outflow to Los Angeles County. Major changes and improvements over the past five years include:

1. Model conversion from UNIX to PC using the Groundwater Vistas as the Graphical User Interface.
2. Extension of the model transient calibration through WY 2010-11. The new calibration period is November 1990 to June 2011 which includes a wide range of basin storage conditions as well as a wide range of hydrologic conditions.
3. Addition of several new Talbert Barrier injection wells and the addition of two new recharge basins, La Jolla and Miraloma Basins.

Typical applications of the Basin Model include estimating the effects of potential future pumping and recharge projects on groundwater levels, storage, and the water budget. The storage coefficients determined during the original Basin Model calibration are also used to estimate annual change in groundwater storage.

Other applications of the Basin Model were related to operation of the Talbert Seawater Barrier. The first was to guide the planning, location and hydraulic effectiveness of supplemental injection wells for the Talbert Barrier. The second was to estimate the general flow paths and subsurface residence time of barrier injection water to delineate the Talbert Barrier's recycled water retention buffer area.

3.3.1 Groundwater Quality Conditions

Salinity

At the state level, the State Water Resources Control Board (SWRCB) and Regional Water Quality Control Boards have authority to manage TDS in water supplies. The salinity management program for the Santa Ana River Watershed is implemented by the Basin Monitoring Program Task Force (Task Force), a group comprised of water districts, wastewater treatment agencies and the Regional Water Board. OCWD is a member of the Task Force.

Historical ambient or baseline conditions were calculated for levels of total dissolved solids (TDS) and nitrate-nitrogen in each of the 39 groundwater management zones in the watershed. Management Zones within the OCWD Management Area are shown in Figure 3-22. The water quality objectives for TDS and ambient water quality levels for the two zones within the OCWD Management Area are shown in Table 3-1.

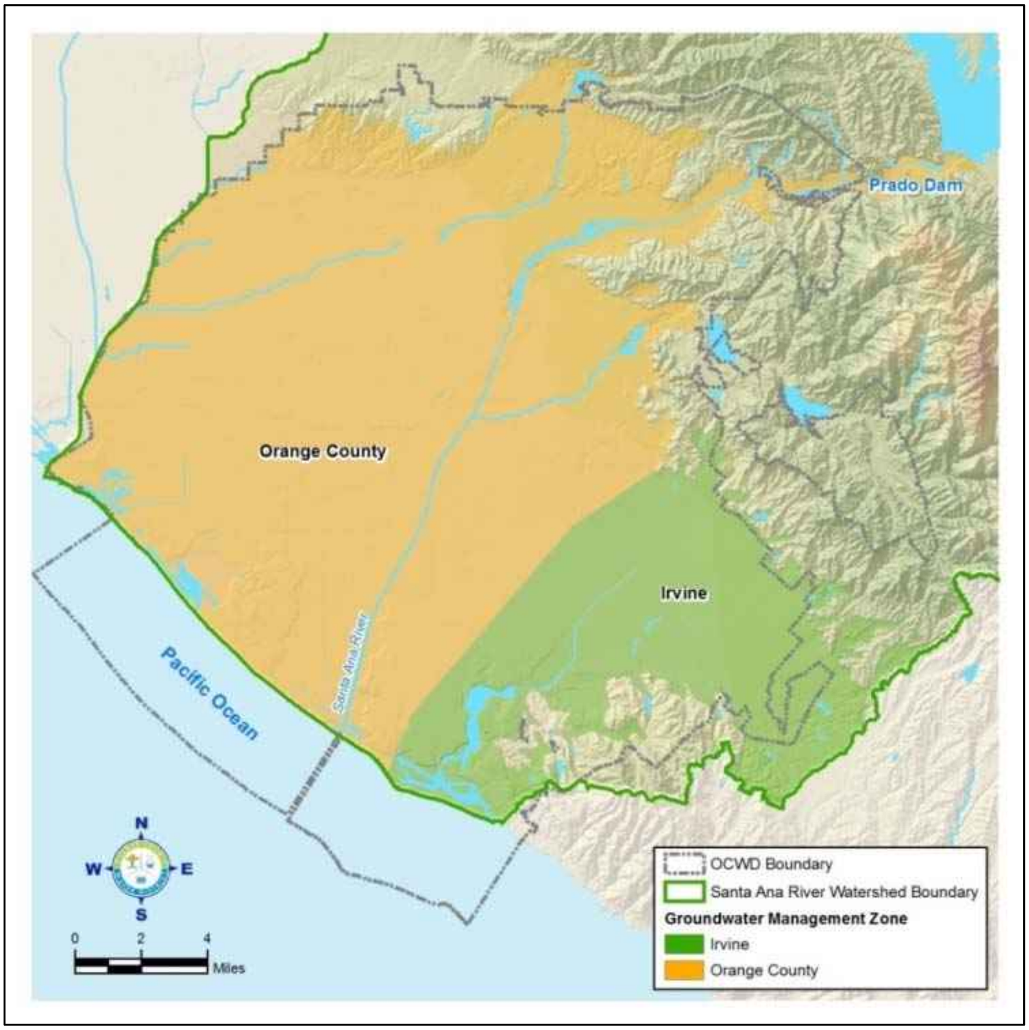


Figure 3-22: Groundwater Management Zones

Table 3-1: TDS Water Quality Objectives for Lower Santa Ana River Basin Management Zones

Management Zone	Water Quality Objective	2012 Ambient Quality
Orange County	580 mg/L	610 mg/L
Irvine	910 mg/L	940 mg/L

(Wildermuth, 2014)

Figure 3-23 shows the average TDS at production wells in the basin for calendar years 2011 to 2015 as well as data available in early 2016. In general, the portions of the basin with the highest TDS levels are located in Irvine, Tustin, Yorba Linda, Anaheim, and Fullerton. There is a broad area in the middle portion of the basin where the TDS generally ranges from 500 to 700 mg/L.

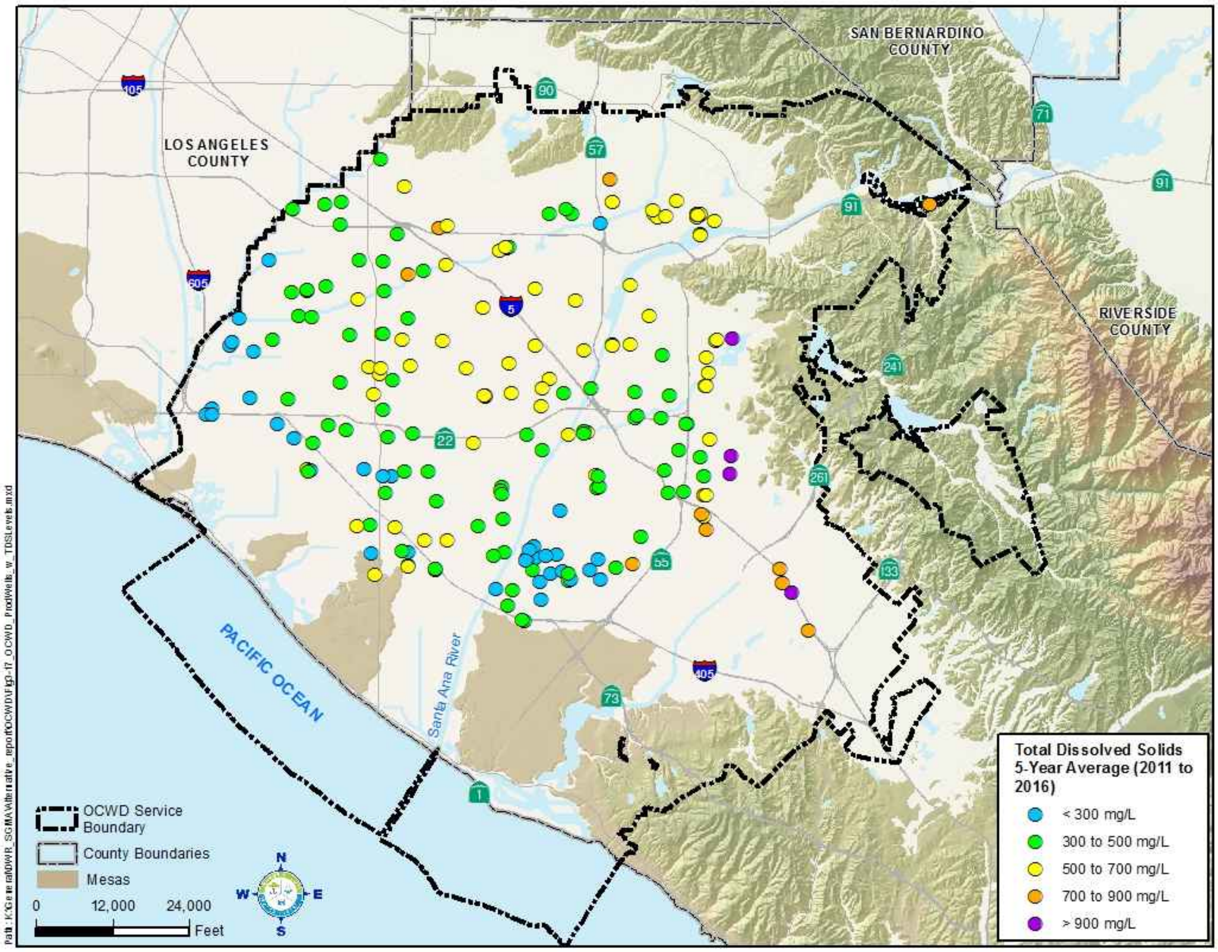


Figure 3-23: TDS in Groundwater Production Wells, 5-year average

Nitrate

Management of nitrate is a component of the salinity management program in the Santa Ana River Watershed. Along with TDS objectives, water quality objectives for nitrate-nitrogen are established for each of the 39 groundwater management zones in the watershed. Water quality objectives and ambient quality levels for the zones within the OCWD Management Area are shown in Table 3-2.

Figure 3-24 shows the 5-year average nitrate-nitrogen levels in production wells for calendar years 2011 to 2015, as well as data available in early 2016. This figure displays data for 306 production wells. Of these 306 wells, twelve exceeded the primary MCL for nitrate-nitrogen of 10 mg/L at least once during the five year period. In cases where pumped groundwater exceeds the MCL, the groundwater producer treats the water to reduce nitrate-nitrogen levels prior to being served to customers.

Table 3-2: Nitrate-nitrogen Water Quality Objective for Lower Santa Ana River Basin Management Zones

Management Zone	Water Quality Objective	Ambient Quality
Orange County	3.4 mg/L	2.9 mg/L
Irvine	5.9 mg/L	6.7 mg/L

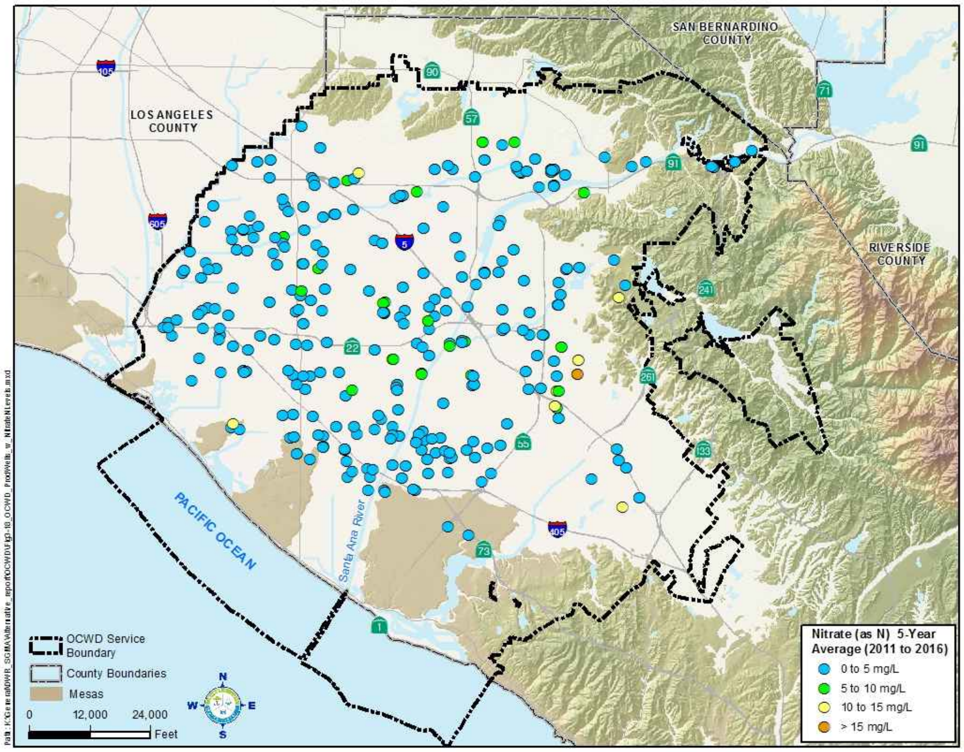


Figure 3-24: Nitrate (as N) Levels in Groundwater Production Wells, 5-year average

Contamination Plumes

Major groundwater contamination sites within the OCWD Management Area include areas where contamination has migrated significantly beyond the contamination sources and threaten the water quality of the underlying groundwater. These plumes, shown in Figure 3-25 are in the process of being remediated.

The North Basin VOC plume area contains contaminated groundwater primarily in the Shallow Aquifer, which is generally less than 200 feet deep with some migration downward into the Principal Aquifer. OCWD is performing a remedial investigation/feasibility study (RI/FS) under the oversight of the U.S. EPA and working with regulatory agencies and stakeholders to evaluate and develop effective remedies to address the contamination under the National Contingency Plan process. The U.S. EPA is the lead agency for this North Basin Groundwater Protection Project (NBGPP).

The South Basin plume area contains VOCs and perchlorate. OCWD has collected data to assist with delineating the plumes. OCWD is performing an RI/FS in consultation with the Regional Water Board, Department of Toxic Substances Control, and stakeholders to evaluate and develop effective remedies to address the contamination under the National Contingency Plan process, designated as the South Basin Groundwater Protection Project (SBGPP).

The U.S. Navy is taking the lead in remediation of three groundwater contamination plumes of VOCs in the vicinity of the former El Toro Marine Corps Air Station (MCAS), former Tustin MCAS, and the Naval Weapons Station Seal Beach.

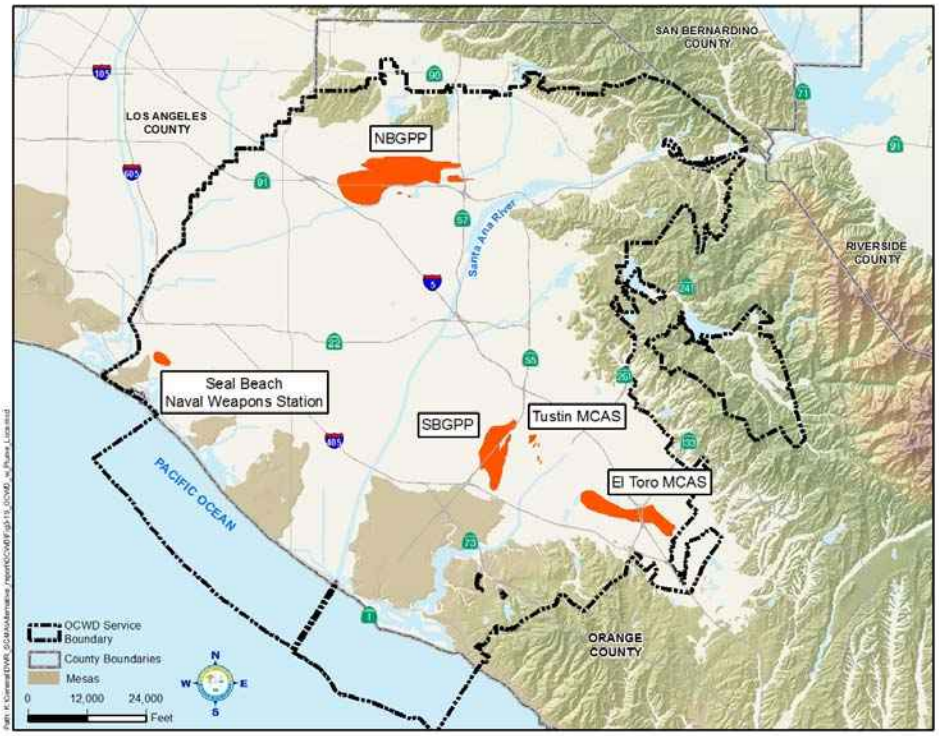


Figure 3-25: Groundwater Contamination Plume Locations

3.3.2 Coastal Gaps

In the coastal area of Orange County, the primary source of saline groundwater is seawater intrusion into the basin through permeable aquifer sediments underlying topographic lowlands or gaps between the erosional remnants or mesas of the Newport-Inglewood Uplift. The susceptible locations from north to south are the Alamitos, Sunset, Bolsa, and Talbert gaps as shown in Figure 3-26.

Alamitos Gap was formed primarily from the ancestral San Gabriel River which carved its way to the ocean as the surrounding hills were contemporaneously being uplifted. Similarly, Bolsa Gap and Talbert Gap were carved by two different paths of the ancestral Santa Ana River as the surrounding mesas were being uplifted by the Newport-Inglewood Fault.

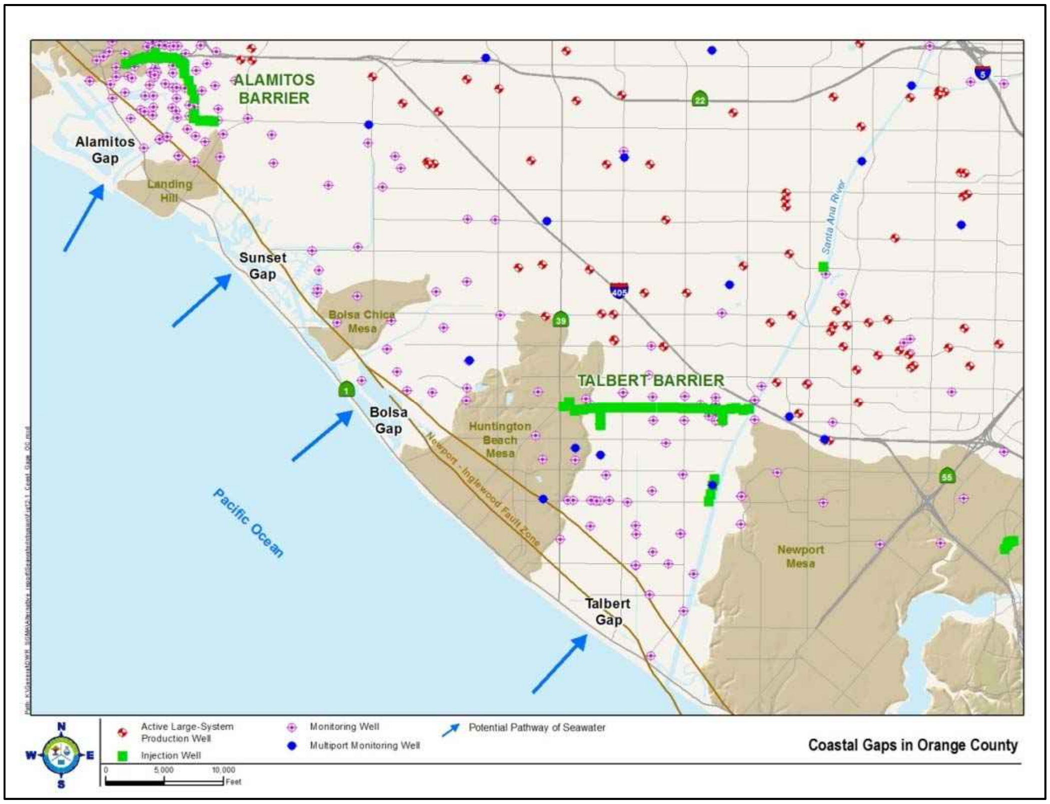


Figure 3-26: Orange County Coastal Gaps

Over Recent geologic time (within the last 12,000 years), the Santa Ana River meandered its way across what is now coastal Orange County reaching as far west as the San Gabriel River. These rivers deposited relatively coarse sands and gravels in their paths and were then subsequently buried with less permeable sediments as sea levels rose coming out of the last ice age. Therefore, in these three gaps, these relatively young river deposits formed permeable aquifers connecting to the Pacific Ocean and thus are the primary conduits for inland migration of seawater, namely the recent aquifer in Alamitos Gap, the Bolsa aquifer in Bolsa Gap, and the Talbert aquifer in Talbert Gap.

In the Alamitos and Talbert gaps, the permeable Recent and Talbert aquifers, respectively, have not been appreciably folded or offset by the Newport-Inglewood Fault Zone due to their geologically young age. Therefore, these shallow aquifers are relatively horizontal, continuous, and in direct hydraulic connection with the Pacific Ocean.

As compared to the Alamitos and Talbert gaps, the permeable Recent deposits forming the Bolsa aquifer in the Bolsa Gap are slightly older and thus are thought to be more offset by the Newport-Inglewood Fault Zone as evidenced by well logs and groundwater level and quality data. Groundwater quality trends (primarily chloride concentrations) from monitoring wells in Bolsa Gap indicate that the Newport-Inglewood Fault Zone restricts groundwater flow and thus impedes the inland migration of seawater.

In the Alamitos, Bolsa, and Talbert gaps, the shallow river-deposited aquifers are locally merged with deeper Upper Pleistocene aquifers, thus providing an avenue for seawater intrusion within the shallow aquifers to migrate vertically downward via these mergence zones into deeper aquifers tapped by production wells further inland.

Sunset Gap is not considered to be an erosional gap carved by a river but rather is a wider and more gradual topographic lowland resulting from a mild dip in the underlying strata. Therefore, Sunset Gap lacks a laterally extensive permeable shallow aquifer comprised of river deposits continuous to the ocean as in the other three gaps discussed above.

OCWD regularly reviews hydrogeologic data, including water quality data, to evaluate the extent of seawater intrusion. In 2016, OCWD documented an updated comprehensive evaluation of the extent of seawater intrusion along the Orange County coast within the OCWD Management Area. The Technical Memorandum, *Summary of Seawater Intrusion in Orange County* (OCWD, 2016a). This report contains detailed descriptions of coastal aquifers, monitoring networks and programs, operation of seawater intrusion barriers, barrier groundwater models, an evaluation of the current extent of seawater intrusion, and descriptions of future plans to protect the water quality of the groundwater basin.

3.3.3 Land Subsidence

In Orange County, subsidence in swampy low-lying coastal areas underlain by shallow organic peat deposits started as early as 1898 when development of these areas for agriculture resulted in excavation of unlined drainage ditches. The ditches drained the swamps and intercepted the shallow water table which was lowered sufficiently to allow the land to drain adequately for irrigated agriculture. When the shallow water table was lowered, it exposed the formerly-saturated peat deposits to oxygen that caused depletion and shrinkage of the peat due to oxidation (Fairchild and Wiebe, 1976).

Subsidence related to shallow peat deposits was associated with land development practices that occurred in Orange County in the late 1800s and early 1900s and, as such, is not something associated with or controlled by groundwater withdrawals in the basin. Another documented cause of subsidence in Orange County unrelated to groundwater basin utilization is oil extraction along the coast, particularly in Huntington Beach (Morton et al., 1976).

Subsidence due to changes in groundwater conditions in the Orange County groundwater basin is variable and does not show a pattern of widespread irreversible permanent lowering of the ground surface. Storage conditions in the groundwater basin were at historical lows in the mid-1950s, but since this time OCWD has operated the groundwater basin within a storage range above this historical low. There are reports that some subsidence may have occurred before OCWD began refilling the groundwater basin in the late 1950s (Morton, et al., 1976); however, the magnitude and scope of this subsidence is uncertain, and it is not clear if this subsidence was permanent. As such, there is no evidence of permanent, inelastic land subsidence in the OCWD Management Area (see Section 13) and future subsidence is not expected as long as OCWD continues to manage basin storage above the historic low observed in the late 1950s.

3.3.4 Groundwater/Surface Water Interactions and Groundwater Dependent Ecosystems

Frequent and destructive flooding of the Santa Ana River in Orange County was the impetus for construction of the Prado Dam in 1941. Prior to the construction of flood control facilities, the banks of the Santa Ana River naturally overflowed periodically and flooded broad areas of Orange County as seen in Figure 3-27. Coastal marshes were inundated during winter storms, and the mouth of the river moved both northward and southward of its present location. In the days before flood control, surface water naturally percolated into the groundwater basin, replenishing groundwater supplies.

Subsequent flood protection efforts included construction of levees along the river and concrete-lined bottoms along portions of the river. Flood risk was reduced, increased pumping of groundwater lowered water levels, and low-lying areas were filled in and/or equipped with drains, pumps and other flood control measures to allow for urban development. Since at least the 1950s, groundwater levels throughout the OCWD Management Area have been low enough that the rising and lowering of groundwater levels do not impact surface water flows or ecosystems.

Although it is outside the OCWD Management Area (within the Santa Ana Canyon Management Area described later), it is noted that from Prado Dam to Imperial Highway, the wide soft-bottomed Santa Ana River channel supports riparian habitats. Riparian habitat is dependent on river water released through Prado Dam, which is predominantly treated wastewater discharged in the upper watershed when storm flow is not present. In aggregate, this stretch is generally considered to be in equilibrium between surface water and groundwater based on available stream gage and groundwater level data, although some infiltration may occur due to minor groundwater pumping in the Santa Ana Canyon Management Area.

As the Santa Ana River enters the OCWD Management Area, from Imperial Highway to 17th Street in Santa Ana, there is minimal riparian habitat, and the river is a losing reach with engineered facilities to infiltrate surface water into groundwater basin. OCWD conducts recharge operations within the soft-bottomed river channel except for a portion of the river where the Riverview Golf Course occupies the river channel. The river levees are constructed of either rip-rap or concrete.

From 17th Street to near Adams Avenue in Costa Mesa, the river channel is concrete-lined for flood control with vertical to sloping concrete side walls and a concrete bottom as shown in Figure 3-38. From Adams Avenue to the coast, the channel has vertical concrete side walls or rip-rap for flood control and a soft bottom. Estuary conditions within the concrete channel exist at the mouth of the river where the ocean encroaches at high tide. The tidal prism extends from the ocean approximately three miles inland to the Adams Avenue Bridge.

There are no surface water bodies within the boundaries of the OCWD Management Area that are dependent on groundwater. Therefore, there are no groundwater-dependent ecosystems issues in the OCWD Management Area.

Some areas in the basin experience relatively high groundwater levels due to perched groundwater where shallow groundwater is impeded from flowing into deeper groundwater by a layer of low-permeable clay or silt, known as an aquitard. Except in very low-lying areas near sea level, the high groundwater is not close enough to the surface to support hydrophilic vegetation. OCWD carefully monitors water levels in the vicinity of the Talbert Seawater Barrier in order to maintain injection well rates to assure that groundwater levels do not rise to levels that could threaten urban infrastructure.

Figure 3-27: Santa Ana River in Orange County,1938

Courtesy of the Anaheim Public Library

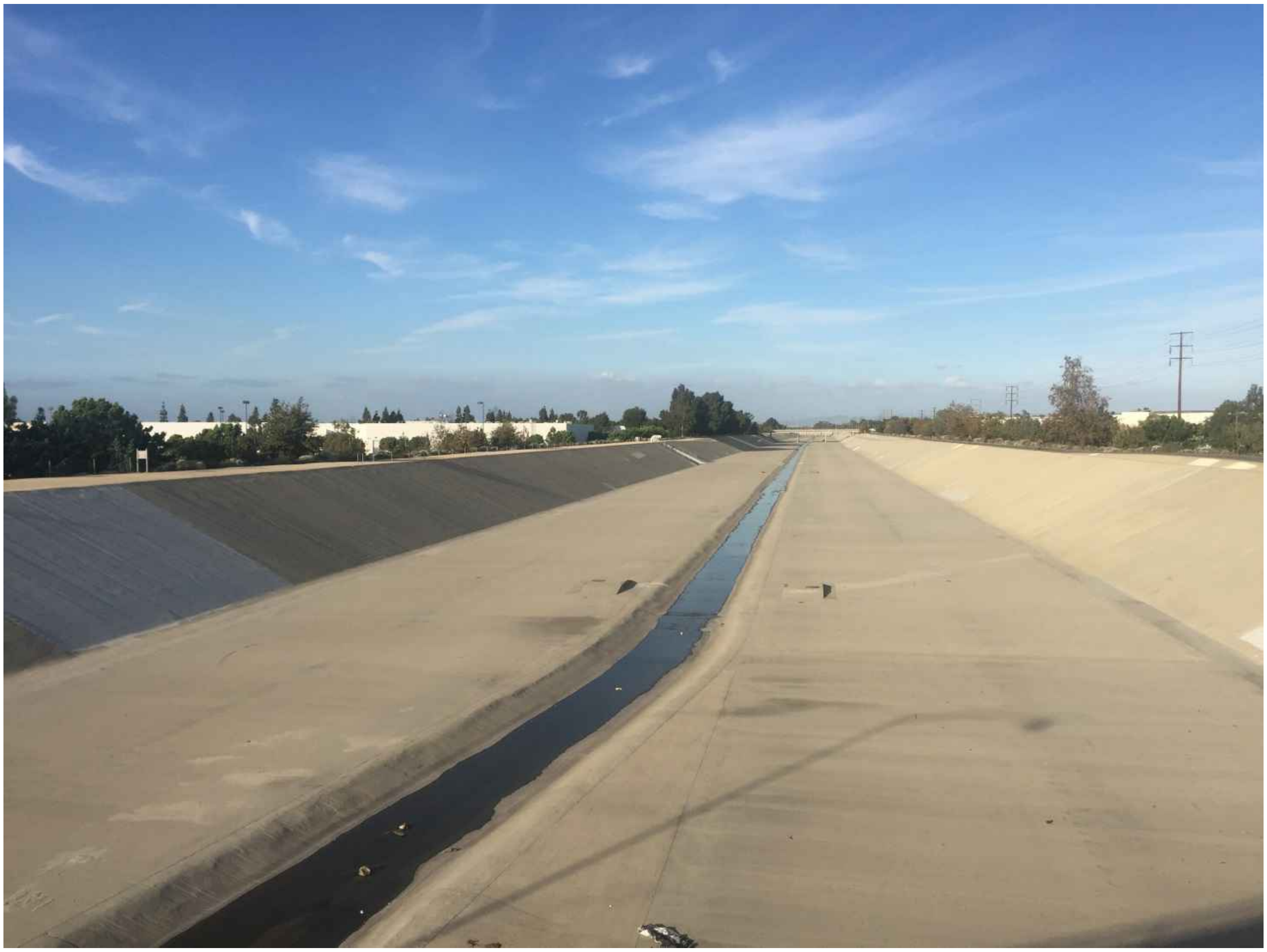


Figure 3-28: Santa Ana River
View upstream from Talbert Avenue Bridge in Fountain Valley. The portion of the river here has both concrete levees and bottom.

SECTION 4 WATER BUDGET

OCWD developed a hydrologic budget (inflows and outflows) for the purpose of constructing a basin-wide groundwater flow model, (Basin Model) and for evaluating basin production capacity and recharge requirements. The key components of the budget include measured and unmeasured (estimated) recharge, groundwater production, and subsurface flows along the coast and across the Orange County/Los Angeles County line. Because the basin is not operated on an annual safe-yield basis, the net change in storage in any given year may be positive or negative; however, over the long-term, the basin is operated within the established operating range. The components of the water budget are described below. OCWD's water year (WY) begins on July 1 and ends on June 30.

4.1 WATER BUDGET COMPONENTS

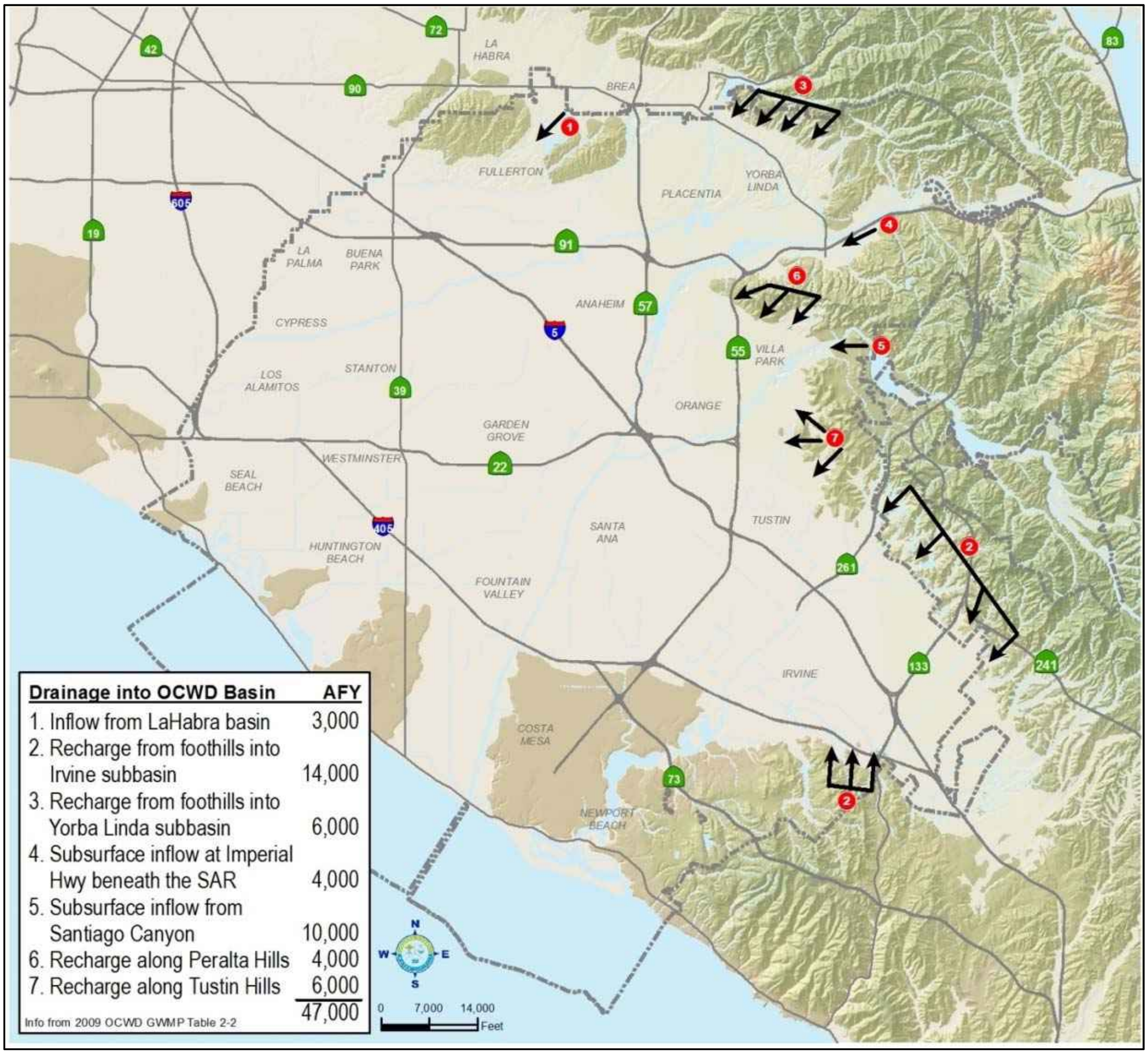
4.1.1 Measured Recharge

Measured recharge consists of all water artificially recharged at OCWD's surface water recharge facilities and water injected in the Talbert and Alamitos Barriers. The majority of measured recharge occurs in the District's surface water system, which receives Santa Ana River baseflow and storm flow, GWRS recycled water, and imported water.

4.1.2 Unmeasured Recharge

Unmeasured recharge also referred to as "incidental recharge" accounts for a significant amount of the basin's recharge, particularly in wet periods. This includes recharge from precipitation, irrigation return flows, urban runoff, seawater inflow through the gaps as well as subsurface inflow at the basin margins along the Chino, Coyote, and San Joaquin hills and the Santa Ana Mountains, and beneath the Santa Ana River and Santiago Creek. Subsurface inflow beneath the Santa Ana River and Santiago Creek refers to groundwater that enters the basin at the mouth of Santa Ana Canyon and in the Santiago Creek drainage below Villa Park Dam. Estimated average subsurface inflow to the basin is shown in Figure 4-1.

OCWD has estimated total unmeasured recharge between 20,000 and 160,000 afy. Net unmeasured or incidental recharge is the amount of incidental recharge remaining in the basin after accounting for underflow losses to Los Angeles County. Under average hydrologic conditions, net incidental recharge averages 62,000 acre-feet per year. This average was substantiated during calibration of the Basin Model and is also consistent with the estimate of 58,000 afy reported by Hardt and Cordes (1971) as part of a USGS modeling study of the basin. Because unmeasured recharge is one of the least understood components of the basin's water budget, the error margin for any given year is likely in the range of 10,000 to 20,000 acre-feet. Since unmeasured recharge is well distributed throughout the basin, the physical significance (e.g., water level drawdown or mounding in any given area) of overestimating or underestimating the total recharge volume within this error margin is considered to be minor.



Drainage into OCWD Basin	AFY
1. Inflow from LaHabra basin	3,000
2. Recharge from foothills into Irvine subbasin	14,000
3. Recharge from foothills into Yorba Linda subbasin	6,000
4. Subsurface inflow at Imperial Hwy beneath the SAR	4,000
5. Subsurface inflow from Santiago Canyon	10,000
6. Recharge along Peralta Hills	4,000
7. Recharge along Tustin Hills	6,000
	47,000

Info from 2009 OCWD GWMP Table 2-2

Figure 4-1: Estimated Subsurface Inflow

4.1.3 Groundwater Production

Entities that produce groundwater within the OCWD Management Area include major groundwater producers and small groundwater producers. Ninety-eight percent of groundwater production within Basin 8-1 occurs within the OCWD Management Area. The major groundwater producers include cities, water districts and water companies that account for approximately 97 percent of the total basin production. These 19 major producers operate approximately 200 large-system wells. Small groundwater producers include entities that typically produce less than 500 afy. These include small mutual water companies, industrial users, agricultural companies, golf courses, cemeteries, and private-well owners. Groundwater pumping for agricultural irrigation use accounts for less than one percent of total basin production.

4.1.4 Subsurface Outflow

Groundwater outflow from the basin across the Los Angeles County/Orange County line has been estimated to range from approximately 1,000 to 14,000 afy based on groundwater elevation gradients and aquifer transmissivity (DWR, 1967; McGillicuddy, 1989). The Water Replenishment District of Southern California also has estimated underflow from Orange County to Los Angeles County within the aforementioned range. Groundwater outflow cannot be directly measured and is accounted for in the basin water budget within the net unmeasured recharge described above.

Modeling by OCWD indicates that underflow to Los Angeles County increases by approximately 7,500 afy for every 100,000 acre-feet of increased groundwater in storage in Orange County, given the assumption that groundwater elevations in Los Angeles County remain constant (see Figure 4-2). With the exception of unknown amounts of semi-perched (near-surface) groundwater being intercepted and drained by submerged sewer trunk lines and unlined flood control channels along coastal portions of the basin, no other significant basin outflows are known to occur.

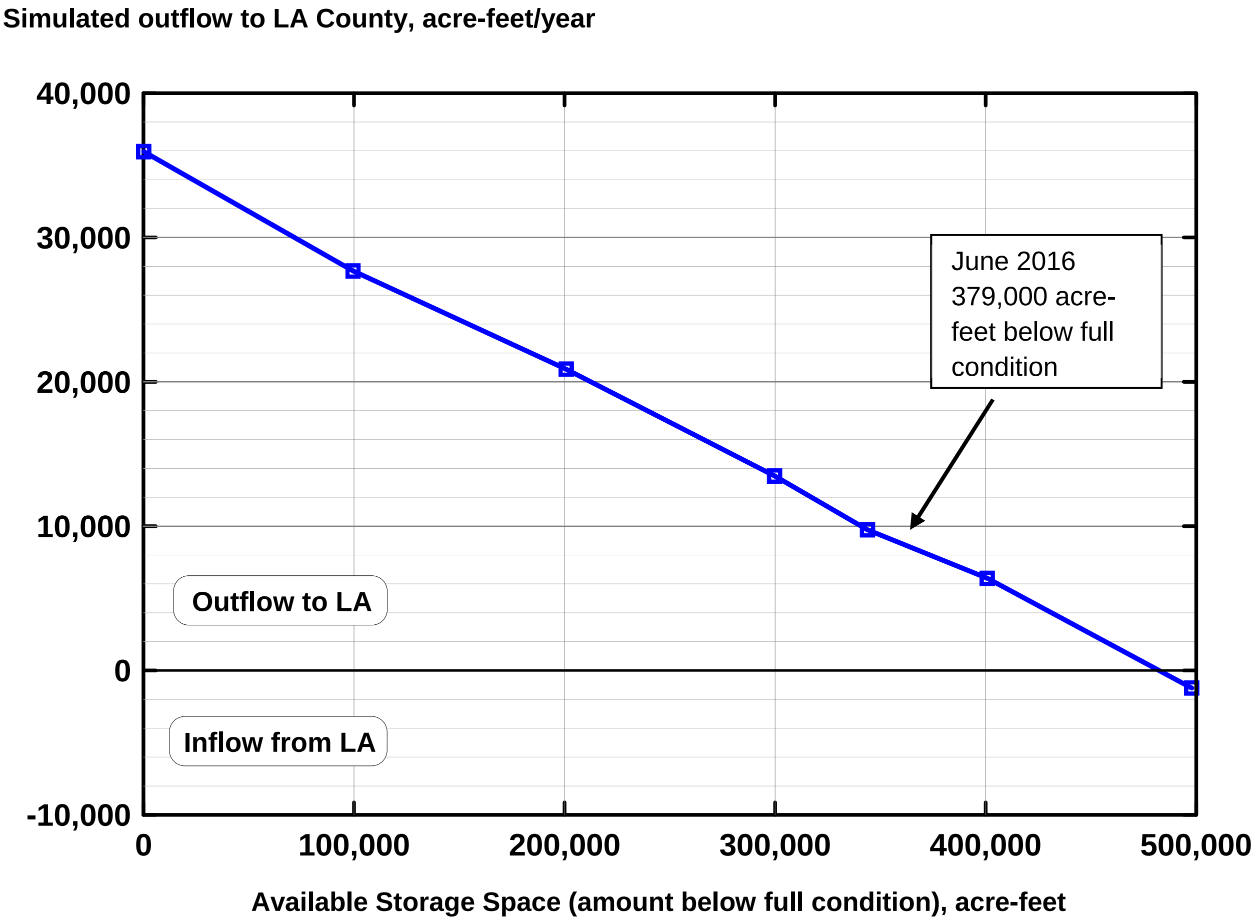


Figure 4-2: Relationship between Basin Storage and Estimated Outflow to Los Angeles County

4.1.5 Evaporation

The total wetted area of the District's recharge system is over 1,000 acres. OCWD estimates the evaporation from this system on a monthly basis. Generally, total evaporation is on the order of 2,000 acre-feet per year which is approximately one percent of the total volume recharged annually. The relatively minor impact of evaporation reflects moderate temperatures in the region and high percolation rates (1 to 10 feet per day).

4.2 WATER YEAR TYPE

As explained previously, OCWD manages groundwater pumping and basin storage over the long-term. Basin storage levels in comparison to wet and dry years from 1957 to present are shown in Figure 10-1. Typically, basin storage levels increase during wet periods and decrease during dry periods. Operating the basin within the operating range provides for maximum basin production while preventing significant and unreasonable undesirable results.

4.3 ESTIMATE OF SUSTAINABLE YIELD

Even though the groundwater basin contains an estimated 66 million acre-feet when full, OCWD operates the basin within an operating range of up to 500,000 acre-feet below full condition to protect against seawater intrusion, inelastic land subsidence, and other potential undesirable results. On a short-term basis, the basin can be operated at an even lower storage level in an emergency.

OCWD manages groundwater production and recharge to maintain groundwater storage levels within the established operating range. In this sense, the basin's sustainable yield can be defined as the volume of groundwater production that can be sustained while maintaining groundwater in storage within the operating range. Basin storage is determined on an annual basis by calculating the difference between groundwater production and recharge based on water year (July 1 to June 30).

In recent years (WY 2002-03 to 2014-15), annual groundwater production has ranged from 270,300 to 366,200 afy (shown in Figure 4-3). The average annual production for the past ten years (WY 2006-07 to 2015-16) was 310,000 afy. The long-term average annual production between WY 1965-666 and 2015-16 was 283,000 afy.

The sustainable yield of the basin is a function of the amount of groundwater recharge from OCWD's managed aquifer recharge program and natural recharge as a result of precipitation and percolation of irrigation flows.

OCWD seeks to maximize recharge in order to support the maximum levels of groundwater production. The increase in sustainable yield as a result of OCWD groundwater management can be illustrated by looking at long-term historical production data. Figure 4-3 shows the increase in annual groundwater production from approximately 150,000 afy in the mid-1950s to a high of 366,000 afy in WY 2007-08.

The process that determines a sustainable level of pumping on an annual basis considers the basin's operating range, basin storage conditions and the amount of available recharge water supplies.

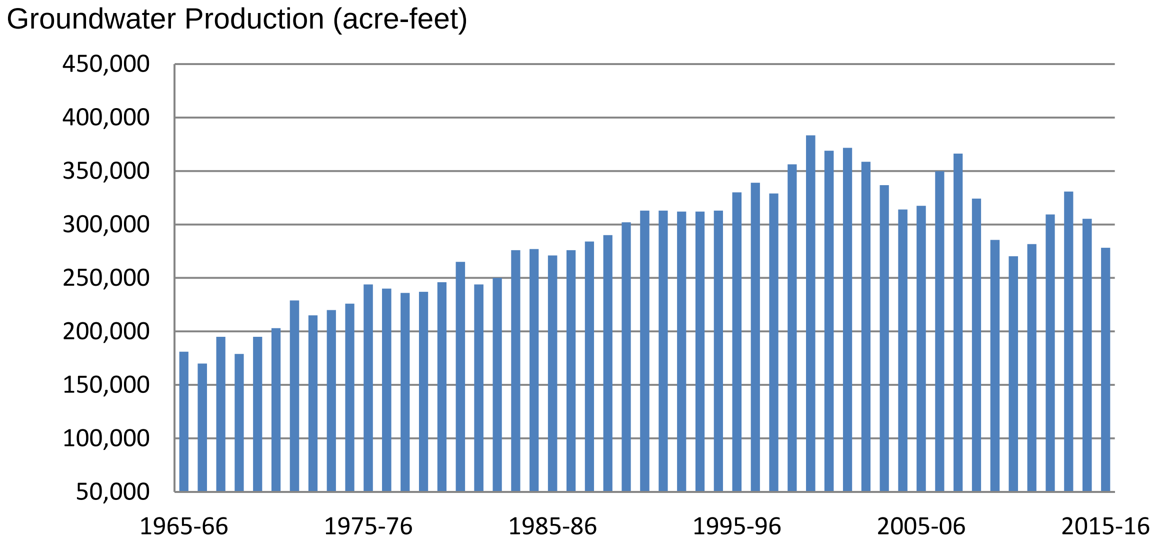


Figure 4-3: Groundwater Production, WY 1965-66 to WY 2015-16

4.4 WATER BUDGETS

Typical water budgets for dry years, average years and wet years as well as a future projected budget are presented in Tables 4-1 to 4-4. For the typical average year, total inflow and outflow are similar, indicating nearly balanced inflow and outflow, as shown in Table 4-1. During a dry year, measured and unmeasured recharge is lower compared with the average year. On the other hand, in a dry year water demands (including groundwater production) are usually higher due to outdoor irrigation. As shown in Table 4-2, the net result is a negative storage change, demonstrating how the groundwater basin serves as a storage reservoir to help meet demands during dry periods. During a wet year, measured and unmeasured recharge is greater compared to average year conditions. Water demands (hence, groundwater production) are often lower in a wet year due to decreased irrigation demands, and the resulting positive change in storage indicates how the basin reservoir is replenished, as shown in Table 4-3.

The average annual stormwater capture volume for the past ten years (WY 2006-07 to 2015-16) was approximately 44,000 acre-feet; however, this period's rainfall was 17% below the long-term average using San Bernardino precipitation data. The average year water budget (Table 4-1) assumed a stormwater capture volume of 52,000 acre-feet, which was based on a longer period (1989-2015) of rainfall and captured stormwater records.

The net estimated unmeasured or incidental recharge for the OCWD Management Area shown in Tables 4-1 through 4-4 include subsurface inflow from the South East, La Habra, and Santa Ana Canyon Management Areas.

Estimates of GWRS recharge volumes and Talbert Barrier injection volumes are based on actual GWRS production and recharge. These volumes do not fluctuate based on the average, dry and wet years. Alamitos Barrier injection volumes were based on long-term records and do not fluctuate significantly between average, wet, or dry years.

Table 4-4 is the projected future water budget under average hydrologic conditions. This projection considers several possible new sources of water supply: the final expansion of GWRS, recharging recycled water produced by a proposed MWD Regional Recycled Water Supply Program, and desalinated ocean water. The future projection accounts for these new water supplies as an increase in total inflow to the basin. The projected amount of groundwater production is increased in order to balance total inflow and outflow. In the case where one or more of the new water supplies is not available in the future, the amount of groundwater production would be reduced in order to create a balanced water budget.

Over the long-term, the basin must be maintained in an approximate balance to ensure the long-term viability of basin water supplies and to prevent the occurrence of undesirable results. In any particular year, water withdrawals may exceed water recharged as long as this is balanced by years when water recharged exceeds withdrawals. OCWD manages groundwater production and recharge to maintain groundwater storage levels within the established operating range as explained in detail in Section 10.

Table 4-1: Water Budget – Average Year

FLOW COMPONENT	Acre-feet
INFLOW	
Measured Recharge	
Santa Ana River baseflow	52,000
Santa Ana River stormflow	52,000
GWRS recharge in Forebay	73,000
Imported Water	65,000
Talbert Barrier injection	30,000
Alamitos Barrier injection in Orange County	2,000
Net Estimated Unmeasured or Incidental Recharge*	62,000
TOTAL INFLOW:	336,000
OUTFLOW	
Groundwater Production	320,000
TOTAL OUTFLOW:	320,000
CHANGE IN STORAGE:	+16,000

*subsurface outflow is included within net unmeasured recharge

Table 4-2: Water Budget – Dry Year

FLOW COMPONENT	Acre-feet
INFLOW	
Measured Recharge	
Santa Ana River baseflow	44,000
Santa Ana River stormflow	35,000
GWRS recharge in Forebay	73,000
Imported Water	50,000
Talbert Barrier injection	30,000
Alamitos Barrier injection in Orange County	2,000
Net Estimated Unmeasured or Incidental Recharge*	40,000
TOTAL INFLOW:	274,000
OUTFLOW	
Groundwater Production	330,000
TOTAL OUTFLOW:	330,000
CHANGE IN STORAGE:	-56,000

*subsurface outflow is included within net unmeasured recharge

Table 4-3: Water Budget – Wet Year

FLOW COMPONENT	Acre-feet
INFLOW	
Measured Recharge	
Santa Ana River baseflow	60,000
Santa Ana River stormflow	80,000
GWRS recharge in Forebay	73,000
Imported Water	65,000
Talbert Barrier injection	30,000
Alamitos Barrier injection in Orange County	2,000
Net Estimated Unmeasured or Incidental Recharge*	80,000
TOTAL INFLOW:	390,000
OUTFLOW	
Groundwater Production	305,000
TOTAL OUTFLOW:	305,000
CHANGE IN STORAGE:	+ 85,000

*subsurface outflow is included within net unmeasured recharge

Table 4-4: Water Budget – Future Projection (Average Rainfall)

FLOW COMPONENT	Acre-feet
INFLOW	
Measured Recharge	
Santa Ana River baseflow	52,000
Santa Ana River stormflow	52,000
GWRS recharge in Forebay	104,000
Imported Water/MWD IPR	65,000
Desalinated Ocean Water	53,000
Talbert Barrier injection	30,000
Alamitos Barrier injection in Orange County	2,000
Net Estimated Unmeasured or Incidental Recharge*	62,000
TOTAL INFLOW:	420,000
OUTFLOW	
Groundwater Production	420,000
TOTAL OUTFLOW:	420,000
CHANGE IN STORAGE:	0

*subsurface outflow is included within net unmeasured recharge

SECTION 5 WATER RESOURCE MONITORING PROGRAMS

5.1 OVERVIEW

Water resource monitoring programs can be categorized into groundwater, surface water, and recycled and imported water programs. These programs are summarized in Table 5-1 and described below.

Table 5-1: Summary of Monitoring Programs

MONITORING PROGRAM	PURPOSE	SCALE	FREQUENCY OF MONITORING
GROUNDWATER			
Groundwater Production	Manage basin storage; collect revenues based on production	All entities that pump groundwater	Producers (approx. 200 large capacity wells producing 97% of total production) track daily production rates and volumes; report totals to OCWD monthly. Others report semi-annually
Groundwater Elevation	Manage basin storage; prepare groundwater level contour maps; manage seawater intrusion barrier injection rates	1,000 individual measuring points	OCWD monitoring wells: all once a year (typically monthly); some measured by-weekly with some equipped with continuous monitoring equipment. Varying frequency for production wells, depending on local protocols
CA Statewide Groundwater Elevation Monitoring (CASGEM) Program	Compliance with state CASGEM program	96 key wells	Quarterly
Title 22 Water Quality Program	Compliance with CA SWRCB Division of Drinking Water, Title 22	All production wells regulated by Title 22	See schedule in Table 5-2

MONITORING PROGRAM	PURPOSE	SCALE	FREQUENCY OF MONITORING
	Monitoring for more than 100 regulated and unregulated chemicals at drinking water wells		
Groundwater Contamination Plumes	Monitor location of contamination plumes and levels of contamination	As needed	Depending on site-specific conditions
Seawater Intrusion	Monitor effectiveness of existing seawater intrusion barriers	425 monitoring and production wells	Semi-annually for all; selected wells monthly; some equipped with pressure transducers and data loggers for twice daily measurements Key parameters include chloride, TDS, electrical conductivity and bromide
SURFACE WATER			
Santa Ana River Monitoring Program	Annual review to affirm that OCWD recharge practices are protective of public health	22 surface water sites	Varying frequencies for general minerals, nutrients, metals, microbial, volatile and semi-volatile organic compounds, total organic halides, radioactivity, perchlorate, chlorate, NDMA, and chemicals of emerging concern.
Basin Monitoring Program Task Force program	Annual report preparation for compliance with Regional Water Board Basin Plan	Compilation of data from all monitoring programs	Collection of data on annual basis
Santa Ana River Watermaster Monitoring	Determine annual baseflow and stormflow and water quality at two locations to comply with judgment on Santa Ana River water rights	Basin-wide data collected by Watermaster parties in the watershed	Monitoring programs in watershed vary depending on individual agencies schedules
Prado Wetlands	Evaluate changes in	Daily flow in	Field parameters

MONITORING PROGRAM	PURPOSE	SCALE	FREQUENCY OF MONITORING
	water quality and effectiveness of wetlands treatment of surface water used for groundwater recharge	and out of wetlands	Biological, inorganic, and organic constituents
Emerging Constituents	Compliance with federal and state regulations	Watershed - wide	Federal or state programs; frequency determined by regulatory requirements
RECYCLED AND IMPORTED WATER			
Recycled Water	Monitor quality of water produced by GWRS	35 monitoring wells	GWRS monitoring wells: Quarterly for general minerals, metals, organics, and microbiological constituents; GWRS final product water: daily & weekly for specific parameters
Recycled Water	Monitor GWRS final product water		Daily or weekly for specific parameters
Imported Water	Monitor water quality of supply used to recharge groundwater basin		General minerals, nutrients, other selected constituents

5.2 GROUNDWATER MONITORING PROGRAMS

OCWD collects samples and analyzes water elevation and water quality data from approximately 400 District-owned monitoring wells (shown in Figure 5-1) and at over 250 privately-owned and publically-owned large and small system drinking water wells that are part of OCWD's Title 22 program, shown in Figure 5-2. OCWD also has access agreements to sample a number of non-District-owned monitoring wells and privately-owned irrigation, domestic and industrial wells, shown in Figure 5-3. Inactive wells are included in District monitoring programs when feasible. An inactive well is defined as a well that is not currently being routinely operated. The number and location of wells that are sampled change regularly as new wells come online and old ones are abandoned and destroyed.

The District collects, stores, and uses data from wells owned and sampled by other agencies. For example, data collected by the Water Replenishment District of Southern California from wells in Los Angeles County along the Orange County boundary are part of the network of wells evaluated to determine annual groundwater elevations and are used for basin modeling. Also included in OCWD's monitoring network are wells that are owned and operated by the U.S.

Navy for remediation of contamination plumes in the cities of Irvine, Seal Beach and Tustin, and wells that are related to operation of the Alamitos Barrier that are located in Los Angeles County. Los Angeles County wells are also used to model the Orange County groundwater basin as groundwater flow is unrestricted across the county line.

Wells sampled under various monitoring programs change in response to fluctuations in the number of available wells, basin conditions, observed water quality, and regulatory and non-regulatory requirements. A comprehensive list of all wells in OCWD's database can be found in Appendix A. This list includes well name, owner, type of well, casing sequence number, depth, screened interval, and aquifer zone monitored, when known.

In some cases well depth and screened intervals are listed on the database as unknown. OCWD maintains data on these wells when water quality or elevation data continues to be collected by the owner or operator. OCWD is able to use data from these wells in monitoring programs, for groundwater modeling, or for other basin programs. Wells on the list also include inactive wells when water quality or water elevation data continues to be collected or the data is utilized in one or more current basin programs. Groundwater elevation and monthly production data are used to quantify total basin pumping, evaluate seasonal groundwater level fluctuations and assess basin storage conditions.

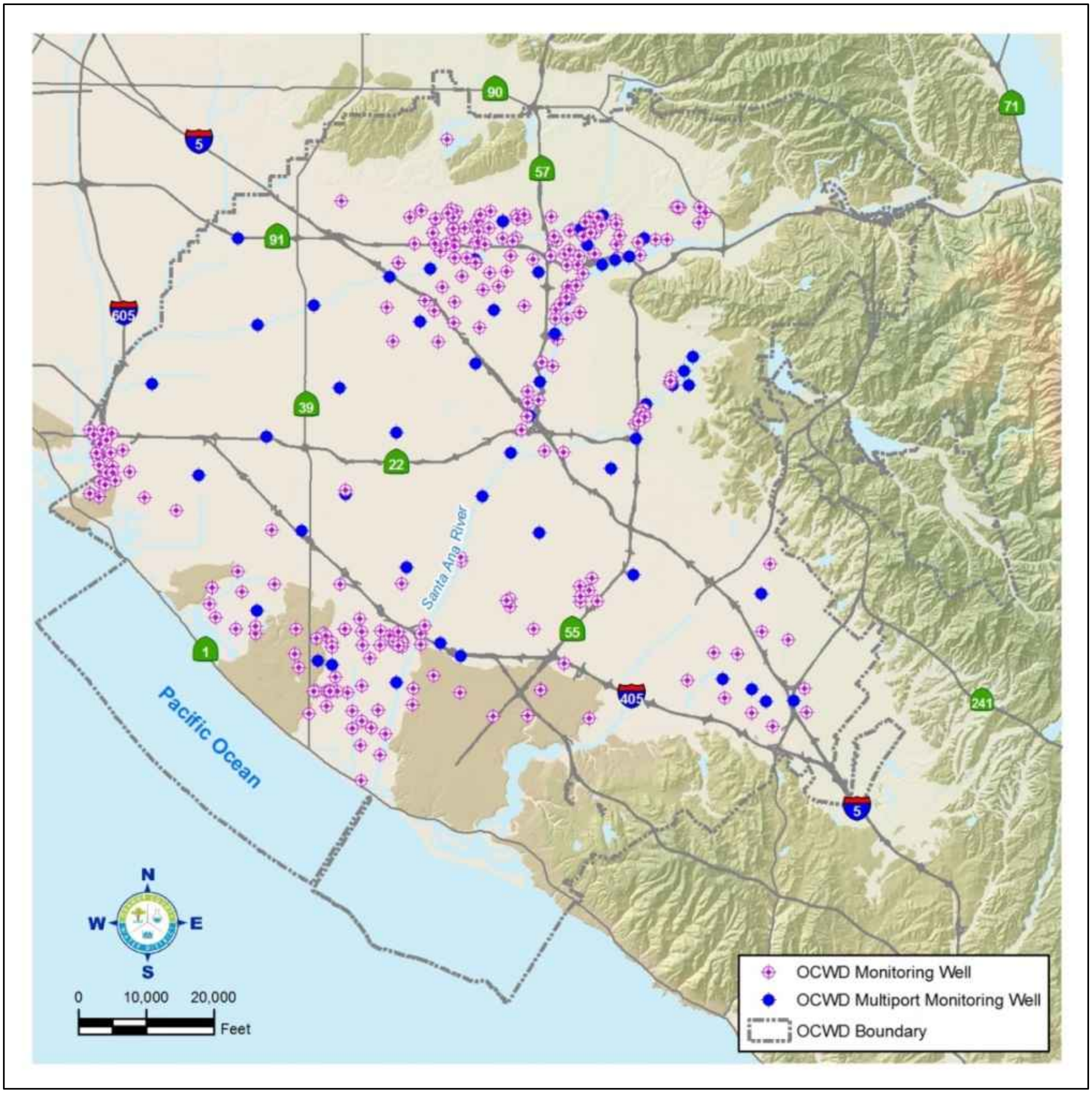


Figure 5-1: OCWD Monitoring Wells

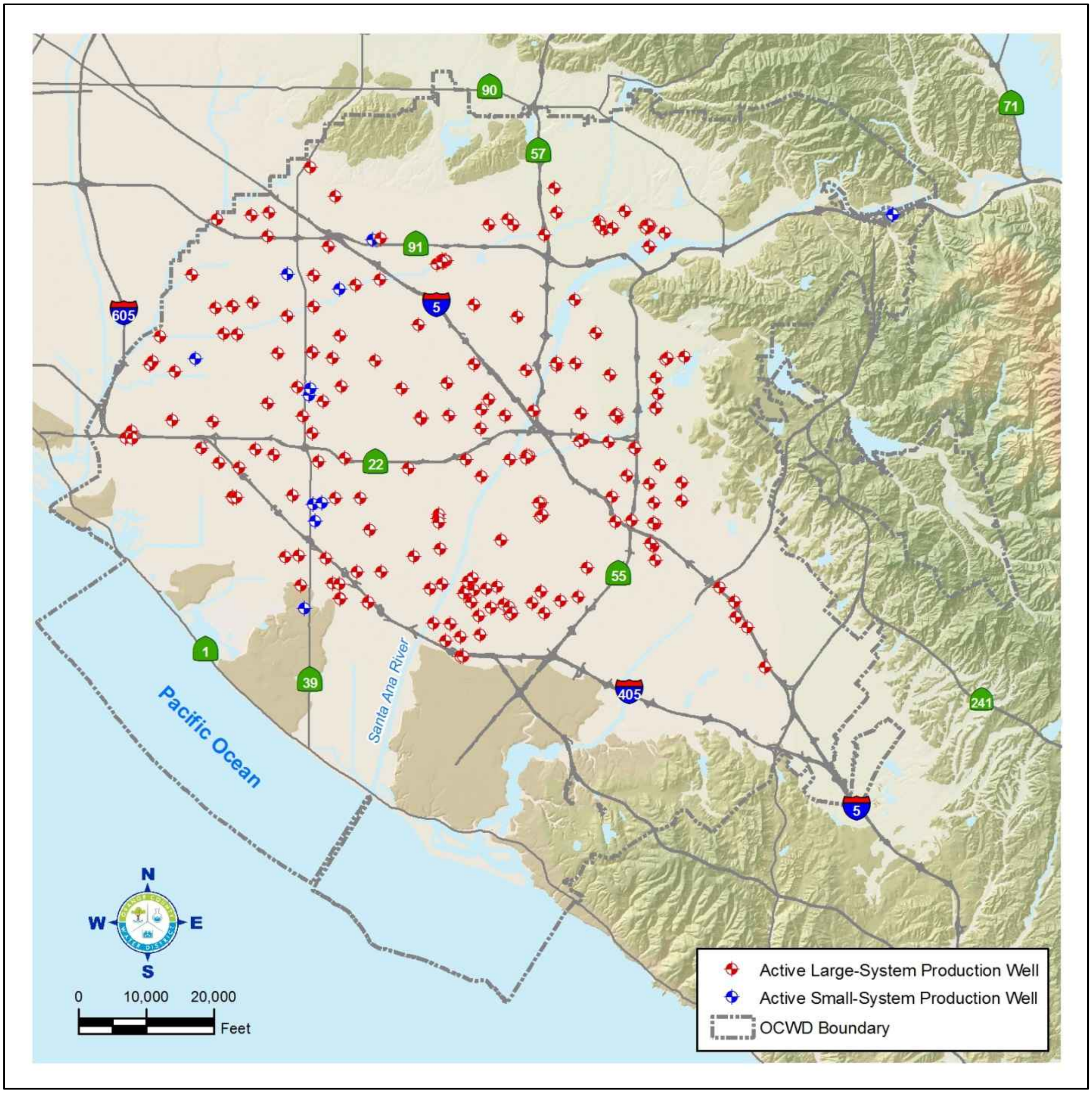


Figure 5-2: Large and Small System Drinking Water Wells in Title 22 Monitoring Program

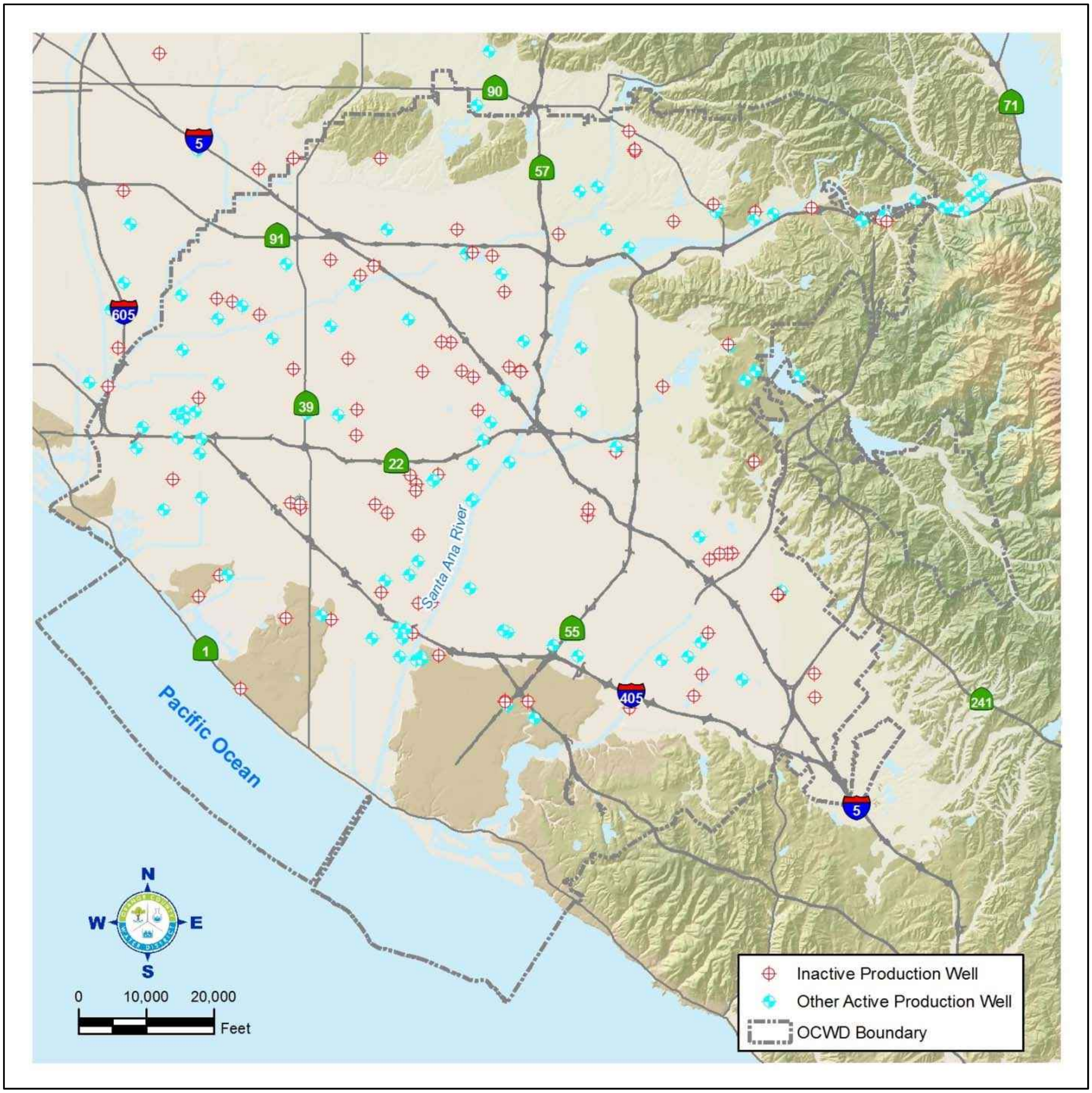


Figure 5-3: Private Domestic, Irrigation and Industrial Wells in OCWD Monitoring Program

5.2.1 Groundwater Production Monitoring

All entities that pump groundwater from the basin are required by the OCWD District Act to report production every six months and pay a Replenishment Assessment. Owners or operators of wells with discharge outlets of two inches in diameter or less and supply an area of no more than one acre pay an annual flat fee instead of the Replenishment Assessment and do not have to report their production.

Approximately 200 large-capacity production wells owned by 19 major water retail agencies account for ninety-seven percent of production. Large-capacity well owners report monthly groundwater production for each of their wells. The production volumes are verified by OCWD field staff. Production data are used to evaluate basin conditions, calculate and manage basin storage, run groundwater model scenarios, and collect revenues. Agricultural production accounts for a small amount of basin pumping. In 2015, irrigation production (including agriculture and nurseries) accounted for less than 2,000 acre-feet.

5.2.2 Groundwater Elevation Monitoring

Production and monitoring wells in the basin are measured for groundwater elevation at varying intervals, as explained below:

- Water elevation measurements are collected for every OCWD monitoring well at least once a year with most wells measured at least monthly;
- Monitoring of production wells is typically monthly but may vary depending on operational status, well maintenance, abandonment, new well construction, and related factors;
- Over 1,000 individual measuring points are monitored for water levels on a monthly or bi-monthly basis to evaluate short-term effects of pumping, recharge or injection operations; and
- Additional monitoring is done as needed in the vicinity of OCWD's recharge facilities, seawater barriers, and areas of special investigation where drawdown, water quality impacts or contamination are of concern.

Beginning in 2011, OCWD began reporting seasonal groundwater elevation measurements to DWR as part of the California Statewide Groundwater Elevation Monitoring (CASGEM) program. OCWD has been designated as the Monitoring Entity for the Orange County Groundwater Basin. Wells monitored under the CASGEM program are listed in Appendix A.

The monitoring well network developed for the CASGEM program and historical and proposed future groundwater elevation monitoring frequency provide a detailed and representative data set, both spatially and temporally. The initial network established in 2011 consisted of a total of 77 monitoring stations distributed laterally and vertically throughout the groundwater basin. Most of the wells are owned by OCWD and have detailed borehole geologic logs and downhole geophysical logs. Figures 5-4 to 5-6 present the monitoring well locations for each of the three aquifer systems. The CASGEM network includes wells within the La Habra-Brea and Santa Ana Canyon Management Areas.

Nearly all of the stations are discretely-screened monitoring wells, with the exceptions being inactive production wells. Many of the monitoring wells are of the "Westbay" or "multi-point" type whereby a single casing with multiple screened intervals is installed in a single borehole. Each screened interval (typically 10 feet long) is hydraulically isolated by permanently installed hydraulic packers inside the blank casing and annular seals outside the blank casing. With few unavoidable exceptions, the wells have known screened intervals, geologic logs, and typically more than 15 years of historical groundwater elevation data. The few wells with unknown screened intervals are the only known wells in their areas and are believed to provide representative groundwater elevation data based on historical measurements and their hydrogeologic setting. Wells in the network are sampled quarterly in order to monitor seasonal trends and amplitude. The quarterly measurements are typically completed within a one- to two-week period. Historical data from the wells within the La Habra-Brea and Santa Ana Canyon Management Areas indicate little seasonal variation in groundwater elevations. Measurements in these areas can be on a reduced scheduled as long as the levels show little variation.

Each monitoring station has been assigned a unique identification name. Most stations have also been assigned a State Well Number, but these are not recommended to be used for the purposes of CASGEM, because State Well Numbers were not assigned to each multi-depth station (or screened interval) and, therefore, are not unique.

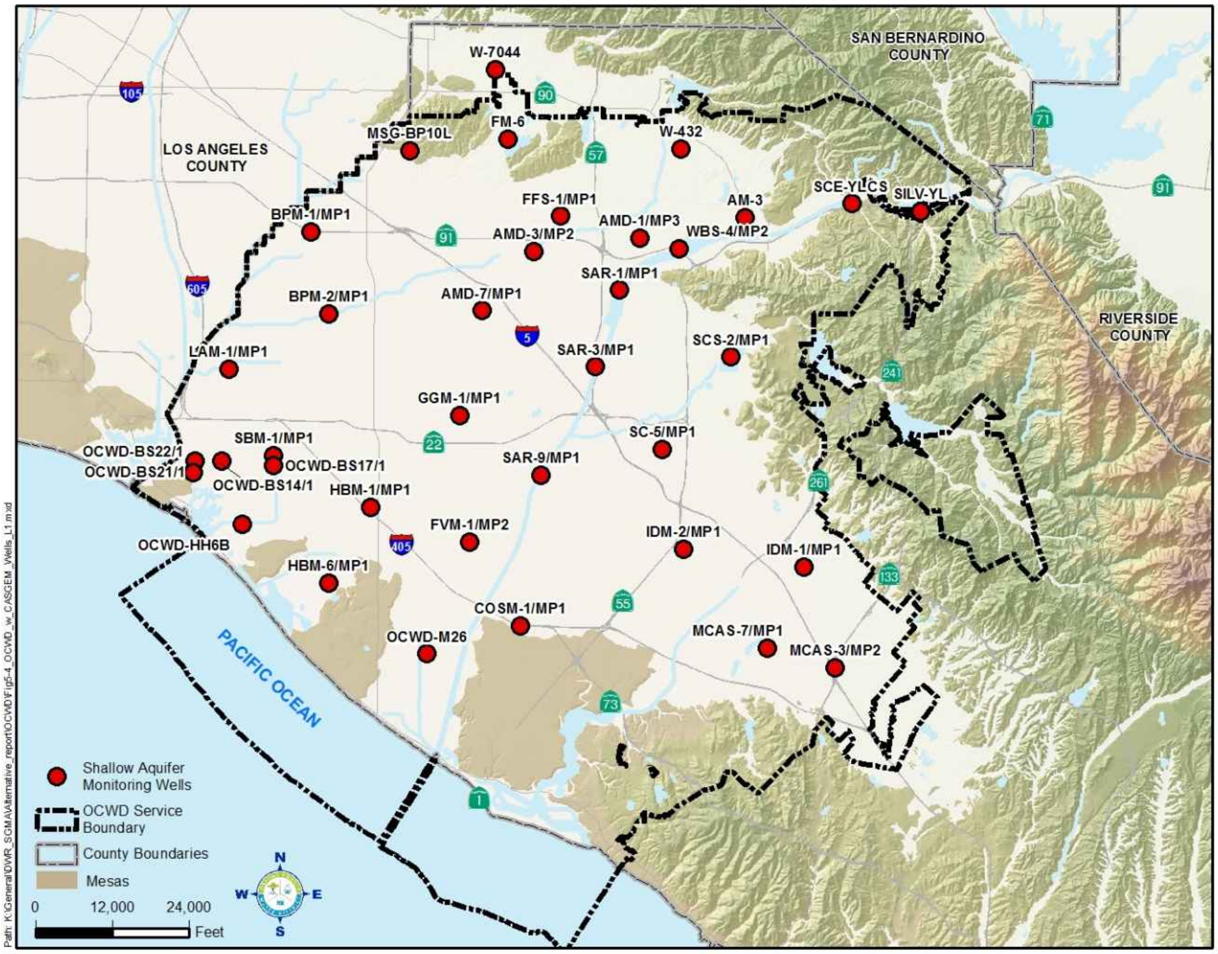


Figure 5-4: CASGEM Shallow Aquifer System Monitoring Well Network

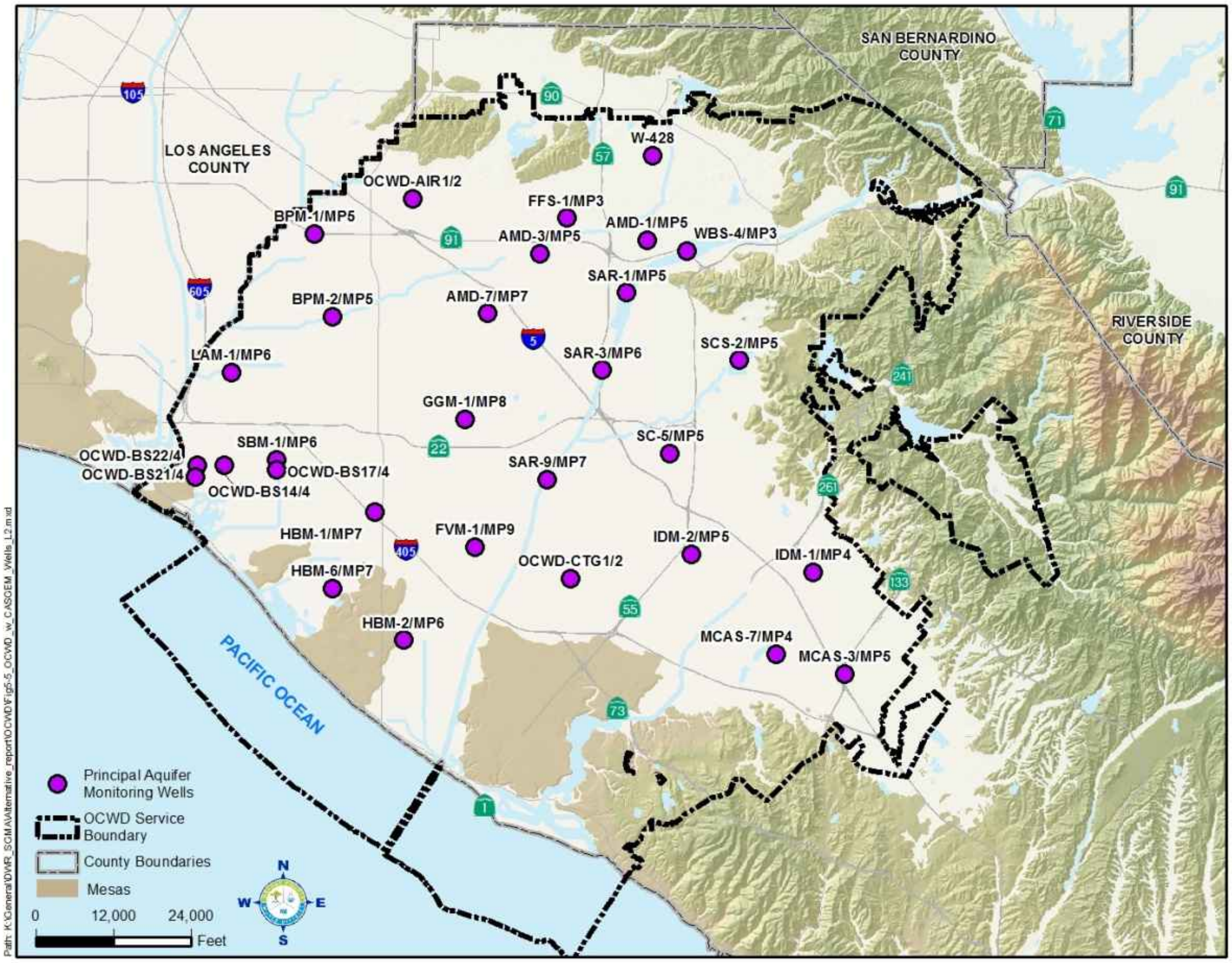


Figure 5-5: CASGEM Principal Aquifer System Monitoring Well Network

The locations of all of the monitoring network wells have been established through a global positioning system with a horizontal accuracy of ±3 feet after data post-processing. The location data are stored in the WRMS database using the projection of State Plane NAD83 California Zone 6, with latitude and longitude available to be reported in either decimal degrees or feet equivalent units.

Each monitoring station has an established reference point description and elevation referenced to the NAVD88 vertical datum. The reference point and ground surface elevations for most of the monitoring stations have been established to the nearest 0.01 foot by licensed surveyors, with elevations for the remaining stations estimated from topographic maps to the nearest foot (±10 feet estimated accuracy). The method of elevation determination for each station reference point is stored and reportable from the database. In the event a reference point elevation changes over time, e.g., a top of casing is raised or lowered, the WRMS database is designed to store historical reference point elevations such that reference point to water level measurements can be converted to an accurate, normalized groundwater elevation over time.

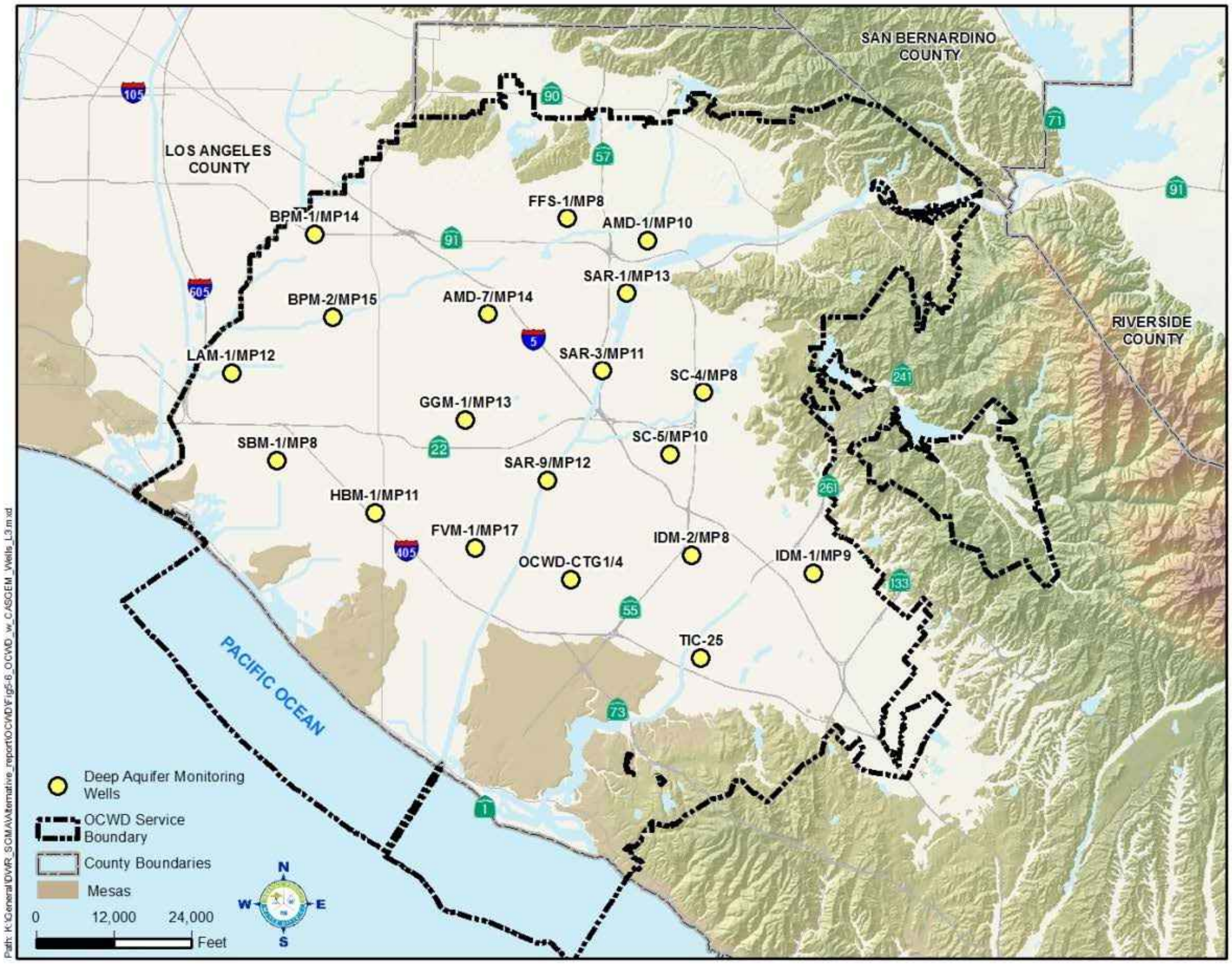


Figure 5-6**:** CASGEM Deep Aquifer System Monitoring Well Network

5.2.3 Groundwater Quality Monitoring

OCWD monitors water quality in production wells on behalf of the Groundwater Producers for compliance with state and federal drinking water regulations. Samples are analyzed for more than 100 regulated and unregulated chemicals at frequencies established by regulation as shown in Table 5-2. Over 425 monitoring and production wells are sampled semi-annually to assess water quality conditions during periods of lowest (winter) and peak production (summer).

The total number of water samples analyzed varies year-to-year due to regulatory requirements, conditions in the basin and applied research and/or special study demands. In 2015, over 15,000 samples were collected by the Water Quality Department and analyzed at OCWD's state-certified Water Quality Assurance Laboratory, of which 20% were for drinking water. OCWD developed specific programs to monitor the North Basin and South Basin plumes, shown in Figures 5-7 and 5-8.

Continual monitoring of groundwater near the coast is done to assess the effectiveness of the Alamitos and Talbert Barriers and track salinity levels in the Bolsa and Sunset Gaps. Key groundwater monitoring parameters used to determine the effectiveness of the barriers include water level elevations, chloride, TDS, electrical conductivity, and bromide. Groundwater elevation contour maps for the aquifers most susceptible to seawater intrusion are prepared to evaluate whether or not the freshwater mound developed by the barrier injection wells is sufficient to prevent the inland movement of saline water.

OCWD's extensive network of monitoring wells within the groundwater basin includes concentrated monitoring along the seawater barrier and near the recharge basins. GWRS-related monitoring wells in the vicinity of Kraemer, Miller, and Miraloma basins are used to measure water levels and to collect water quality samples. In addition to ensuring the protection of water quality, these wells have been used to determine travel times from recharge basins to production wells.

Permits regulating operation of GWRS require adherence to rigorous product water quality specifications, extensive groundwater monitoring, buffer zones near recharge operations, reporting requirements, and a detailed treatment plant operation, maintenance and monitoring program. GWRS product water is monitored daily, weekly, and quarterly for general minerals, metals, organics, and microbiological constituents. Focused research-type testing has been conducted on organic contaminants and selected microbial species.

Table 5-2: Monitoring of Regulated and Unregulated Chemicals in Production Wells

CA SWRCB Division of Drinking Water (DDW) Title 22 Drinking Water: Groundwater Source Monitoring Frequency - Regulated Chemicals		
Chemical Class	**Frequency**	**Monitoring Notes**
Inorganic - General Minerals	Once every 3 years	
Inorganic - Trace Metals	Once every 3 years	
Nitrate and nitrite	Annually	New wells sampled quarterly for 1st year
Detected ≥ 50% MCL	Quarterly	
Perchlorate		New wells sampled quarterly for 1st year
Detected ≥ DLR	Quarterly	State Detection limit = 4 ppb; OCWD RDL = 2.5 ppb
Non-detect at < DLR	Once every 3 years	
Volatile organic chemicals (VOC)	Annually	New wells sampled quarterly for 1st year
Detected VOC	Quarterly	
Synthetic organic chemicals (SOC)		New wells sampled quarterly for 1st year; if non-detect, susceptibility waiver for 3 years
Simazine	Once every 3 years	Must sample 2 consecutive quarters once every 3 years
Radiological		New wells sampled quarterly for 1st year (initial screening) to determine reduced monitoring frequency for each radionuclide
Detected at > 1/2 MCL to MCL	Once every 3 years	Per radionuclide
Detected at ≥ DLR ≤ 1/2 MCL	Once every 6 years	Per radionuclide
Non-detect at < DLR	Once every 9 years	Per radionuclide
EPA and DDW Unregulated Chemicals		
DDW : 4-Inorganic and 5-Organic chemicals	Two required GW samples: (1) Vulnerable period: May-Jun-Jul-Aug-Sep (2) 5 to 7 months before or after the sample collected in the vulnerable period. No further testing after completing the two required sampling events	Monitoring completed for existing wells in 2001-2003; new wells tested during 1st year of operation
EPA UCMR1 - List 1: 1-Inorganic and 10-Organic chemicals		UCMR1 program completed Jan 2001 - Dec 2003
EPA UCMR1 - List 2: 13-Organic chemicals		
EPA UCMR2 - List 1: 10 Organic chemicals		UCMR2 program completed Jan 2008 - Dec 2010
EPA UCMR2 - List 2: 15 Organic chemicals		
EPA UCMR3 List 1: 7-Inorganic and 14-Organic chemicals		All water utilities serving >10,000 people. Monitoring period: Jan 2013 - Dec 2015
EPA UCMR3 List 2: 7-Organic chemicals (Hormones)		All water utilities serving population >100,000 and EPA selected systems serving <100,000 population. Monitoring period: Jan 2013 - Dec 2015

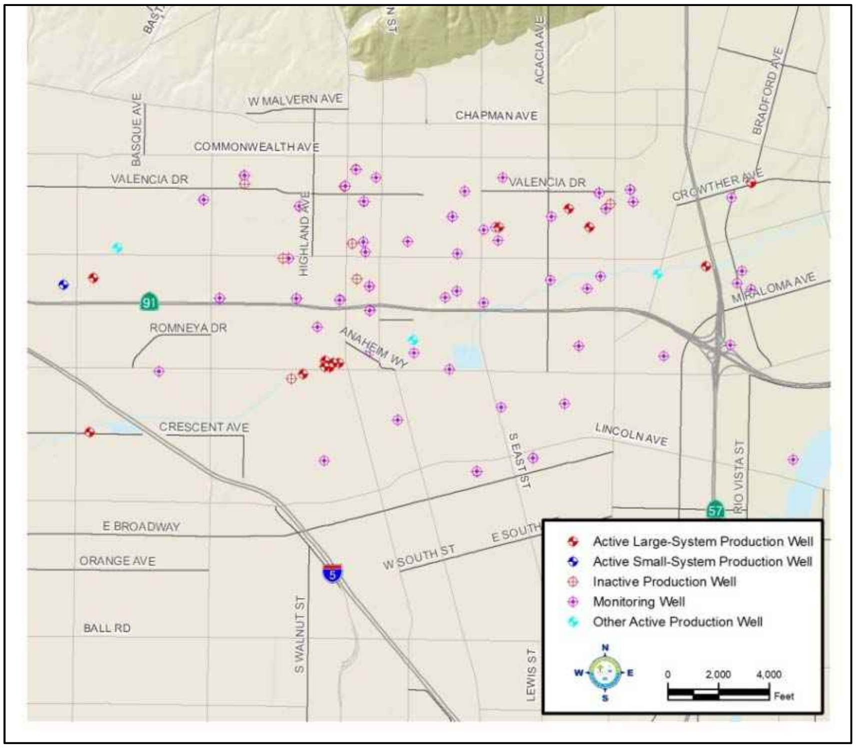


Figure 5-7: North Basin Monitoring Wells

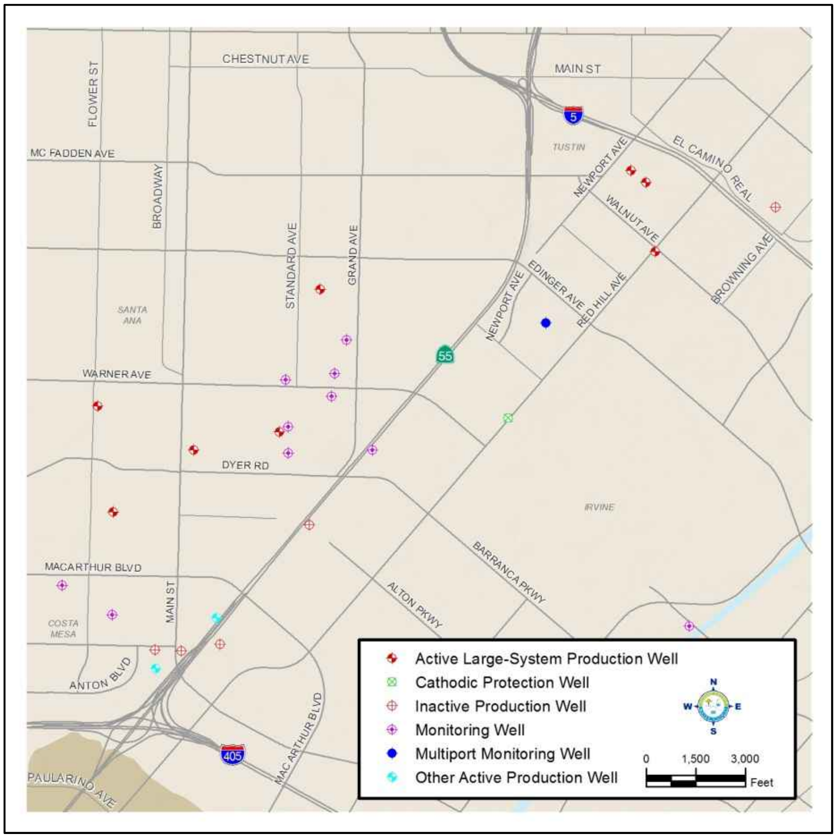


Figure 5-8: South Basin Monitoring Wells

5.2.4 Coastal Area Monitoring

OCWD operates and maintains a network of coastal area monitoring wells that provide water level and water quality data that allow staff to evaluate the performance of seawater intrusion barriers and to identify potential intrusion in coastal areas. The monitoring well network has been expanded and improved over time based on new information and a greater understanding of the basin hydrogeology.

In addition to obtaining groundwater level and quality data from the coastal monitoring well network, valuable geologic information is gained whenever a new well is drilled. Analysis of lithologic logs and geophysical logs produced during well drilling helps fill in data gaps and better define the structure of the underlying strata, such as the depth, thickness, and composition of the various aquifer zones susceptible to seawater intrusion. This geologic information, coupled with groundwater level and quality data, has led to an improved and refined conceptual model of Orange County coastal stratigraphy and characterization of seawater intrusion in the area.

Approximately 200 monitoring and production well sites are monitored for groundwater levels and quality within a 4- to 5- mile area from the coast, generally seaward or south of the 405 freeway, as shown in Figure 5-9. The monitoring wells are largely located in the coastal gaps as well as on the coastal mesas. The mesas are not impermeable features; rather, the marine deposition Pleistocene aquifers extend beneath the mesas to the basin production wells and provide potential avenues for seawater intrusion.

OCWD conducts the groundwater monitoring for the majority of the monitoring wells with the exception of the Alamitos Barrier monitoring wells. The Alamitos Seawater Intrusion Barrier is located along the border of Los Angeles and Orange counties and is jointly owned by OCWD and LACDPW. LACDPW operates, maintains, and samples Alamitos Barrier monitoring and injection wells, including those owned by OCWD located within Orange County. Through an interagency cooperative agreement dating to 1964, operational costs and data are shared between the two agencies with a joint report on the status of the barrier prepared on an annual basis.

Most of the monitoring wells shown in Figure 5-9 are owned by OCWD and are either single-point or nested. Single-point monitoring wells have one screened interval in one targeted aquifer zone, while nested wells have multiple (2 to 6) casings within the same borehole, with each casing screened in a separate aquifer zone at a discrete depth. A handful of OCWD monitoring wells in the coastal area are Westbay multi-port type, having only one well casing but with multiple monitoring ports each separated by inflatable packers. Therefore, although there are approximately 200 monitoring and production well sites in the coastal groundwater monitoring program, there are as many as 436 individual sampling points.

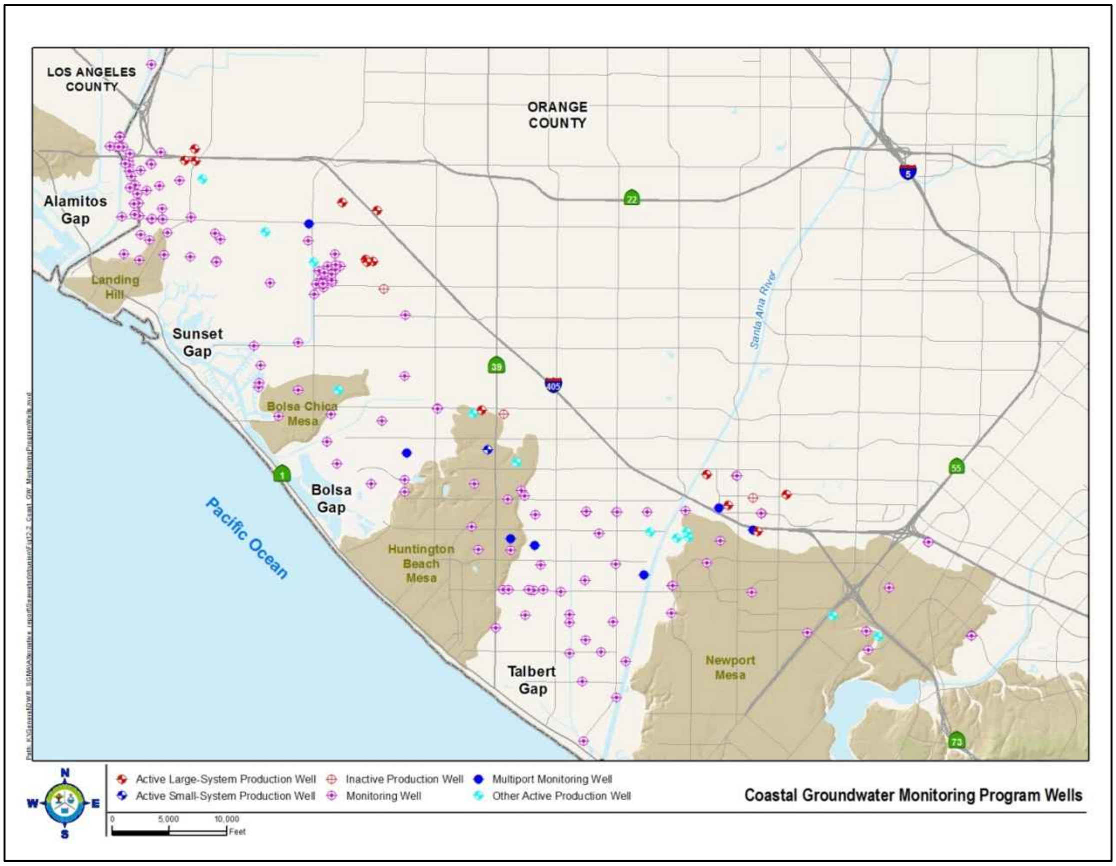


Figure 5-9: Seawater Intrusion Monitoring Wells

In addition to OCWD monitoring wells, there are a few privately owned monitoring wells and active municipal production wells included in OCWD's coastal monitoring program. For example, in Sunset Gap there are a few monitoring wells owned by The Boeing Company (Boeing) related to a shallow VOC plume in the area; Boeing monitors these wells twice a year (groundwater levels and VOCs), and OCWD obtains split samples with Boeing for seawater intrusion monitoring. The retail water agency production wells in the coastal monitoring program include three wells inland of the Alamitos Barrier (City of Seal Beach and Golden State Water Company) and three wells just inland of Sunset Gap (City of Huntington Beach). A complete list of all wells in the coastal groundwater monitoring program, along with their screened interval depths, can be found in Appendix A.

Groundwater levels are measured bi-monthly (every 2 months) at the majority of coastal monitoring wells, with many wells done monthly where seasonally changing gradients and protective elevations must be evaluated throughout the year to evaluate the potential for intrusion and the effectiveness of injection barrier operations at the Alamitos and Talbert barriers. In addition, several key coastal wells are also equipped with pressure transducers connected to automated data loggers that are downloaded regularly and record twice-daily groundwater level readings.

Nearly all of the coastal monitoring wells are sampled semi-annually (March and September) for key groundwater quality parameters to assess seawater intrusion and barrier operations. Some wells in the immediate vicinity of the injection barriers are sampled more frequently (e.g., quarterly) to track injection water pathways and travel times, per the permit requirements for the direct injection of purified recycled water. Key groundwater quality parameters analyzed for the coastal monitoring program include chloride, bromide, and electrical conductivity (EC), which is a surrogate for TDS. The EC is typically measured both in the field at the time of sampling and in the laboratory.

Dissolved chloride concentrations and EC are used both to track seawater intrusion and to trace the injection of purified recycled water at the barriers, especially the Talbert Barrier in which the injection supply consists of 100 percent recycled water having a much lower salinity signal than native fresh groundwater. Chloride is considered to be a good conservative intrinsic tracer since it is relatively unaffected by sorption- and chemical-, or biological reactions in the subsurface. Bromide concentrations in brackish groundwater samples are valuable to help determine the origin or source of intrusion by evaluating the chloride to bromide ratio. Chloride to bromide ratios in the range of 280-300 in brackish coastal samples suggest relatively young active intrusion from the ocean or water body connected to the ocean, whereas lower ratios may indicate intrusion from past oil brine disposal or an influence of very old connate water from the original marine depositional process when these coastal aquifers were first formed.

5.3 SURFACE WATER AND RECYCLED WATER MONITORING

Surface water from the Santa Ana River is a major source of recharge supply for the groundwater basin. As a result, the quality of the surface water has a significant influence on groundwater quality. Therefore, characterizing the quality of the river and its effect on the basin is necessary to verify the sustainability of continued use of river water for recharge and to safeguard a high-quality drinking water supply for Orange County. Several on-going programs monitor the condition of Santa Ana River water. OCWD monitoring sites along the river and its tributaries are shown in Figure 5-10.

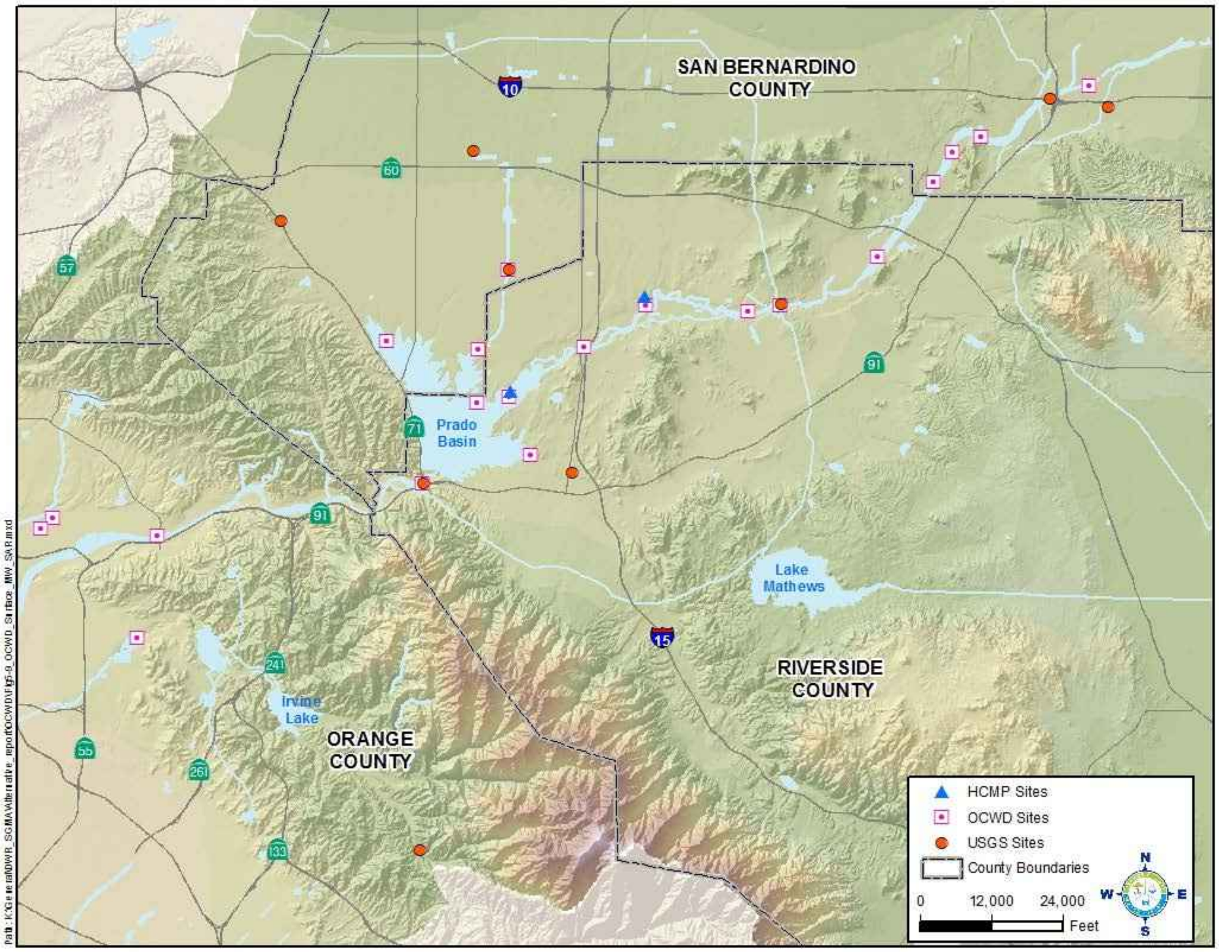


Figure 5-10**:** Surface Water Monitoring Locations

5.3.1 Surface Water Monitoring Programs

SARMON Monitoring

OCWD implements a comprehensive surface water and groundwater monitoring program, referred to as the Santa Ana River Monitoring (SARMON) Program. Monitoring activities include sites on the Santa Ana River, Anaheim Lake, Miraloma Basin, and Santiago Basin, as well as selected monitoring wells downgradient from the recharge basins to provide data on travel time, to assess water quality changes and ensure the continued safety of recharging Santa Ana River water into the groundwater basin.

On-going monthly surface water monitoring of the Santa Ana River is conducted at Imperial Highway near the diversion of the river to the off-river recharge basins and at a site below Prado Dam. Sampling frequencies for selected river sites and recharge basins are shown in Table 5-3.

Table 5-3: Surface Water Quality Sampling Frequency within Orange County
(A= annual, S= semi-annual, M = monthly, Q = quarterly)

CATEGORY	SAR Below Dam	SAR Imperial Hwy	Anaheim Lake	Miraloma Basin	Santiago Basins
General Minerals	M	M	Q	Q	M
Nutrients	M	M	Q	Q	M
Metals	Q	Q	Q	Q	Q
Microbial	M	M	Q	M	M
Volatile Organic Compounds (VOC)	Q	M	Q	Q	M
Semi-Volatile Organic Compounds	Q	Q	Q	Q	Q
Total Organic Halides (TOX)	M	M	Q	--	M
Radioactivity	Q	Q	Q	--	Q
Perchlorate	M	M	Q	Q	M
Chlorate	Q	M	Q	Q	M
NDMA Formation Potential (NDMA-FP)	--	S	--	--	--
Chemicals of Emerging Concern (CEC)*	Q	Q	Q	Q	Q

*Imperial Highway samples are tested for a full suite of CECs. The other sites are tested for a reduced list of analytes.

Basin Monitoring Program Annual Report of Santa Ana Water Quality

The Basin Monitoring Program Task Force (Task Force) monitors levels of Total Inorganic Nitrogen (TIN) and Total Dissolved Solids (TDS) in groundwater basins in the Santa Ana River Watershed. The Task Force is a group of 22 water and wastewater agencies in the watershed that conducts this work under the direction of the Regional Water Board. The Board requires that the Task Force prepare an annual report of the Santa Ana River water quality. Sampling locations used for this program include sites, shown in Figure 5-10, sampled by OCWD, USGS, and the Chino Basin Watermaster/Inland Empire Utilities Agency for the Hydrologic Control Monitoring Program (HCMP).

Santa Ana River Watermaster Monitoring

The Santa Ana River Watermaster produces an annual report in fulfillment of requirements of the Stipulated Judgment in the case of Orange County Water District v. City of Chino, et al., Case No. 117628-County of Orange, entered by the court on April 17, 1969. The Judgment settled water rights between entities in the Lower Area of the Santa Ana River Basin downstream of Prado Dam against those in the Upper Area tributary to Prado Dam. The court-appointed Watermaster Committee consists of representatives of the Orange County Water District representing the Lower Area and San Bernardino Municipal Water District, Western Municipal Water District, and the Inland Empire Utilities Agency, representing the Upper Area.

The Watermaster annually compiles the basin hydrologic and water quality data necessary to determine compliance with the provisions of the Judgment. The data include records of stream discharge (flow) and quality for the Santa Ana River at Prado Dam and at Riverside Narrows as well as discharges for most tributaries; flow and quality of non-tributary water entering the river; rainfall records at locations in or adjacent to the watershed; and other data that may be used to support the determinations of the Watermaster.

Data collected by the USGS at two gaging stations, “Santa Ana River below Prado” and “Santa Ana River at Metropolitan Water District Crossing” are used. Discharge data at both stations consists of computed daily mean discharges based on continuous recordings and daily maximum and minimum and mean values for EC measured as specific conductance and monthly measured values for total dissolved solids.

Stream gage data collected by the USGS at the following gaging stations are also used: Santa Ana River at E Street in San Bernardino, Chino Creek at Schaefer Avenue, Cucamonga Creek near Mira Loma, and Temescal Creek in the City of Corona. Precipitation data is collected at the USGS Gilbert Street Gage in San Bernardino and by OCWD in Orange County.

Emerging Constituents

OCWD participated in a watershed-wide Emerging Constituents Monitoring Program administered by the Santa Ana Watershed Project Authority. This group was formed in 2010 to characterize emerging constituents in 1) municipal wastewater effluents, 2) the Santa Ana River at various locations, and 3) imported water. Three years of testing (2011-2013) were completed as directed by the Regional Water Quality Control Board (R8-2009-0071). OCWD monitored two sites twice a year on the Santa Ana River for this program. Watershed-wide testing may be conducted in the future.

OCWD monitors two surface water sites monthly on the Santa Ana River and at groundwater monitoring wells downgradient of the recharge area. In addition, OCWD sampled for emerging constituents at the diversion into the Prado Wetlands once during the winter and fall and monthly from spring through summer as part of a focused research study.

For the GWRS, OCWD performs the emerging constituents monitoring required by its Regional Water Board permit and by the Amended Recycled Water Policy adopted by the State Water Resources Control Board in 2013. Samples are analyzed for pharmaceuticals, endocrine disruptors and other emerging constituents such as personal care products, food additives, pesticides and industrial chemicals.

Metropolitan Water District of Southern California Imported Water

Imported water purchased by OCWD from the Metropolitan Water District of Southern California (MWD) is monitored for general minerals, nutrients and other selected constituents. OCWD may also monitor metals, volatile organics and select semi-volatile organics (e.g., pesticides and herbicides). MWD performs its own comprehensive monitoring and provides data to the District upon request.

5.3.2 Recycled Water Monitoring

Performance of the GWRS is monitored on a routine basis. Annual GWRS reports are prepared by a diplomate of the American Academy of Environmental Engineering and an Independent Advisory Panel (IAP) to document ongoing scientific peer review. The IAP analyzes data in OCWD's Annual GWRS Report as well as water quality data collected throughout the groundwater basin. The IAP is appointed and administered by the National Water Research Institute to provide credible, objective review of all aspects of GWRS by scientific and engineering experts. In addition to formal written reports, the IAP also offers suggestions for enhancing monitoring of water quality, improving the efficiency of current GWRS technologies and evaluating future projects associated with the GWRS.

Use of GWRS water is regulated by the Regional Water Board and the Division of Drinking Water. Monitoring is performed at the WRD-owned Leo J. Vander Lans Advanced Water Treatment Facility that supplies recycled water to the Alamitos Seawater Barrier for injection.

To comply with the permit to operate the GWRS, groundwater samples are taken from 35 monitoring wells at nine sites to monitor GWRS water after percolation or injection. Samples are also taken from wells downgradient and along the groundwater flow path to collect data for long-term analysis of the effect of using GWRS supply for groundwater recharge. The location of these wells is shown in Figure 5-11. Monitoring frequencies are shown in Table 5-4.

Because of the low concentration of salts in GWRS water, OCWD initiated a Metals Mobilization Study to analyze for trace metals in selected wells near and downgradient of basins used for recharge of GWRS water. The GWRS Independent Advisory Panel recommended this study to evaluate the potential of GWRS water to alter existing groundwater geochemical equilibria, such as causing metals currently bound to aquifer sediments to be released when GWRS water mixes with an aquifer matrix that is in equilibrium with the ambient groundwater.

OCWD is investigating the feasibility of injecting 100 percent GWRS water directly into the Principal Aquifer in the central part of the basin. The Mid-Basin Injection Demonstration Project consists of a test injection well (MBI-1) along with seven nearby monitoring wells (SAR-10/1-4 and SAR-11/1-3) located approximately three miles north of the Talbert Barrier, along the GWRS pipeline at the Santa Ana River and Edinger Avenue in Santa Ana.

Ambient water quality conditions are monitored in the vicinity of the demonstration project to establish a water quality baseline to evaluate the potential of metals mobilization upon injection of GWRS water and to access any other water quality changes should they occur once injection of GWRS water at the site commences. Samples are analyzed for microbial, general minerals, trace metals, semi-volatile organic compounds, and radiological constituents. Data from this Mid-Basin Injection Demonstration Project will support the design and permitting of future additional wells in the basin.

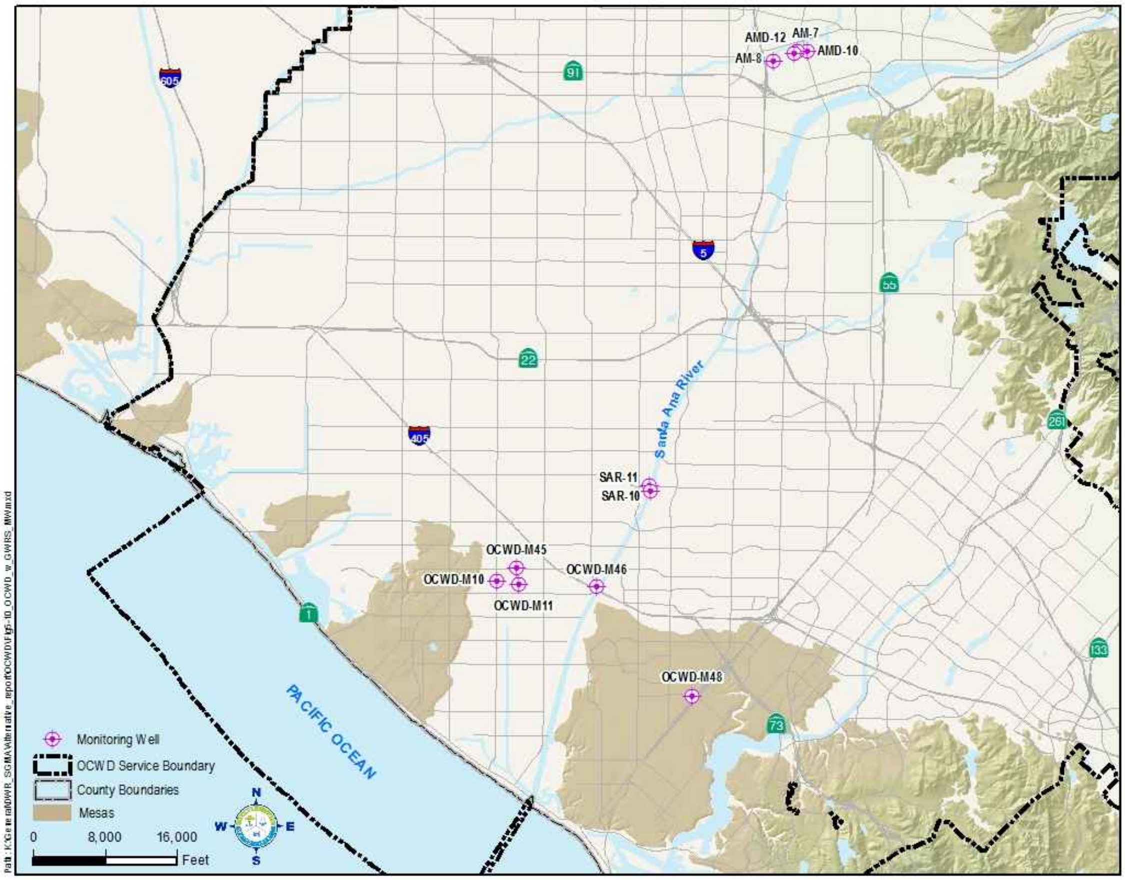


Figure 5-11: Recycled Water Monitoring Wells

Table 5-4: Groundwater Replenishment System Product Water Quality Monitoring

CATEGORY	TESTING FREQUENCY
General Minerals	monthly
Nitrogen Species (NO3, NO2, NH3, Org-N)	twice weekly
TDS	weekly
Metals	quarterly
Inorganic Chemicals	quarterly
Microbial	daily
Total Organic Carbon (TOC)	daily
Non-volatile Synthetic Organic Compounds (SOCs)	quarterly
Disinfection Byproducts	quarterly
Radioactivity	quarterly
Emerging Constituents	quarterly

SECTION 6 WATER RESOURCE MANAGEMENT PROGRAMS

6.1 LAND USE ELEMENTS RELATED TO BASIN MANAGEMENT

The OCWD Management Area is highly urbanized. Monitoring potential impacts from proposed new land uses and planning for future development are key management activities essential for sustainable management of the groundwater basin.

OCWD monitors, reviews and comments on local land use plans and environmental documents such as Environmental Impact Reports, Notices of Preparation, amendments to local General Plans and Specific Plans, proposed zoning changes, draft Water Quality Management Plans, and other land development plans. District staff also review draft National Pollution Discharge Elimination System and waste discharge permits issued by the Regional Water Board. The proposed projects and programs may have elements that could cause short- or long-term water quality impacts to source water used for groundwater replenishment or have the potential to degrade groundwater resources. Monitoring and reviewing waste discharge permits provides OCWD with insight on activities in the watershed that could affect water quality.

The majority of the basin’s land area is located in a highly urbanized setting and requires tailored water supply protection strategies. Reviewing and commenting on stormwater permits and waste discharge permits adopted by the Regional Water Board for the portions of Orange, Riverside and San Bernardino counties that are within the Santa Ana River watershed are conducted by OCWD on a routine basis. These permits can affect the quality of water in the Santa Ana River and other water bodies, thereby impacting groundwater quality in the basin.

OCWD works with local agencies having oversight responsibilities on the handling, use and storage of hazardous materials; underground tank permitting; well abandonment programs; septic tank upgrades; and drainage issues. Participating in basin planning activities of the Regional Water Board and serving on technical advisory committees and task forces related to water quality are also valuable activities to protect water quality.

6.1.1 Summary of Plans Related to Basin Management

Municipal Stormwater Permit

The municipal separate storm sewer systems (MS4) permit (Order R-8-2009-0030) was adopted by the Regional Water Board with specific requirements for new development and significant redevelopment to manage stormwater on-site. Low impact development (LID) is a stormwater management strategy that emphasizes conservation and use of existing site features integrated with distributed stormwater controls. The strategy is designed to mimic natural hydrologic patterns of undeveloped sites as opposed to traditional stormwater management controls. LID includes both site design and structural measures used to manage stormwater on a particular development site.

The MS4 permit requires that any new development or significant re-development project consider groundwater conditions as part of the preparation of a Project Water Quality Management Plan (WQMP). The County of Orange prepared a Model WQMP to explain the requirements and types of analyses that are required in preparing a Conceptual/Preliminary or Project WQMP in compliance with the permit. A Technical Guidance Document (TGD) was prepared as a technical resource companion to the Model WQMP.

To assist municipalities in implementing the stormwater program, the county prepared detailed maps showing areas where infiltration potentially is feasible and areas where infiltration is likely to be infeasible due to soil conditions, high groundwater, potential for landslides, and groundwater contamination. These maps are included as Figure XVI.2 in Appendix XVI of the Technical Guidance Document that can be found at:
http://cms.ocgov.com/gov/pw/watersheds/documents/wqmp/default.asp

A permit condition requires that municipalities consult with the applicable groundwater management agency in reviewing on-site project plans that propose to infiltrate storm water on-site. As such, OCWD reviews these plans within OCWD boundaries to evaluate potential impacts to groundwater quality due to infiltration of stormwater at particular sites.

The TGD contains specific criteria to protect groundwater quality as part of local efforts to manage stormwater infiltration. The depth to seasonal high groundwater table beneath the project may preclude on-site infiltration of stormwater. In areas with known groundwater and soil contamination, infiltration may need to be avoided if it could contribute to the movement or dispersion of soil or groundwater contamination or adversely affect ongoing cleanup efforts. Potential for contamination due to infiltration is dependent on a number of factors including local hydrogeology and the chemical characteristics of the pollutants of concern. If infiltration is under consideration in areas where soil or groundwater pollutant mobilization is a concern, a site-specific analysis must be conducted to determine where infiltration-based BMPs can be used without adverse impacts.

Criteria for infiltration related to protection of groundwater quality include:

- Minimum separation between the ground surface and groundwater including guidance for calculating mounding potential
- Categorization of infiltration BMPs by relative risk of groundwater contamination
- Pollutant sources in the tributary watershed and pretreatment requirements
- Setbacks from known plumes and contaminated sites
- Guidelines for review by applicable groundwater management agencies

North Orange County Integrated Regional Water Management Plan

This plan was prepared by the County of Orange with the participation of a diverse group of stakeholders. The North Orange County planning area encompasses the Santa Ana River Watershed, the Lower San Gabriel River, Coyote Creek Watershed, and the Anaheim Bay-Huntington Harbour Watershed. The North Orange County Integrated Regional Watershed Management Plan was prepared in 2011 to maximize use of local water resources, to increase collaboration and to apply multiple water management strategies by implementing multi-purpose projects in the region. The plan was designed to help agencies, governments and community groups manage their water, wastewater and ecological resources and to identify potential projects to improve water quality, engage in long range water planning and obtain funding. OCWD participated in the preparation of this plan and submitted proposed projects to be considered as regional projects to augment local water supplies, protect groundwater quality and increase water supply reliability.

Central Orange County Integrated Regional and Coastal Watershed Management Plan

The Central Orange County plan was prepared in 2011 by the County of Orange and local stakeholders, including OCWD, to serve as a planning tool to effectively manage the region’s water resources. The central area encompasses the entire Newport Bay Watershed and the northern portion of the adjacent Newport Coast Watershed that lies within the jurisdiction of the Santa Ana Regional Water Quality Control Board. The plan sets goals and objectives, identifies water resource projects, and discusses ways to integrate a proposed project with other projects.

One Water One Watershed (OWOW) 2.0

The Integrated Regional Watershed Management Plan for the Santa Ana Watershed is referred to as the OWOW 2.0 plan. Drafted by watershed stakeholders, including OCWD, under the direction of the Santa Ana Watershed Project Authority (SAWPA), this updated plan was adopted by the SAWPA Commission in 2014. The plan details the water resource related opportunities and constraints with the aim of developing proposed projects that provide a regional benefit, are integrated, and are proposed by more than one agency.

Municipal Water District of Orange County

Urban Water Management Plan

The Municipal Water District of Orange County (MWDOC) is a water wholesaler and regional planning agency serving 26 cities and water districts throughout Orange County, which includes OCWD’s service area. MWDOC prepared its 2015 Regional Urban Water Management Plan to provide a comprehensive assessment of the region’s water services, sources and supplies, including imported water, groundwater, surface water, recycled water, and wastewater. Findings and projections in the plan are used by OCWD and water retailers.

Orange County Reliability Study

The Orange County Reliability Study was prepared in 2016 to comprehensively evaluate current and future water supply and system reliability for Orange County. Water demands and supplies were evaluated for current and future conditions with a planning horizon from 2015 to 2040 using a simulation model developed for this study.

6.1.2 Land Use Development and Water Demands and Supply

Water demands within the OCWD Management Area for water year (WY) 2015-16 totaled approximately 364,000 acre-feet, which reflects the state-mandated water use reductions in response to the extended drought. Total demands include the use of groundwater, surface water from Santiago Creek and Irvine Lake, recycled water, and imported water. As shown in Figure 6-1, water demands between WY1989-90 and 2014-15 have fluctuated between approximately 413,000 afy to 515,000 afy.

Since its founding, OCWD has grown in area from 162,676 to 243,968 acres and has experienced an increase in population from approximately 120,000 to 2.4 million people. OCWD has employed groundwater management techniques to increase the annual yield from the basin including operating over 1,500 acres of infiltration basins. Annual groundwater production increased from approximately 150,000 acre-feet in the mid-1950s to a high of over 360,000 acre-feet in WY 2007-08. OCWD strives to maximize production from the basin through maximizing recharge of the groundwater basin. The groundwater basin is managed within the established operating range independently of total regional water demands as total water demands are met by a combination of groundwater and imported water.

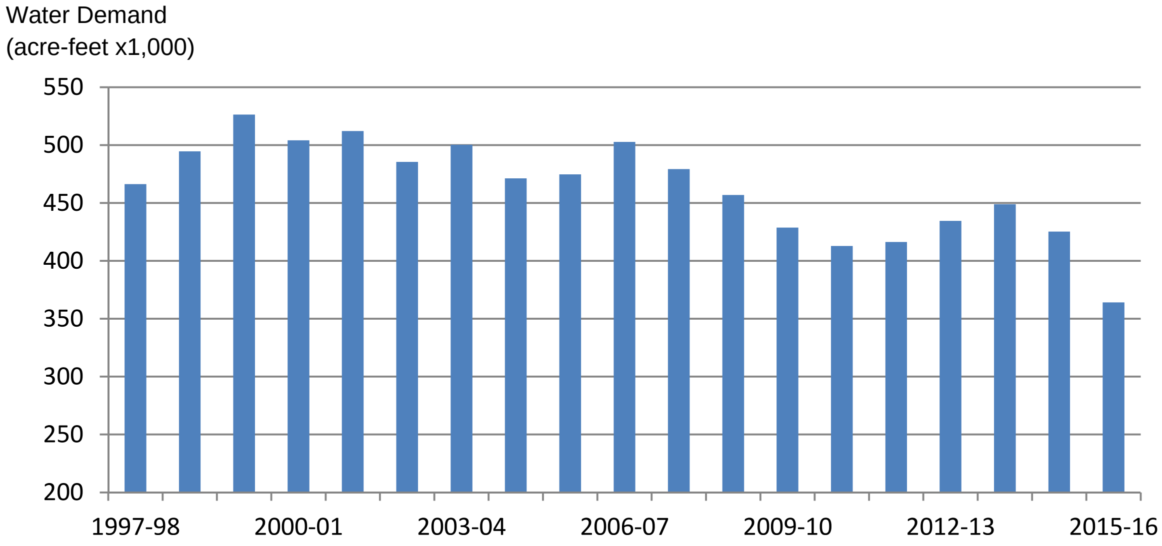


Figure 6-1: Historic Total Water Demands

6.1.3 Well Development, Management, and Closure

To comply with federal Safe Drinking Water Act requirements regarding the protection of drinking water sources, the California Department of Public Health (now the Division of Drinking Water) created the Drinking Water Source Assessment and Protection (DWSAP) program. Water suppliers must submit a DWSAP report as part of the drinking water well permitting process and have it approved before providing a new source of water from a new well. OCWD provides technical support to groundwater producers in the preparation of these reports.

This program requires all well owners to prepare a drinking water source assessment and establish a source water protection program for all new wells. The source water program must include: (1) a delineation of the land area to be protected, (2) the identification of all potential sources of contamination to the well, and (3) a description of management strategies aimed at preventing groundwater contamination.

Developing management strategies to prevent, reduce, or eliminate risks of groundwater contamination is one component of the multiple barrier protection of source water. Contingency planning is an essential component of a complete DWSAP and includes developing alternate water supplies for unexpected loss of each drinking water source, by man-made or catastrophic events.

Wells constructed by OCWD are built to prevent the migration of surface contamination into the subsurface. This is achieved through the placement of annular well seals and surface seals during construction. Also, seals are placed within the borehole annulus between aquifers to minimize the potential for flow between aquifers.

Well construction ordinances adopted and implemented by the Orange County Health Care Agency (OCHCA) and municipalities follow state well construction standards established to protect water quality under California Water Code Section 231. Cities within OCWD boundaries that have local well construction ordinances and manage well construction within their local jurisdictions include the cities of Anaheim, Fountain Valley, Buena Park, and Orange. To provide guidance and policy recommendations on these ordinances, the County of Orange established the Well Standards Advisory Board in the early 1970s. The five-member appointed Board includes OCWD’s Chief Hydrogeologist. Recommendations of the Board are used by the OCHCA and municipalities to enforce well construction ordinances within their jurisdictions.

A well is considered abandoned when the owner has permanently discontinued its use or it is in such a condition that it can no longer be used for its intended purpose. This often occurs when wells have been forgotten by the owner, were not disclosed to a new property owner, or when the owner is unknown.

A properly destroyed and sealed well has been filled so that it cannot produce water or act as a vertical conduit for the movement of groundwater. In cases where a well is paved over or under a structure and can no longer be accessed it is considered destroyed but not properly sealed. Many of these wells may not be able to be properly closed due to overlying structures, landscaping or pavement. Some of them may pose a threat to water quality because they can be conduits for contaminant movement as well as physical hazards to humans and/or animals.

Information on the status of wells is kept within OCWD's Water Resource Management System data base. Records in this data base show 606 wells that have been destroyed and properly sealed, 217 destroyed wells with inadequate information to determine if properly sealed and 948 abandoned wells most of which have inadequate information to determine if the well is accessible or covered over.

OCWD supports and encourages efforts to properly destroy abandoned wells. As part of routine monitoring of the groundwater basin, OCWD will investigate on a case-by-case basis any location where data suggests that an abandoned well may be present and may be threatening water quality. When an abandoned well is found to be a significant threat to the quality of groundwater, OCWD will work with OCHCA and the well owner, when appropriate, to properly destroy the well.

The City of Anaheim has a well destruction policy and has an annual budget to destroy one or two wells per year. The funds are used when an abandoned well is determined to be a public nuisance or needs to be destroyed to allow development of the site. The city's well permit program requires all well owners to destroy their wells when they are no longer needed. When grant funding becomes available, the city uses the funds to destroy wells where a responsible party has not been determined and where the well was previously owned by a defunct water consortium.

6.2 GROUNDWATER QUALITY PROTECTION AND MANAGEMENT

6.2.1 OCWD Groundwater Quality Protection Policy

OCWD adopted the first Groundwater Quality Protection Policy in 1987 under statutory authority granted under Section 2 of the OCWD Act. A revised policy was adopted by the Board of Directors in 2014. The policy guides the actions of OCWD to:

- Maintain groundwater quality suitable for all existing and potential beneficial uses;
- Prevent degradation of groundwater quality and protect groundwater from contamination;
- Assist regulatory agencies in identifying sources of contamination to assure cleanup by the responsible parties;
- Support regulatory enforcement of investigation and cleanup requirements on responsible parties in accordance with law;
- Undertake investigation and cleanup projects as necessary to protect groundwater from contamination;
- Maintain consistency with the National Contingency Plan when seeking recovery of investigation and response costs;
- Negotiate with and engage in mediation with parties responsible for contamination when possible to resolve issues related to cleanup and abatement of contamination;

- Establish a Groundwater Contamination Cleanup Fund to hold proceeds received from settlement of lawsuits for each groundwater contamination case for which the District received moneys;
- Maintain surface water and groundwater quality monitoring programs and monitoring well network;
- Maintain the database system, geographic information system, and computer models to support water quality programs;
- Maintain an Emergency Response Fund to ensure adequate funds are available to contain and clean up catastrophic releases of chemicals or other substances that may contaminate surface water or groundwater;
- Coordinate with groundwater producer(s) impacted or threatened by any groundwater contamination and work to develop appropriate monitoring and remediation if necessary; and
- Encourage the beneficial use and appropriate treatment of poor-quality groundwater where the use of such groundwater will reduce the risk of impact to additional production wells, increase the operational yield of the basin and/or provide additional water quality improvements to the basin.

6.2.2 Salinity Management Programs

Increasing salinity in water supplies is a significant water quality problem in many parts of the southwestern United States and southern California. Programs to manage salinity within the OCWD Management Area are described in this section. These programs include both programs within the management area as well as those related to management of surface water in the upper watershed that affect the quality of water used by OCWD for groundwater replenishment. Seawater intrusion barrier programs are described in Section 6.5.

Coastal Pumping Transfer Program

The Coastal Pumping Transfer Program (CPTP) allows OCWD to manage salinity levels in the groundwater basin by encouraging the shifting of groundwater production from the coastal area to inland areas. The purpose of the CPTP is to encourage inland producers to pump more groundwater and coastal producers to pump less in order to raise coastal groundwater levels, which lessens the potential for seawater intrusion. Inland producers participate in this cooperative program to increase pumping and both inland and coastal producers are compensated so that it is a cost-neutral program for the groundwater producers.

Groundwater Replenishment System

The GWRS plant produces highly-treated recycled water to be used for groundwater recharge and to operate the Talbert Seawater Intrusion Barrier. The TDS of water produced by GWRS is approximately 50 mg/L. Recharging the groundwater basin with this water supply significantly improves the water quality of the basin.

Septic Systems

Another source of salinity in the basin originates from onsite wastewater treatment systems, commonly known as septic systems. There are an estimated 2,500 septic systems in operation within the OCWD Management Area. Septic systems operate by collecting wastewater in a holding tank and then allowing the liquid fraction to leach out into the underlying sediments where it becomes filtered and eventually becomes part of the groundwater supply. A properly maintained system can be effective at removing many contaminants from the wastewater but salts remain in the leachate. Septic systems are typically in older communities that were developed prior to the construction of sewer systems or located in an area some distance from existing sewers. The State Water Board and Regional Water Board regulate the siting of new septic systems to reduce the possibility of groundwater contamination. Within Orange County, water districts and local officials work to expand sewer systems in order to reduce the use of septic systems to the extent feasible and economical.

Nitrogen and Selenium Management Program

Selenium is a naturally-occurring micronutrient found in soils and groundwater in the Newport Bay watershed. Selenium is essential for reproductive health and immune system function in humans, fish and wildlife. However, selenium bio-accumulates in the food chain and can result in deformities, stunted growth, reduced hatching success, and suppression of immune systems in fish and wildlife.

Prior to urban development, in the western portion of the Irvine Subbasin was an area of shallow groundwater that contained an area known as the Swamp of the Frogs (Cienega de Las Ranas). Runoff from local foothills over several thousands of years accumulated selenium-rich deposits in the swamp. To make this region suitable for farming, drains and channels were constructed in the early 1900s. This mobilized selenium from sediments into the shallow groundwater drained by the channels that eventually discharge to Newport Bay.

The Nitrogen and Selenium Management Program was formed to develop and implement a work plan to address selenium and nitrate in the watershed. This stakeholder working group that includes the County of Orange, affected cities, environmental organizations, Irvine Ranch Water District, the Irvine Company and the Regional Water Board are implementing a long-term work plan. Management of selenium is difficult as there is no off-the-shelf treatment technology available.

Groundwater Desalters and the Inland Empire Brineline and Non-Reclaimable Waste Line

Several water treatment plants that are designed to remove salts from groundwater, commonly referred to as desalters, have been built in Orange, Riverside, and San Bernardino counties. These plants are effectively reducing the amount of salt buildup in the watershed. Managing salinity in the upper watershed is important to OCWD as this protects the water quality in the Santa Ana River that is used in Orange County for groundwater recharge. The Inland Empire Brine Line, formerly called the Santa Ana Regional Interceptor (SARI), built by SAWPA, has operated since 1975 to remove salt from the watershed by transporting industrial wastewater and brine produced by desalter operations directly to OCSD for treatment.

The other brine line in the upper watershed, the Non-Reclaimable Waste Line in the Chino Basin operated by the Inland Empire Utilities Agency (IEUA), segregates high TDS industrial wastewater and conveys this flow to Los Angeles County for treatment and disposal.

In Orange County, salinity management projects include groundwater desalters located in the cities of Tustin and Irvine that are pumping and treating high salinity groundwater. The saline groundwater in Tustin and Irvine is a combination of naturally occurring salts and impacts from past agricultural activities.

Basin Monitoring Program Task Force

In 1995, a task force of over 20 water and wastewater resource agencies and local governments, including OCWD, initiated a study to evaluate the impacts to groundwater quality of elevated levels of total inorganic nitrogen (TIN) and total dissolved solids (TDS) in the watershed. This study was completed and resulted in adoption in 2004 of amendments to the Water Quality Control Plan for the Santa Ana River Basin (Basin Plan). This nearly 10-year effort involved collecting and analyzing data in 25 newly defined groundwater management zones in the watershed to recalculate nitrogen and TDS levels and to establish new water quality objectives.

One major challenge of this effort was developing the tools and collecting data to assess and monitor surface water and groundwater interactions. Although typically regulated and managed separately, stakeholders recognized that surface water and groundwater in the watershed are interconnected and as such protection of these resources would require a comprehensive program. Models were developed and data collected to enable an evaluation of the potential short-term and long-term impacts on water resources due to changes in land use, the quantity and quality of runoff, and point source discharges.

The Basin Plan charges the Task Force with implementing a watershed-wide TDS/Nitrogen management program. Task Force members agreed to fund and participate in a process to recalculate ambient water quality every three years in each of the 25 groundwater management zones and to compare water quality to the water quality objectives in order to measure compliance with the Basin Plan. The latest recalculation, the third since adoption of the amendment, was completed in 2014 (Wildermuth, 2014).

Salinity Management and Imported Water Recharge Workgroup

The Salinity Management and Imported Water Recharge Workgroup, in cooperation with the Regional Water Board, implements a cooperative agreement signed in 2008 by water agencies that use imported water for groundwater recharge. The objective of this effort is to evaluate and monitor the long-term impacts of recharging groundwater basins with imported water. The workgroup analyzes water quality data and estimates future conditions to evaluate the potential impact of recharging imported water. TDS and nitrate data are collected and analyzed to determine whether the intentional recharge of imported water may have adverse impacts on compliance with salinity objectives in the region.

Management of Nitrates

OCWD regularly monitors nitrate levels in groundwater and works with Groundwater Producers to treat individual wells when nitrate concentrations exceed safe levels. Construction of the Tustin Main Street Treatment Plant is an example of such an effort.

Within Orange County, nitrate (as N) levels in groundwater generally range from 4 to 7 mg/L in the Forebay area and from 1 to 4 mg/L in the Pressure area. One of OCWD's programs to reduce nitrate concentrations in groundwater is managing the nitrate concentration of water recharged in OCWD facilities. This includes managing the quality of surface water flowing to Orange County through Prado Dam. To reduce nitrate concentrations in Santa Ana River water, OCWD owns and operates an extensive system of wetlands in the Prado Basin.

The 465-acre Prado Constructed Wetlands, shown in Figure 6-2 are designed to remove nitrogen and other contaminants from the Santa Ana River before the water is diverted from the river in Orange County for recharge through OCWD's surface water recharge system. The majority of the baseflow (non-stormwater flow) in the Santa Ana River is comprised of treated wastewater. On an annual basis, about 50 percent of the SAR flow entering the Prado Basin is treated wastewater, but during summer months, treated wastewater can comprise more than 90 percent of the baseflow. OCWD diverts approximately half of the base flow of the Santa Ana River through the wetland ponds, which remove an estimated 15 to 40 tons of nitrate a month depending on the time of year. The wetlands are more effective from May through October when the water temperatures are warmer and daylight hours are longer. During summer months the wetlands reduce nitrate from nearly 10 mg/L to 1 to 2 mg/L.

Figure 6-2: OCWD Prado Wetlands

6.2.3 Regulation and Management of Contaminants

A variety of federal, state, county and local agencies have jurisdiction over the regulation and management of hazardous substances and the remediation of contaminated groundwater supplies. OCWD does not have regulatory authority to require responsible parties to clean up pollutants that have contaminated groundwater. In some cases, OCWD has pursued legal action against entities that have contaminated the groundwater basin to recover OCWD's remediation costs or to compel those entities to implement remedies. OCWD also coordinates and cooperates with regulatory oversight agencies that investigate sources of contamination. OCWD efforts to assess the potential threat to public health and the environment from contamination in the Santa Ana River Watershed and within the County of Orange include:

- Reviewing ongoing groundwater cleanup site investigations and commenting on the findings, conclusions, and technical merits of progress reports;
- Providing knowledge and expertise to assess contaminated sites and evaluating the merits of proposed remedial activities; and
- Conducting third-party groundwater split samples at contaminated sites to assist regulatory agencies in evaluating progress of groundwater cleanup and/or providing confirmation data of the areal extent of contamination.

The following is a summary of the potential contaminants of greatest concern for basin water quality management.

Methyl Tertiary Butyl Ether (MTBE)

Methyl tertiary butyl ether (MTBE) is a synthetic, organic chemical that was added to gasoline to increase octane ratings during the phase-out of leaded gasoline. In the mid-1990s, the percentage of MTBE added to gasoline increased significantly to reduce air emissions. MTBE is a serious threat to groundwater quality as it sorbs weakly to soil and does not readily biodegrade. The greatest source of MTBE contamination comes from underground fuel tank releases. The State of California banned the use of the additive in 2004 in response to its widespread detection in groundwater throughout the state.

In 2003, OCWD filed suit against numerous oil and petroleum-related companies that produce, refine, distribute, market, and sell MTBE and other oxygenates. The suit seeks funding from these responsible parties to pay for the investigation, monitoring and removal of oxygenates from the basin.

Volatile Organic Compounds

Volatile organic compounds (VOCs) in groundwater come from a number of sources. From the late 1950s through early 1980s, VOCs were used for industrial degreasing in metals and electronics manufacturing. Other common sources include paint thinners and dry cleaning solvents. OCWD’s comprehensive water quality monitoring programs include testing for a wide-range of potential VOC contaminants in order to discover incidents of groundwater contamination at the earliest possible stage.

N-Nitrosodimethylamine (NDMA)

N-Nitrosodimethylamine (NDMA) is a low molecular weight compound that can occur in wastewater after disinfection of water or wastewater via chlorination and/or chloramination. It is also found in food products such as cured meat, fish, beer, milk, and tobacco smoke. OCWD routinely monitors for NDMA in the groundwater and in water supplies used for recharge.

Dioxane

A suspected human carcinogen, 1,4-dioxane, is used as a solvent in various industrial processes such as the manufacture of adhesive products and membranes and may be present in consumer products such as detergents, cosmetics, pharmaceuticals, and food products.

Constituents of Emerging Concern

Constituents of emerging concern (CECs) are synthetic or naturally occurring substances that are not formally regulated in water supplies or wastewater discharges but can now be detected using very sensitive analytical techniques. One of the newest groups of constituents of emerging concern includes pharmaceuticals, personal care products and endocrine disruptors. Due to the potential impact of EDCs on water reclamation projects, OCWD prioritizes monitoring of these chemicals.

OCWD's state-certified laboratory is one of a few in the state that has a program to continuously develop capabilities to analyze for new compounds and works on developing low detection levels for chemicals likely to be targeted for future regulation or monitoring.

OCWD advocates the following general principles as water suppliers and regulators develop programs to protect public health and the environment from adverse effects of CECs:

- Monitoring should focus on constituents that pose the greatest risk.
- Constituents that are prevalent, persistent in the environment, and may occur in unsafe concentrations should be prioritized.
- Analytical methods to detect these constituents should be approved by the state or federal government.
- Studies to evaluate the potential risk to human health and the environment should be funded by the state or federal government.
- The state and federal government should encourage programs to educate the public on waste minimization and proper disposal of unused pharmaceuticals.

OCWD is committed to (1) track new compounds of concern; (2) research chemical occurrence and treatment; (3) communicate closely with the Division of Drinking Water on prioritizing investigation and guidance; (4) coordinate with Orange County Sanitation District, upper watershed wastewater dischargers and regulatory agencies to identify sources and reduce contaminant releases; and (5) inform the Groundwater Producers on emerging issues**.**

6.3 RECYCLED WATER PRODUCTION

6.3.1 Overview

The Groundwater Replenishment System (GWRS) is a joint project built by OCWD and the Orange County Sanitation District that began operating in 2008. Wastewater that otherwise would be discharged to the Pacific Ocean is purified using a three-step advanced process to produce high-quality water used to control seawater intrusion and recharge the groundwater basin. The GWRS produces up to 100 million gallons per day (mgd) of highly-treated recycled water. Plans are underway for expansion of GWRS to increase total capacity to 130 mgd. The system includes three major components (1) the Advanced Water Purification Facility (AWPF), (2) the Talbert Seawater Intrusion Barrier, and (3) recharge basins where GWRS water is percolated into the groundwater basin, schematically illustrated in Figure 6-3.

Secondary-treated wastewater is conveyed to OCWD from OCSD Plant No.1, located adjacent to OCWD's facilities in Fountain Valley. The water undergoes an advanced treatment process that includes microfiltration, reverse osmosis and advanced oxidation/disinfection with hydrogen peroxide and ultraviolet light exposure followed by de-carbonation and lime stabilization. The Full Advanced Treated water is used for groundwater recharge, to supply the Talbert Seawater Barrier and provide recycled water for three industrial/commercial users. On average, 34 percent of the water is injected in the Talbert Barrier and 66 percent is percolated in the recharge basins. Industrial and commercial uses include cooling water for the City of Anaheim's Canyon Power Plant, recycled water for the Anaheim Regional Transportation Intermodal Center, and hydrostatic testing of new secondary treatment basins at OCSD Plant No.1.

GWRS water is recharged in Kraemer, Miller and Miraloma basins, located in the city of Anaheim. Water is conveyed to these basins through a 13-mile pipeline in the west levee of the Santa Ana River through the cities of Fountain Valley, Santa Ana, Orange, and Anaheim and along the Carbon Canyon Diversion Channel. Five feet in diameter at its end point, this pipeline is capable of delivering over 80 million gallons of highly-treated recycled water to the basins each day.

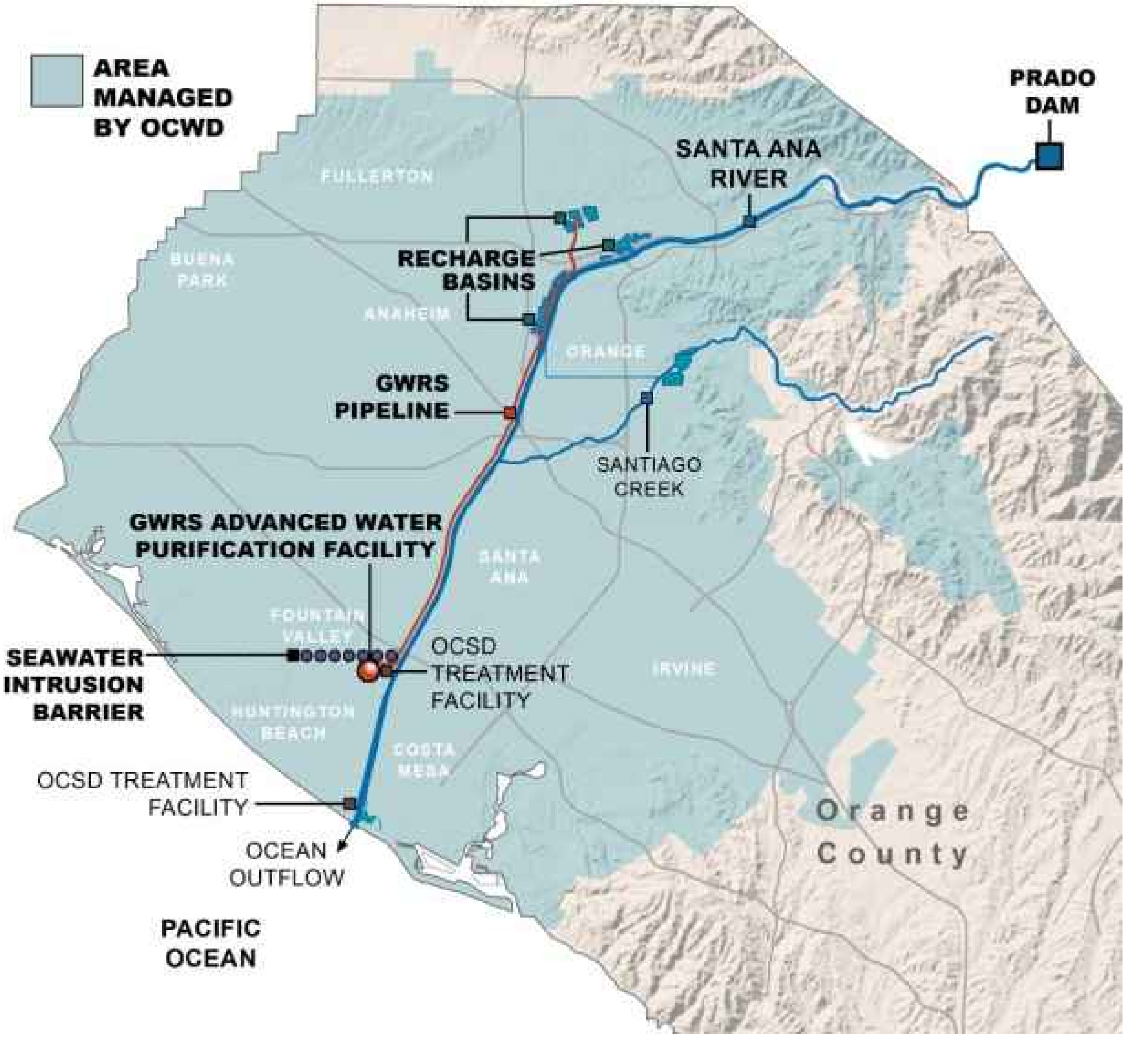


Figure 6-3: Groundwater Replenishment System

6.4 CONJUNCTIVE USE PROGRAMS

Recharge water sources include water from the Santa Ana River and tributaries, imported water, and recycled water supplied by the GWRS as well as incidental recharge from precipitation and subsurface inflow. OCWD owns over 1,500 acres of land on which there are 1,067 wetted acres of recharge facilities. These facilities are located in the Forebay of the groundwater basin adjacent to the Santa Ana River and Santiago Creek.

Managed aquifer recharge began in the 1930s, in response to declining water levels in the basin. OCWD began purchasing portions of the river channel, eventually acquiring six miles of the channel in Orange County, in order to maximize the recharge of Santa Ana River water to the basin.

Recharge of imported water began in 1949 when OCWD began purchasing Colorado River water from MWD. In 1958, OCWD purchased and excavated a 64-acre site one mile north of the Santa Ana River to create Anaheim Lake, OCWD's first recharge basin. Today OCWD operates a network of 25 facilities that recharge an average of over 230,000 afy.

6.4.1 Sources of Recharge Water Supplies

Water supplies used to recharge the groundwater basin are listed in Table 6-1. Figure 6-4 shows the historical recharge by source from 1936 to 2016. Table 6-2 shows the average annual recharge by source between WY 2006-07 and 2015-16.

Santa Ana River

Water from the Santa Ana River is a primary source of water used to recharge the groundwater basin. OCWD diverts river water into recharge facilities where the water percolates into the groundwater basin. Recharge facilities are capable of recharging all of the baseflow. Both the Santa Ana River baseflow and storm flow vary from year to year as shown in Figure 6-5. Recent trends show a decline in baseflow, which may be a result of increased recycling, drought conditions, and declining per capita water use in the upper watershed. The volume of storm water that can be recharged into the basin is highlight dependent on the amount and timing of precipitation in the upper watershed, which is highly variable, as shown in Figure 6-6. OCWD has water rights to all storm flows that reach Prado Dam. When storm flows exceed the capacity of the diversion facilities, river water reaches the ocean and this portion is lost as a water supply.

Santiago Creek

Santiago Creek is the primary drainage for the northwest portion of the Santa Ana Mountains and ultimately drains into the Santa Ana River. OCWD captures and recharges water in Santiago Creek that flows into the Santiago Recharge Basins. During dry periods, the Santiago basins are used to recharge Santa Ana River flows which are pumped to the basins.

Table 6-1: Sources of Recharge Water Supplies

SUPPLY SOURCES AND DESCRIPTION			RECHARGE LOCATION
Santa Ana River	Base Flow	Perennial flows from the upper watershed in Santa Ana River; predominately treated wastewater discharges	Santa Ana River, recharge basins, and Santiago Creek
	Storm Flow	Precipitation from upper watershed flowing in Santa Ana River through Prado Dam	Santa Ana River, recharge basins, and Santiago Creek
Santiago Creek	Storm Flow / Santa Ana River	Storm flows in Santiago Creek and Santa Ana River water pumped from Burris Basin via Santiago Pipeline	Santiago Creek, Santa Ana River, recharge basins
Incidental Recharge	Precipitation and subsurface inflow	Precipitation and runoff from Orange County foothills, subsurface inflow from basin boundaries	Basin-wide
Recycled Water	Groundwater Replenishment System	Advanced treated wastewater produced at GWRS plant in Fountain Valley	Injected into Talbert Barrier; recharged in Kraemer, Miller, and Miraloma basins
	Water Replenishment District of Southern CA	Water purified at the Leo J. Vander Lans Treatment Facility in Long Beach	Injected into Alamitos Barrier
Imported Water	Untreated	State Water Project and Colorado River Aqueduct	Various recharge basins
	Treated	State Water Project and Colorado River Aqueduct treated at MWD Diemer Water Treatment Plant	Injected into Talbert and Alamitos Barriers

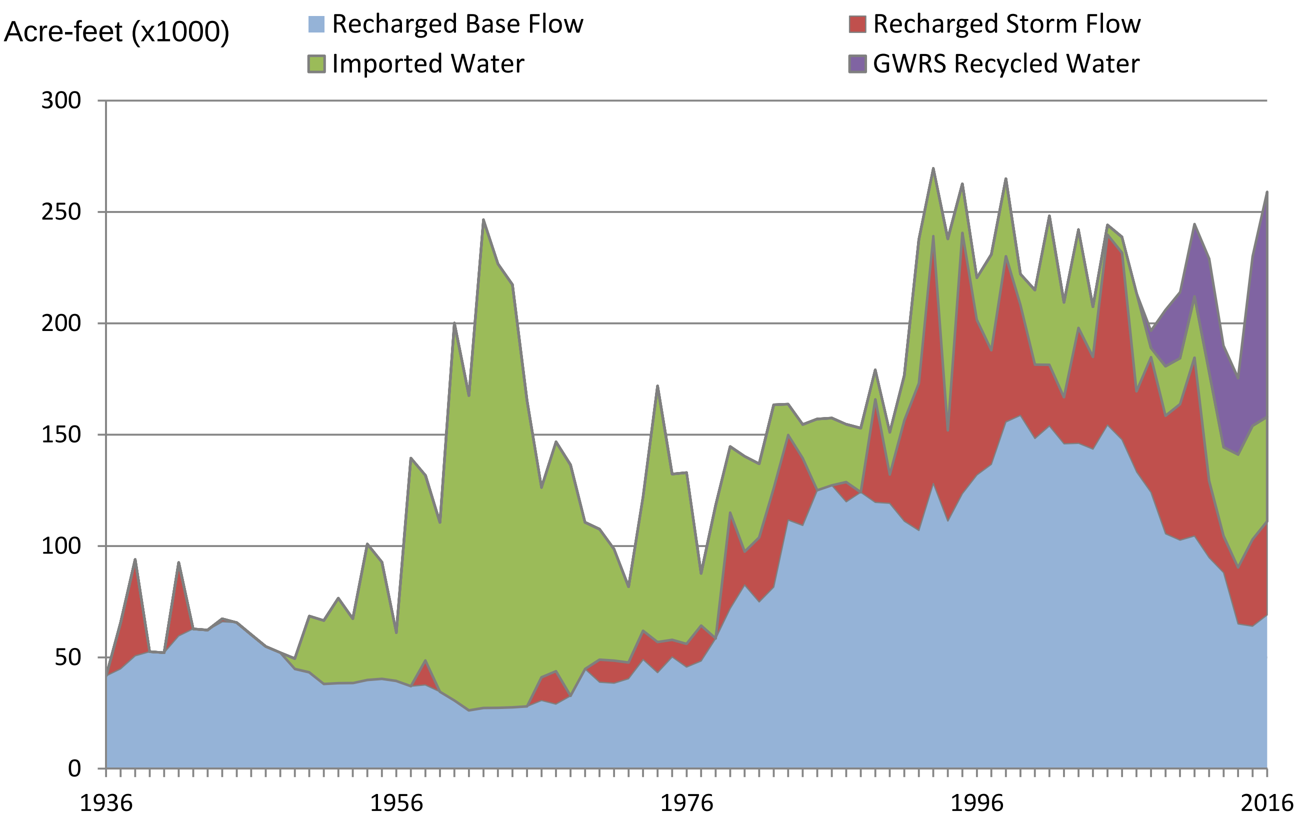


Figure 6-4**:** Historical Recharge in Surface Water Recharge System

Table 6-2: Annual Recharge by Source, Water Year 2006-07 to 2015-16 (acre-feet)

Water year	Santa Ana River		Recycled Water	Imported Water	In-Lieu	Incidental Recharge	Total
	Base Flow	Storm Flow					
2006-07	133,000	39,000	400	111,000	37,000	14,000	334,40 0
2007-08	122,000	61,000	18,000	15,000	0	46,000	262,00 0
2008-09	106,000	52,000	55,000	33,000	0	68,000	334,00 0
2009-10	103,000	59,000	67,000	22,000	0	83,000	332,00 0
2010-11	104,000	78,000	67,000	36,000	10,000	94,000	389,00 0
2011-12	95,000	32,000	72,000	90,000	31,000	27,000	347,00 0
2012-13	85,000	18,000	73,000	41,000	0	20,000	237,00 0

Water year	Santa Ana River		Recycled Water	Imported Water	In-Lieu	Incidental Recharge	Total
	Base Flow	Storm Flow					
2013-14	65,000	25,000	66,000	53,000	0	32,000	241,000
2014-15	63,000	39,000	76,000	51,000	0	50,000	279,000
2015-16	69,000	42,000	101,000	47,000	0	42,000	259,000
Average	95,000	45,000	60,000	50,000	8,000	48,000	304,000
Average %	31%	15%	19%	16%	3%	16%	100%

Notes: (1) "Storm Water" includes total storm flow recharged in both the Santa Ana River and Santiago Creek, a tributary of the Santa Ana River (2) "Imported water" includes water used for Alamitos and Talbert Barriers, water purchased by and recharged by OCWD, MWD CUP supply and MWD CUP in lieu supply recharged in the Forebay.

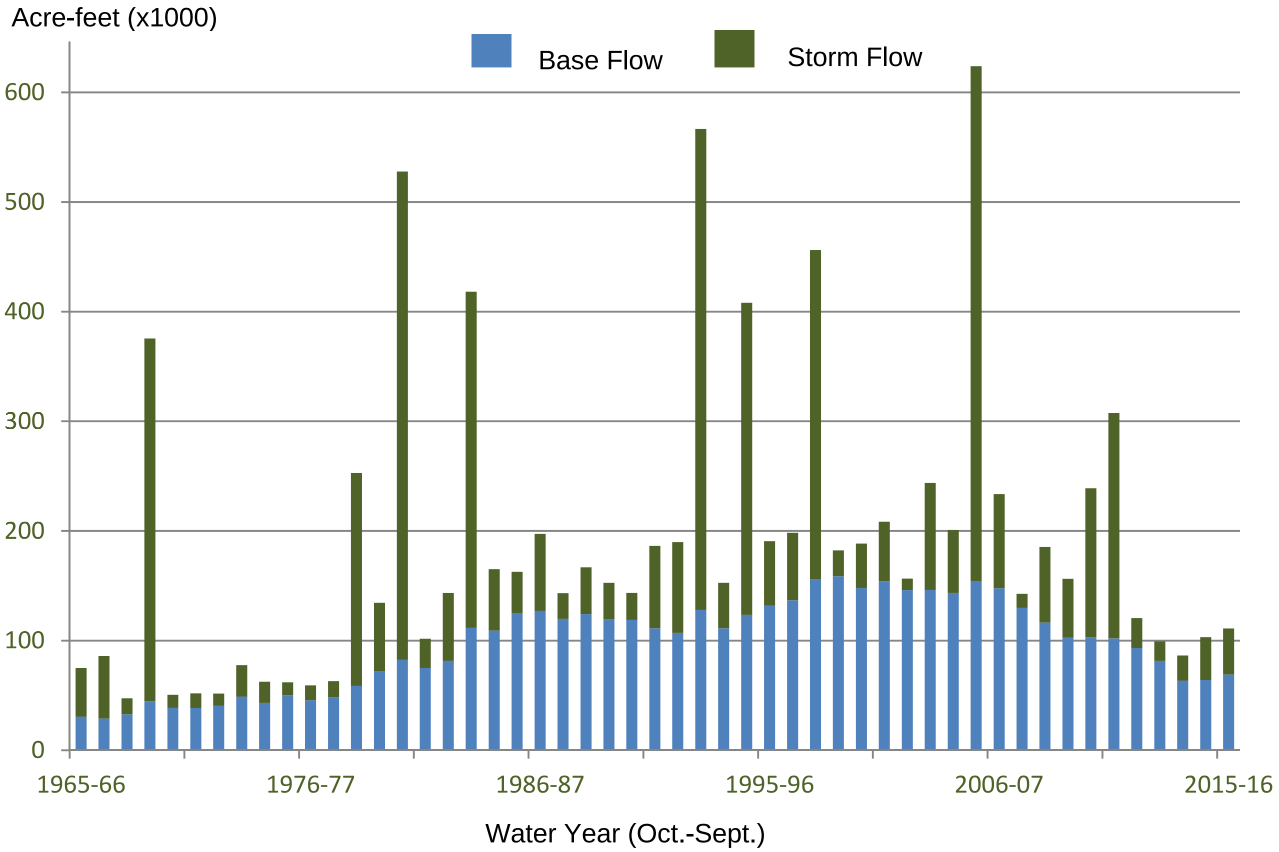


Figure 6-5: Annual Base and Storm Flow in the Santa Ana River at Prado Dam
Source: Santa Ana River Watermaster, 2014

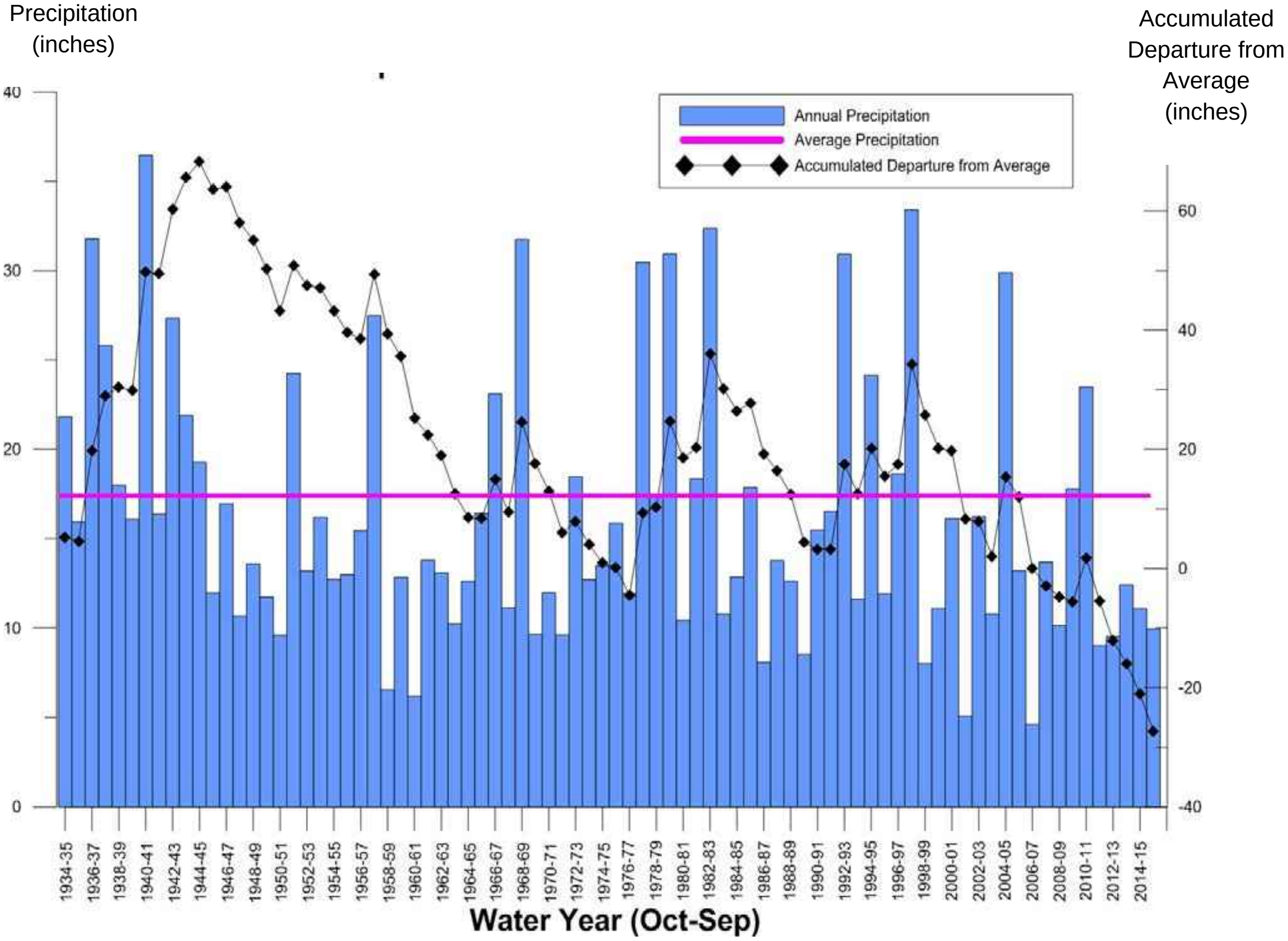


Figure 6-6: Precipitation at San Bernardino, Water Year (Oct.-Sept.) 1934-35 to 2015-16

Incidental Recharge

Also discussed in Section 4.1, l incidental recharge is comprised of subsurface inflow from the local hills and mountains, infiltration of precipitation and irrigation water, recharge in small flood control channels, and groundwater underflow to and from Los Angeles County and the ocean. Since the amount of incidental recharge cannot be directly measured, it is also referred to as unmeasured recharge. Each year, an estimate is made of the amount of net incidental recharge based on OCWD’s annual groundwater storage calculation. In general, since the Central Basin in Los Angeles County is usually operated at a lower level than the Orange County basin, there is usually a net flow of water out of the Orange County basin to the Central Basin. This outflow is subtracted from the total incidental recharge to get the net incidental recharge to the basin, which is the value reported in this document. Figure 6-7 shows the amount of net incidental recharge from WY 2000-01 to 2013-14. Note the correlation between amount of precipitation and net incidental recharge.

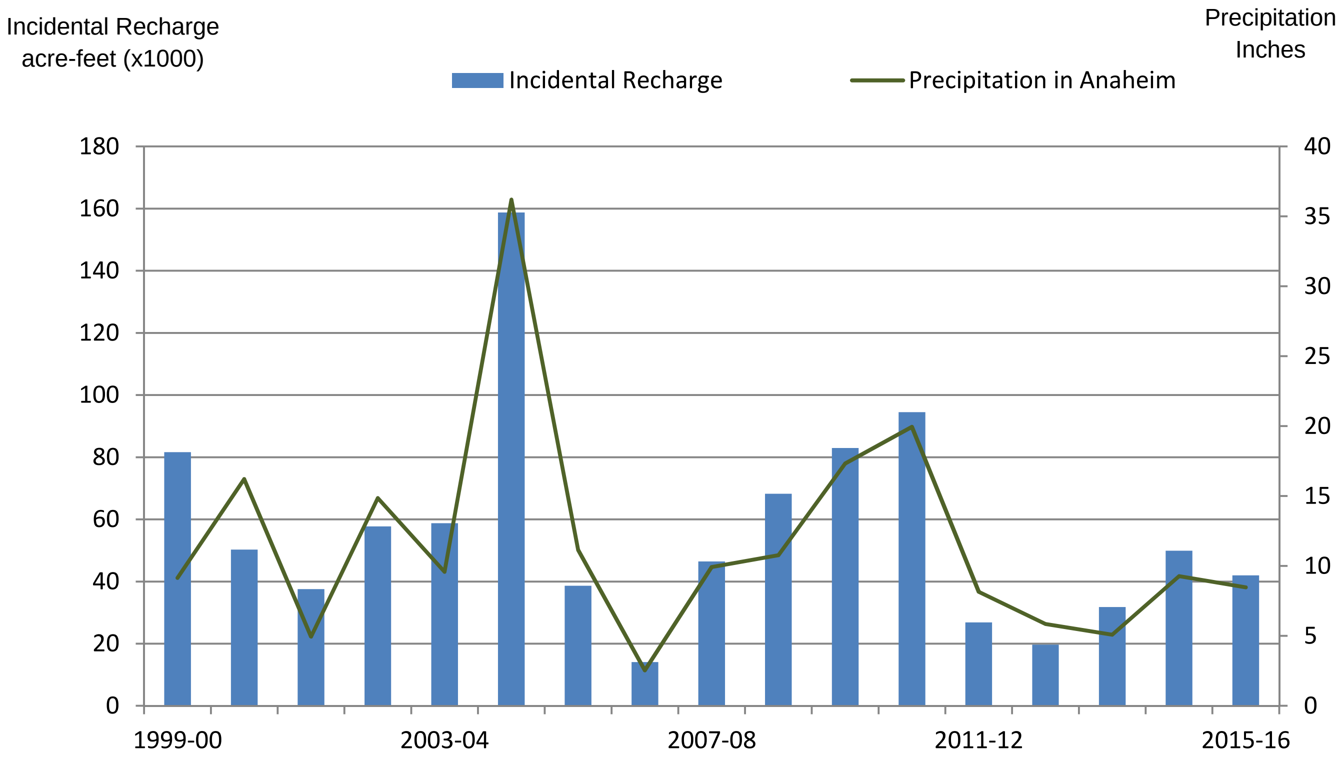


Figure 6-7: Net Incidental Recharge and Precipitation, WY 1999-00 to WY 2015-16

Recycled Water

The basin receives two sources of recycled water for recharge, the GWRS and the Leo J. Vander Lans Treatment Facility that supplies water to the Alamitos Seawater Barrier. Only a portion of the water recharged in the Alamitos Barrier recharges the Orange County Groundwater Basin with the remainder recharging the Central Basin in Los Angeles County.

Imported Water

OCWD purchases imported water for recharge from the Municipal Water District of Orange County (MWDOC), which is a member agency of MWD. Untreated imported water can be delivered to the surface water recharge system in multiple locations, including Anaheim Lake (OC-28/28A), Santa Ana River (OC-11), Irvine Lake (OC-13A), and San Antonio Creek near the City of Upland (OC-59). These locations are shown in Figure 6-8. Connections OC-28, OC-11 and OC-13 supply OCWD with Colorado River Aqueduct water. Connection OC-59 supplies OCWD with State Water Project water, and OC-28A supplies OCWD with a variable blend of water from these two sources.

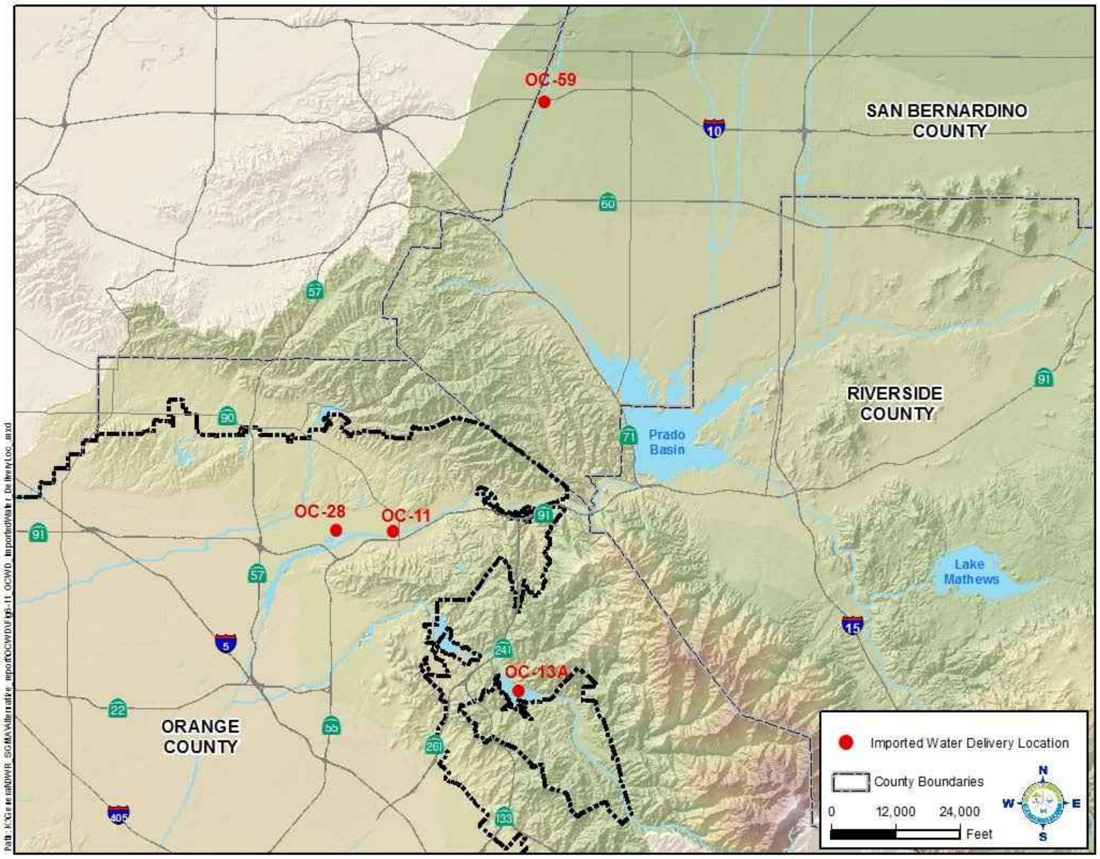


Figure 6-8: Locations of Imported Water Deliveries

6.4.2 Surface Water Recharge Facilities

OCWD's surface water recharge system is comprised of 24 facilities covering over 1,000 wetted acres and a total storage capacity of approximately 26,000 acre-feet. The locations of these facilities are shown in Figure 6-9. OCWD carefully tracks the amount of water being recharged in each facility on a daily basis.

Three full-time hydrographers control and monitor the recharge system. These hydrographers and other OCWD staff prepare a monthly *Water Resources Summary Report*, which lists the source and volume for each recharge water supply, provides an estimate of the amount of water percolated in each recharge basin, documents total groundwater production from the basin, and estimates the change in groundwater storage. The report also estimates the amount of incidental recharge, evaporation and losses to the ocean – essentially a monthly water budget accounting. The monthly figures are compiled to determine yearly recharge and production totals and used in the year-end determination of groundwater storage change.

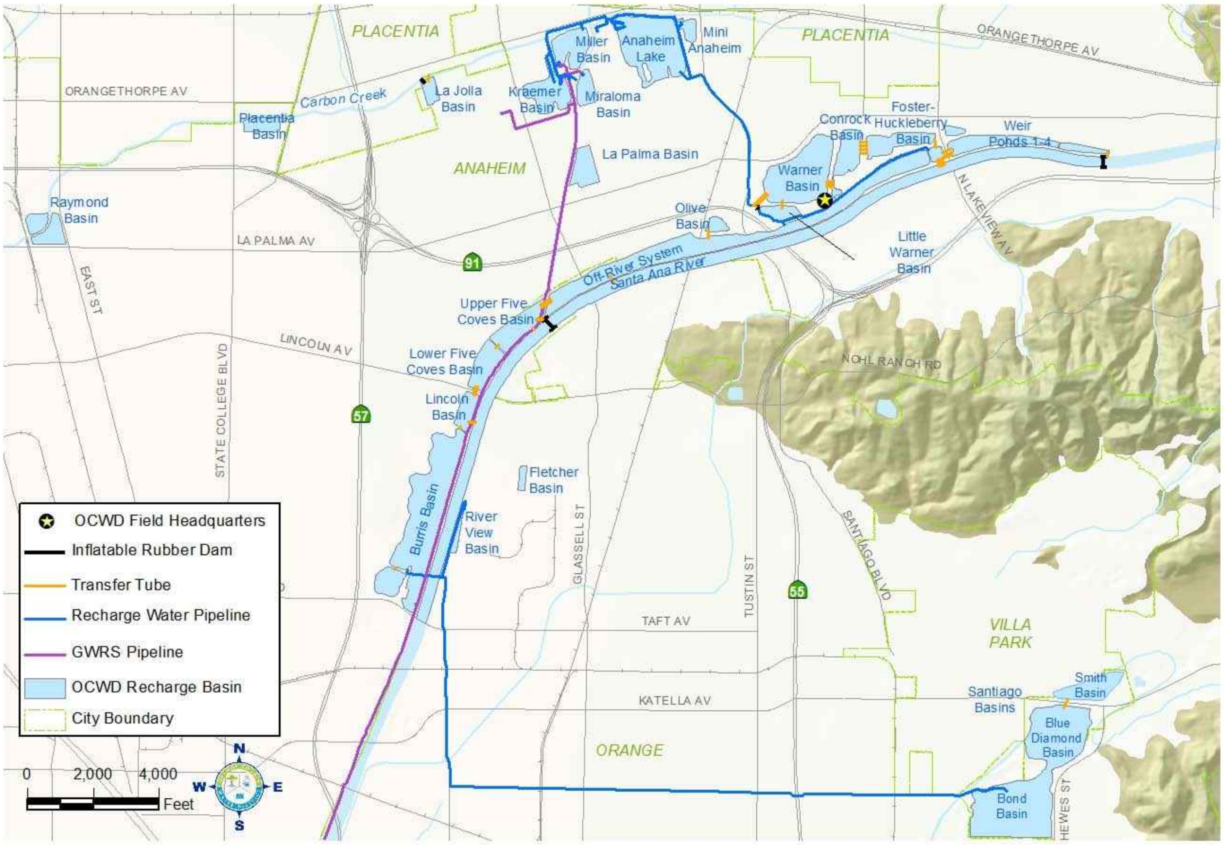


Figure 6-9: OCWD Surface Water Recharge Facilities

6.5 MANAGEMENT OF SEAWATER INTRUSION

In the coastal area of Orange County, the primary source of saline groundwater is seawater intrusion into the groundwater basin through permeable sediments underlying topographic lowlands or gaps between the erosional remnants or mesas of the Newport-Inglewood Uplift. The susceptible locations are the Talbert, Bolsa, Sunset, and Alamitos gaps as shown previously in Figure 3-26.

Seawater intrusion in the Talbert Gap area began as early as the 1920s as the previously flowing artesian conditions within the shallow Talbert aquifer were gradually lowered until groundwater levels declined below sea level due to unrestricted agricultural pumping. By the 1930s and 1940s, seawater had advanced more than one mile inland within the Talbert Gap, forcing the closure of municipal supply wells owned and operated by the cities of Newport Beach and Laguna Beach due to elevated salinity.

Seawater intrusion became a critical problem in the 1950s. Overdraft of the basin caused water levels to drop as much as 40 feet below sea level. By the mid-1960s seawater had intruded nearly four miles inland within the Talbert Gap. Intrusion was also observed in the Alamitos Gap area along the Orange County/Los Angeles County border. During the 1950s and 1960s seawater intrusion investigations in coastal Orange County were conducted by the USGS, DWR and OCWD to define the nature and extent of the problem. During this time, OCWD slowed seawater intrusion by filling the basin with imported Colorado River water in the Anaheim Forebay area, thus reducing the overdraft throughout the basin and raising coastal groundwater levels (DWR, 1966).

Largely based on the 1966 DWR study, OCWD constructed the initial Talbert Seawater Intrusion Barrier in 1975 with 23 injection well sites. In 1965, a line of injection wells was constructed across the Alamitos Gap to form a subsurface freshwater hydraulic barrier. The Alamitos and Talbert barriers control seawater intrusion in their respective gaps by injecting fresh water into a series of multi-depth wells targeting each individual aquifer zone that is susceptible to seawater intrusion. The pressure mound resulting from this injection minimizes seawater intrusion through these gaps into the basin.

Both the Alamitos and Talbert barriers have been expanded and improved periodically and have allowed the basin to be operated more flexibly as a storage reservoir with an operating range of 500,000 acre-feet below full condition.

In July 2014, the OCWD Board of Directors adopted a Seawater Intrusion Prevention Policy that contained the following tenets:

- Prevent degradation of the quality of the groundwater basin from seawater intrusion.
- Effectively operate and evaluate the performance of the seawater barrier facilities.
- Adequately identify and track trends in seawater intrusion in susceptible coastal areas and evaluate and act upon this information, as needed, to protect the groundwater basin.

6.5.1 Talbert Seawater Intrusion Barrier

The Talbert Barrier consists of 36 injection well sites, shown in Figure 3-26, with the primary alignment along Ellis Avenue approximately four miles inland from the ocean. Barrier injection raises groundwater levels in the immediate vicinity and thus creates a groundwater mound that acts as a hydraulic barrier to seawater that would otherwise migrate inland toward areas of groundwater production.

From 1975 until 2008, a blend of deep well water, imported water and recycled water from the former Water Factory 21 was injected into the barrier. In 2008, GWRS recycled water became the primary supply used for the injection wells, with a small and intermittent portion of the supply from potable imported water delivered via the City of Huntington Beach at the OC-44 turnout and potable water delivered by the City of Fountain Valley (a blend of groundwater and imported water). Since approval by the Regional Water Board in 2009, OCWD uses recycled water for all of the injection well supply at the Talbert Barrier.

Prior to GWRS, barrier capacity averaged approximately 15 MGD but now averages approximately 30 MGD with a typical seasonal range of 20 to nearly 40 MGD. The approximately doubled injection capacity was necessary to prevent seawater intrusion as groundwater production increased and was made possible by construction of additional injection wells and pipelines, superior water quality (100% purified recycled water), and improved barrier operations, such as more frequent back-washing and rehabilitation. Barrier injection rates are adjusted based on overall basin storage conditions and seasonally varying coastal water levels. Therefore, injection is typically lower in the winter months and higher in the summer when increased coastal production causes lower coastal groundwater levels. Approximately 85 to 90 percent of barrier injection is typically targeted into the shallow and intermediate aquifer zones for seawater intrusion control on an annual basis, while the other 10 to 15 percent goes into the deeper Main aquifer zone primarily for basin replenishment. Based on the much steeper hydraulic gradient inland toward pumping depressions (relative to that toward the coast), OCWD estimates that approximately 95 percent of the water injected at the Talbert Barrier flows inland to replenish the basin, with the remainder ultimately flowing to the ocean as subsurface outflow.

6.5.2 Alamitos Seawater Intrusion Barrier

The Alamitos Barrier Project was initially constructed in 1964 and went into operation in 1965 to create a freshwater pressure ridge to prevent seawater intrusion from migrating through the Alamitos Gap into the Central Basin of Los Angeles County and the Orange County groundwater basin. The barrier alignment straddles the Los Angeles-Orange County border and spans approximately 1.8 miles across the Alamitos Gap from Bixby Ranch Hill in the City of Long Beach to the vicinity of Landing Hill in the City of Seal Beach.

Under the terms of the 1964 Agreement for Cooperative Implementation of the Alamitos Barrier Project (1964 Agreement), the barrier facilities are co-owned by OCWD and the Los Angeles County Flood Control District (LACFCD, a division of LACDPW) and currently include 41 injection wells and 220 active monitoring wells as shown in Figure 3-26. The barrier is operated and maintained by LACDPW under the direction of the Alamitos Barrier Joint Management Committee (JMC), whose membership includes OCWD, LACDPW, Water Replenishment District of Southern California (WRD), City of Long Beach, and Golden State Water Company.

The barrier has been incrementally expanded over time to include the construction of additional injection and monitoring wells. Since the initial 14 injection wells were constructed in 1964, an additional 27 injection wells have been installed over seven phases of well construction.

Similar to the Talbert Barrier, the Alamitos Barrier consists of both nested and cluster-type injection wells screened discretely in each aquifer zone in order to control the injection rate and injection pressure into each targeted aquifer zone independently since each aquifer zone has different physical characteristics and groundwater levels. In addition, there are a couple “dual-point” injection wells that consist of only one well casing but two different screened interval depths separated inside the well by an inflatable packer and two separate injection drop pipes.

SECTION 7 NOTICE AND COMMUNICATION

7.1 DESCRIPTION OF GROUNDWATER USERS

The local agencies that produce the majority of the groundwater from the basin are listed in Table 7-1 with geographic boundaries shown in Figure 3-3. OCWD meets monthly with 19 major water retail agencies, referred to as the Groundwater Producers, to discuss and evaluate basin management issues and proposed projects and work cooperatively among the agencies in the OCWD Management Area.

Table 7-1: Major Groundwater Producers

CITIES		
Anaheim	Huntington Beach	Santa Ana
Buena Park	La Palma	Seal Beach
Fountain Valley	Newport Beach	Tustin
Fullerton	Orange	Westminster
Garden Grove		

WATER DISTRICTS AND WATER COMPANIES	
East Orange County Water District	Mesa Water District
Golden State Water Company	Serrano Water District
Irvine Ranch Water District	Yorba Linda Water District

The monthly meeting with OCWD staff and the Groundwater Producers provides a forum for the Groundwater Producers to provide their input to OCWD on important issues such as:

- Setting the Basin Production Percentage (BPP) each year;
- Reviewing the merits of proposed capital improvement projects;
- Purchasing imported water to recharge the groundwater basin;
- Reviewing water quality data and regulations;
- Maintaining and monitoring basin water quality; and
- Budgeting, replenishment assessment and considering other important policy decisions.

7.2 PUBLIC PARTICIPATION

With passage of the Sustainable Groundwater Management Act (SGMA) in 2014, OCWD began discussing with Groundwater Producers and other stakeholders the potential impacts of this new law and options for compliance within Basin 8-1 and the OCWD Management Area. OCWD held discussions with Groundwater Producers and published articles concerning SGMA in the *Hydrospectives* newsletter, described below in this section. These forums provided opportunities for discussions about SGMA, the option for OCWD to become a Groundwater Sustainability Agency and prepare a Groundwater Sustainability Plan (GSP), and the option to develop an Alternative to a GSP. These discussions included conducting meetings with affected agencies and local and county government representatives in areas within the boundaries of Basin 8-1 both inside and outside of the service area of OCWD. A joint decision was made to proceed with preparation of this Basin 8-1 Alternative for submittal to DWR in compliance with SGMA.

In 2015, stakeholders within the OCWD Management Area participated in the preparation and completion of an update to the OCWD Groundwater Management Plan. This was the fifth update of OCWD's first Groundwater Management Plan adopted in 1989, under authority granted by the OCWD Act. In preparing each of these plan updates, OCWD presented groundwater basin conditions, the status of water supply monitoring, management of recharge operations, operation of seawater intrusion barriers and coastal water quality monitoring, water quality protection programs, and natural resource and collaborative watershed programs. The Groundwater Management plans were prepared to evaluate basin conditions and to document the continuing long-term sustainable management of the groundwater basin, and provided the foundation for the preparation of the Basin 8-1 Alternative. Preparation and adoption of the Groundwater Management plans included a public participation component with public notices, newsletter articles, posting on the OCWD website, and meetings with Groundwater Producers (see OCWD Groundwater Management Plan 2015 Update, Appendix A).

The draft Basin 8-1 Alternative, including the OCWD Management Area section, was posted on OCWD's website on November 4, 2016, for public review and comment. Additional public notification of the opportunity to review and comment on the draft document was provided through an article in OCWD's *Hydrospectives* newsletter. The OCWD Board of Directors was presented a draft version of the Basin 8-1 Alternative on November 9, 2016.

7.3 COMMUNICATION PLAN

Proactive community outreach and public education are central to OCWD. OCWD is dedicated to the creation, promotion and management of water education and conservation programs throughout Orange County. Each year, staff members give more than 70 offsite presentations to community leaders and citizens, conduct nearly 200 onsite presentations and tours of OCWD facilities, and take an active part in community events. The goal of OCWD's water-use efficiency and education programs, local water briefings, and outreach to organizations is to draw attention to state and local water needs and current issues, teach useful and simple ways to reduce water consumption and respect this natural resource, and encourage local citizens to make life-long commitments to conserving water. The components that comprise OCWD's water-use efficiency, outreach and public education events and programs are described in this section.

Children’s Water Education Festival

The Children’s Water Education Festival is the largest event of its kind in the nation, serving approximately 7,000 elementary school students annually. Thanks to more than 400 volunteers and the support of the Disneyland Resort, the National Water Research Institute and OCWD’s Groundwater Guardian Team, the Festival celebrated its 20th anniversary in March 2016. The two-day Festival teaches children about water and the environment through hands-on educational activities. Topics include water resources, watersheds, wildlife and natural habitats, biology, chemistry and recycling at this unique event. Since inception, more than 110,000 students have attended.

O.C. Water Hero Program

The O.C. Water Hero Program was designed to make water conservation fun while helping children and parents develop effective water-use efficiency habits that will last a lifetime. When children sign up to commit to saving 20 gallons of water per day, they will enjoy videos, games, trivia, and other incentives they can access via the website and smartphone applications. The purpose of the O.C. Water Hero Program is to raise awareness of the need to conserve water and motivate county residents to reduce their water consumption by 20 gallons per day, per person. Since its inception in 2007, nearly 20,000 Water Heroes and Superheroes have enrolled in the program. In 2015, OCWD revamped the program to upgrade the technology platform in order to increase participation.

Groundwater Guardian

OCWD was recognized by The Groundwater Foundation as a Groundwater Guardian member in 1996, thereafter forming the OCWD Groundwater Guardian Team. This program is designed to empower local citizens and communities to take voluntary steps toward protecting groundwater resources. The OCWD Groundwater Guardian Team primarily supports the Children’s Water Education Festival.

Social Media

Social media is a unique opportunity to provide information directly to people interested in OCWD and the topics associated with the organization. Through vehicles such as Facebook, Twitter, YouTube, Instagram and others, OCWD posts information of immediate importance, as well as joins the conversation on trending topics. OCWD engages in social media several times during a given week, primarily to followers of its Facebook and Twitter accounts.

OC Water Summit

The annual OC Water Summit teaches individuals, business, and community and civic leaders where our water comes from, and provides information about the water supply crisis and water quality challenges we face. The event, held annually since 2008, educates the public on what temporary measures are in place to address these issues as well as possible solutions to water reliability and preserving the Bay-Delta Region, California’s main source of water. A collaborative effort between businesses, water agencies and local governments, the OC Water Summit provides a platform for individuals in the community to work with water utilities and legislators on creating and implementing solutions that will see Orange County through future water challenges. Topics for each Summit are determined according to the topical water issues each year. This event is hosted in conjunction with the Municipal Water District of Orange County and the Disneyland Resort.

Groundwater Adventure Tour

Nearly 150 guests attend the Groundwater Adventure Tour that takes place each fall. The annual event highlights OCWD operations that include the Groundwater Replenishment System, the Advanced Water Quality Assurance Laboratory, Recharge Operations, and Prado Wetlands. The day's activities are designed to provide an inside look at Orange County's water supply, as well as provide a better understanding of groundwater recharge operations.

Tour attendees include staff from cities, offices of elected officials, water districts, universities, state and county agencies, students, chambers of commerce members, service club members, and other stakeholders. Information is presented to attendees in a variety of formats including speeches, tours, video and question and answer sessions. OCWD executive management and supporting staff share their knowledge and facilitate activities throughout the day.

Website

The Public Affairs Department hosts the OCWD website, www.ocwd.com, to provide information on an array of subjects about OCWD, its board, facilities, and its programs. It includes access to important documents and forms providing transparency and public access. In 2015, OCWD merged the website with a separate site that was dedicated to information about the Groundwater Replenishment System, www.gwrsystem.com . The website helps to engage the citizens of north and central Orange County and water-related agencies to learn more about OCWD's operations.

Hydrospectives Newsletter

The *Hydrospectives* newsletter is a monthly OCWD publication with a circulation of approximately 5,700 subscribers from the water industry, government officials and agencies, OCWD staff, and the general public. It reflects the progress and decisions of OCWD, its achievements and influences and information pertinent to the groundwater industry in north and central Orange County. Each month, it offers a variety of subjects that include a message from the board president, important contributions from departments and staff, global and regional news, and celebrations and accomplishments of which OCWD is a part.

Media Coverage/Exposure

OCWD facilities and programs have been featured in thousands of print and broadcast stories, both mainstream and trade press, locally, nationally and internationally. OCWD and the Groundwater Replenishment System have been featured in National Geographic magazine, Wall Street Journal and on the 60 Minutes television program. They have also been featured in several documentaries including “Tapped – The Movie;” “Ecopolis” and “How Stuff Works” for *Discovery TV*; “Urban Evolution: The Story of Pure Water” for London’s Institution of Engineering & Technology; “America’s Infrastructure Report Card- Water” (ASCE 2009); in an episode of “Off Limits” for the *Travel Channel*; and referenced in the documentary titled “Last Call at the Oasis.”

Facility Tours and Speakers Bureau

OCWD receives hundreds of requests each year to provide tours and briefings for visitors from local colleges, water agencies, the surrounding community, and international organizations. Through its active speaker’s bureau program, OCWD also receives requests for representatives to go out to the community and speak to numerous organizations and schools, as well as at local, national and international conferences.

Since the GWRS came online in January 2008, more than 24,000 visitors have toured the facility. During FY 2013-14, OCWD conducted 198 public tours of the GWRS plant and the Advanced Water Quality Laboratory with a total of 3,432 participants.

Public Tours

Since the GWRS came on-line in January 2008, more than 24,000 visitors have toured the facility. During FY 2013-14, OCWD conducted 198 public tours of the GWRS plant and the Advanced Water Quality Laboratory with a total of 3,432 participants. Tour groups included 10 local high schools and 20 colleges and universities. In addition to many groups from throughout the United States, OCWD hosted tours from China, Korea, Japan, Saudi Arabia, Thailand, Australia, Switzerland, and Russia.

SECTION 8 SUSTAINABLE BASIN MANAGEMENT

8.1 SUSTAINABILITY GOAL

The sustainability goal for the OCWD Management Area is as follows:

> Continue to manage the groundwater basin to prevent basin conditions that would lead to significant and unreasonable undesirable results as defined by California Water Code Section 10721 (x).

Existing monitoring and management programs in place today enable OCWD to sustainably manage the groundwater basin. Since its founding in 1933, OCWD has developed a managed aquifer recharge program, constructed hundreds of monitoring wells, developed water quality monitoring programs, constructed a large surface water recharge system, installed seawater intrusion barriers, and managed the volume of groundwater production through a scientifically-based understanding of the basin's sustainable yield and the use of financial incentives. Continued successful protection of the groundwater basin requires that OCWD's management of the basin be able to adapt to changing conditions affecting the groundwater basin. The following sections describe the sustainable basin management for each of the undesirable results as defined in the California Water Code, Section 10721(x).

SECTION 9 SUSTAINABLE MANAGEMENT RELATED TO GROUNDWATER LEVELS

9.1 HISTORY/SUMMARY

OCWD manages the basin for long-term sustainability by maximizing recharge of the basin and managing basin production within sustainable levels. This section will discuss the relationship between groundwater elevations and sustainable groundwater management.

Groundwater elevations over the last twenty years exhibit short-term changes and long-term (multi-year) trends see Figures 3-11 through 3-14). Short-term elevation changes typically reflect seasonal variations in pumping and recharge, while multi-year trends reflect the effects of extended periods of above- or below-average precipitation and/or availability of imported water.

Groundwater elevation is monitored at over 1,000 individual measuring points, including the key wells designated under the California Statewide Groundwater Elevation Monitoring (CASGEM) program. OCWD was designated the Monitoring Entity for the Orange County groundwater basin under the CASGEM program. As such, OCWD designated key wells distributed laterally and vertically throughout the basin for the purpose of monitoring water elevations over the long-term.

In general, groundwater elevations in the Shallow Aquifer system show less amplitude than those in the underlying Principal and Deep Aquifer systems due to the higher degree of pumping and confinement of the Principal and Deep Aquifer systems. Because approximately 95 percent of all production occurs from wells screened within the Principal Aquifer system, groundwater elevations within this system are typically lower than those in the overlying Shallow Aquifer system and, in some areas, the underlying Deep Aquifer system. Vertical hydraulic gradients created by pumping and recharge drive groundwater into the Principal Aquifer system from the overlying Shallow Aquifer system and, to a lesser extent, from the Deep Aquifer system.

Long-term data demonstrates that groundwater elevations in the basin have exhibited multi-year cyclical patterns and have not experienced chronic lowering due to OCWD's management approach of maintaining basin storage within the established operating range. As a result, the undesirable effect of "chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply" is not occurring in the OCWD Management Area and is not expected to occur in the future as OCWD continues to manage the basin as described in this Basin 8-1 Alternative.

9.2 MONITORING OF GROUNDWATER LEVELS FOR SUSTAINABILITY

As explained in Section 3.2, OCWD monitors water levels at over 1,000 individual measuring points on a monthly or bi-monthly basis to evaluate the effects of pumping, recharge or injection operations. Additional monitoring is conducted as needed in the vicinity of OCWD's recharge facilities, seawater barriers and areas of special investigation where drawdown, water quality impacts or contaminants are of concern.

Groundwater elevation contour maps for the Shallow, Principal and Deep Aquifers are prepared annually and are scanned and digitized into OCWD's GIS database. The changes in groundwater elevations for the three aquifers are also calculated on an annual basis. The contoured water level changes for each of the three aquifers for June 2015 to June 2016 are shown in Figures 9-1, 9-2 and 9-3.

9.3 MANAGEMENT OF GROUNDWATER LEVELS FOR SUSTAINABILITY

For each of the three major aquifer systems, GIS mapping is used to multiply the water level changes by a grid of aquifer storage coefficients from OCWD's calibrated groundwater flow model. This results in a storage change volume for each of the three aquifer layers which are totaled to provide a net annual storage change for the basin. Thus, measurements of groundwater elevations are ultimately used to calculate total basin storage levels each year.

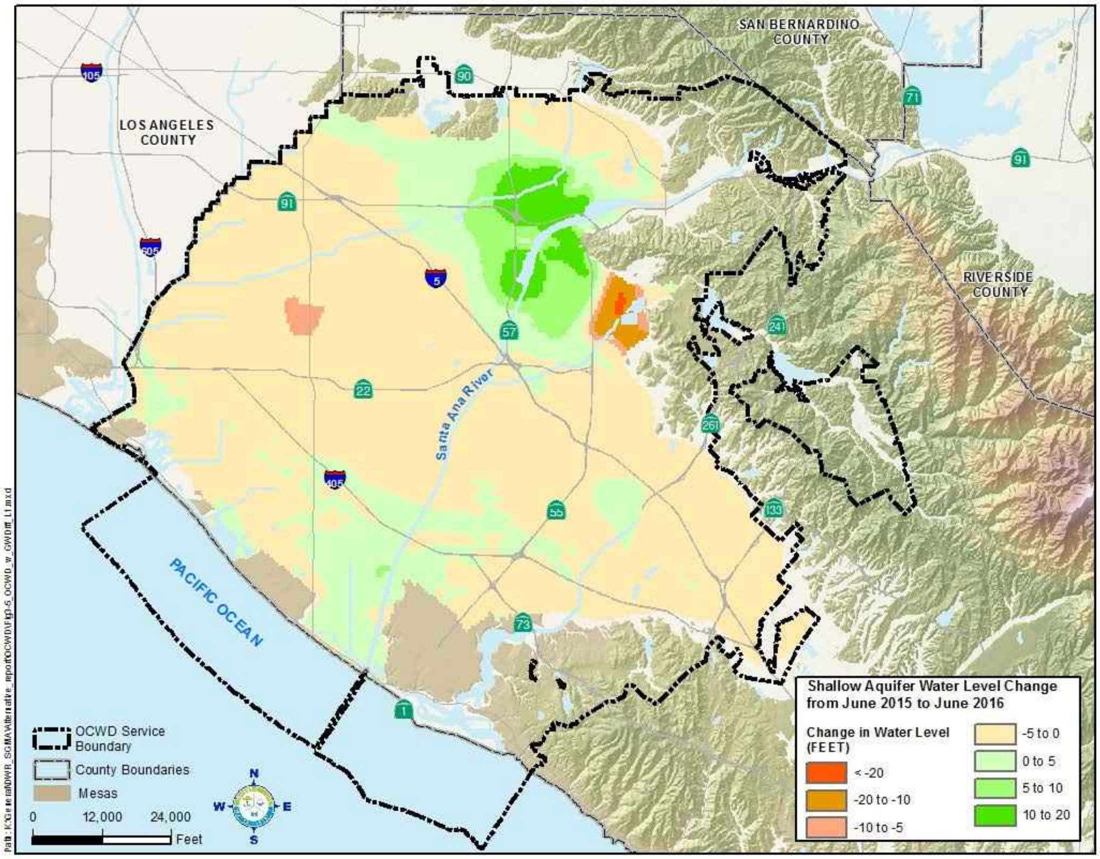


Figure 9-1: Shallow Aquifer Water Level Change, June 2015 to June 2016

In determining the operating range for groundwater storage levels, OCWD considered the potential negative impacts that could occur due to unreasonable and chronic lowering of groundwater elevations. These potential negative impacts include increased costs for groundwater producers to pump groundwater, decreased yield in production wells, increased risk of land subsidence, and increased risk of seawater intrusion.

Monitoring and management of groundwater elevations in the OCWD Management Area is most important in the coastal areas in order to protect groundwater basin water quality from seawater intrusion. Management programs that enable long-term sustainable basin management related to groundwater elevations in the coastal areas include the Coastal Pumping Transfer Program and operation of the Alamitos and Talbert Seawater Intrusion Barriers.

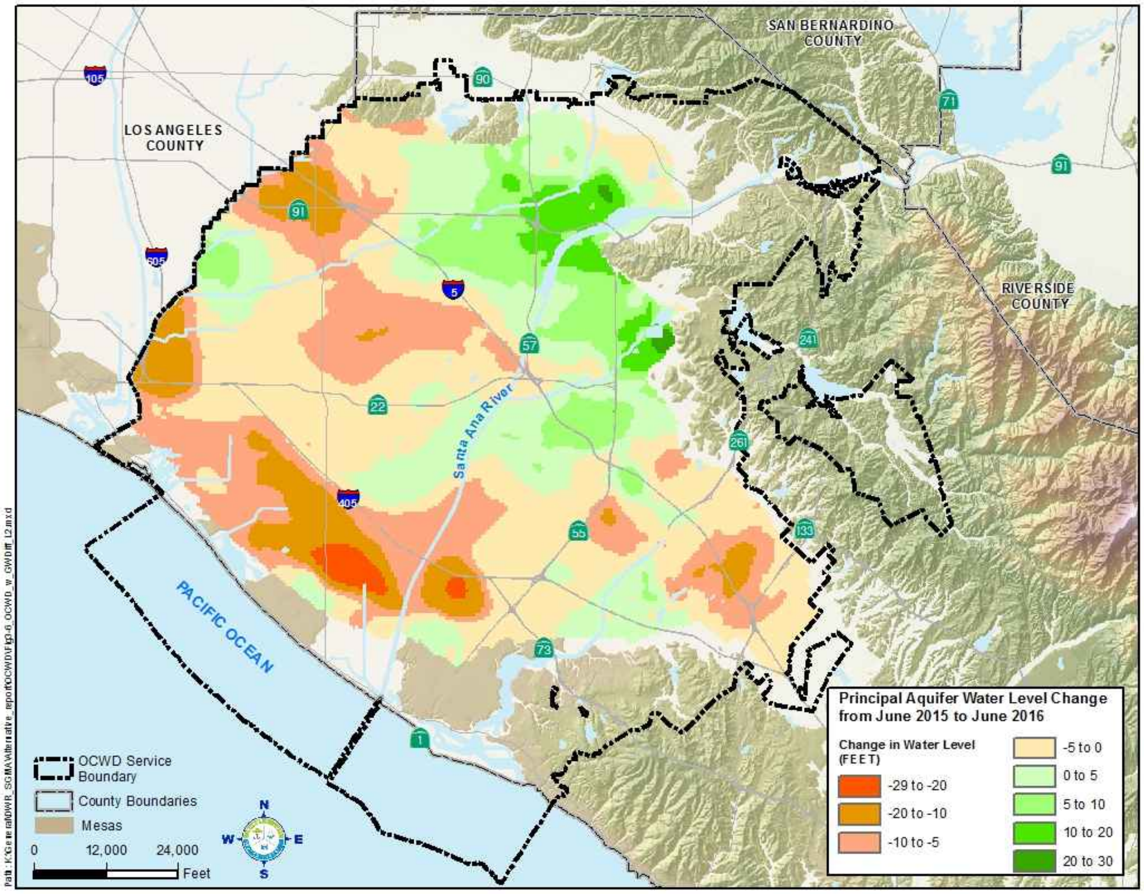


Figure 9-2: Principal Aquifer Water Level Change, June 2015 to June 2016

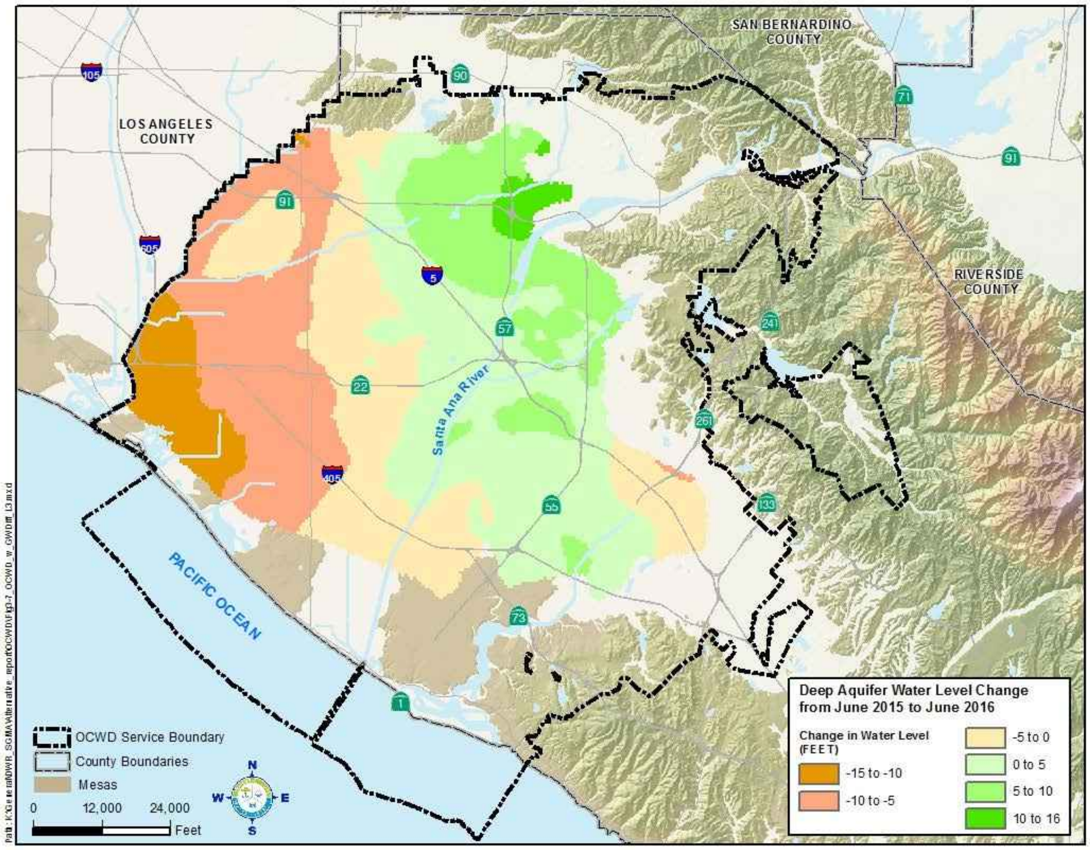


Figure 9-3: Deep Aquifer Water Level Change, June 2015 to June 2016

9.4 DEFINITION OF SIGNIFICANT AND UNREASONABLE LOWERING OF GROUNDWATER LEVELS

OCWD closely monitors groundwater levels in the three major aquifer systems (Shallow, Principal and Deep) for a number of purposes including determination of groundwater storage within the basin. OCWD uses groundwater storage conditions to manage the basin sustainably by keeping storage levels within an operating range up to 500,000 acre-feet below full condition. Significant and unreasonable reduction of groundwater in storage could occur in the event that the volume of groundwater in storage fell below the 500,000 acre-feet below full condition for an extended period of time. If OCWD were to consider an operating range below 500,000 acre-feet from full condition, additional analysis and monitoring would be needed.

9.5 DETERMINATION OF MINIMUM THRESHOLD

The minimum threshold for significant and unreasonable reduction in groundwater levels is reached when the storage volume of the groundwater basin falls below the operating range of up to 500,000 acre-feet below full condition for an extended period of time.

SECTION 10 SUSTAINABLE MANAGEMENT RELATED TO BASIN STORAGE

10.1 HISTORY

Within the Orange County Groundwater Basin, there is an estimated 66 million acre-feet of water in storage (OCWD, 2007). In spite of the large amount of stored water, there is a comparatively narrow operating range within which the basin can be safely operated.

The operating range of the basin is considered to be the maximum allowable storage range over the long-term without incurring detrimental impacts. The upper limit of the operating range is defined by the full basin condition. Although it may be physically possible to fill the basin higher than this full condition, it could lead to detrimental impacts such as percolation reductions in recharge facilities and increased risk of shallow groundwater seepage in low-lying coastal areas.

The lower limit of the operating range is considered to be 500,000 acre-feet below full condition. Although it may be considered to be acceptable to allow the basin to decline below 500,000 acre-feet below full condition for brief periods due to severe drought conditions and lack of imported water for basin recharge, it is not considered to be an acceptable management practice to intentionally manage the basin for sustained periods at this lower limit for the following reasons:

- Increased risk of seawater intrusion
- Increased risk of land subsidence
- Depletion of water in storage available for future drought conditions
- Some wells potentially becoming inoperable due to lower groundwater levels
- Increased costs to pump groundwater for groundwater users
- Increased potential for upwelling of amber-colored groundwater from the Deep Aquifer

It is important to note that detrimental impacts do not suddenly happen when storage levels fall to 500,000 or more acre-feet below full condition; rather, they occur incrementally, or the potential for their occurrence grows as the basin declines to lower levels. OCWD has used the basin model computer simulations to evaluate the potential for detrimental impacts if storage were to fall to 700,000 acre-fee from full. Basin model runs at 700,000 acre-feet below full condition indicates the potential for increased seawater intrusion and considerably more production wells being impacted by low pumping levels. Thus, a reduction of up to 700,000 acre-feet of groundwater in storage is only considered acceptable during an extreme emergency, such as a disruption in imported water supplies due to an earthquake. Negative or adverse impacts that are considered when establishing the operating range include chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply if continued over the long-term, increased seawater intrusion, significant and unreasonable land subsidence that substantially interferes with surface land uses, and increased pumping costs.

The current policy of maintaining a groundwater storage level of up to 500,000 acre-feet below full was established based on completion of a comprehensive hydrogeological study of the basin in 2007 (OCWD, 2007).

The basin's storage level is quantified based on a benchmark defined as the full basin condition. Although the groundwater basin rarely reaches the full basin condition, basin storage has fluctuated within the operating range for many decades. OCWD manages groundwater pumping such that it is sustainable over the long term; however, in any given year pumping may exceed recharge or vice versa. Thus, the amount of groundwater stored in or withdrawn from the basin varies from year to year and often goes through multi-year cycles of emptying and filling, which typically correlates with state-wide and/or local precipitation patterns.

Each year OCWD calculates the volume of groundwater storage change from a theoretical "full" benchmark condition based on a calculation using changes in groundwater elevations in each of the three major aquifer systems and aquifer storage coefficients. This calculation is checked against an annual water budget that accounts for all production, measured recharge, and estimated unmeasured recharge. The amount of available or unfilled storage from the theoretical full condition from WY 1958-59 to WY 2015-16 is shown in Figure 10-1.

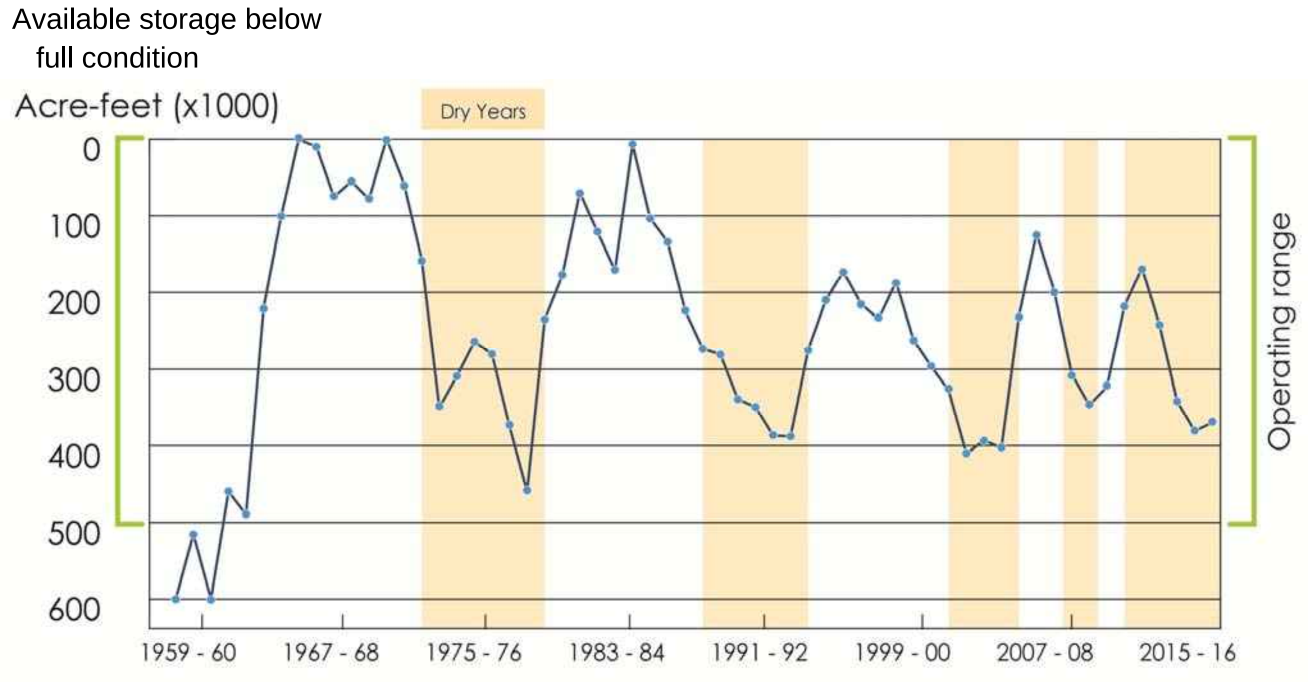


Figure 10-1: Basin Storage Levels WY 1958-59 to WY 2015-16

Maintaining the basin storage condition on a long-term basis within this operating range allows for long-term sustainable management of the basin without experiencing undesirable effects. Short-term excursions from the operating range due to extreme drought or other factors are not expected to cause adverse impacts but would need to be monitored closely and be of limited duration. In the California Water Plan Update 2013 this manner of groundwater basin management is described as follows:

> "Change in groundwater storage is the difference in stored groundwater volume between two time periods…However, declining storage over a period characterized by average hydrologic conditions does not necessarily mean that the basin is being managed unsustainably or is subject to conditions of overdraft. Utilization of groundwater in storage during years of diminishing surface water supply, followed by active recharge of the aquifer when surface water or other alternative supplies become available, is a recognized and acceptable approach to conjunctive water management." (CWP, p. SC-77)

10.2 CALCULATION OF GROUNDWATER STORAGE LEVELS

The estimated historical minimum storage level of 500,000 to 700,000 acre-feet below full condition occurred in 1956-57 (DWR, 1967; OCWD, 2003). Since this time, the basin storage fluctuated within the operating range reaching a full condition in 1969 and 1983.

OCWD uses two methods to calculate the storage condition of the basin: (1) water budget method and (2) three-layer storage change method. The water budget method is simply an accounting of the inflows to the basin and outflows. This data is collected and compiled on a monthly basis. Estimates of unmeasured or incidental recharge are used based on a statistical relationship between historical local precipitation and calculated unmeasured recharge. Unmeasured recharge is trued up at the end of the year with the final reports of inflows and outflows and basin storage change (based on groundwater level changes). This method produces a monthly estimate of the change in groundwater storage and allows for real-time decision making with respect to managing the basin.

In 2007, OCWD instituted a new three-layer change in storage method for calculating the amount of groundwater in storage (OCWD, 2007). The three-layer method involves creating groundwater elevation contour maps for each of the three aquifer layers (Shallow, Principal and Deep aquifers) for conditions at the end of June of each year. Prior to this time, groundwater storage was determined based on a single groundwater elevation map that was essentially a composite of the Shallow and Principal aquifers.

The need for this revised method was driven by the record-setting wet year of 2004-05, in which water levels throughout the basin approached a near-full condition. An analysis of the amount of groundwater in storage compared to the estimate using a one-layer change in storage method showed a discrepancy of 150,000 acre-feet. The discrepancy of 150,000 acre-feet in two different calculations indicated that the current condition could not be properly rectified back to the prior 1969 benchmark. This brought to light three important discoveries:

- The one-layer storage change calculation contained considerable uncertainty that when cumulatively added over tens of years led to a large discrepancy in the level of water in storage relative to 1969.

- Water level conditions in 1969 no longer represented a full basin, particularly because of changes in pumping and recharge conditions.
- A more accurate storage change calculation should be based on water level changes and storage coefficients for each of the three major aquifer systems, as was now made possible given OCWD's mature groundwater monitoring well network.

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

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

This method involves annually contouring water levels for each aquifer system annually and digitizing them and storing them in OCWD's GIS database. The previous year's water levels are subtracted from the current water levels to calculate change in water levels. Water level change contour maps are prepared for each of the three aquifer layers. For each of the three aquifers, the GIS data are used to multiply the water level changes by a grid of aquifer storage coefficients from OCWD's calibrated groundwater flow model. This results in a storage change volume for each of the three aquifers which are totaled to provide a net annual storage change for the basin. In cases where there is a calculation discrepancy between the storage changes estimated by the two methods, the unmeasured recharge value (previously estimated based on local rainfall) is adjusted to eliminate the difference.

A more detailed description of the full basin storage determination and three-layer methodology is presented in OCWD's *Report on Evaluation of Orange County Groundwater Basin Storage and Operational Strategy* (OCWD, 2007) and can be found in Appendix D of the *OCWD Groundwater Management Plan 2015 Update* (OCWD, 2015)*.*

10.3 SUSTAINABLE MANAGEMENT PROGRAMS

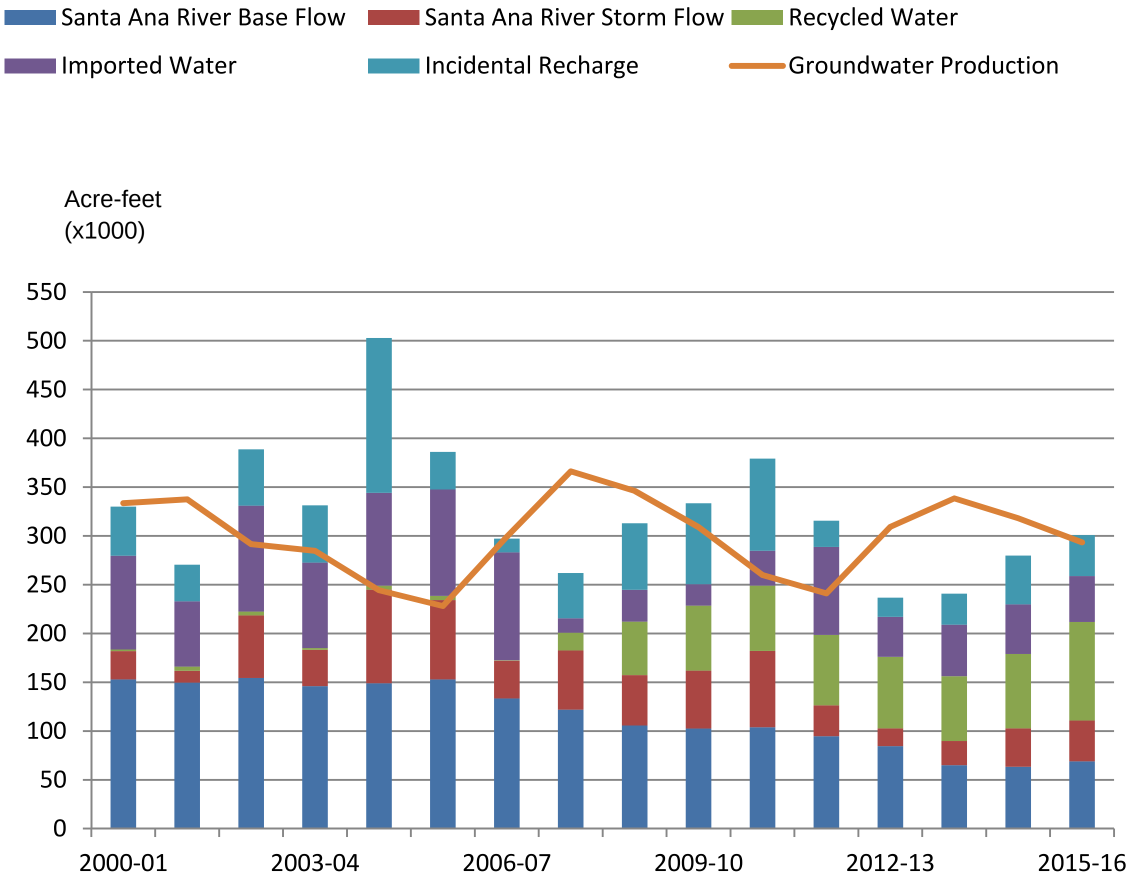
10.3.1 Basin Operating Range

Each year OCWD assesses current basin storage and projected water supply availability as factors in its determination of setting the Basin Production Percentage for the following year, as described in Section 10.3.3. If basin storage approaches or falls within the lower end of the established operating range, issues that are evaluated when considering the management of the basin include the current status of seawater intrusion protective measures, monitoring of ground surface elevations to assess the risk of land subsidence, inflow of amber-colored water or poor quality groundwater into the Principal Aquifer from underlying or overlying aquifers, and the number of shallow production wells that would become affected by lower groundwater levels. On the other hand, when operating the basin near the higher end of the storage range, considerations include the potential to increase the Basin Production Percentage, purchase less imported replenishment water, and the potential for more groundwater outflow to Los Angeles County.

OCWD does not directly limit pumping from the groundwater basin. Instead, basin storage and total pumping are managed by using the Basin Production Percentage and pumping assessments to apply financial incentives to encourage groundwater producers to pump an aggregate amount of water that is sustainable over the long- term. The process that determines a sustainable level of pumping considers the basin's operating range, basin storage conditions, water demands, the amount of recharge water available to OCWD, and other factors. The basin is managed to avoid groundwater storage levels declining to levels that could result in long-term significant negative or adverse impacts.

10.3.2 Balancing Production and Recharge

Over the long-term, the basin must be maintained in an approximate balance to ensure the long-term viability of basin water supplies. In one particular year, water withdrawals may exceed water recharged as long as over the course of a number of years this is balanced by years where water recharged exceeds withdrawals. Levels of total basin production and total water recharged since WY 2000-01 are shown in Figure 10-2.



Notes: (1) "Imported Water" includes water purchased by OCWD for recharge and water recharged under both the MWD Conjunctive Use Program (CUP) and the in-lieu program. (2) "Production" includes water produced from the basin by groundwater producers and under the MWD CUP program.

Figure 10-2: Basin Production and Recharge Sources, WY 2000-01 to WY 2015-16

10.3.3 Managing Basin Pumping

The primary mechanisms used by OCWD to manage pumping are the Basin Production Percentage (BPP) and the Basin Equity Assessment (BEA). The ability to assess the BPP and the BEA were provided to OCWD through an amendment to the OCWD Act in 1969. Section 31.5 of the OCWD Act empowers the Board to annually establish the BPP, defined as:

> "…the ratio that all water to be produced from groundwater supplies with the district bears to all water to be produced by persons and operators within the District from supplemental sources and from groundwater within the District during the ensuing water year."

In other words, the BPP is a percentage of each Producer's water supply (supplemental and groundwater sources) that comes from groundwater pumped from the basin. The BPP is set uniformly for all Groundwater Producers. Groundwater production at or below the BPP is assessed the Replenishment Assessment (RA). Any production above the BPP is charged the RA plus the Basin Equity Assessment (BEA). The BEA is set by the Board and is presently calculated so that the cost of groundwater production above the BPP is equivalent to the cost of purchasing imported potable supplies. This approach serves to discourage, but not eliminate, production above the BPP. In practice, Groundwater Producers rarely pump in excess of the BPP as doing so triggers a requirement to pay the BEA, thereby eliminating any cost savings that a pumper might obtain by pumping an amount in excess of the BPP. Collection of the BEA provides funds for OCWD to purchase additional replenishment water (where determined appropriate by OCWD). If necessary, the BEA can be increased to even further to discourage production above the BPP.

The BPP is set after evaluating groundwater storage conditions, availability of recharge water supplies and basin management objectives. OCWD’s goal is to set the BPP as high as possible to allow Groundwater Producers to sustainably maximize pumping and reduce their overall water supply cost.

To change the BPP, the Board of Directors must hold a public hearing. Raising or lowering the BPP allows OCWD to manage the amount of pumping from the basin. The BPP is lowered when basin conditions necessitate a decrease in pumping. A lower BPP results in the need for Groundwater Producers to purchase additional, more expensive imported water.

Methodology for Setting the Basin Production Percentage

To determine the initial estimated BPP for a given year, the amount of water available for basin recharge in the coming year is estimated. The supplies of recharge water that are estimated are:

- Santa Ana River stormflow
- Natural incidental recharge
- Santa Ana River baseflow
- Highly purified recycled water produced by the GWRS
- “Supplemental” supplies such as imported water originating outside of the Santa Ana River Watershed
- Recycled water purchased by OCWD for operation of the Alamitos Seawater Barrier

Water demands by the Groundwater Producers are also estimated, as this factors into the BPP formula. Expected water quality pumping above the BPP refers to the authorization for a Groundwater Producer to pump above the BPP (with an exempted or reduced BEA) in order to address a localized water quality issue.

BPP Policy

The Board of Directors has several policy considerations that may be considered as the BPP is determined at least annually. For example, the Groundwater Producers generally prefer that the BPP be changed gradually (generally not more than five percent from one year to the next).

In some situations, for example, the Board may need to consider lowering the BPP more than five percent, such as in response to relatively low groundwater storage levels.

In 2013, the Board of Directors adopted a policy to work toward achieving and maintaining a 75% BPP. Principles of this policy include:

- OCWD sets a goal for achieving a stable 75% BPP, while maintaining the same process of setting the BPP on an annual basis, with the BPP set in April of each year after holding a public hearing and based upon the public hearing testimony, presented data and reports provided at that time.
- OCWD must sustainably manage the groundwater basin for future generations. If future conditions warrant, the BPP will be reduced.
- Projects and programs to achieve the 75% BPP goal will be individually reviewed and assessed for their economic viability. Economical projects and programs that could support a BPP above 75% also would be considered.

The groundwater basin's storage levels would be managed to support the 75% BPP policy. As long as the storage levels remain between 100,000 and 300,000 acre-feet from full, there would be a presumption that the BPP would not be decreased. Table 10-1 shows the management actions to be used to guide OCWD in setting the BPP. As the BPP is annually set in April for the following fiscal year (but may be changed throughout the year), the projected change in basin storage would be estimated for the end of that fiscal year (as of June 30), given various assumptions of basin pumping, inflows and outflows.

Table 10-1: Management Actions based on Change in Groundwater Storage

Available Storage Space (amount below full basin condition)	Basin Management Actions to Consider
Less than 100,000 acre-feet	Raise BPP
100,000 to 300,000 acre-feet	Maintain and/or raise BPP towards 75% goal
300,000 to 350,000 acre-feet	Seek additional supplies to refill basin and/or lower the BPP
Greater than 350,000 acre-feet	Seek additional supplies to refill basin & lower the BPP

Maintaining some available storage space in the basin allows for maximizing surface water recharge when such supplies are available, especially in relatively wet years. By keeping the basin relatively full during wet years and for as long as possible in years with near-normal recharge, the maximum amount of groundwater could be maintained in storage for future drought conditions. During dry hydrologic years when less water would be available for recharge, the BPP could need to be lowered to maintain groundwater storage levels.

At the beginning of 2015, OCWD committed to purchase 650,000 acre-feet of imported water to recharge the basin over a ten-year time period. This amount of imported water for recharge into the basin will help maintain the BPP and assist in managing the basin storage level within the operating range. OCWD works to maintain a Water Reserve Fund to purchase imported water from MWD. Each year, a specific amount of money is budgeted to purchase imported water and, if water is not available from MWD, the funds are carried over to the next year in the Water Reserve Fund.

Basin Production Limitation

Another management tool that enables OCWD to sustainably manage the basin is the Basin Production Limitation. Section 31.5(g)(7) of the OCWD Act authorizes limitations on production and the setting of surcharges when those limits are exceeded. This provision can be used when it is necessary to shift pumping from one area of the basin to another. An example of this is the Coastal Pumping Transfer Program, which shifts pumping from the coastal area to inland to minimize seawater intrusion, when necessary.

10.3.4 Supply Management Strategies

One of OCWD's basin management objectives is to maximize groundwater recharge. This is achieved through increasing the efficiency of and expanding OCWD's recharge facilities and the supply of recharge water. Construction and operation of the GWRS has provided a substantial increase in supply of water available to recharge the basin. Additional OCWD supply management programs include developing increased stormwater capture programs behind Prado Dam in cooperation with the U.S. Army Corps of Engineers, encouraging and participating in water conservation efforts, and working with MWD and the Municipal Water District of Orange County in developing and conducting other supply augmentation projects and strategies.

Conjunctive Use and Water Transfers

By agreement with OCWD, MWD established a Conjunctive Use Project (CUP) in the OCWD Management Area by purchasing the right to use up to 66,000 acre-feet of storage space in the groundwater basin until 2028. OCWD used the funds provided by MWD to improve basin management facilities including the construction of eight new production wells for water retail agencies and new injection wells for the Talbert Barrier. Under the agreement, MWD may request that stored water be extracted up to a maximum of 22,000 acre-feet each year.

OCWD reviews opportunities for additional conjunctive use projects that would store water in the basin and potentially in other groundwater basins. Additionally, OCWD reviews opportunities for water transfers that could provide additional sources of recharge water. Such projects are evaluated carefully with respect to their impact on available storage, reliability and cost effectiveness.

10.3.5 Water Demands

Water demands within the OCWD Management Area for WY 2014-15 totaled approximately 425,000 acre-feet. Total demand includes the use of groundwater, surface water from Santiago

Creek and Irvine Lake, recycled water, and imported water. As shown in Figure 6-1, water demands between WY1989-90 and 2014-15 have ranged between approximately 413,000 and 515,000 afy.

Projected Water Demands

OCWD estimated future water demands within the OCWD Management Area to be 447,000 afy in 2035. This is an average of two numbers: (1) a summation of the 19 major Groundwater Producers individually-estimated future water demands provided in their 2015 Urban Water Management Plans, which totaled 459,000 afy; and (2) the Municipal Water District of Orange County's Water Supply Reliability Study estimate of 435,000 afy (MWDOC, 2016). Population within OCWD's service area is projected to increase from the current 2.38 million to 2.54 million by 2035.

Drought Management

During a drought, flexibility to manage pumping from the basin becomes increasingly important. The OCWD Management Area typically experiences a decline in the supply of recharge water (local supply of Santa Ana River water and net incidental recharge) of up to 55,000 afy or more during drought.

Provided that the basin has available water in storage within the established operating range, this stored water provides a valuable water supply asset during drought conditions. Ensuring that the basin can provide a buffer against drought conditions requires:

- Maintaining sufficient water in storage that can be pumped out in time of need; and
- Possessing a plan to recover basin storage following the drought, including having a reserve account with sufficient funds to purchase replenishment water.

A sufficient supply of stored groundwater provides a safe and reliable buffer to manage for drought periods. If the basin, for example, has an available storage level of 150,000 acre-feet and can be drawn down to 500,000 acre-feet without irreparable seawater intrusion, a supply of 350,000 acre-feet is available for increased production. In a hypothetical five-year drought, an additional 70,000 afy may be produced from the basin for five years without jeopardizing the long-term health of the basin. In addition to reducing pumping when the basin is at lower storage levels, planning for refilling the basin is important. Approaches for refilling the basin are described in Table 10-2.

10.4 DEFINITION OF SIGNIFICANT AND UNREASONABLE REDUCTION OF GROUNDWATER STORAGE

OCWD manages the groundwater basin to maintain groundwater storage levels within an operating range of up to 500,000 acre-feet below the full condition. Significant and unreasonable reduction of groundwater in storage would occur when the volume of groundwater in storage fell below the 500,000 acre-feet below full condition for an extended period of time. If

OCWD were to consider an operating range below 500,000 acre-feet additional analysis and monitoring would be needed.

10.5 DETERMINATION OF MINIMUM THRESHOLDS

The minimum threshold for significant and unreasonable reduction in groundwater in storage is reached when the storage volume of the groundwater basin falls below the operating range of up to 500,000 acre-feet below full condition for an extended period of time

Table 10-2: Approaches to Refilling the Basin

APPROACH	DISCUSSION
Decrease Total Water Demands	• Increase water conservation and water-use efficiency measures
Decrease BPP	• Allows groundwater levels to recover rapidly • Decreases revenue to the OCWD • Increases water cost for producers • Does not require additional recharge facilities • Dependent upon other sources of water (e.g., imported water) being available to substitute for reduced groundwater pumping
Increase Recharge	• Dependent on increased supply of recharge water • Replenishment could be in the form of in-lieu water (additional imported water delivered to Producers instead of groundwater pumping) • Water transfers and exchanges could be utilized to provide the increased supply of recharge water • May be dependent on building and maintaining excess recharge capacity (which may be under-utilized in non-drought years)
Combination of the Above	• A combination of the approaches provides flexibility and a range of options for refilling the basin

.

SECTION 11 SUSTAINABLE MANAGEMENT RELATED TO WATER QUALITY

OCWD has extensive monitoring and management programs in place to protect the groundwater basin from significant and unreasonable degradation of water quality including migration of contaminant plumes that impair water supplies. These programs are described in previous sections. This section describes sustainable basin management related to the water quality programs and projects instituted to prevent degradation of water quality and to remediate water quality problems in the OCWD Management Area.

11.1 SALINITY MANAGEMENT

Management of salt and nitrate concentrations in groundwater is important to maintaining the long-term sustainable use of groundwater supplies. OCWD's programs to manage water quality include monitoring, remediation of contaminated groundwater, and recharging high-quality recycled water. OCWD also operates the Prado Wetlands to remove nitrate from Santa Ana River (SAR) water that is recharged into the groundwater basin. These efforts help provide high-quality groundwater to water users in Orange County.

In July 2016, OCWD completed an evaluation of future TDS and nitrate concentrations in the OCWD Management Area (OCWD, 2016b). This involved using a model to evaluate the effects of different basin management scenarios on TDS and nitrate concentrations over the next 30 years. The report was prepared to meet regulatory requirements of the Regional Water Board as part of the watershed-wide salt and nutrient management plan.

Data and information used for this analysis included:

- Quantity and quality of water recharged through surface recharge facilities;
- Quantity and quality of water recharged through seawater injection barriers;
- Quantity and quality of unmeasured recharge, such as percolation of irrigation water into the groundwater basin;
- Measurements of groundwater pumping; and
- Estimates of groundwater outflow from the Orange County Management Zone.

Data from a variety of sources, included:

- OCWD measurements of the quantities of water recharged at surface recharge facilities;
- OCWD measurements of the quantities of water recharged at the Talbert Seawater Barrier;
- OCWD measurements of water quality for water recharged at surface recharge facilities and the Talbert Seawater Barrier;

- Los Angeles County Department of Public Works measurements of the quantities of water recharged at the Alamitos Seawater Barrier;
- Water Replenishment District of Southern California measurements of water quality for the Alamitos Seawater Barrier;
- MWD measurements of water quality for imported water purchased by OCWD; and
- OCWD measurements of water quality for imported water purchased from MWD by OCWD.

The quantity and quality of water recharged in the model are shown in Table 11-1.

Table 11-1: Example Projected Future Salt Inflows

Source of Water Recharge	**Volume (acre-feet)**	**TDS Conc. (mg/L)**	**Mass (tons)**
Deep percolation of precipitation*	6,500	100	900
Percolation of applied water*	9,000	1,900	23,200
Subsurface inflow*	37,500	1,177	59,200
SAR baseflow	52,000	700	49,200
SAR stormflow	50,000	200	13,600
Recycled water (Forebay & Talbert Barrier)	103,000	60	8,400
Alamitos Barrier	2,500	350	1,200
MWD imported water	65,000	650	57,300
Total	325,500	479	213,000

*Component of unmeasured recharge

The model was used to predict the ambient water quality of the basin for TDS using nine scenarios with differing volumes of recharge water sources. Sources of water recharge volume and TDS concentrations in Table 11-1 were used as the base case. Eight additional scenarios were chosen to represent potential future portfolios of available water sources.

For the modeled scenarios, the ambient concentration of TDS in the groundwater basin was predicted in 30 years to be between 565 and 588 mg/L. In all cases the long-term flow-weighted concentration of TDS of inflow to the groundwater basin was projected to be below the current ambient concentration of 610 mg/L. The model predicts a gradual decrease in the TDS concentration in the groundwater basin over time. Based on the current ambient TDS concentration of 610 mg/L and the projected inflow TDS of 479 mg/L in Table 11-1, the average mass of TDS pumped from the OCWD Management Zone is projected to surpass the total mass of TDS inflow.

With regards to nitrate, the approach used to estimate future nitrate concentrations was similar to the approached used for TDS projections. The nitrate (as nitrogen, or nitrate-N) concentration for each inflow component was estimated using available data. Table 11-2 summarizes the inflow terms and their nitrate-N concentrations.

The flow-weighted average nitrate-N concentration for all inflows to the management zone is 2.1 mg/L. The initial concentration was set at 2.9 mg/L (based on the current ambient concentration for the most recent 20-year period). Since the inflow concentration is less than the initial concentration, the estimated future nitrate-N concentration gradually decreases.

The model was used to predict the ambient water quality of the basin for nitrate-N using three scenarios with differing volumes of recharge water sources. The concentration of 2.1 mg/L for nitrate-N in inflows is below the water quality objective of 3.4 mg/L nitrate-N. The results indicate a gradual decrease in the nitrate concentration over the long-term. Based on the current ambient nitrate-N concentration of 2.9 mg/L and the projected inflow nitrate-N of 2.1 mg/L, the average mass of nitrate pumped from the OCWD Management Zone is projected to surpass the total mass of nitrate inflow.

Table 11-2: Example Projected Future Nitrate-N Inflows to OCWD Management Area

Inflow	Volume (Acre-Feet)	Nitrate-N Conc.(mg/L)	Mass (tons)
Deep percolation of precipitation*	6,500	1	9
Percolation of applied water*	9,000	10	122
SAR baseflow	52,000	4.5	318
SAR stormflow	50,000	0.9	61
Imported water recharge	65,000	0.6	53
Recycled water recharge (Forebay & Talbert Barrier)	103,000	1.7	238
Subsurface inflow*	37,500	3.5	178
Alamitos Barrier	2,500	2	7
Total	325,500	2.1	986

*component of unmeasured recharge

11.2 GROUNDWATER QUALITY IMPROVEMENT PROJECTS

This section describes specific projects that improve groundwater quality by removing TDS, nitrate, VOCs and other constituents. The location of these projects is shown in Figure 11-1.

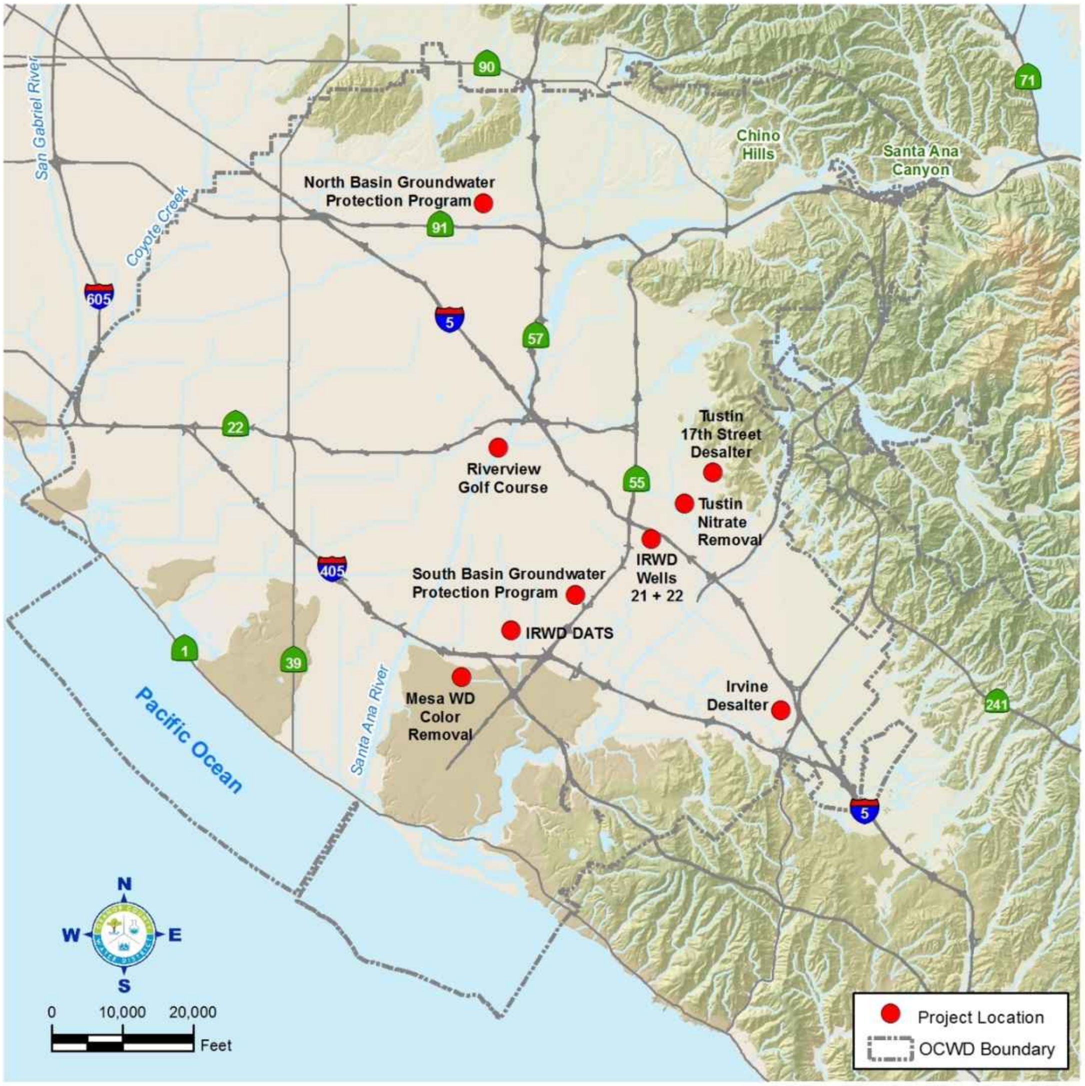


Figure 11-1: Water Quality Improvement Projects and Programs

North Basin Groundwater Protection Program

The U.S. Environmental Protection Agency (USEPA) is taking the lead to remediate a VOC plume in the North Basin area of the groundwater basin as shown in Figure 11-2. Groundwater contamination is primarily found in the Shallow Aquifer, which is generally less than 200 feet deep; however, VOC-impacted groundwater has migrated downward into the Principal Aquifer tapped by production wells. The contamination continues to migrate both laterally and vertically threatening downgradient production wells operated by the cities of Fullerton and Anaheim and other agencies. OCWD is conducting a remedial investigation/feasibility study under USEPA oversight to evaluate and develop effective remedies to address the contamination under the National Contingency Plan (NCP) process.

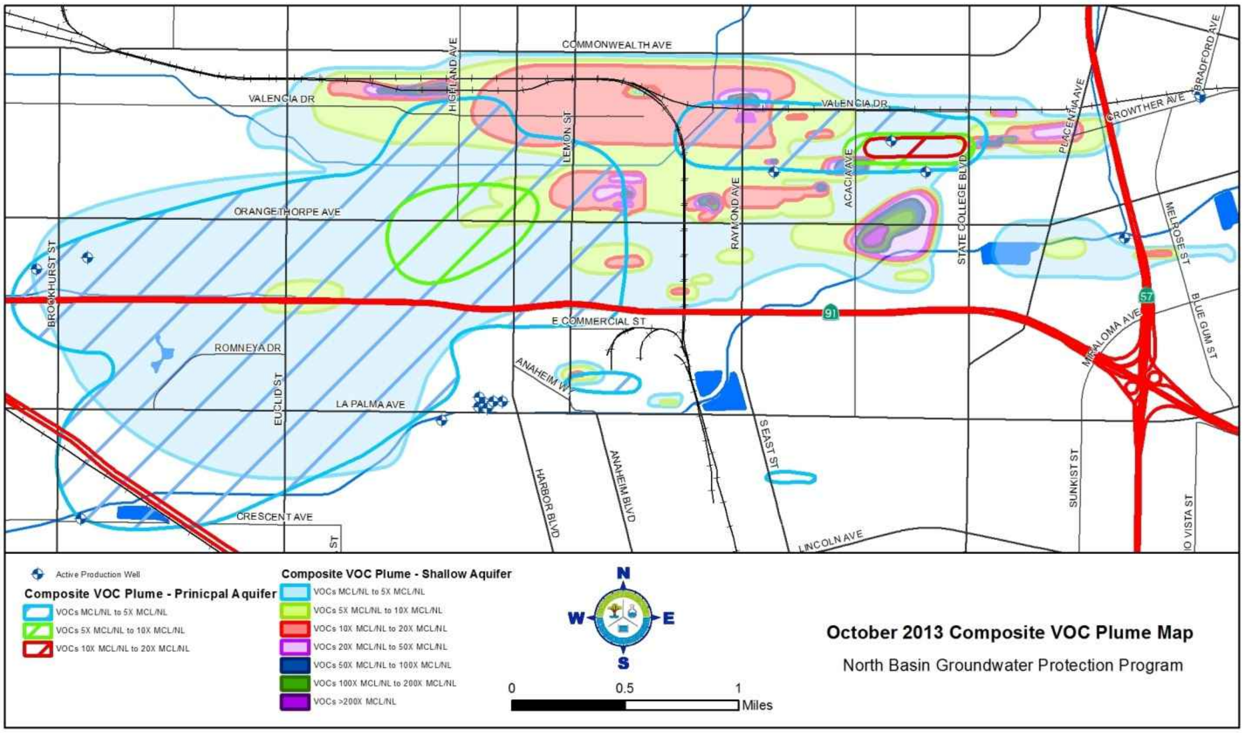


Figure 11-2: North Basin Groundwater Protection Program Plume

South Basin Groundwater Protection Program

Groundwater contaminated with VOCs and perchlorate in the South Basin area of the groundwater basin is shown in Figure 11-3. The extent of groundwater contamination has been investigated, contamination plumes have been delineated, and the remedial program is being developed in cooperation with regulatory agencies and stakeholders following the NCP process.

Elevated concentrations of perchloroethylene (PCE), TCE, and perchlorate were detected in Irvine Ranch Water District's Well No. 3, located in Santa Ana. OCWD is currently working with the Regional Water Board and the California Department of Toxic Substances Control to require aggressive cleanup actions at nearby sites that are sources of the contamination.

MTBE Remediation

In 2003, OCWD filed suit against numerous oil and petroleum-related companies that produce, refine, distribute, market, and sell MTBE and other oxygenates. The suit seeks funding from these responsible parties to pay for the investigation, monitoring and removal of oxygenates from the basin.

Treatment technologies used to remove MTBE from groundwater include granular activated carbon or advanced oxidation. Depending upon site-specific requirements, a treatment train of two or more technologies in series may be appropriate (i.e., use one technology to remove the bulk of MTBE and a follow-up technology to polish the effluent water stream).

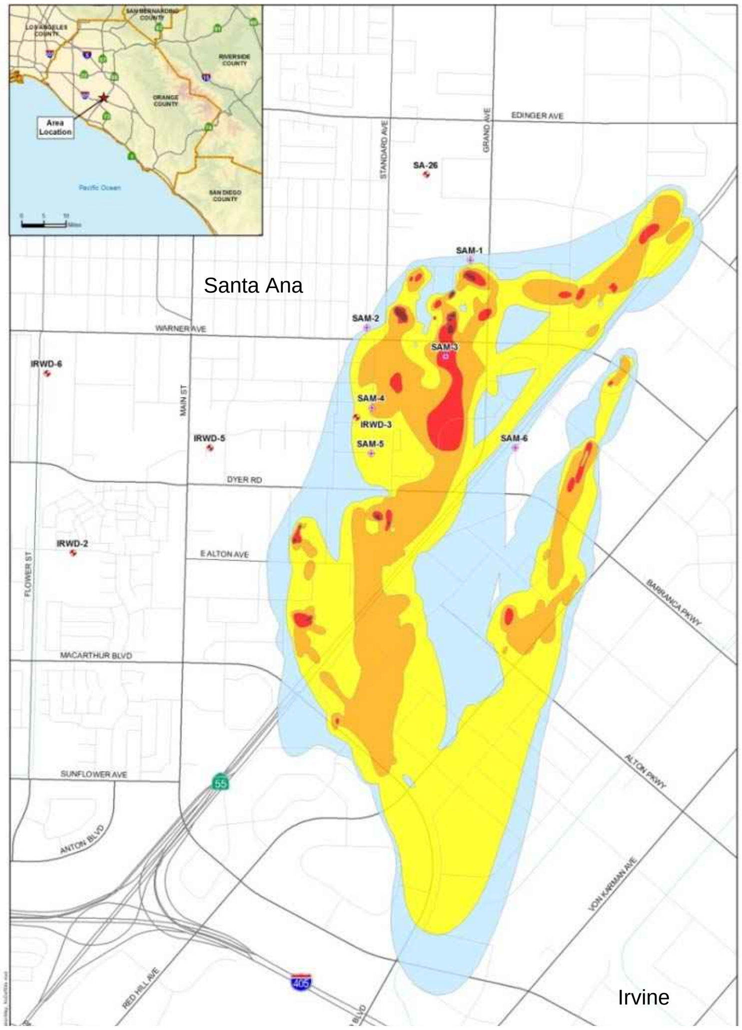


Figure 11-3: South Basin Groundwater Protection Program Plume

Irvine Desalter

The Irvine Desalter was built in response to elevated TDS and nitrate and the discovery in 1985 of VOCs beneath the former El Toro Marine Air Corps Station and the central area of Irvine. A plume of TCE migrated off base and threatened the groundwater basin. Irvine Ranch Water District and OCWD cooperated with the U.S. Department of Navy in building production wells, pipelines and two treatment plants, both of which are now owned and managed by Irvine Ranch Water District. The two plants remove VOCs by air-stripping and vapor-phase carbon adsorption with the treated water used for irrigation and recycled water purposes. A third plant treats groundwater outside the plume to remove excess nitrate and TDS concentrations using reverse osmosis (RO) membranes for drinking water purposes. Combined production of the Irvine Desalter wells is approximately 8,000 afy. OCWD provides a financial subsidy to IRWD in the form of a BEA exemption to help offset the treatment costs.

Tustin Desalters

Tustin's Main Street Treatment Plant has operated since 1989 to reduce nitrate levels from the groundwater produced by Tustin's Main Street Wells Nos. 3 and 4. The groundwater undergoes either RO or ion exchange treatment. The RO membranes and ion exchange units operate in a parallel treatment train. Approximately 1 mgd is bypassed and blended with the treatment plant product water to produce up to 2 mgd or 2,000 afy**.**

The Tustin Seventeenth Street Desalter began operation in 1996 to reduce high nitrate and TDS concentrations from the groundwater pumped by Tustin's Seventeenth Street Wells Nos. 2 and 4 and Tustin's Newport Well. The desalter utilizes two RO membrane trains to treat the groundwater. The treatment capacity of each RO train is 1 mgd. Approximately 1 mgd is bypassed and blended with the RO product water to produce up to 3 mgd or 3,000 afy. OCWD provides a financial subsidy to the City of Tustin in the form of a BEA exemption to help offset the treatment costs.

River View Golf Course

VOC contamination, originating from an up-gradient source, was discovered in a well owned by the City of Orange in the last 1980s. The well was subsequently closed. After an investigation by OCWD, it was determined that an existing irrigation well operated by River View Golf Course, located in the City of Santa Ana would help to contain and remove the VOC contamination. OCWD provides a financial incentive to keep the golf course well in operation to remove VOC contamination from the basin.

Irvine Ranch Water District Wells 21 and 22

Water produced by IRWD Wells 21 and 22 contain nitrate (as N) at levels exceeding the primary MCL of 10 mg/L. TDS concentrations range from 650-740 mg/L, which is above the secondary MCL of 500 mg/L. Because of the elevated nitrate, TDS, and hardness concentrations, IRWD constructed a RO treatment facility to reduce concentrations in the water before conveying to the potable supply distribution system. Operation of the treatment facility provides 6,300 afy of drinking water and benefits the groundwater basin by reducing the spread of impaired groundwater to other portions of the basin. OCWD provides a financial subsidy to IRWD in the form of a BEA exemption to help offset the treatment costs.

Amber-Colored Groundwater

Amber-colored water is found in the Deep Aquifer (600 to 2,000 feet below ground surface). Natural organic material from ancient buried plant and wood material gives the water an amber tint and a sulfur odor. Although this water is of high quality, its color and odor produce negative aesthetic qualities that require treatment before use as drinking water.

Two facilities currently treat colored groundwater in Orange County. In 2001, Mesa Water District opened its Colored Water Treatment Facility (CWTF) capable of treating 5.8 mgd. This facility was replaced in 2012 by the 8.6-mgd Mesa Water Reliability Facility that uses nanofiltration membranes to remove color. OCWD provides a financial subsidy to Mesa Water District in the form of a BEA exemption to help offset the treatment costs. The second facility is the Deep Aquifer Treatment System (DATS), a treatment facility operated by the IRWD since 2002 that uses nano-filtration membranes. This facility purifies 7.4 mgd of amber- colored water.

BEA Exemption for Water Quality Improvement Projects

In some cases, OCWD encourages the pumping of groundwater that does not meet drinking water standards in order to protect water quality. This is achieved by using a financial incentive called the Basin Equity Assessment (BEA) Exemption. The benefits to the basin include promoting beneficial uses of poor-quality groundwater and reducing or preventing the spread of poor-quality groundwater into non-degraded aquifer zones.

OCWD uses a partial or total exemption of the BEA to compensate a qualified participating agency or Groundwater Producer for the costs of treating poor-quality groundwater. These costs typically include capital, interest and operations and maintenance (O&M) costs for the treatment facilities.

Using this approach, OCWD has exempted all or a portion of the BEA for pumping and treating groundwater for removal of nitrates, TDS, VOCs, and other contaminants. Water quality improvement projects that currently are receiving BEA exemptions are listed in Table 11-3.

Table 11-3 Summary of BEA Exemption Projects

Project Name	Project Description	BEA Exemption Approved	Production above BPP (afy)	OCWD BEA Subsidy
Irvine Desalter	Remove nitrates, TDS, and VOCs	2001	10,000	Exemption
Tustin Desalter	Remove nitrates and TDS	1998	3,500	Exemption
Tustin Nitrate Removal	Remove nitrates	1998	1,000	Exemption
River View Golf Course	Remove VOCs	1998	350	$50/af BEA reduction
Mesa WD Colored Water Removal	Remove color	2000	8,700	Exemption
IRWD Wells 21 and 22	Remove nitrates	2012	7,000	Exemption

11.3 DEFINITION OF SIGNIFICANT AND UNREASONABLE DEGRADATION OF WATER QUALITY

There are three elements that must be considered when evaluating the impact of groundwater quality degradation.

The first element is considering the causal nexus between groundwater management activities and groundwater quality. For example, groundwater contamination due to improper handling of toxic materials impacts groundwater quality; however, this water quality degradation is not caused by groundwater management activities.

The second element is the beneficial uses of the groundwater and water quality regulations, such as MCLs and other potable water quality requirements.

The third element that must be considered is the volume of groundwater impacted by groundwater quality degradation. If small volumes are negatively affected that do not materially affect the use of the aquifer or basin for its existing beneficial uses, then this would not represent a significant and unreasonable degradation of water quality. However, if the impacted volume grows, then it could reach a level that it becomes significant and unreasonable.

When considering all three elements, “significant and unreasonable degradation of water quality” is defined as degradation of groundwater quality attributable to groundwater production or recharge practices in the OCWD Management Area and to the extent that a significant volume of groundwater becomes unusable for its designated beneficial uses.

11.4 DETERMINATION OF MINIMUM THRESHOLDS

The minimum thresholds for groundwater quality are exceedances of MCLs or other applicable regulatory limits that are directly attributable to groundwater management actions in the OCWD Management Area that prevents the use of groundwater for its designated beneficial uses.

SECTION 12 SUSTAINABLE MANAGEMENT RELATED TO SEAWATER INTRUSION

In the coastal area of the Orange County groundwater basin, the primary source of saline groundwater is seawater intrusion through permeable aquifer sediments underlying topographic lowlands or gaps between the erosional remnants or mesas of the Newport-Inglewood Uplift. The susceptible locations from north to south are the Alamitos, Sunset, Bolsa, and Talbert gaps as shown in Figure 3-26.

OCWD's policy regarding control of seawater intrusion is implemented through a comprehensive program that includes operating seawater intrusion barriers, monitoring and evaluating barrier performance, monitoring and evaluating susceptible coastal areas, and coastal groundwater management. These programs, described below, enable OCWD to sustainably manage groundwater conditions in the basin in order to prevent significant and unreasonable seawater intrusion.

12.1 TALBERT GAP

The Talbert Gap, also referred to as the Santa Ana Gap, is shown in Figure 12-1. Figure 12-2 shows a geologic cross-section through the Talbert Gap and the 2015 chloride concentrations within the various aquifers dissected by this cross-section alignment. The furthest seaward mergence zone between the Talbert and Lambda aquifers in the vicinity of Adams Avenue is a primary pathway by which seawater can potentially migrate inland and downward within the Talbert Gap. The chloride concentrations shown on this cross-section are updated annually to determine if intrusion is worsening or being pushed seaward with the information published in the GWRS Annual Report (OCWD, 2016c).

OCWD monitoring well M26 is strategically located seaward of the barrier in the Talbert-Lambda aquifer mergence zone in the middle of the Talbert Gap and is screened within the merged Talbert and Lambda aquifers (see Figure 12-3). Therefore, M26 is a key monitoring well for evaluating barrier injection requirements versus seawater intrusion potential and is used to assess whether protective groundwater elevations are being achieved in the Talbert Gap to prevent seawater intrusion. At the location of well M26, the protective groundwater elevation is approximately 3.5 feet above mean sea level (msl), as explained below.

The protective groundwater elevation is based on the Ghyben-Herzberg relation (Ghyben, 1888; Herzberg, 1901; Freeze and Cherry, 1979, pp. 375-376), which takes into account the depth of the Talbert aquifer at a given location along with the density difference between saline and fresh groundwater. Using this relation, for every 40 feet that the bottom of the aquifer is below sea level, there should be about one foot of head of fresh water above sea level to overcome the density effect of seawater. In the case of well M26, the bottom of the merged Talbert-Lambda aquifer is approximately 140 feet below sea level. Therefore, the fresh water head (protective elevation) should be approximately 140 feet divided by 40 which equals 3.5 feet above sea level. Achieving this protective elevation at well M26 is OCWD's goal to prevent brackish water in the Talbert aquifer from migrating down into the Lambda aquifer that is tapped by inland production wells.

Figure 12-3 shows the historical inter-relationship between coastal groundwater production, Talbert Barrier injection, and groundwater elevations at well M26 over the last 10 years. The largest annual decline in groundwater elevations at well M26 occurred in 2007, from a winter high of approximately 4 ft msl down to a low in the fall of approximately -18 ft msl. This 22-foot decline was primarily due to the unusually large amount of groundwater production that year (historical maximum) combined with an unusually low amount of barrier injection; barrier injection supply was limited to the imported water MWD OC-44 connection during this transition period after Interim Water Factor 21 (IWF-21) was decommissioned and prior to commencement of GWRS operations.

With the commencement of GWRS purified recycled water injection in January 2008 and the contemporaneous startup of 8 new injection well sites, the Talbert Barrier injection volume was essentially doubled from previous years, causing groundwater elevations at well M26 to steadily rise over a two-year period to reach protective elevations. Since 2010, groundwater elevations at well M26 have consistently been maintained at or above protective elevations with the exception of brief periods related to GWRS shutdowns. To date, the longest shutdown occurred in June 2014 (26 days) related to GWRS Initial Expansion construction activities. Most other shutdowns have been one day or less.

Operationally, when groundwater elevations at well M26 rise above 6 ft msl, barrier injection is incrementally reduced by 1 to 2 mgd to prevent additional groundwater elevation increases (ground surface elevation at well M26 is approximately 8 ft msl). Conversely, when groundwater elevations at well M26 drop below 3 ft msl (protective elevation), then barrier injection is incrementally increased by 1 to 2 MGD until groundwater elevations again stabilize within the desired 3 to 6 ft msl range. When groundwater levels drop below mean sea level at M26, like after prolonged barrier shutdowns as occurred in June 2014, subsequent barrier injection is then maximized and prioritized into the shallow and intermediate depth aquifer zones susceptible to seawater intrusion in order to get back to protective elevations as quickly as possible. For more detailed information on the operation of the Talbert Seawater Barrier, see *GWRS 2015 Annual Report* prepared for the Regional Water Board, June 17, 2016.

Since 2010, a seaward gradient has been predominantly maintained in the Talbert aquifer seaward of the barrier within the Talbert Gap. Under these conditions, brackish groundwater that had migrated inland in previous years has slowly begun to migrate back towards the ocean as evidenced by recent declines in chloride concentrations at well M26 and other monitoring wells seaward of the barrier.

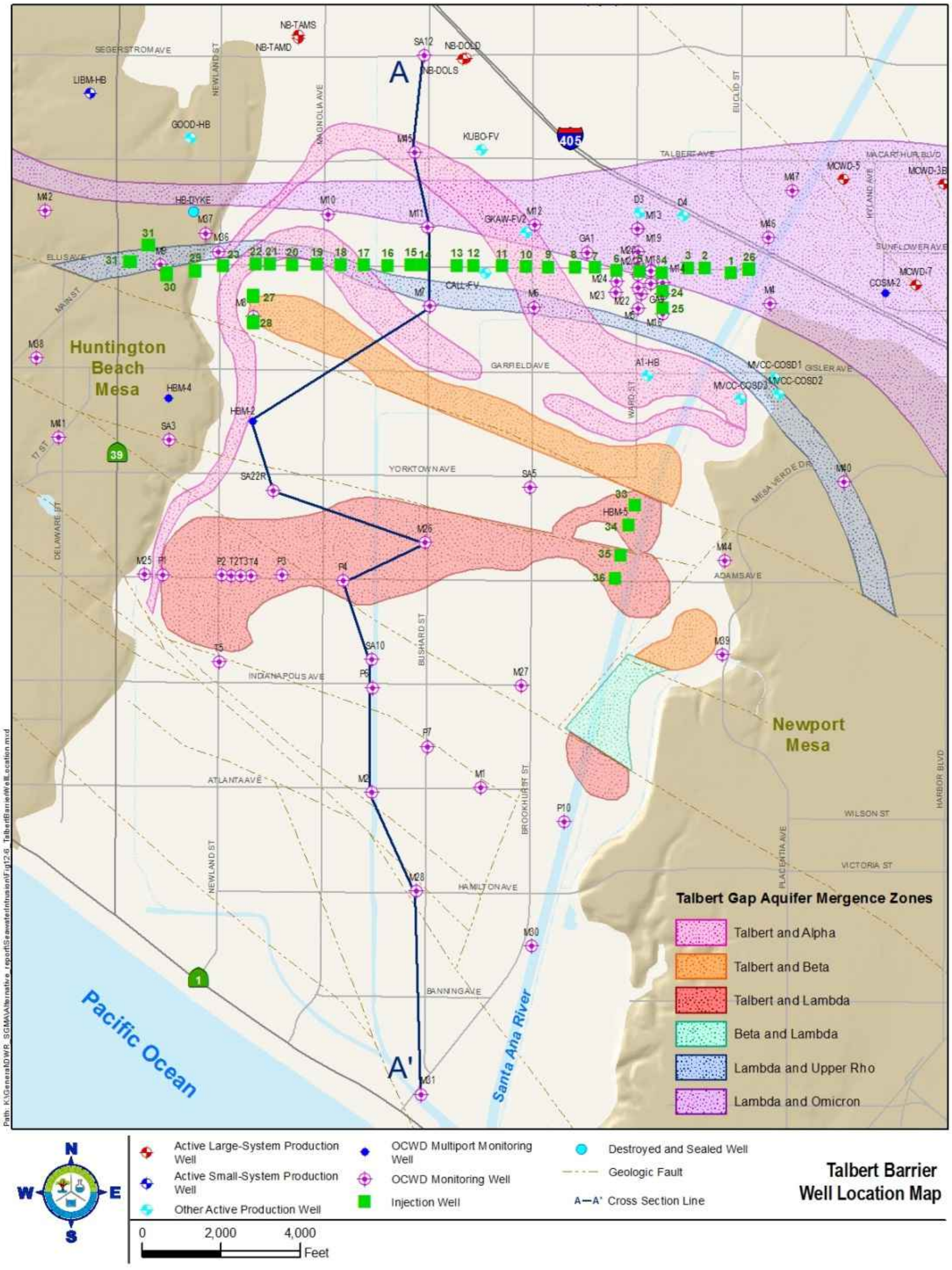


Figure 12-1: Talbert Gap – Seawater Intrusion Barrier and Cross-Section Location

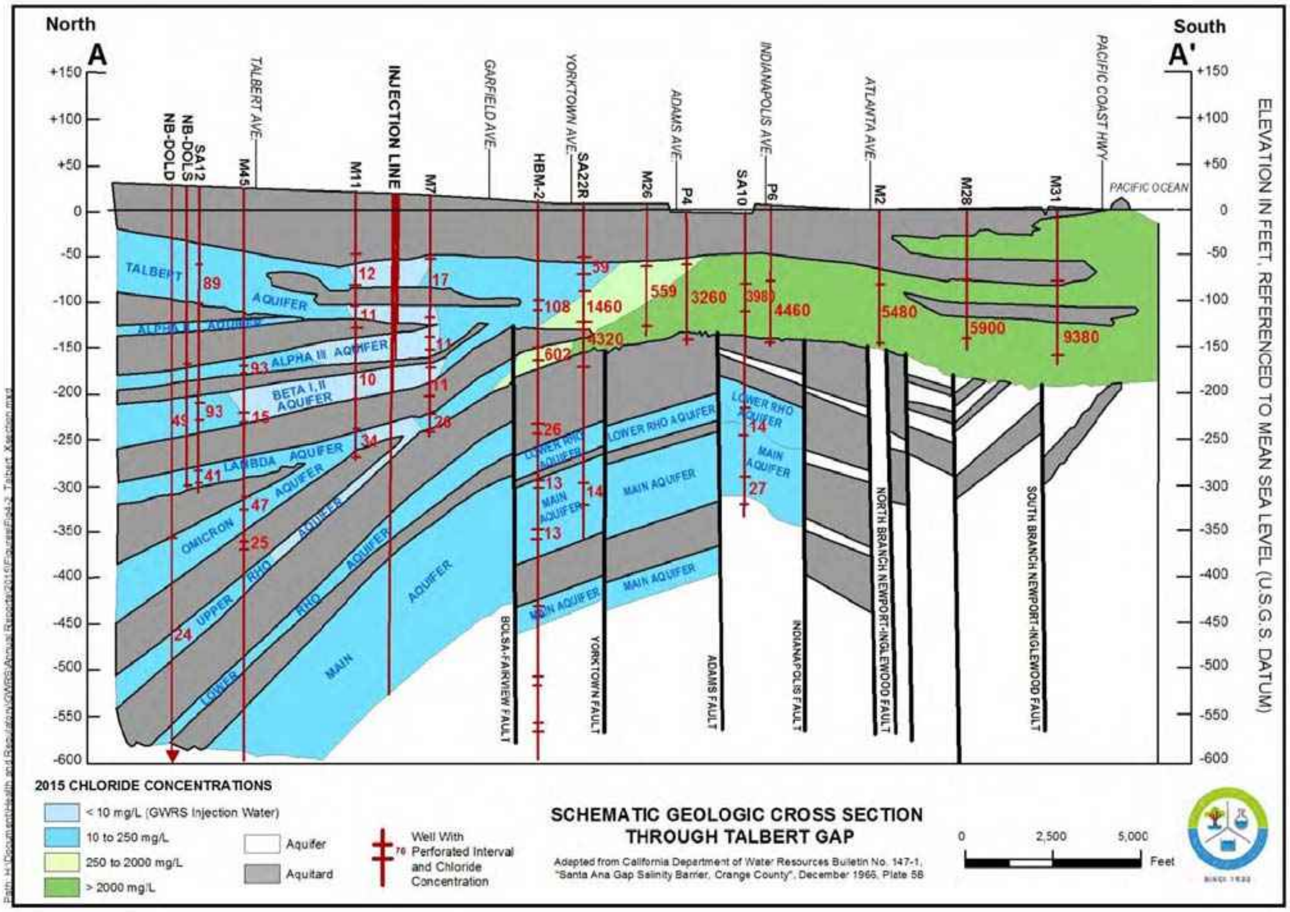


Figure 12-2: Geologic Cross-Section through Talbert Gap Showing 2015 Chloride Concentrations

Figure 12-4 shows the 250 mg/L chloride concentration contour for the selected years of 1993, 1998, 2008, and 2016 in the Talbert and Bolsa gaps and adjacent mesas. The 250 mg/L chloride contour is used to delineate the inland extent of intrusion because this is above ambient (non-intruded) groundwater quality and is equal to the secondary drinking water standard. Native fresh groundwater in this area typically has a chloride concentration well below 100 mg/L, while the GWRS injection supply has a chloride concentration of approximately 10 mg/L. During the 1990s prior to any barrier expansion, the 250 mg/L chloride contour progressed inland. From 1998-2008, intrusion was held at bay without appreciably worsening as five new injection well sites came online. Since 2008 when eight new injection well sites came online along with the GWRS, the 250 mg/L chloride contour has been pushed slightly seaward primarily due to doubling barrier injection and other basin management practices. The Coastal Pumping Transfer Program and Coastal In-Lieu Program reduced coastal groundwater production by either shifting it inland or purchasing imported water in lieu of groundwater, thus helping to raise coastal groundwater levels.

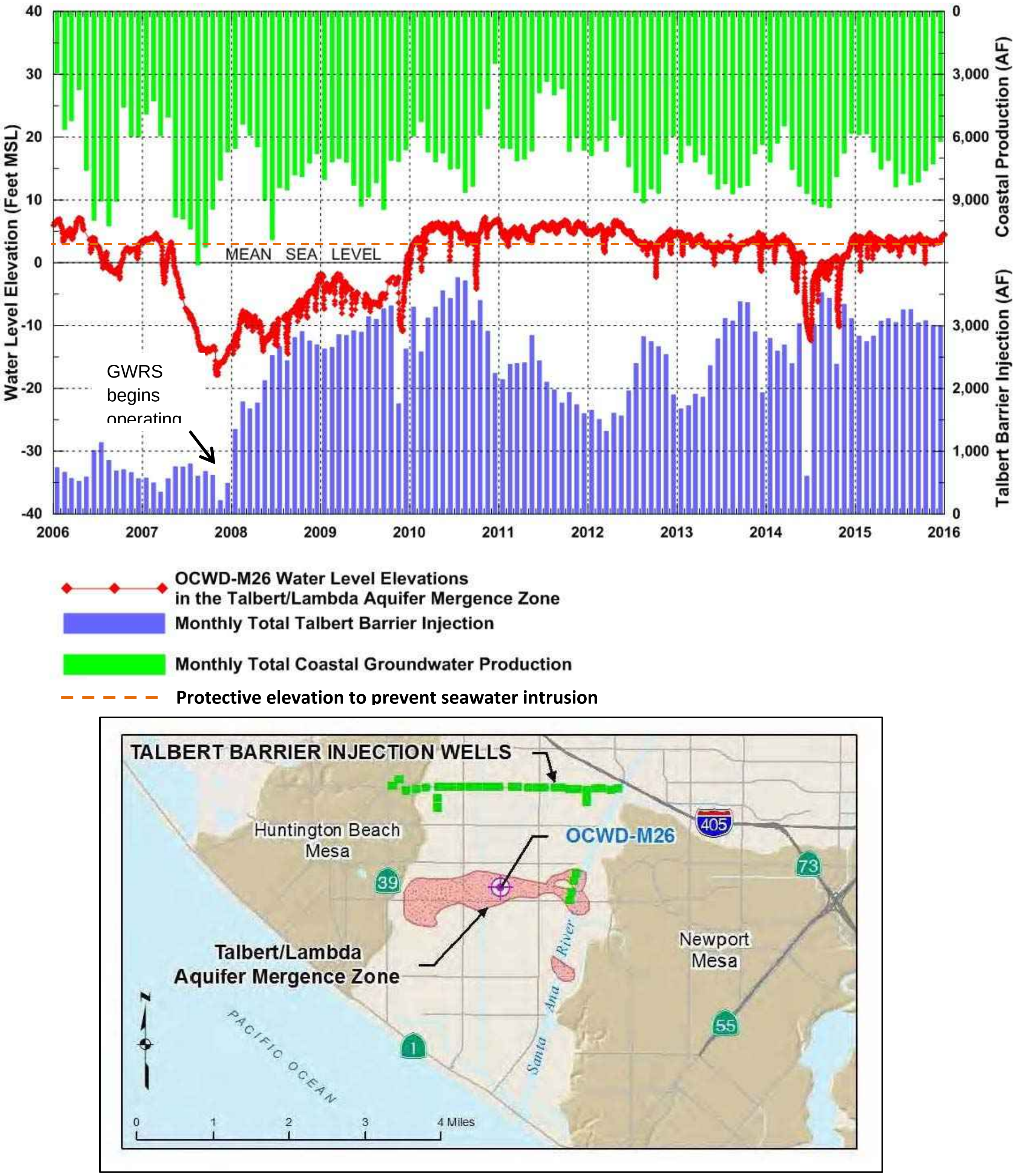


Figure 12-3: Key Well OCWD-M26 Groundwater Levels, Talbert Barrier Injection, and Coastal Pumping

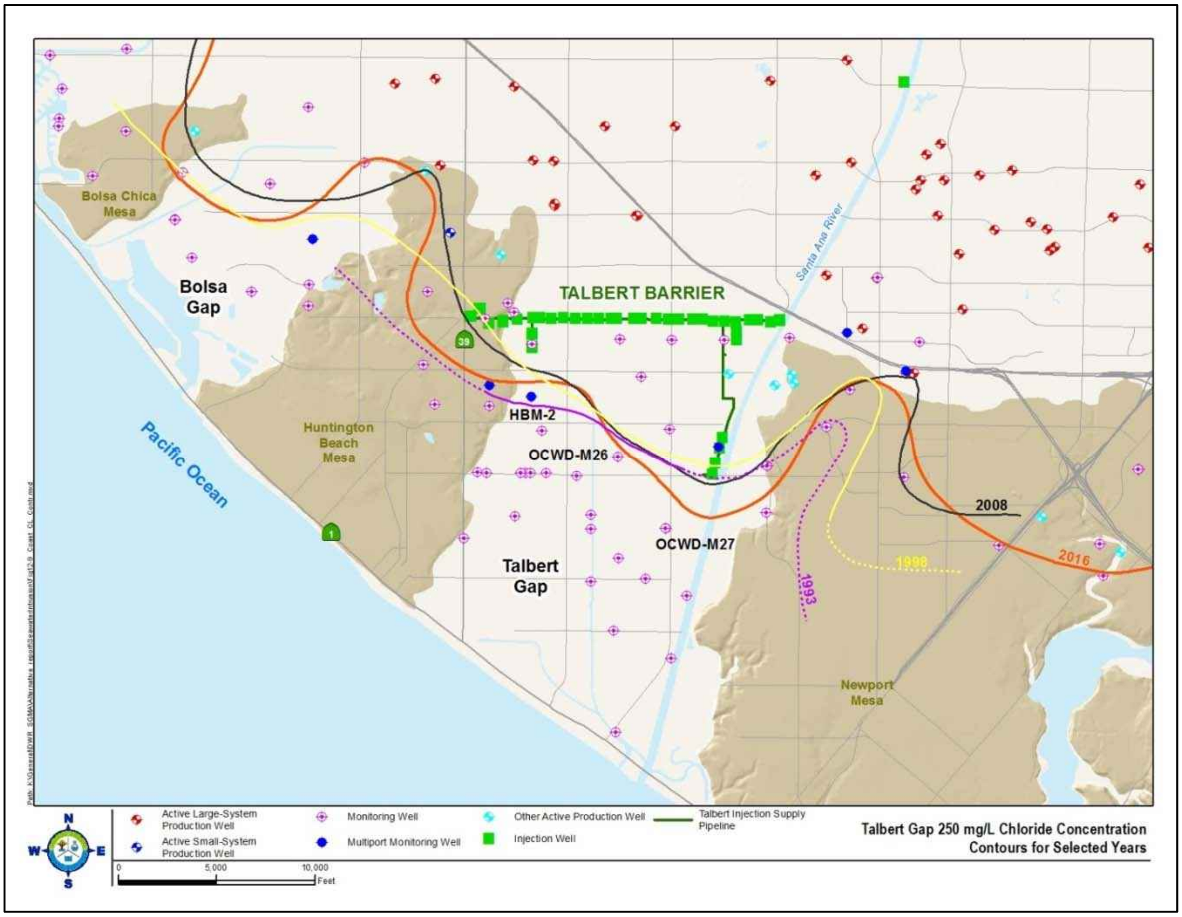


Figure 12-4: Talbert Gap 250 mg/L Chloride Concentration Contours for Selected Years

In addition to chloride contour maps, OCWD prepares and reviews chloride concentration time series graphs at individual wells to identify and evaluate trends in specific aquifer zones. Seaward of the barrier at coastal monitoring wells with elevated salinity, chloride concentrations tend to be inversely related to groundwater elevations. When groundwater elevations decline significantly below mean sea level in the area of the intrusion front, chloride concentrations generally increase and seawater intrusion moves inland. Conversely, when groundwater elevations rise and are sustained above mean sea level, chloride concentrations decrease and intrusion is pushed seaward.

12.1.1 Talbert Barrier Groundwater Model

A numerical groundwater flow model of the Talbert Barrier and surrounding vicinity (Talbert Model) was originally developed by Camp, Dresser & McKee, Inc. (CDM; now CDM Smith) in 1999-2000 with oversight from OCWD. The original Talbert Model was a seven-layer transient model developed as part of the initial planning for the GWRS to evaluate the expansion needs of the existing Talbert Barrier (CDM, 2000). In 2003, the Talbert Model was refined to 13 layers by explicitly modeling the intervening aquitards between the aquifer zones so that the model would be suitable for solute transport simulations in addition to groundwater flow.

The Talbert Model area covers approximately 85 square miles and uses the MODFLOW code (Harbaugh and McDonald, 1996) with 13 vertical layers and 509,000 grid cells (uniform grid with 250 feet x 250 feet horizontal grid cell dimensions). The model layering generally follows the conceptual model of aquifers, aquitards, and mergence zones developed by DWR (1966) with some refinements in the stratigraphy by OCWD based on newer data.

The Talbert Model was calibrated under transient conditions over the nine-year period 1990-99 and provided a sufficient match to observed historical groundwater levels. Along the ocean boundary a constant head condition was employed, whereas time-varying specified head conditions were used along the three inland boundaries based on observed groundwater levels at monitoring wells near those boundaries.

In addition to helping to guide the planning, location, and hydraulic effectiveness of the supplemental injection wells for the Talbert Barrier during pre-GWRS planning activities, the Talbert Model was also used to estimate the general groundwater flow paths and subsurface residence time of barrier injection water by using the USGS particle tracking code MODPATH (Pollack, 1994). This modeling work provided the basis for delineating a recycled water retention buffer area surrounding the Talbert Barrier at a distance of 2,000 feet and one-year travel distance. No new drinking water production wells are allowed within this buffer area, as required by the original California Department of Public Health requirements contained within the original permit to operate GWRS (RWQCB, 2004; OCWD, 2005).

12.2 ALAMITOS GAP

As explained earlier, the Alamitos Barrier Project was initially constructed in 1964 and became operational in 1965 to manage seawater intrusion in the Alamitos Gap. The barrier has been expanded over time to include the construction of additional injection and monitoring wells.

The 41 existing injection wells, shown in Figure 12-5, are screened in several Upper Pleistocene-aged aquifers, referred to locally as the C, B, A and I aquifer zones. The underlying Main and Sunnyside (Lower Main) aquifers are not considered to be susceptible to intrusion due to being offset by the Newport-Inglewood Fault Zone (locally referred to as the Seal Beach Fault) and are not hydraulically merged with either the Recent or the overlying C, B, A, and I aquifers, as shown in Figure 12-6. Consequently, none of the Alamitos Barrier injection wells extend into the Main or Sunnyside aquifers.

The Recent aquifer in Alamitos Gap is age correlative with the Talbert aquifer in Talbert Gap. However, the Recent aquifer in Alamitos Gap is considerably thinner (approximately 40 feet thick) and somewhat finer grained than the more transmissive Talbert aquifer. Since there are no production wells screened in the Recent aquifer and it is generally of poor quality, none of the Alamitos Barrier injection wells are screened in the Recent aquifer.

Similar to the Talbert Barrier, the Alamitos Barrier consists of both nested and cluster-type injection wells screened discretely in each aquifer in order to control the injection rate and injection pressure into each targeted aquifer independently since each aquifer has different physical characteristics and groundwater levels. In addition, there are two “dual-point” injection wells that consist of only one well casing but two different screened interval depths separated inside the well by an inflatable packer and two separate injection drop pipes.

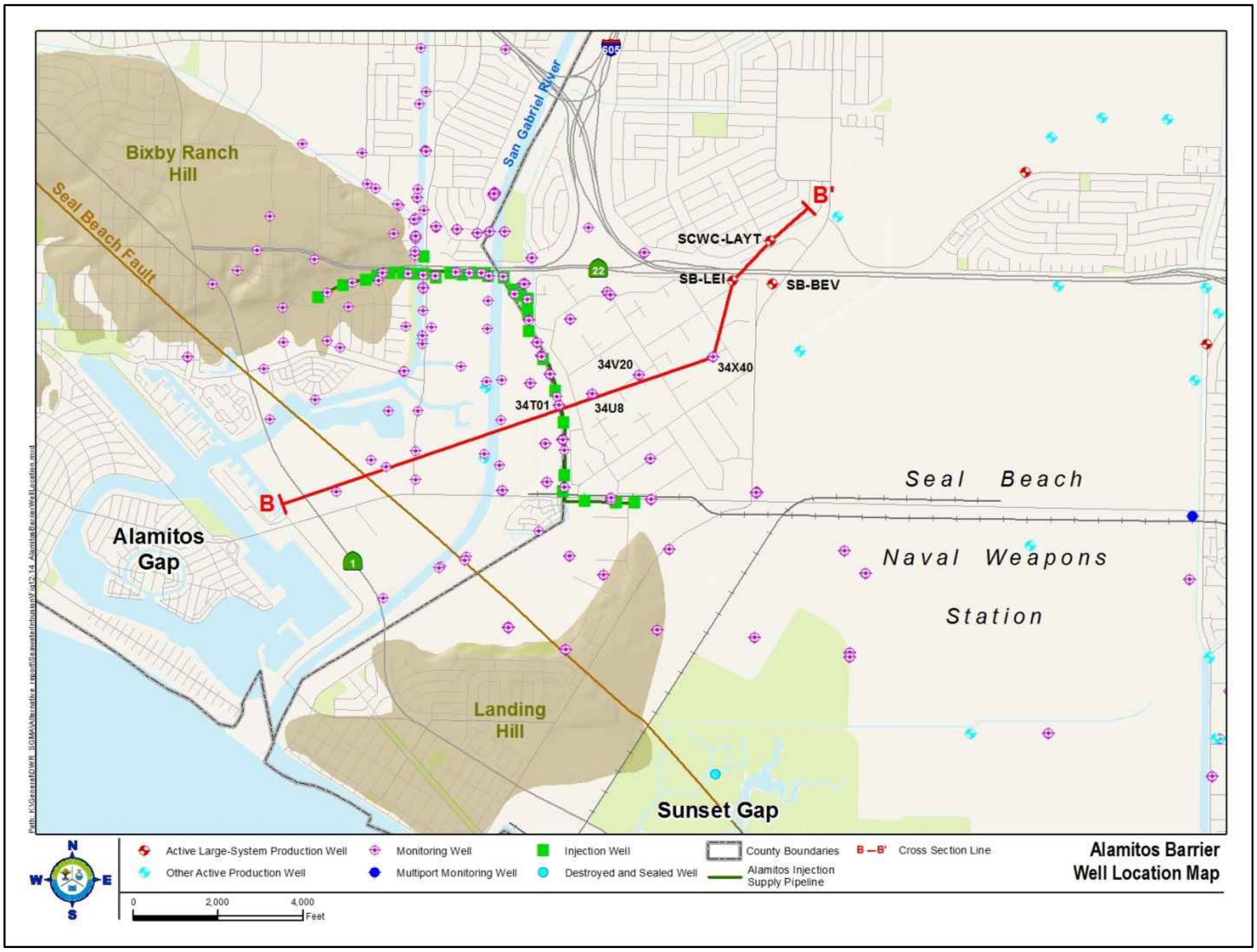


Figure 12-5: Alamitos Barrier

The pathways for intrusion in Alamitos Gap are similar to the Talbert Gap. As previously discussed, the Recent aquifer is connected to the Pacific Ocean. Once seawater migrates inland within the Recent aquifer past the Seal Beach Fault, the brackish water can then migrate downward into the C, B, A, and I aquifers via areas of hydraulic mergence with the Recent aquifer where the intervening low-permeability aquitards are absent. Similar to the Talbert Gap, these susceptible Pleistocene aquifers were warped upward by the Newport-Inglewood Fault Zone and then during Recent geologic time were eroded away and subsequently overlain by the Recent aquifer river deposits. Although similar in structure to the Talbert Gap, the Alamitos Gap aquifers are typically shallower, thinner, and finer grained.

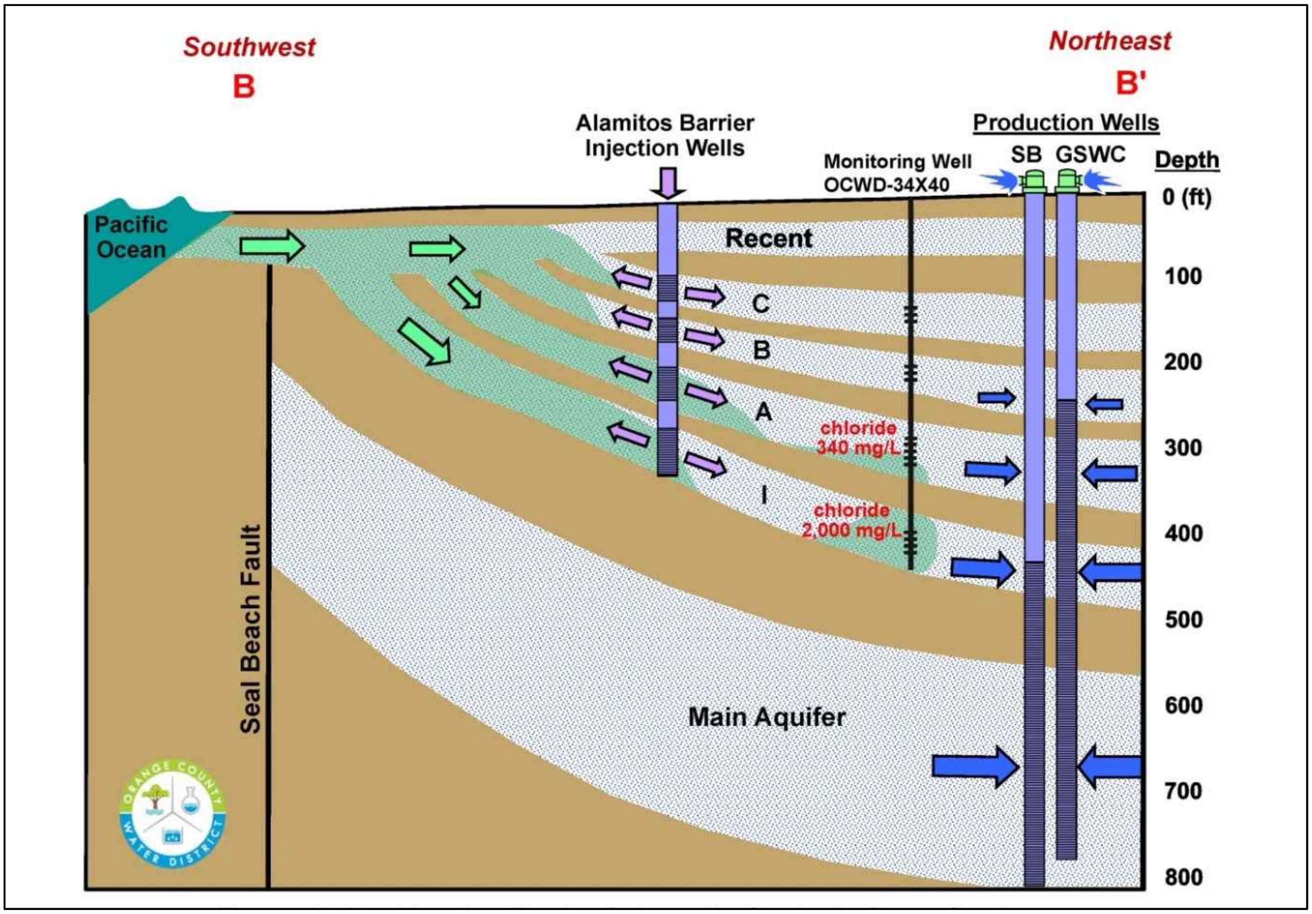


Figure 12-6: Alamitos Barrier Schematic Geologic Cross-Section

In 2008, OCWD identified data gaps where seawater intrusion was suspected but unconfirmed. Staff installed four monitoring wells in 2009 at three sites downgradient of the Orange County portion of the Alamitos Barrier. Analysis of groundwater elevations and chloride concentrations from the existing and new monitoring wells in the area confirmed that pockets of elevated chloride concentrations above the secondary drinking water standard (250 mg/L) had migrated inland of the barrier within Orange County. Potential causes of elevated salinity pulses include insufficient injection well spacing, injection well clogging (low injection rates), and injection wells being offline for extended periods for maintenance and repairs.

The aquifers susceptible to intrusion are generally thinner and finer-grained than their counterparts in Talbert Gap. Therefore, per-well injection capacity is relatively low and thus requires more injection wells and denser spacing to achieve sufficient injection for creating a continuous pressure ridge that achieves protective elevations. Annual Alamitos Barrier injection is typically about 6,000 AF spread over 40 injection well points. In comparison, annual Talbert Barrier injection is typically about 36,000 AF spread over 103 injection well points, resulting in more than double the amount of average injection per well point than Alamitos Barrier.

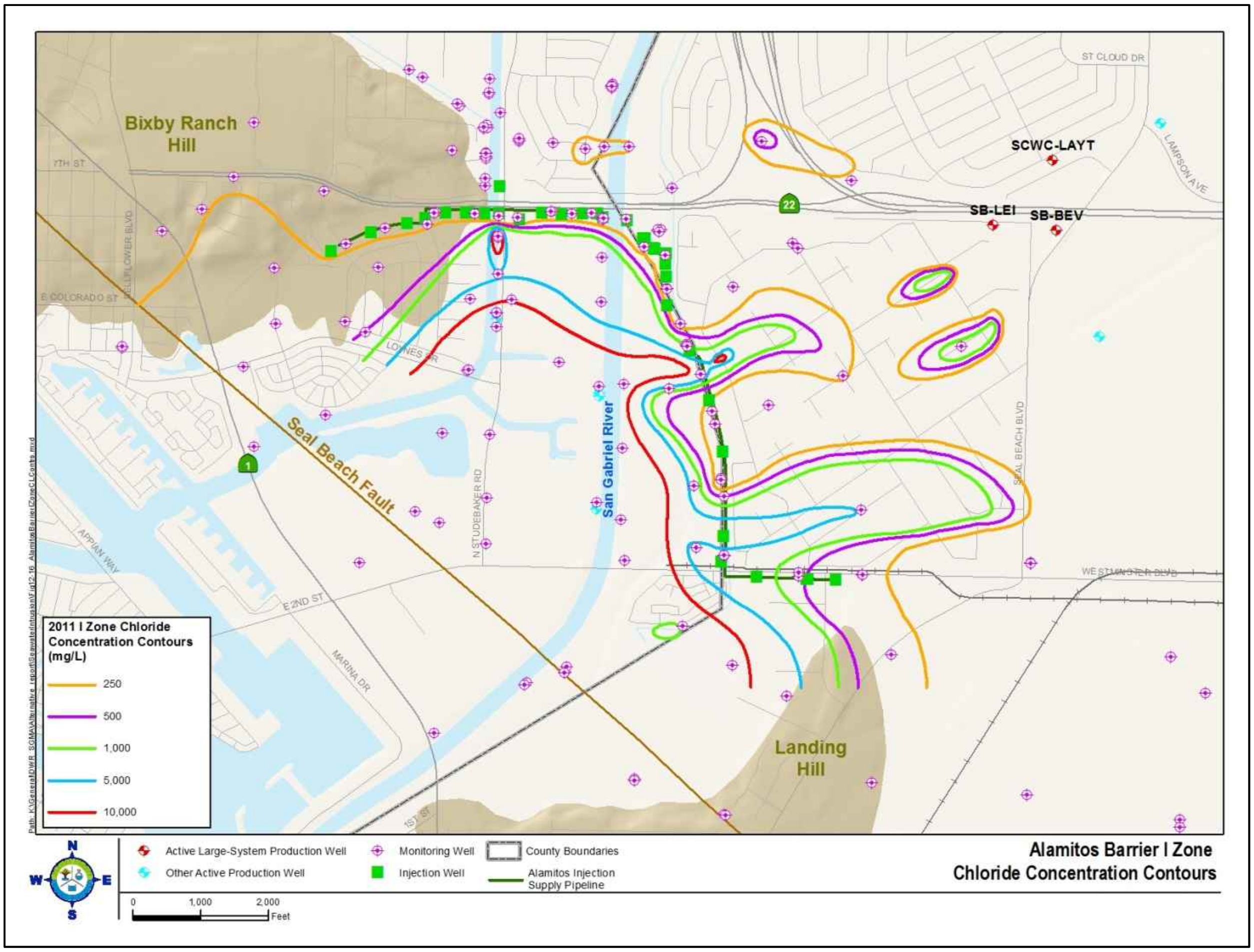


Figure 12-7: Alamitos Barrier I Zone Chloride Concentration Contours

In an effort to control the identified breaches through the barrier and to address barrier deficiencies along the north-south reach where injection well spacing is too large and injection well capacity too small, OCWD developed the Alamitos Barrier Improvement Project consisting of:

- 17 injection wells at eight locations to augment injection capacity along the north-south reach of the barrier
- Four nested monitoring wells to enhance the inter-nodal monitoring network at and near the barrier
- Two piezometers to monitor shallow (semi-perched) groundwater

With a project budget of $15 million, drilling and construction of the wells began in 2016. Once constructed, the new monitoring and injection wells will be operated and maintained by LACDPW along with the existing barrier facilities (OCWD, 2013).

12.2.1 Alamitos Barrier Groundwater Model

A transient groundwater flow and solute transport model of the Alamitos Barrier area was developed and calibrated in 2010 by Intera, Inc. with oversight and cost sharing from OCWD, LACDPW, and Water Replenishment District of Southern California. The model was developed to provide a useful tool to evaluate the existing barrier's effectiveness, determine barrier expansion requirements, evaluate migration of saline intrusion as well as migration of recycled injection water towards production wells for regulatory purposes, and optimize existing barrier operations.

The Alamitos Barrier Model (ABM) has 13 layers, each corresponding to an individual aquifer or aquitard and uses the MODFLOW-2000 code (Harbaugh et al., 2000). The ABM has a uniform grid consisting of 100-ft x 100-ft square grid cells with varying vertical thickness based on the stratigraphy defined in the conceptual model, which was largely based on Callison et al. (1991) in the immediate vicinity of the barrier and OCWD geologic interpretations at monitoring and production wells in the outlying area of the model domain. The 100-ft grid cell size ensures that nearly every monitoring and injection well occupies its own grid cell. The ABM was calibrated to match observed historical groundwater level and chloride (salinity) conditions over the period 1999-2009 (Intera, 2010).

Findings from predictive scenarios simulated with the calibrated model confirmed that new injection wells along the north-south barrier alignment were needed to augment injection capacity in areas where breaches are occurring, and to raise the average groundwater levels to protective elevations. The ABM was also used to determine the number, locations, and approximate flow rates of additional injection wells needed to control seawater intrusion along the north-south reach of the barrier. These findings culminated in the Alamitos Barrier Improvement Project currently under construction, as described above.

Results from the ABM scenarios indicated that approximately 10,400 AFY of total barrier injection may be needed during low-basin conditions to entirely prevent seawater intrusion on both the Los Angeles and Orange County sides of the barrier, including the aforementioned intrusion eastward south of the existing barrier into Sunset Gap. This modeled injection amount represents almost twice the typical historical injection of 6,000 AFY and at least preliminarily confirmed the potential need for a future barrier extension south to the Seal Beach Fault to help protect Sunset Gap.

Upon completion of the current Alamitos Barrier Improvement Project, groundwater elevations and chloride concentrations resulting from the newly expanded barrier will be closely monitored for at least one full year prior to determining potential southerly barrier extension requirements that would trigger the need for an additional injection supply source and new barrier pipeline.

12.3 SUNSET GAP

Sunset Gap has historically been considered to be a much lesser seawater intrusion threat compared to the Talbert and Alamitos Gaps. Recent monitoring data, however, indicate that seawater intrusion is occurring in Sunset Gap, as shown schematically in Figure 12-8.

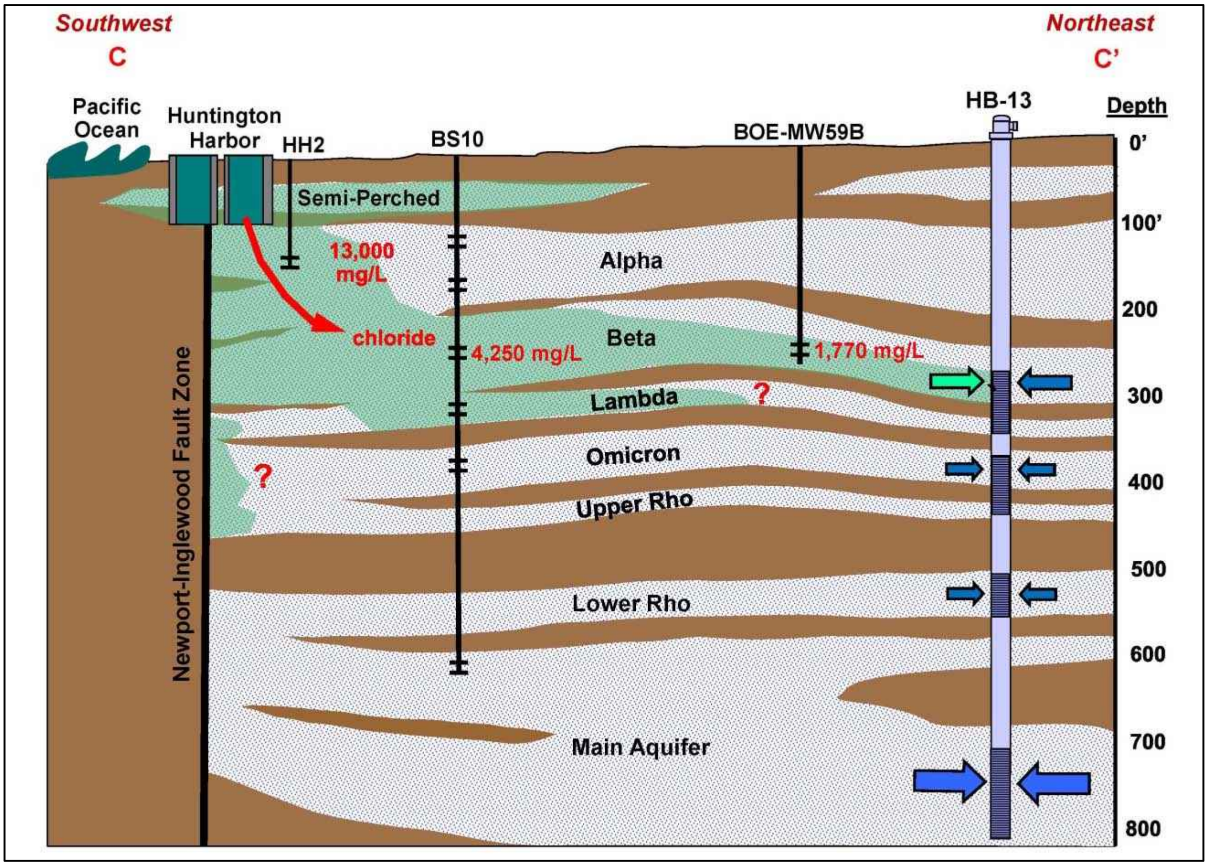


Figure 12-8: Schematic Geologic Cross-Section from Huntington Harbor through Sunset Gap

Three potential source areas appear likely:

- Intrusion from Alamitos Gap south of Alamitos Barrier moving in an easterly direction;
- Intrusion moving north-northeasterly from the Huntington Harbor Marina where dredged canals may have breached through the shallow aquitard overlying the shallow-most potable aquifer; and
- Lateral leakage across the Newport/Inglewood Fault Zone (Seal Beach Fault) in the Landing Hill area in one or more of the Upper Pleistocene aquifers.

In the southeast portion of Sunset Gap, dredging associated with construction of the boat canals in Huntington Harbor during the 1960s was the subject of several studies at that time regarding the potential for causing saline intrusion. Conclusions of these studies were inconsistent and inconclusive. Studies done by the USGS (1966) and DWR (1968) found that seawater intrusion into the semi-perched aquifer (generally the uppermost 50 feet) associated with the harbor development was occurring, but this was considered to be of little to no significance due to the lack of beneficial use of this near-surface water bearing zone.

Approximately 10 years after construction of Huntington Harbor, chloride concentrations began to rise during the mid-1970s at OCWD monitoring well HH2 screened in the shallow-most Pleistocene Alpha aquifer at a depth of 85-95 ft bgs and located just inland of the Bolsa-Fairview Fault in the Huntington Harbor area. The Bolsa-Fairview Fault is the farthest inland branch of the Newport-Inglewood Fault Zone in the area. Chloride concentrations at this well rose steadily over time to very brackish levels today, suggesting an inland gradient and active pathway for inland intrusion.

In 2004, elevated chloride concentrations ranging from 300 to 800 mg/L were first discovered at two monitoring wells owned by the Boeing Corporation (BOE-MW16 and BOE-MW17) screened in the Beta aquifer. OCWD commissioned a geophysical survey in 2010 at the Seal Beach Naval Weapons Station to delineate the extent and depth of intrusion and to help guide the number and location of proposed monitoring wells necessary to sufficiently define the extent of intrusion.

Based on groundwater elevation contours (see Figure 12-9), the elevated salinity plume is not expected to migrate farther inland past wells HB-4, HB-7, and HB-13 since the pumping from these three wells appears to create a local depression and because of the lack of other large system production wells within this vicinity. Only two City of Westminster production wells (WM-125 and WM-RES2) are located within one mile of these three Huntington Beach wells and based on the gradient direction do not appear to be threatened so long as the three Huntington Beach wells remain active.

One large system production well (HB-12) was shut down and destroyed due impacts from advancing intrusion in Sunset Gap. Since 2012, OCWD has constructed seven of nine planned multi-depth monitoring wells to depths up to 1,000 feet in Sunset Gap to better define the source areas, pathways, and overall inland extent of seawater intrusion in that area as the first step towards identifying feasible remedies.

12.3.1 Planned Modeling to Evaluate Sunset Gap Alternatives

Existing data are sufficient to warrant timely evaluation and planning of potential project alternatives to address the intrusion in Sunset Gap. To accomplish this, the existing Alamitos Barrier groundwater model (ABM) is currently being expanded to cover the entire Sunset Gap area and beyond. In addition to expanding the model domain, model layering and aquifer parameters (e.g., hydraulic conductivity) is being refined using data from the new OCWD monitoring wells, which were constructed after completion of the original ABM. Once the model expansion is completed and recalibrated, various predictive model scenarios will be simulated to analyze the effects of potential remedial alternatives.

Potential short-term remedies to evaluate would likely include:

- Reduce coastal pumping in this area and/or shift pumping inland via the Coastal Pumping Transfer or Coastal In-Lieu programs;
- Brackish extraction wells upgradient of Huntington Beach production wells; and
- Equip wells HB-4, HB-7, and HB-13 with liners or packers to prevent production from the uppermost Beta aquifer screened interval.

Potential long-term remedies to evaluate would likely include:

- Southerly extension of Alamitos Barrier to the Seal Beach Fault;
- Sunset Gap injection barrier along the eastern edge of the SBNWS (Bolsa Chica Rd.);
- Combination injection/extraction barrier in Sunset Gap; and
- Physical barrier along Edinger Avenue just north of Huntington Harbor.

The expanded model will be used to evaluate these alternatives as to the number of wells, locations, injection/extraction requirements, and the resulting groundwater elevations and chloride concentrations after several years of simulated operation. In addition, during model development and calibration, areas still lacking sufficient data would be identified for potential locations of additional monitoring wells.

In conjunction with the groundwater modeling activities, engineering feasibility studies would be necessary for the proposed alternatives, such as to determine a reliable water supply for the proposed Alamitos Barrier southerly extension and/or an entirely new Sunset Gap injection barrier. Other potential injection supplies include deep colored water from the Lower Main aquifer, which is not considered to be susceptible to intrusion, and treated brackish water.

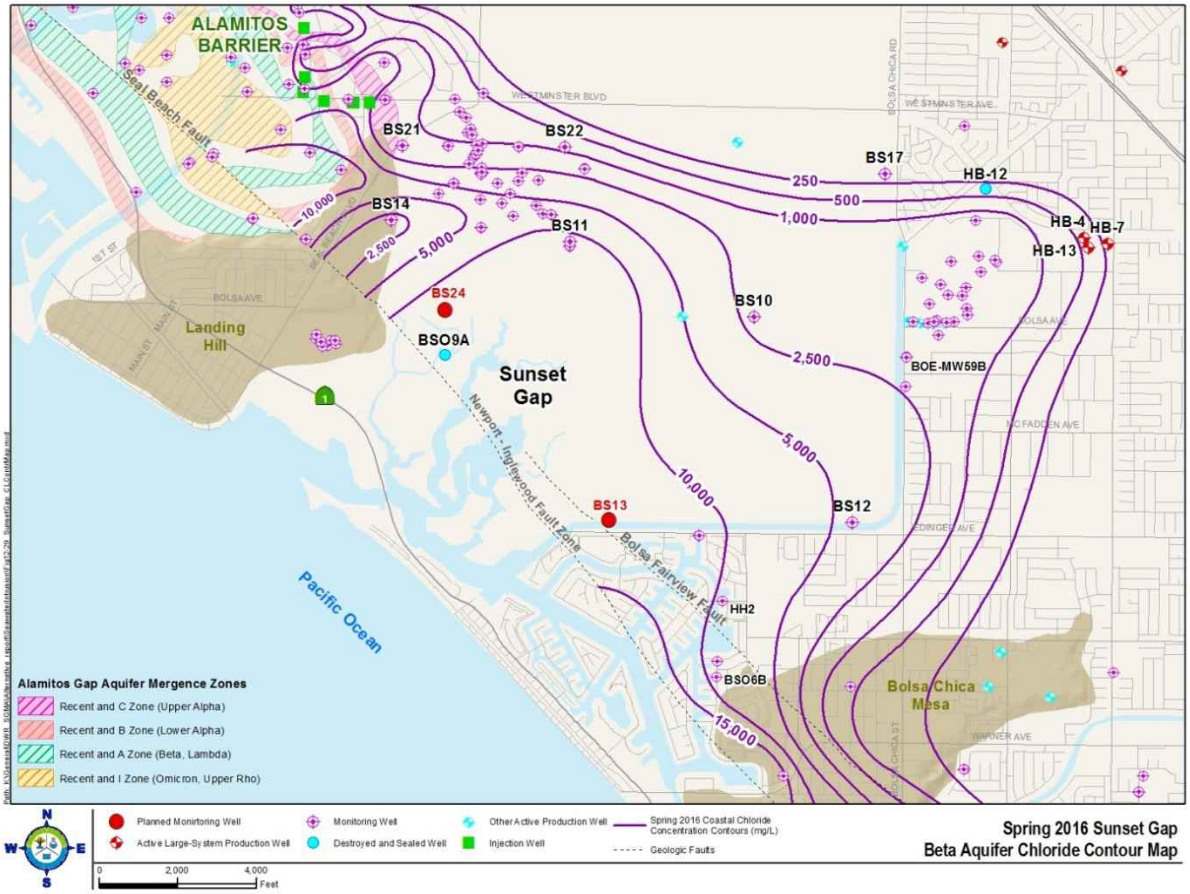


Figure 12-9: Sunset Gap Chloride Contours

12.4 BOLSA GAP

In the Bolsa Gap, seawater intrusion extends approximately 1.3 miles inland from the Pacific Ocean. The highest chloride concentrations in Bolsa Gap have remained seaward of the Bolsa-Fairview Fault, which is the farthest inland branch of the Newport-Inglewood Fault Zone in that area. Therefore, it appears that saline groundwater is largely restricted from migrating inland across these faults within the Bolsa aquifer under normal basin conditions, as the Bolsa aquifer zones of mergence with the underlying Pleistocene aquifers are all inland of the Bolsa-Fairview Fault. An area of slightly elevated salinity has existed beneath the Huntington Beach Mesa for many years and is thought to be due to past disposal practices of oil field brines in the early 1900s rather than active seawater intrusion from the ocean. This area of saline groundwater is being pushed westerly into Bolsa Gap due to increased injection at the west end of the Talbert Barrier but is not expected to be a threat to any active production wells or groundwater resources.

12.5 NEWPORT MESA

Chloride concentrations in the Beta/Lambda aquifers in the Newport Mesa area have either remained stable or decreased over the last 10 years even though groundwater elevations have typically been below sea level in these two aquifers in this area. Main aquifer chloride concentrations in this area have either decreased or have remained relatively stable for the last 10 years. A proposed extension of the Talbert Barrier eastward along Adams Avenue onto the Newport Mesa has been preliminarily evaluated and modeled by OCWD staff using the Talbert Model. Such a project would serve to provide assurance against any future intrusion in the Beta/Lambda and Main aquifers under lower basin conditions and would thus protect production wells owned by Mesa Water District in addition to replenishing the basin. Based on the stability of chloride concentrations in the Newport Mesa, there is no need to advance this project at this time.

In 2014, OCWD constructed four new multi-depth monitoring wells (M51, M52, M53, MRSH) farther east on the Newport Mesa whose locations are shown on Figure 12-10. These four well sites are now a part of OCWD’s coastal monitoring program for both groundwater levels and seawater intrusion sampling. The East Newport Mesa area was previously a data gap in which the aquifer stratigraphy and groundwater flow patterns were not well understood.

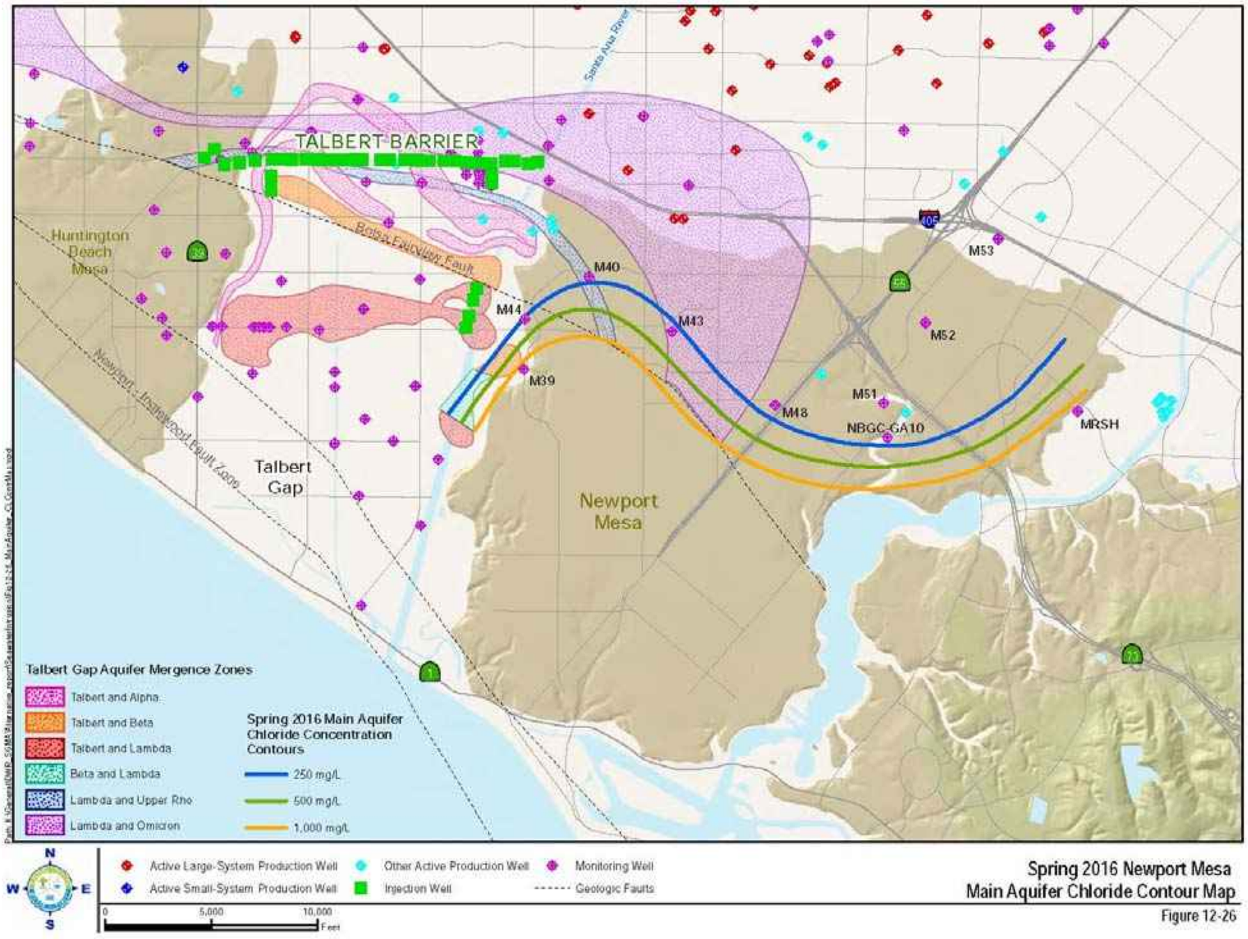


Figure 12-10: Newport Mesa Chloride Contours

12.6 IMPLEMENTATION OF SEAWATER INTRUSION PREVENTION POLICY

Implementation of OCWD's seawater intrusion prevention policy, described in Section 6.5, is summarized below. These programs enable OCWD to continue sustainably managing the groundwater basin to prevent significant and unreasonable seawater intrusion.

12.6.1 Effective Barrier Operations

The effective operation of the Talbert and Alamitos barriers is critical to the protection of the basin aquifers from seawater intrusion. This program includes, but is not limited to, the following activities:

1. Injection of sufficient water quantities combined with other basin management programs, such that protective groundwater elevations are established and maintained, where applicable, based on local hydrogeologic characteristics.
2. Regular maintenance of injection facilities to provide sufficient injection quantities. Such maintenance includes backwashing, redevelopment, and replacement (if necessary) of injection wells and operational fitness checks/repairs of flow meters, pressure reducing valves, and telemetry equipment.
3. Regular communications and coordination between operations, hydrogeology, and engineering staff on barrier operations and activities.
4. Annual reporting on barrier facilities status and operations. The report will include recommendations, as necessary, for barrier improvements to achieve policy objectives.

12.6.2 Barrier Performance Monitoring and Evaluation

Monitoring and evaluating barrier performance provides the basis on which to determine if the barriers are preventing seawater intrusion from occurring. This program consists of the following activities:

1. Semi-annual sampling and testing of designated monitoring wells in the vicinity of the seawater barriers. Testing will include parameters such as total dissolved solids, chloride, and electrical conductivity as indicators of seawater intrusion. Wells will be designated to provide adequate spatial coverage, particularly near likely seawater pathways and near the interface between seawater and freshwater.
2. Quarterly water level measurements at designated monitoring wells in the vicinity of the seawater barriers. More frequent measurements will be collected as needed at key locations.
3. Installation of monitoring wells in areas where it is determined that data gaps exist near the seawater barriers that may allow seawater intrusion to go undetected or would otherwise significantly impede the ability to assess barrier performance.
4. Annual evaluation and reporting of barrier performance based on surrounding groundwater level and quality data.

12.6.3 Susceptible Coastal Area Monitoring and Evaluation

This program addresses the assessment and ongoing monitoring of the coastal gaps and other areas that are not currently protected from seawater intrusion by the Talbert and Alamitos barriers. These areas include the Bolsa and Sunset gaps and adjacent mesas. This program includes the following activities:

1. Semi-annual sampling and testing of designated monitoring wells. Testing includes parameters such as total dissolved solids, chloride, and electrical conductivity as indicators

of seawater intrusion. Wells have been designated to provide adequate spatial coverage, particularly near likely seawater pathways.

2. Quarterly water level measurements at designated monitoring wells. More frequent measurements will be collected as needed at key locations.
3. Installation of monitoring wells in areas where it is determined that data gaps exist that may allow seawater intrusion to go undetected or would significantly impede the ability to understand the location of and trends in seawater intrusion.
4. Annual evaluation and reporting of the coastal area monitoring program, including recommendations, as needed, for further investigation or other potential actions to address seawater intrusion.

12.6.4 Coastal Groundwater Management

In addition to operating the seawater barriers, OCWD has implemented other basin management activities to lessen the potential for seawater intrusion. These activities have included the Coastal Pumping Transfer Program, Coastal In-Lieu Program, and maintaining basin storage levels within the operating range. Each of these activities shall continue to be considered and implemented as deemed necessary along with other potential actions to complement and enhance the OCWD seawater prevention program.

12.7 DEFINITION OF SIGNIFICANT AND UNREASONABLE SEAWATER INTRUSION

As explained above, OCWD conducts comprehensive programs to protect the groundwater basin from the undesirable effect of significant and unreasonable seawater intrusion. Seawater intrusion in the OCWD Management Area would be considered significant and unreasonable if a significant and continuing reduction in usable storage volume in the groundwater basin occurs as a result of increased salinity due to seawater intrusion.

12.8 DETERMINATION OF MINIMUM THRESHOLDS

The minimum threshold for seawater intrusion that defines an undesirable result is (1) the shutdown of active large system production wells due to seawater-derived salinity, and (2) continuing loss of a significant amount of basin storage due to seawater-derived salinity.

SECTION 13 SUSTAINABLE MANAGEMENT RELATED TO LAND SUBSIDENCE

Management of the groundwater basin by maintaining storage levels within OCWD's established operating range has prevented significant and unreasonable land subsidence that substantially interferes with surface uses. Within the OCWD Management Area there is no evidence of continuing irreversible land subsidence, nor is there evidence that land subsidence has interfered with surface uses. Therefore, the undesirable result of "significant and unreasonable land subsidence that substantially interferes with surface uses" is not present and is not anticipated to occur in the OCWD Management Area in the future

Subsidence due to changes in groundwater conditions in the Orange County groundwater basin is variable and does not show a pattern of irreversible permanent lowering of the ground surface. Some subsidence may have occurred before OCWD began refilling the groundwater basin in the late 1950s after storage conditions reached a historic low (Morton, et al., 1976); however, the magnitude and scope of this subsidence is uncertain and it is not clear if this subsidence was permanent. Since this time OCWD has operated the groundwater basin within the established operating range.

More recent data show a consistent pattern of the ground surface rising and falling in tandem with groundwater levels and overall changes in basin groundwater storage. This is referred to as elastic subsidence. Interferometric Synthetic Aperture Radar (InSAR) data collected from satellites and data collected by the Orange County Surveyor (Surveyor) show that ground surface elevations in Orange County both rise and fall in response to groundwater recharge and withdrawals. InSAR data during the period 1993-1999 shows temporary seasonal land surface changes of up to 4.3 inches (total seasonal amplitude from high to low) in the Los Angeles-Orange County area and a net decline of approximately 0.5 inch/year near Santa Ana over the period 1993 to 1999, which happened to coincide with a period of a net decrease in groundwater storage in the basin (Bawden, 2001; 2003).

The Surveyor's office maintains more than 1,500 elevation benchmarks throughout Orange County. Periodically, the Surveyor resurveys the benchmarks to detect changes in elevation. The Surveyor maintains the survey records and makes them available to the public (http://ocpublicworks.com/survey/services/ocrtn) and provides the data to OCWD upon request. The Surveyor also maintains an Orange County Real Time Network (OCRTN) that consists of continuously operating GPS reference stations that monitor horizontal and vertical movement throughout Orange County. Figure 13-1 shows the locations of the GPS stations in Orange County.

Based on real time GPS data, the BLSA and SACY sites show the greatest range of elevation change of any of the sites in Orange County. Ground surface elevation changes at these sites from 2002 to 2014 correlate well with changes in groundwater storage, as shown on Figure 13-2. Note that this period of time includes a very wet period (2004-06) when basin groundwater storage increased significantly and a dry period (2010-2014) when basin groundwater storage decreased significantly.

In reviewing the available sources of data, it is clear that depending on the time period selected, the ground surface is rising, falling, or remaining stable. GPS data collected by the Surveyor over the past 12 years (2002-14) show that the ground surface fluctuations appear to be completely elastic, reversible, and well correlated with fluctuations in groundwater levels. These data indicate that there has not been any permanent, irreversible subsidence of the ground surface over the past 12 years.

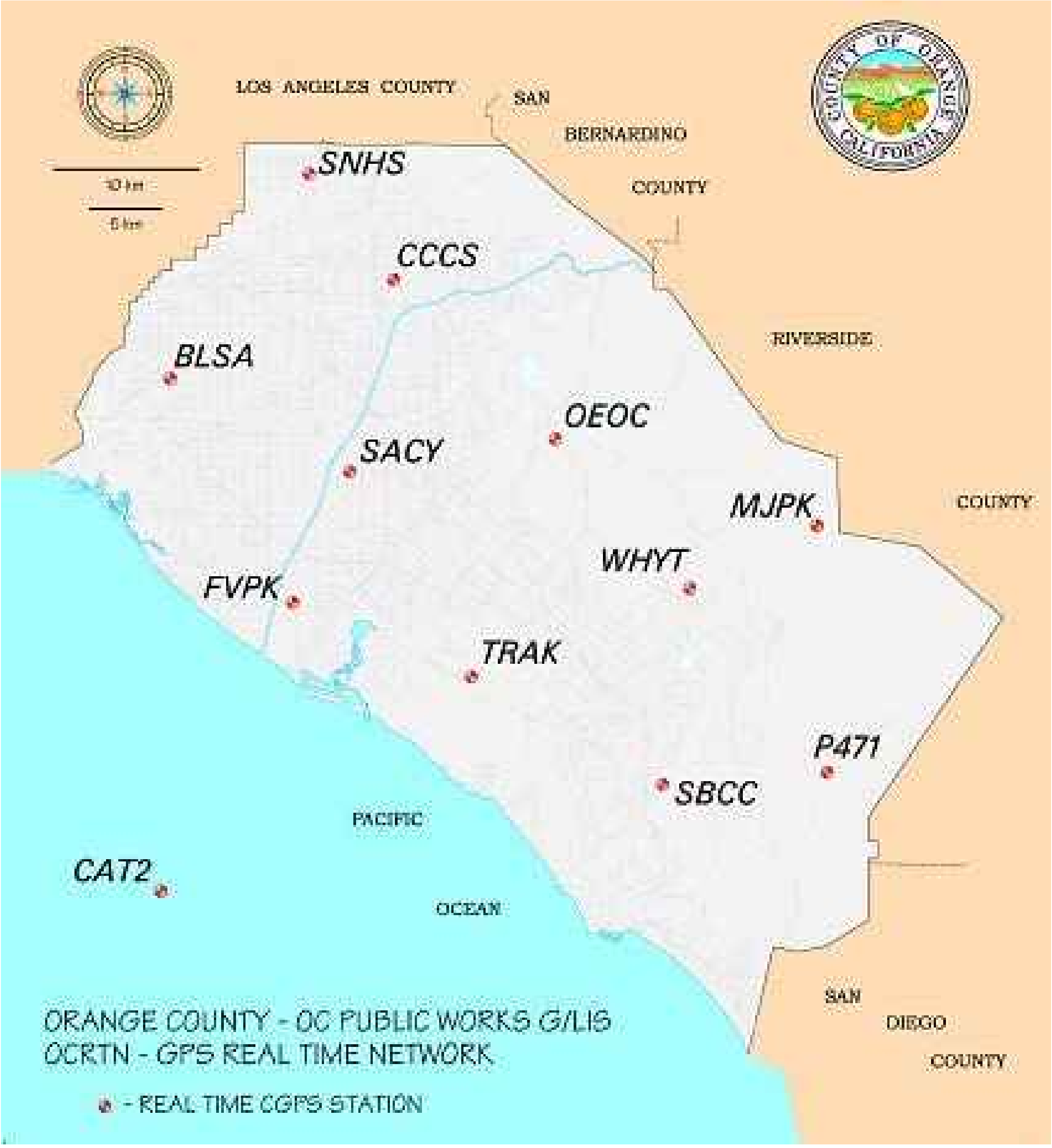


Figure 13-1: Orange County Public Works GPS Real Time Network

Finally, there is little potential for future widespread permanent, irreversible subsidence given OCWD's commitment to sustainable groundwater management and policy of maintaining groundwater storage levels within a specified operating range. Nevertheless, OCWD annually reviews Surveyor data to evaluate ground surface fluctuations within OCWD's service area. If irreversible subsidence was found to occur in a localized area in relation to groundwater pumping patterns or groundwater storage conditions, OCWD would coordinate with local officials to investigate and develop an approach to address the subsidence. This could include OCWD managing the basin at higher groundwater storage levels.

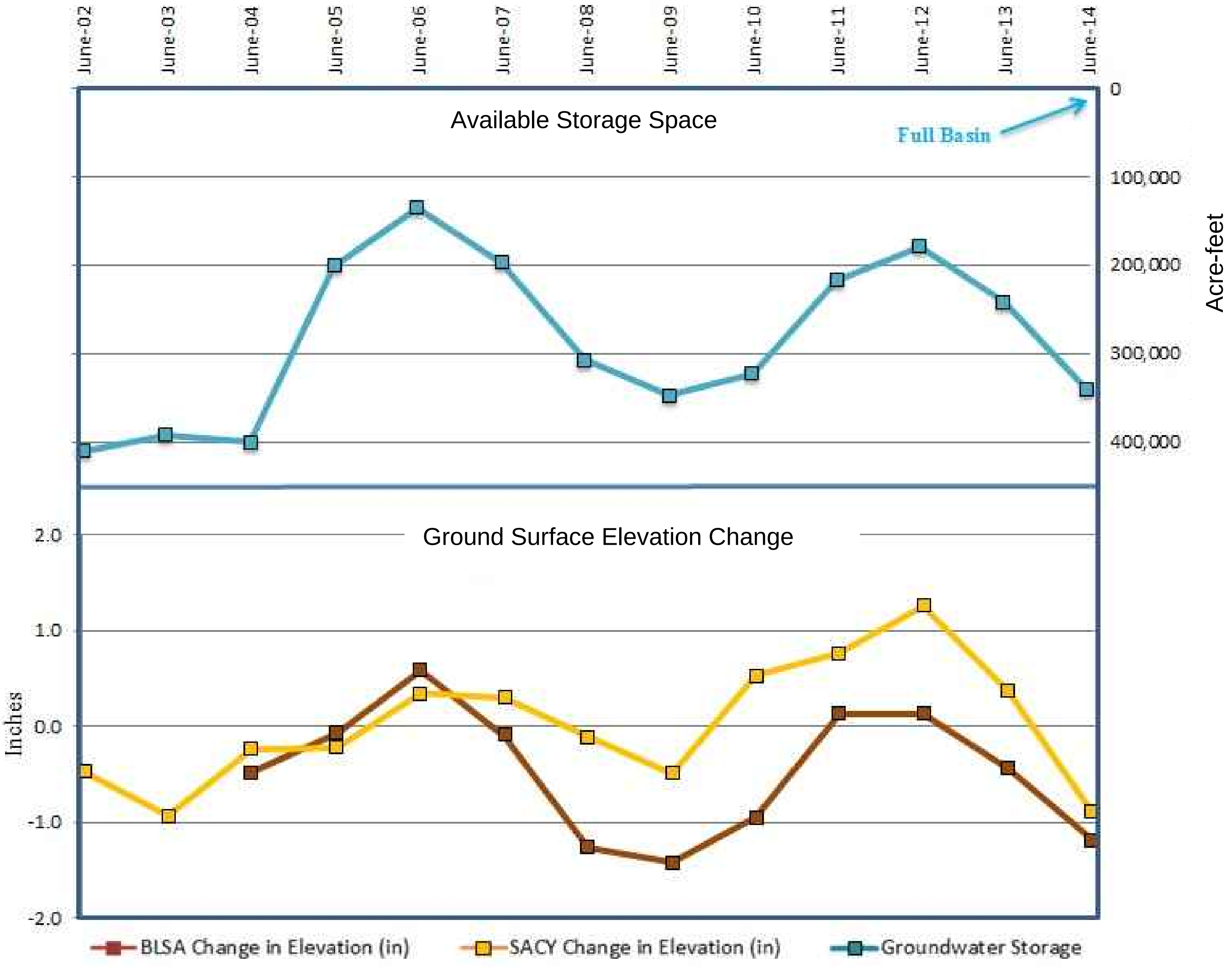


Figure 13-2: Available Groundwater Basin Storage and Ground Surface Elevation Change, 2002-2014

13.1 DEFINITION OF SIGNIFICANT AND UNREASONABLE LAND SUBSIDENCE THAT SUBSTANTIALLY INTERFERES WITH SURFACE USES

As stated above, data indicates that there is no inelastic land subsidence within the OCWD Management Area due to changes in groundwater elevation or groundwater storage levels. Land subsidence would be considered to be significant and unreasonable if ground surface elevation changes as measured by Orange County Public Works are determined to be inelastic over a significant period of time, these elevation changes are attributed to declines in groundwater storage, and these changes are likely to significantly interfere with surface uses.

13.2 DETERMINATION OF MINIMUM THRESHOLDS

The minimum threshold for land subsidence that defines an undesirable result is a sustained lowering of ground surface elevation that is attributable to lowering of groundwater storage in the basin and is likely to significantly interfere with surface uses.

SECTION 14 SUSTAINABLE MANAGEMENT RELATED TO GROUNDWATER DEPLETIONS IMPACTING SURFACE WATER

There are no surface water bodies within the OCWD Management Area that are interconnected and dependent on groundwater basin conditions. Therefore, the undesirable result of "depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water due to groundwater conditions occurring throughout the basin" is not present and in the future is not anticipated to occur in the OCWD Management Area due to OCWD's management programs.

14.1 SANTA ANA RIVER

The Santa Ana River in Orange County flows through a highly urbanized environment. Flood protection infrastructure has constrained the flow of the river with engineered levees along most of its course.

From Imperial Highway to 17th Street in Santa Ana (Figure 14-1 and 14-2), the river is a losing reach with surface water percolating into groundwater. OCWD conducts recharge operations within the soft-bottomed river channel except for a portion of the river where the Riverview Golf Course occupies the river channel. The river levees are constructed of either rip-rap or concrete. The river bed is utilized for groundwater recharge. OCWD diverts surface water flows into recharge basins at Imperial Highway and at another diversion point farther downstream. Nearly all the water that remains in the river during non-storm conditions percolates into the groundwater basin upstream of 17th Street.

When the groundwater basin is in a nearly full condition, groundwater levels in the Shallow Aquifer in this area are generally 20 feet to greater than 60 feet below ground surface. When groundwater storage levels are in the lower portion of the operating range, groundwater levels in the Shallow Aquifer are even further below ground surface. Data indicate that this reach of the river has historically been a losing reach that was frequently dry during summer months. There is no evidence that changes in groundwater levels have had an impact on flows in the Santa Ana River from Imperial Highway to 17th Street in Santa Ana.

From 17th Street to near Adams Avenue in Costa Mesa (Figure 3-28), the river channel is concrete-lined for flood control with sloping or vertical concrete side levees and a concrete bottom. The flood control infrastructure in this section of the Santa Ana River creates a barrier between surface water and underlying groundwater.

From Adams Avenue to the coast, the channel has concrete side walls or rip-rap for flood control and a soft bottom. The river here is brackish as it is subject to tidal influences. Estuary conditions within the concrete or rip-rap channel exist at the mouth of the river where the ocean encroaches at high tide. The tidal prism extends from the ocean to approximately the Adams Avenue Bridge.

Figure 14-1: View of Santa Ana River (left) with OCWD recharge facilities (right). An inflatable rubber dam that crosses the river here enables OCWD to divert some river flows into basins for percolation.

Figure 14-2: Santa Ana River, looking upstream in the vicinity of Ball Road. Here the river, with side levees and a soft bottom, is typically dry during non-storm conditions.

14.2 SANTIAGO CREEK

Santiago Creek is a major tributary of the Santa Ana River. The creek is the primary drainage for the northwest portion of the Santa Ana Mountains. Under natural conditions, the creek is ephemeral, with dry conditions predominant during most of the year (Figures 14-3 and 14-4). Water from the creek is impounded by Santiago Dam and Villa Park Dam. Downstream of the Villa Park Dam, OCWD conducts groundwater recharge operations. OCWD manages infiltration of stormwater in Santiago Basins and releases water into the creek at rates that maximize percolation in the creek bed. Recharge occurs in the basins as well as downstream in the creek from the basins to Hart Park in the city of Orange. OCWD also conveys water via a pipeline from the recharge facilities along the Santa Ana River for percolation in the Santiago recharge facilities. This supply is a combination of Santa Ana River flow and imported water. During most of the year, there is more flow in the creek due to OCWD recharge operations than would be under natural conditions. Data indicates that Santiago Creek naturally loses flow through percolation into the groundwater and that groundwater levels have no impact on creek flows due to the vadose zone being tens of feet thick in this area.

Figure 14-3: Santiago Creek,view upstream in the vicinity of Hart Park in Orange

Figure 14-4: Santiago Creek, view upstream from Tustin Avenue in Orange

SECTION 15 PROTOCOLS FOR MODIFYING MONITORING PROGRAMS

Protocols that trigger a change in a monitoring program include:

- a recommendation by the GWRS Independent Advisory Panel for resampling or increased monitoring of a particular constituent of concern;
- a recommendation by the Independent Advisory Panel that reviews OCWD use of Santa Ana River water for groundwater recharge and related water quality;
- a change in regulation or anticipation of a change in regulation;
- a constituent in a sample approaches or exceeds a regulatory water quality limit or Maximum Contaminant Level, notification level, or first-time detection of a constituent;
- the computer program built by OCWD to validate water quality data prior to transfer to the WRMS data base flags a variation in historical data that may indicate a statistically significant change in water quality;
- analysis of water quality trends conducted by water quality, hydrogeology, or recycled water production staff indicate a need to change monitoring; or
- OCWD initiates a special study, such as quantifying the removal of contaminants using treatment wetlands or testing the infiltration rate of a proposed new recharge basins.

SECTION 16 EVALUATION OF POTENTIAL PROJECTS

16.1 FACILITIES IMPROVEMENT PROJECTS AND STUDIES

OCWD regularly evaluates potential projects and conducts studies to improve the existing facilities and build new facilities, such as:

- Increasing the capacity to transfer water from one basin to another;
- Reconfiguring a basin to improve infiltration rates;
- Evaluating potential sites for new recharge facilities such as existing flood control facilities;
- Developing new water supply sources such as water recycling and increasing stormwater capture; and
- Developing remediation plans to protect basin water quality.

16.2 LONG-TERM FACILITIES PLANS

The Long-Term Facilities Plan (LTFP) is a strategic planning tool which identifies potential projects that advance the mission of OCWD. The key purpose in preparing the LTFP is to identify the most important and effective potential projects so that available resources can be focused appropriately. Preparation of the LTFP helps OCWD prioritize its efforts to those potential projects that should be further developed. Plan development includes consideration of current and projected water demands, current water supplies available for groundwater recharge, and estimated costs and benefits of potential projects.

The Long-Term Facilities Plan 2014 Update evaluated 65 potential projects grouped by project type (water supply, basin management, recharge facilities, operational improvements, and operational efficiency). Each project was reviewed and evaluated by OCWD staff with regards to its economic and technical feasibility. Benefits of projects were evaluated based on the following:

- Increase supply of recharge water;
- Increase recharge capacity and efficiency of recharge facilities;
- Cleanup of contaminated groundwater;
- Protection of groundwater quality; and
- Control of seawater intrusion.

Seventeen of the 65 projects were selected for additional focused study. For these projects more detailed cost estimates were prepared along with an analysis of the project’s feasibility, potential constraints, and estimated timeline for construction. Groundwater recharge projects were evaluated using the Recharge Facilities Model, described in the following section.

16.3 RECHARGE STUDIES AND EVALUATIONS

OCWD has an ongoing program to continually assess potential enhancements to existing recharge facilities, evaluate new recharge methods and analyze potential new recharge facilities. The planning and implementation horizon for recharge facilities varies from a near term horizon of 5 to 10 years for development of specific projects to 50-year projections of the future availability of recharge water supplies, as described below.

Recharge Enhancement Working Group

The Recharge Enhancement Working Group is comprised of OCWD staff from multiple departments that works to maximize the efficiency of existing recharge facilities and evaluate new concepts to increase recharge capacity. Proposed projects under investigation are continually evolving as needs and conditions change. Potential projects/concepts considered include reconfiguration of existing basins, operational improvements to increase flexibility in the management of the basins, alternative basin cleaning methods, potential sites for new basins, and control of sediment concentrations.

Computer Model of Recharge Facilities

One of the challenges OCWD faces in determining the value of improving existing recharge facilities, storing more water at Prado Dam and purchasing new recharge facilities is estimating the amount of additional water that could be recharged due to a potential project. Given the complexity and interconnectivity of the recharge system, a model was needed to isolate the impacts of various proposed projects in order to determine the increased recharge potential due to a specific project.

OCWD developed the Recharge Facilities Model, which is a computer model of the recharge system that simulates Prado Dam operations, Santa Ana River flow and each recharge facility. This model is primarily a planning tool that is used to evaluate various conditions including estimating recharge benefits if new recharge facilities are constructed, existing facilities are improved, increased storage is achieved at Prado Dam, or baseflow changes occur in the Santa Ana River. The model can be operated by OCWD staff from a desktop computer using a graphical user interface.

The Recharge Facilities Model was completed in 2009 with the assistance of CH2M HILL and is based on GoldSim software, which is a general simulation software solution for dynamically modeling complex systems in business, engineering and science http://www.goldsim.com/Home/) (CH2M HILL, 2009).

Key features of the Recharge Facilities Model include:

- Ability to simulate different surface water inflow scenarios (e.g., high base flow, low base flow, etc.)
- Inflatable rubber dam operations (e.g., diversion rates, deflation/inflation)

- Conveyance capacity of system (e.g., pipeline and pumping capacities)
- Basin recharge capacities
- Reductions in basin capacities caused by clogging
- Maintenance thresholds that cause basins to be taken out of service and cleaned
- Different Prado Dam conservation pool elevations and release rates
- Different sedimentation levels behind Prado Dam
- Ability to add imported water to system when excess capacity is available

Output from the model includes:

- Amount of water recharged in each facility, storage at Prado Dam, release rates from Prado Dam, storage in each facility, etc.;
- Amount of water that could not be recharged and water losses to the ocean;
- Optimal amount of cleaning operations;
- Available (unused) recharge capacity; and
- Amount of imported water that can be recharged using unused capacity.

The RFM is flexible and allows for the development and simulation of a wide array of different scenarios. Examples of how the model has been used to evaluate potential recharge projects include:

- Estimate of the additional amount of water available for recharge if the water conservation pool behind Prado Dam is raised to 505 ft msl year round
- Estimate of the impact of the recent trend toward decreasing base flows in the Santa Ana River.
- Estimate of how much imported water could be purchased using unused system capacity.

16.3.1 Future Santa Ana River Flow Projections

OCWD prepares projections and works with other agencies to prepare projections of future Santa Ana River flows. Previous summaries are discussed in OCWD's Groundwater Management Plan (OCWD, 2015). The most recent projection is discussed below.

In 2014, projections of future Santa Ana River flows were developed for OCWD and the Army Corps to evaluate the feasibility of increasing the volume of water that can be stored behind Prado Dam (WEI, 2014). An existing model developed by Wildermuth Environmental, Inc. (WEI) called the Waste Load Allocation Model (WLAM), was used to estimate non-discharge inputs contributing to river flows. The WLAM is a hydrologic simulation tool of the Santa Ana River watershed tributary to Prado Dam and was developed for the Santa Ana Watershed

Project Authority (SAWPA) by WEI (2010). WEI began development of the WLAM for SAWPA in 1994 and has improved it over time to support numerous water resources investigations.

The WLAM uses historic rainfall and stream flow along the model boundaries for the 50-year period from 1950 to 1999. The model also accounts for the contribution of rising groundwater to Santa Ana River flows. The volume of rising groundwater has decreased in recent years due to lower groundwater levels in the southern portion of the Chino Groundwater Basin. Groundwater levels in this area are expected to remain low as this is part of the basin management strategy to reduce the migration of poor quality groundwater into the Santa Ana River.

Estimated future discharges of water from wastewater treatment plants to the Santa Ana River are expected to decline due to conservation and increased recycling. This, along with reductions in rising groundwater, means that projected Santa Ana River base flows reaching Prado Dam are significantly lower than what occurred from the early 1990s to 2005.

As a result of this work, OCWD developed three Santa Ana River base flow projections:

1. High Base Flow Condition: 101,700 afy
2. Medium Base Flow Condition: 52,400 afy
3. Low Base Flow Condition: 36,000 afy

Per the 1969 Stipulated Judgment in the case of Orange County Water District v. City of Chino, et al., Case No. 117628-County of Orange, a minimum annual Santa Ana River base flow of 42,000 afy is required to reach Prado Dam. However, a system of credits in the judgment allows the Santa Ana River base flow to be as low as 34,000 afy until the credits are exhausted. Given the large credit that exists due to many years of base flow exceeding 42,000 afy, the minimum flow of 34,000 afy could be in place for many decades. Even though the minimum allowable base flow is 34,000 afy, the annual base flow simulated was 36,000 afy for the low base flow condition due to minor variations in rising groundwater produced by the WLAM.

In developing estimates of future Santa Ana River storm flows arriving at Prado Dam, land use conditions in the WLAM were reviewed. For future conditions, SCAG 2005 land use data was modified to represent future (2071) land uses. The assumptions made in modifying the 2005 land use data were: (1) already developed urban areas and surrounding mountain areas were assumed not to change; (2) dairy, poultry, intensive livestock, as well as land use classified as “other agriculture” were assumed to be developed; and, (3) vacant and undeveloped areas were also assumed to be developed by 2071. In addition, all new developed land use in 2071 was assumed to be high density residential. This analysis resulted in an increase in high density residential area of approximately 71 square miles, a decrease dairy, poultry, horse ranch, etc. areas by approximately 11 square miles, and a decrease in undeveloped areas by approximately 59 square miles.

The increased runoff generated by future land uses is offset by plans for storm water harvesting by upstream agencies. Plans were identified for future storm water harvesting from Seven Oaks Dam, diversions from the Santa Ana River and its tributaries, and on-site infiltration that would be required by the Municipal Separate Storm Sewer System (MS4) permit. To develop the lowest flow condition possible, it was assumed that projects that have reached the environmental review stage would be constructed. As a result, the average annual storm flow arriving at Prado Dam is reduced by 27,360 afy (WEI, 2014).

Future estimates of Santa Ana River storm flow arriving at Prado Dam are presented in Table 16-1. The three Santa Ana River base flow conditions were combined with the estimated storm flow arriving at Prado Dam to develop three inflow conditions as summarized in Table 16-2.

Table 16-1**:** Estimated Future Santa Ana River Storm Flow Arriving at Prado Dam

STORM FLOW RUNOFF CONDITION	**Average Storm Flow to Prado Basin (afy)**
Current Land Uses	118,000
Future (2071) Land Uses	125,970
Future (2071) Land Uses, Maximum Storm Water Harvesting	98,610

Table 16-2: Santa Ana River Flow Conditions and Estimated Average Inflow to Prado Dam

CONDITION	**DESCRIPTION**	**Santa Ana River Flow to Prado (afy)**		**Total Average Flow (afy)**
		Average Base Flow	**Average Storm Flow**	
High	High Base Flow, Current Land Uses	101,700	118,000	219,700
Medium	Medium Base Flow, Future (2071) Land Uses	52,400	125,970	178,370
Low	Low Base Flow, Future (2071) Land Uses, Maximum Storm Water Harvesting	36,000	98,610	134,610

Sixteen potential recharge projects were evaluated using the Recharge Facilities Model (RFM) as part of the preparation of OCWD's Long-Term Facilities Plan 2014 Update. Key assumptions used in the RFM are as follows:

1. The Prado Dam conservation pool is operating at 505 feet year round. Work to raise the flood season pool from 498 to 505 feet is ongoing and is expected to be completed and implemented in the next few years.
2. All GWRS water conveyed to Anaheim, including flows from the final expansion of GWRS, will be recharged in Miraloma Basin and La Palma Basin. This assumption frees up the capacity of the remainder of the recharge system for Santa Ana River flows and imported water.

The approach to modeling each project was to compare the total system recharge with and without the project for each flow condition. For example, total system recharge was modeled for the high flow condition with and without a project. The difference in the recharge obtained for the entire system comparing the two runs defined the benefit of the project being modeled. This was then repeated for the medium and low flow conditions. Table 16-3 shows the additional yield produced by each potential project for the high, medium, and low flow conditions.

The RFM was also used to evaluate the loss of storm flow capture that will result as sediment continues to accumulate in the Prado Basin. Based on the historical rate of sediment accumulation of approximately 350 acre-feet per year, the storage within the conservation pool is projected to fill up within the next 50 years. If the conservation pool becomes filled with sediment, the eventual loss of storm water available for recharge will range from 30,000 to 38,000 acre-feet per year.

Table 16-3: Annual Yield of Potential Surface Water Recharge System Projects based on Recharge Facilities Model

PROJECT NAME	Santa Ana River Flow Condition (afy)		
	High	Medium	Low
Desilting Santa Ana River Flows	10	390	10
Enhanced Recharge in Santiago Creek at Grijalva Park	10	10	85
Subsurface Collection and Recharge System in Off-River and Five Coves	610	730	150
Enhanced Recharge in Santa Ana River Between Five Coves/Lincoln Ave.	10	220	20
Enhanced Recharge in Santa Ana River Below Ball Road	730	600	230
Recharge in Lower Santiago Creek	270	150	90
Five Coves Bypass Pipeline	130	10	10
Five Coves Bypass Pipeline with Lincoln Basin Rehabilitation	710	490	100
Placentia Basin Improvements	75	170	260
Raymond Basin Improvements	40	230	350
River View Basin Expansion	10	100	10
Additional Warner to Anaheim Lake Pipeline	10	10	30
Lakeview Pipeline	10	10	10
Warner System Modifications	210	250	10
Anaheim Lake Re-contouring	10	125	10

SECTION 17 REFERENCES

Alley, William M., 2006, Another Water Budget Myth: The Significance of Recoverable Ground Water in Storage, Ground Water, National Ground Water Association.

Banks, Harvey O., Consulting Engineer, 1984, *Groundwater Management*, Irvine Area, Orange County, California, prepared for the Orange County Water District.

Bawden, Gerald W., Wayne Thatcher, Ross S. Stein, Ken W. Hudnut, and Gilles Peltzer, 2001, *Tectonic Contraction Across Los Angeles After Removal of Groundwater Pumping Effects*, Nature, Vol. 412, pp. 812-815.

Bawden, G.W., 2003, Separating ground-water and hydrocarbon-induced surface deformation from geodetic tectonic contraction measurements across metropolitan Los Angeles, California. In K.R. Prince and Galloway, D.L., eds., U.S. Geological Survey subsidence interest group conference, proceedings of the technical meeting, Galveston, Texas, November 27-29, 2001. U.S. Geological Survey Open-File Report 03-308. http://pubs.usgs.gov/of/2003/ofr03-308/.

Blomquist, William, 1992, *Dividing the Waters: Governing Groundwater in Southern California*, Center for Self-Governance, San Francisco.

Boyle Engineering Corporation and Orange County Water District, 1997*, Coastal Groundwater Management Investigation*.

California Department of Public Health (CDPH), 2013. Groundwater Replenishment Reuse Draft Regulation, March 28, 2013.

California Department of Water Resources, 1966, *Ground Water Basin Protection Project: Santa Ana Gap Salinity Barrier, Orange County*, Bulletin No. 147-1.

***** 1967, *Progress Report on the Ground Water Geology of the Coastal Plain of Orange County*.

***** 1968, *Sea-Water Intrusion: Bolsa-Sunset Area, Orange County*, Bulletin No. 63-2.

Callison, J., M. Amabisco, and A. Wilkens, 1991, *Hydrogeology of Alamitos Gap*" and *Hydrogeology of Alamitos Gap – Appendix C*, Los Angeles County Department of Public Works Hydraulic/Water Conservation Division.

California Regional Water Quality Control Board, Santa Ana Region (RWQCB). 2004. Order No. R8-2004-0002, Producer/User Water Recycling Requirements and Monitoring and Reporting Program for the Orange County Water District Interim Water Factory 21 and Groundwater Replenishment System Groundwater Recharge and Reuse at Talbert Gap Seawater Intrusion Barrier and Kraemer/Miller Basins. March 12, 2004.

***** 2008, Order No. R8-2008-0058

Camp Dresser & McKee Inc., 2000, *Groundwater Replenishment System, Project Development Phase – Development Information Memorandum No. 9A, Barrier System*

Modeling/Design Criteria, 100% Submittal, prepared for OCWD and Orange County Sanitation District.

*****	2003, *Talbert Gap Model Refinement Report*, prepared for OCWD.

Clark, J. F., Hudson G.B, Davisson, M.L., Woodside, G., and Roy Herndon, 2004, *Geochemical Imaging of Flow Near an Artificial Recharge Facility, Orange County, California.* Ground Water. Vol 42, 2, 167-174.

Clark, Jordan F. 2009. The 2008 Kraemer Basin Tracer Experiment Final Report, Department of Earth Sciences, University of California, Santa Barbara. August 7, 2009.

Dasgupta. P.K., et al., 2005. The origin of naturally occurring perchlorate: The role of atmospheric processes. Environmental Science and Technology, 39, 1569-1575.

DDBE, Inc. 2009. Demonstration Mid-Basin Injection Project Plan, prepared for OCWD.

Fairchild, F.B. and Wiebe, K.H., 1976. Subsidence of organic soils and salinity barrier design in coastal Orange County, California. In A.I. Johnson, ed., Proceedings of the Second International Symposium on Land Subsidence, Anaheim, California, December 13–17,1976, *International Association of Hydrological Sciences Publication* 121, 334-346.

Foubister, Vida. 2006. Analytical Chemistry, pages 7914-7915.

Freeze, R. Allan and John A. Cherry. 1979. *Groundwater*. Prentice-Hall, Inc., 604 pp.

Ghyben, W.B. 1888. Nota in verband met de voorgenomen putboring nabij Amsterdam. *Tijdschrift van Let Koninklijk Inst. Van Ing.*

Golder Associates Inc., 2009, Santa Ana River Bed Sediment Gradation Characterization Study: Phase III, prepared for OCWD.

Happel, A. M., Beckenback, E. H., and Halden, R. U., 1998, *An evaluation of MTBE impacts to California groundwater resources* (UCRL-AR-130897), Livermore, CA, Lawrence Livermore National Laboratory.

Harbaugh, A.W., and McDonald, M.G., 1996, User's documentation for MODFLOW-96, an update to the U.S. Geological Survey modular finite-difference ground-water flow model: USGS Open-File Report 96-485, 56 p.

Harbaugh, A.W., Banta, E.R., Hill, M.C., and McDonald, M.G., 2000, *MODFLOW-2000, The U.S. Geological Survey Modular Ground-Water Model – User Guide to Modularization Concepts and the Ground-Water Flow Process*, USGS Open-File Report 00-92, 121 pp.

Hardt, William F. and E. H. Cordes, 1971, *Analysis of Ground-Water System in Orange County, California by Use of an Electrical Analog Model*, USGS Open-File Report.

Harley, et al., 1999, *Model Advisory Panel Report*. Prepared for OCWD.

*****	2001, *Model Advisory Panel Report*. Prepared for OCWD.

Herndon, Roy L. and John D. Bonsangue. 2006. *Hydrogeology of the Orange County Groundwater Basin – An Updated Overview*, Geology of the Orange County Region, Southern California, Annual Field Trip Guide No. 33, South Coast Geological Society, Inc.

Herzberg, A. 1901. Die Wasserversorgung einiger Nordseebader. *J. Gasbeleucht. Wasserversorg., 44, pp. 815-819.*

Intera, Inc., 2010. *Alamitos Barrier Model Final Report*, prepared for OCWD.

Interstate Technology & Regulatory Council. 2005. *Perchlorate: Overview of Issues, Status, and Remedial Options.* Perchlorate-1. Washington D.C.: Interstate Technology & Regulatory Council Perchlorate Team. Available on the internet at http://www.itrcweb.org

Irvine Ranch Water District, May 1994, *Organic Removal Testing Pilot Program*.

Kolpin, et al., 2002, Pharmaceuticals, Hormones, and Other Organic Wastewater Contaminants in U.S. Streams, 1999-2000: A National Reconnaissance, Environmental Science and Technology, 36, 1202-1211.

Leake, S.A. and Prudic, D.E., 1991. Documentation of a computer program to simulate aquifer-system compaction using the modular finite-difference ground-water flow model, USGS, Techniques of Water-Resources Investigations, Book 6, Chapter A2 Appendix C: Time-Variant Specified-Head Package.

Los Angeles County Department of Public Works, 2016. *Alamitos Barrier Project Annual Report on the Control of Seawater Intrusion 2014-2015*.

McDonald and Harbaugh, 1988, *Techniques of Water-Resources Investigations of the United States Geological Survey, Book 6, A Modular Three-Dimensional Finite-Difference Ground-Water Flow Model.*

McGillicuddy, Kevin B., 1989, *Ground Water Underflow Beneath Los Angeles-Orange County Line,* unpubl. M.S. thesis, Univ. of Southern California Dept. of Geological Sciences.

Metropolitan Water District of Southern California and U.S. Department of Interior, Bureau of Reclamation, 1999, *Salinity Management Study*.

Mills, William R. and Associates, 1987, *Hydrogeology of the Yorba Linda Subarea and Impacts from Proposed Class III Landfills*, prepared for OCWD.

Montgomery, James M., Consulting Engineers, Inc., 1974, *Bolsa Chica Mesa Water Quality Study,* prepared for OCWD.

Morton, Paul K., et al., 1976, *Environmental Geology of Orange County, California*, California Division of Mines and Geology Open-File Report No. 79-8 LA.

Municipal Water District of Orange County, 2016, Technical Memorandum on Orange County Reliability Study, Water Demand Forecast and Supply Gap Analysis, prepared by CDM Smith for MWDOC, April 20, 2016.

National Research Council, 2005, *Health Implications of Perchlorate Ingestion*.

National Water Research Institute, 2000, *Treatment Technologies for Removal of MTBE from Drinking Water: Air Stripping, Advanced Oxidation Processes, Granular Activated Carbon, Synthetic Resin Sorbents*, Second Edition.

***** 2013, *Report of the Scientific Advisory Panel, OCWD's Santa Ana River Water Quality and Health Study.*

***** 2014, *Final Report of the November 12, 2013 Meeting of the Independent Advisory Panel on Reviewing the Orange County Water District's Santa Ana River Monitoring Program*, prepared for OCWD.

Nevada Division of Environmental Protection. 2009. http://ndep.nv.gov/BCA/perchlorate05.htm. Accessed on July 7, 2009.

Orange County Water District, 1996, *Evaluation of the Orange County Colored Water Groundwater Resource: Hydrology, Water Quality and Treatment*.

***** June 1997, *Issues Paper – Development of the Colored Water Zone.*

***** 1999, 2020 *Master Plan Report for the Orange County Water District.*

***** 1970 to 2015, *Engineer's Report on Groundwater Conditions, Water Supply and Basin Utilization*.

***** 2003, *Orange County Water District Recharge Study*.

***** 2005. Board of Directors Resolution No. 05-4-40: Establishing a GWR System Buffer Area around the GWR System injection operation at the Talbert Gap Seawater Intrusion Barrier, April 20, 2005, Fountain Valley, California.

***** 2006, OCWD Application to State Water Resources Control Board to Appropriate Santa Ana River Water.

***** 2007, *Report on Evaluation of Orange County Groundwater Basin Storage and Operational Strategy.*

***** 2013, *Geologist's/Engineer's Report: Alamitos Barrier Improvement Project (Construction Unit 14).*

***** 2014, *Orange County Water District Long-Term Facilities Plan.*

***** 2015, *Orange County Water District Groundwater Management Plan 2015 Update,* June 17, 2015.

***** 2016a, *Summary of Seawater Intrusion in Orange County*, OCWD Technical Memorandum by Tim Sovich, December 14, 2016.

***** 2016b, *Salt and Nitrate Projections for Orange County Management Zone*, Final Technical Memorandum by Greg Woodside, July 18, 2016.

***** 2016c, Groundwater Replenishment System 2015 Annual Report, prepared for the California Regional Water Quality Control Board, Santa Ana Region Order No. R8-2004-0002, as amended by Order No. R8-2008-0058.

Poland, J. F. et al., 1956, *Ground Water Geology of the Coastal Zone Long Beach-Santa Ana Area, California*, USGS Water Supply Paper 1109.

Pollack, D.W., 1994. User's Guide for MODPATH/MODPATH-PLOT, Version 3: A particle tracking post-processing package for MODFLOW, the U. S. Geological Survey finite-difference ground-water flow model, USGS Open File Report 94-464.

Santa Ana River Watermaster, 2014, Forty-Third Annual Report, Orange County Water District vs. City of Chino et al., Case No. 117628 – County of Orange.

Santa Ana Watershed Project Authority, 2002, *Integrated Watershed Plan*.

***** 2004*, Santa Ana River Projected Flow Impacts Report*.

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

Sovich, Tim, 2016, *Summary of Seawater Intrusion in the Orange County Groundwater Basin*, OCWD technical memorandum, September 1, 2016.

Tan, Lo and R. G. Sudak, January 1992, Removing Color From a Groundwater Source, AWWA Journal.

Urbansky, E.T., et al. 2001. Environmental Pollution: 112, pages 299-302.

U.S. Army Corps of Engineers, September 1994, *Water Control Manual for the Prado Dam and Reservoir, Santa Ana River.*

***** 2004, *Prado Basin Water Conservation Feasibility Study, Main Report and Draft Environmental Impact Statement/Environmental Impact Report*, *Draft F5 Document*.

U.S. Bureau of Reclamation, 2013, *Climate Change Analysis for the Santa Ana River Watershed, Santa Ana Watershed Basin Study, California Lower Colorado Region*, U.S. Bureau of Reclamation, Water and Environmental Resources Division (86-68200) Water Resources Planning and Operations Support Group (86-68210) Technical Services Center, Denver Colorado Technical Memorandum No. 86-68210-2013-02.

U.S. Geological Survey, 1953, *Native and Contaminated Ground Waters in the Long Beach-Santa Ana Area, California*, Water-Supply Paper 1136.

***** 1967, *An Investigation of Potential Salt-Water Intrusion from Inland Waterways in the Shallow Alluvial and Coastal Deposits of Sunset and Bolsa Gaps, Orange County, California*, USGS Water Resources Division, Open-File Report, July 17, 1967.

***** 1999*, Land Subsidence in the United States*, Circular 1182.

Wildermuth Environmental, 2010, Recent Changes in Santa Ana River Discharge, White Paper.

***** 2014, *Recomputation of Ambient Water Quality in the Santa Ana Watershed for the Period 1993-2012, Final Technical Memorandum,* prepared for the Basin Monitoring Task Force.

APPENDIX A

List of Wells in OCWD Monitoring Network

List of Wells in OCWD Monitoring Programs

KEY

Aquifer Zone: S=Shallow Aquifer, P=Principal Aquifer, D= Deep Aquifer

Program: 1) monitoring well, 2) production well, 3) irrigation or industrial well, 4) injection well, 5) Mid-Basin Injection well, 6) seawater intrusion monitoring well, 7) well monitored by OCWD for Title 22 compliance, 8) North Basin Groundwater Protection Program wells, 9) South Basin Groundwater Protection Program wells, 10) wells in CASGEM monitoring program

Well Name	Well Owner	Bore Depth (ft. bgs)	Casing Sequence	Screened Interval (ft.bgs)		Type of Well	Aquifer Zone	Program
				Top	Bottom			
ABC-KISCH	ABC SCHOOL DIST.	0		0	0	Inactive Production		2
ABC-MESCH	ABC SCHOOL DIST.	0		0	0	Other Active Production		2
ABC-TETZL	ABC SCHOOL DIST.	0		0	0	Other Active Production		2
W-5470	ABC SCHOOL DIST.	282		190	240	Inactive Production		2
ACP-I03	AC PRODUCTIONUCTS	460		370	450	Injection		4
ACP-P01	AC PRODUCTIONUCTS	200		90	140	Inactive Production		2,3
ACP-P02	AC PRODUCTIONUCTS	190		100	180	Other Active Production		2
AVCC-P	ALTA VISTA COUNTRY CLUB	438		0	0	Other Active Production		2,3
AVCC-P2	ALTA VISTA COUNTRY CLUB	803		210	770	Other Active Production	P	2,3
A-14	ANAHEIM	450		309	425	Inactive Production	P	2,8
A-36	ANAHEIM	818		651	796	Inactive Production	P	2,7
A-39	ANAHEIM	1493		540	1280	Active Large Production	P	2,7
A-40	ANAHEIM	1308		505	1220	Active Large Production	P	2,7
A-41	ANAHEIM	1532		437	1450	Active Large Production	P	2,7
A-42	ANAHEIM	1260		430	1180	Active Large Production	P	2,7
A-43	ANAHEIM	1400		530	1210	Active Large Production	P	2,7
A-44	ANAHEIM	1155		450	1130	Active Large Production	P	2,7
A-45	ANAHEIM	1430		455	1410	Active Large Production	P	2,7
A-46	ANAHEIM	1565		599	1529	Active Large Production	P	2,7
A-47	ANAHEIM	1500		482	1375	Active Large Production	P	2,7,8
A-48	ANAHEIM	1450		932	1344	Active Large Production	P	2,7
A-49	ANAHEIM	1498		580	1450	Active Large Production	P	2,7,8
A-51	ANAHEIM	1310		525	965	Active Large Production	P	2,7
A-52	ANAHEIM	1210		570	1066	Active Large Production	P	2,7
A-53	ANAHEIM	1350		945	1270	Active Large Production	P	2,7
A-54	ANAHEIM	0		680	1480	Active Large Production	P	2,7
A-55	ANAHEIM	1340		370	1300	Active Large Production	P	2,7
A-56	ANAHEIM	1600		725	1300	Active Large Production	P	2,7
A-58	ANAHEIM	1218		400	930	Inactive Production		2,7
ADEV-AM1	ANAHEIM	157		110	150	Monitoring		1
A-DMGC	ANAHEIM	500		430	482	Other Active Production	P	2,3
A-YARD-MW1	ANAHEIM	112		85	109	Monitoring		1
A-YARD-MW2	ANAHEIM	111		86	110	Monitoring		1
W-15896	ANAHEIM MOTEL, LIMITED	200		0	0	Inactive Production		2,3
ANGE-O	ANGELICA HEALTHCARE SERVICES	670		186	639	Other Active Production		2,3
AET-RMW10	ARCO/TOSCO/EQUIVA	129		127	128	Monitoring		1
AET-RMW14	ARCO/TOSCO/EQUIVA	197		195	196	Monitoring		1
AET-RMW15	ARCO/TOSCO/EQUIVA	142		140	141	Monitoring		1
AET-RMW16	ARCO/TOSCO/EQUIVA	200		189	190	Monitoring		1
AET-RMW17	ARCO/TOSCO/EQUIVA	218		217	218	Monitoring		1
AET-RMW2	ARCO/TOSCO/EQUIVA	199		196	197	Monitoring		1
AET-RMW20	ARCO/TOSCO/EQUIVA	100		98	99	Monitoring		1
AET-RMW23	ARCO/TOSCO/EQUIVA	124		119	120	Monitoring		1
AET-RMW3	ARCO/TOSCO/EQUIVA	200		194	195	Monitoring		1
AET-RMW5	ARCO/TOSCO/EQUIVA	200		195	196	Monitoring		1
AET-RMW6	ARCO/TOSCO/EQUIVA	184		116	117	Monitoring		1
AET-RMW7	ARCO/TOSCO/EQUIVA	113		108	109	Monitoring		1
AET-RMW8	ARCO/TOSCO/EQUIVA	98		94	95	Monitoring		1
AET-RMW9	ARCO/TOSCO/EQUIVA	112		107	108	Monitoring		1
ARMD-LA3	ARMED FORCES RESERVE CENTER	965		333	363	Inactive Production		2
ARMD-LARA	ARMED FORCES RESERVE CENTER	0		0	0	Inactive Production		2
AR-PUMP	ARTESIA	217		0	0	Other Active Production		2,3
W-14107	ARTESIA ICE CO.	51		0	0	Inactive Production		2,3
ARCO-FBH11	ATLANTIC RICHFIELD CO.	62		50	62	Monitoring		1
ARCO-FBH12	ATLANTIC RICHFIELD CO.	75		55	75	Monitoring		1
ARCO-FBH14	ATLANTIC RICHFIELD CO.	75		0	0	Monitoring		1
ARCO-FBH17	ATLANTIC RICHFIELD CO.	140		124	139	Monitoring		1
ARCO-FBH5	ATLANTIC RICHFIELD CO.	75		0	0	Monitoring		1
ARCO-FBH6	ATLANTIC RICHFIELD CO.	80		48	80	Monitoring		1
ARCO-T2209	ATLANTIC RICHFIELD CO.	150		82	143	Injection		4
BF-BF1	BELLFLOWER	1200		574	1160	Active Large Production		2
PEER-17	BELLFLOWER MUNICIPAL WATER CO.	1030		610	1012	Active Small Production		2
PEER-2	BELLFLOWER MUNICIPAL WATER CO.	204		162	177	Active Large Production		2
PEER-7	BELLFLOWER MUNICIPAL WATER CO.	108		0	0	Active Small Production		2
PEER-8	BELLFLOWER MUNICIPAL WATER CO.	174		113	153	Other Active Production		2
FUJI-FV	BERUMEN FARMS	170		0	0	Other Active Production		2,3
FUJI-WM	BERUMEN FARMS	150		0	0	Inactive Production		2,3

List of Wells in OCWD Monitoring Programs

KEY

Aquifer Zone: S=Shallow Aquifer, P=Principal Aquifer, D= Deep Aquifer

Program: 1) monitoring well, 2) production well, 3) irrigation or industrial well, 4) injection well, 5) Mid-Basin Injection well, 6) seawater intrusion monitoring well, 7) well monitored by OCWD for Title 22 compliance, 8) North Basin Groundwater Protection Program wells, 9) South Basin Groundwater Protection Program wells, 10) wells in CASGEM monitoring program

Well Name	Well Owner	Bore Depth (ft. bgs)	Casing Sequence	Screened Interval (ft.bgs)		Type of Well	Aquifer Zone	Program
				Top	Bottom			
BOE-EW101	BOEING CO.	77		57	77	Other Active Production	S	2
BOE-EW102	BOEING CO.	87		62	82	Other Active Production	S	2
BOE-EW103	BOEING CO.	85		63	83	Other Active Production	S	2
BOE-EW104	BOEING CO.	83		57	82	Other Active Production	S	2
BOE-MW16	BOEING CO.	297		260	280	Monitoring		1,6
BOE-MW17	BOEING CO.	298		255	275	Monitoring		1,6
BOE-MW19A	BOEING CO.	173		153	173	Monitoring		1,6
BOE-MW20S	BOEING CO.	84		59	80	Monitoring	S	1
BOE-MW21S	BOEING CO.	81		59	79	Monitoring	S	1
BOE-MW27A	BOEING CO.	172		139	159	Monitoring		1,6
BOE-MW31S	BOEING CO.	92		78	88	Monitoring	S	1
BOE-MW34	BOEING CO.	278		252	267	Monitoring		1,6
BOE-MW37A	BOEING CO.	172		135	165	Monitoring		1,6
BOE-MW38A	BOEING CO.	170		135	165	Monitoring		1,6
BOE-MW41A	BOEING CO.	177		149	169	Monitoring		1,6
BOE-MW42A	BOEING CO.	173		140	170	Monitoring		1,6
BOE-MW57A	BOEING CO.	172		150	170	Monitoring		1,6
BOE-MW58A	BOEING CO.	175		150	170	Monitoring		1,6
BOE-MW59B	BOEING CO.	268		240	250	Monitoring		1,6
BOE-MW60A	BOEING CO.	172		150	170	Monitoring		1,6
BOE-MW61A	BOEING CO.	172		150	170	Monitoring		1,6
BOE-MW72A	BOEING CO.	132		112	127	Monitoring		1,6
BOE-MW73A	BOEING CO.	137		113	133	Monitoring		1,6
BOE-MW75	BOEING CO.	227		202	222	Monitoring		1,6
BOE-MW95A	BOEING CO.	172		135	165	Monitoring		1,6
BOE-MW96A	BOEING CO.	175		150	170	Monitoring		1,6
BOE-MW97A	BOEING CO.	215		170	175	Monitoring		1,6
BOE-MW98A	BOEING CO.	215		169	174	Monitoring		1,6
BOE-MW99A	BOEING CO.	210		146	166	Monitoring		1,6
BOTT-C	BOTT TRACT MUTUAL WATER CO.	150		0	0	Other Active Production		2,3
LB-NLB10	BOY SCOUTS OF AMERICA	378		357	374	Monitoring		1
BR-1	BREA	500		78	115	Other Active Production		2,3
BROS-WM	BRORS OF ST.PATRICK	106		98	105	Other Active Production		2
BP-BALL	BUENA PARK	890		260	870	Active Large Production	P	2,7
BP-BOIS	BUENA PARK	1505		475	1355	Active Large Production	P	2,7
BP-CABA	BUENA PARK	1430		250	1010	Active Large Production	P	2,7
BP-FREE	BUENA PARK	1000		260	1000	Active Large Production	P	2,7
BP-HOLD	BUENA PARK	1020		250	1000	Active Large Production	P	2,7
BP-KNOT	BUENA PARK	1020		260	1000	Active Large Production	P	2,7
BP-LIND	BUENA PARK	1410		470	1221	Active Large Production	P	2,7
BP-SM	BUENA PARK	1038		308	1038	Active Large Production	P	2,7
OCWD-BGO10	CA STATE LANDS COMMISSION	110		80	100	Monitoring		1
SLC-MW1	CA STATE LANDS COMMISSION	25		5	25	Monitoring		1
SLC-MW10	CA STATE LANDS COMMISSION	32		10	30	Monitoring		1
SLC-MW11	CA STATE LANDS COMMISSION	32		10	30	Monitoring		1
SLC-MW12	CA STATE LANDS COMMISSION	32		10	30	Monitoring		1
SLC-MW13	CA STATE LANDS COMMISSION	32		10	30	Monitoring		1
SLC-MW14	CA STATE LANDS COMMISSION	32		10	30	Monitoring		1
SLC-MW15	CA STATE LANDS COMMISSION	32		10	30	Monitoring		1
SLC-MW16	CA STATE LANDS COMMISSION	32		10	30	Monitoring		1
SLC-MW2	CA STATE LANDS COMMISSION	25		5	25	Monitoring		1
SLC-MW3	CA STATE LANDS COMMISSION	25		5	25	Monitoring		1
SLC-MW4	CA STATE LANDS COMMISSION	25		5	25	Monitoring		1
SLC-MW5	CA STATE LANDS COMMISSION	25		5	25	Monitoring		1
SLC-MW6	CA STATE LANDS COMMISSION	25		5	25	Monitoring		1
SLC-MW7	CA STATE LANDS COMMISSION	32		10	30	Monitoring		1
SLC-MW8	CA STATE LANDS COMMISSION	32		10	30	Monitoring		1
SLC-MW9	CA STATE LANDS COMMISSION	32		10	30	Monitoring		1
SLC-P10	CA STATE LANDS COMMISSION	25		5	15	Monitoring		1
SLC-P11	CA STATE LANDS COMMISSION	25		5	15	Monitoring		1
SLC-P13	CA STATE LANDS COMMISSION	25		5	15	Monitoring		1
SLC-P14	CA STATE LANDS COMMISSION	25		5	15	Monitoring		1
SLC-P15	CA STATE LANDS COMMISSION	25		5	15	Monitoring		1
SLC-P16	CA STATE LANDS COMMISSION	25		5	20	Monitoring		1
SLC-P17	CA STATE LANDS COMMISSION	25		5	20	Monitoring		1
SLC-P18	CA STATE LANDS COMMISSION	25		5	20	Monitoring		1
SLC-P19	CA STATE LANDS COMMISSION	40		5	20	Monitoring		1

List of Wells in OCWD Monitoring Programs

KEY

Aquifer Zone: S=Shallow Aquifer, P=Principal Aquifer, D= Deep Aquifer

Program: 1) monitoring well, 2) production well, 3) irrigation or industrial well, 4) injection well, 5) Mid-Basin Injection well, 6) seawater intrusion monitoring well, 7) well monitored by OCWD for Title 22 compliance, 8) North Basin Groundwater Protection Program wells, 9) South Basin Groundwater Protection Program wells, 10) wells in CASGEM monitoring program

Well Name	Well Owner	Bore Depth (ft. bgs)	Casing Sequence	Screened Interval (ft.bgs)		Type of Well	Aquifer Zone	Program
				Top	Bottom			
SLC-P20	CA STATE LANDS COMMISSION	25		5	10	Monitoring		1
SLC-P21	CA STATE LANDS COMMISSION	25		5	15	Monitoring		1
SLC-P22	CA STATE LANDS COMMISSION	25		5	20	Monitoring		1
SLC-P23	CA STATE LANDS COMMISSION	25		5	15	Monitoring		1
SLC-P24	CA STATE LANDS COMMISSION	25		5	15	Monitoring		1
SLC-P25	CA STATE LANDS COMMISSION	25		5	20	Monitoring		1
SLC-P26	CA STATE LANDS COMMISSION	25		5	20	Monitoring		1
SLC-P27	CA STATE LANDS COMMISSION	40		5	20	Monitoring		1
SLC-P29	CA STATE LANDS COMMISSION	25		6	21	Monitoring		1
SLC-P30	CA STATE LANDS COMMISSION	46		22	37	Monitoring		1
SLC-P31	CA STATE LANDS COMMISSION	25		5	20	Monitoring		1
SLC-P32	CA STATE LANDS COMMISSION	25		8	23	Monitoring		1
SLC-P33	CA STATE LANDS COMMISSION	40		6	21	Monitoring		1
SLC-P34	CA STATE LANDS COMMISSION	40		6	21	Monitoring		1
SLC-P35	CA STATE LANDS COMMISSION	40		7	22	Monitoring		1
SLC-P36	CA STATE LANDS COMMISSION	40		6	21	Monitoring		1
SLC-P4	CA STATE LANDS COMMISSION	25		5	20	Monitoring		1
SLC-P5	CA STATE LANDS COMMISSION	25		5	15	Monitoring		1
SLC-P6	CA STATE LANDS COMMISSION	25		5	15	Monitoring		1
SLC-P9	CA STATE LANDS COMMISSION	25		5	20	Monitoring		1
CIFM-CH	CA. INSTITUE FOR MEN - CHINO	239		122	226	Other Active Production		2
CIFM-CH1A	CA. INSTITUE FOR MEN - CHINO	529		0	0	Other Active Production		2
CSF-1	CA. STATE UNIV., FULLERTON	842		130	726	Multiport Monitoring	S/P/D	1
FPRK-YLE	CANYON RV PARK	98		60	84	Active Small Production	S	2,7
FPRK-YLW	CANYON RV PARK	98		48	80	Active Small Production	S	2,7
CARD-O	CARDINAL MANAGEMENT	70		0	0	Other Active Production		2,3
MKSSN-A	CCDA WATERS, LLC	800		635	755	Other Active Production		2,3
CE-C1	CERRITOS	1035		295	976	Active Large Production		2
CE-C2	CERRITOS	1050		280	980	Active Large Production		2
CE-C4	CERRITOS	1030		305	955	Active Large Production		2
CHEV-HBP4	CHEVRON U.S.A. - LA HABRA	680		490	640	Inactive Production		2,3
CHEV-NOR4	CHEVRON U.S.A. - LA HABRA	1023		990	1005	Inactive Production		2,3
W-18110	CHEVRON U.S.A.-HUNTINGTON BCH.	116		85	115	Monitoring		1
PLMP-YL	CITY OIL CORP	77		0	0	Inactive Production		2,3
CCOL-C	COMMUNITY COLLEGE DIST.	395		365	395	Other Active Production		2,3
COMM-LP	COMMUNITY WATER ASSOC.	0		0	0	Inactive Production		2
CNXT-NBEI1	CONEXANT SYSTEMS, INC.	100		60	100	Inactive Production		2
CNXT-NBEI2	CONEXANT SYSTEMS, INC.	100		60	100	Inactive Production		2
CNXT-NBEI3	CONEXANT SYSTEMS, INC.	100		60	100	Inactive Production		2
CNXT-NBEI4A	CONEXANT SYSTEMS, INC.	104		65	100	Inactive Production		2
CNXT-NBES1	CONEXANT SYSTEMS, INC.	43		22	42	Inactive Production		2
CNXT-NBES2	CONEXANT SYSTEMS, INC.	45		21	41	Inactive Production		2
CNXT-NBES3A	CONEXANT SYSTEMS, INC.	46		24	44	Inactive Production		2
CNXT-NBES4B	CONEXANT SYSTEMS, INC.	47		23	43	Inactive Production		2
CNXT-NBES5A	CONEXANT SYSTEMS, INC.	42		20	40	Inactive Production		2
CNXT-NBES6	CONEXANT SYSTEMS, INC.	45		25	40	Inactive Production		2
CNXT-NBI17	CONEXANT SYSTEMS, INC.	105		0	0	Injection		4
CNXT-NBMW27	CONEXANT SYSTEMS, INC.	40		10	40	Monitoring		1
CNXT-NBMW28	CONEXANT SYSTEMS, INC.	82		60	82	Monitoring		1
CNXT-NBMW29	CONEXANT SYSTEMS, INC.	42		21	40	Monitoring		1
CNXT-NBMW30	CONEXANT SYSTEMS, INC.	42		21	42	Monitoring		1
CNXT-NBRI1	CONEXANT SYSTEMS, INC.	105		77	102	Injection		4
CNXT-NBRI2	CONEXANT SYSTEMS, INC.	115		75	110	Injection		4
CNXT-NBRI3	CONEXANT SYSTEMS, INC.	122		75	115	Injection		4
CNXT-NBRI4	CONEXANT SYSTEMS, INC.	97		0	0	Injection		4
CO-16	CORONA	850		415	755	Active Large Production		2
CMW-CO	CORONITA MUTUAL WATER CO.	270		126	234	Other Active Production		2
MCWD-GC	COSTA MESA	225		195	215	Monitoring		1,6
W-3799	COSTA MESA SCHOOL DIST.	297		0	0	Inactive Production		2,3
CCC-LA1	COTTONWOOD CHRISTIAN CENTER	340		140	310	Other Active Production		2
MRCF-GG	CROSBY WATER SYSTEM	240		0	0	Other Active Production		2
MBF-FM2	CT STORAGE - FULLERTON, LLC	135		110	134	Monitoring		1,8
MBF-FM3	CT STORAGE - FULLERTON, LLC	135		110	134	Monitoring		1,8
FJC-LAK2	CYPRESS GC LLC/CYPRESS GOLF CL	620		300	570	Other Active Production	P	2,3
W-18698	DEGUSSA FLAVOR & FRUIT SYSTEMS	90		70	90	Monitoring		1
OCWD-BS103	DEPT. OF WATER RESOURCES	484		184	205	Monitoring	S	1,6
OCWD-BS105	DEPT. OF WATER RESOURCES	394		150	197	Monitoring	S	1,6

List of Wells in OCWD Monitoring Programs

KEY

Aquifer Zone: S=Shallow Aquifer, P=Principal Aquifer, D= Deep Aquifer

Program: 1) monitoring well, 2) production well, 3) irrigation or industrial well, 4) injection well, 5) Mid-Basin Injection well, 6) seawater intrusion monitoring well, 7) well monitored by OCWD for Title 22 compliance, 8) North Basin Groundwater Protection Program wells, 9) South Basin Groundwater Protection Program wells, 10) wells in CASGEM monitoring program

Well Name	Well Owner	Bore Depth (ft. bgs)	Casing Sequence	Screened Interval (ft.bgs)		Type of Well	Aquifer Zone	Program
				Top	Bottom			
OCWD-BS106	DEPT. OF WATER RESOURCES	556		213	255	Monitoring	S	1,6
OCWD-BS107	DEPT. OF WATER RESOURCES	738		398	441	Monitoring		1,6
OCWD-BS111	DEPT. OF WATER RESOURCES	483		184	205	Monitoring		1,6
OCWD-BSO1A	DEPT. OF WATER RESOURCES	500		245	335	Monitoring		1
OCWD-BSO1B	DEPT. OF WATER RESOURCES	500		80	104	Monitoring		1
OCWD-BSO4	DEPT. OF WATER RESOURCES	700		268	498	Monitoring		1
OCWD-BSO6A	DEPT. OF WATER RESOURCES	150		85	135	Monitoring		1,6
OCWD-BSO6B	DEPT. OF WATER RESOURCES	305		235	295	Monitoring		1,6
OCWD-BSO9A	DEPT. OF WATER RESOURCES	445		195	285	Monitoring	S	1,6
OCWD-BSO9B	DEPT. OF WATER RESOURCES	624		520	615	Monitoring	P	1,6
OCWD-BSO9C	DEPT. OF WATER RESOURCES	450		340	435	Monitoring		1,6
OCWD-SA10	DEPT. OF WATER RESOURCES	483		300	330	Monitoring	S/P	1,6
OCWD-SA12	DEPT. OF WATER RESOURCES	715		305	325	Monitoring	S	1
OCWD-SA3	DEPT. OF WATER RESOURCES	401		100	160	Monitoring	S	1,6
OCWD-SA5	DEPT. OF WATER RESOURCES	401		273	312	Monitoring	P	1,6
DICE-SA2	DIAMONITORINGD ICE CORP	1003		330	990	Inactive Production		2,3
SSPG-O	DS WATERS OF AMERICA, INC.	270		250	270	Inactive Production		2
EOCW-E	EAST ORANGE COUNTY WATER DIST.	504		324	450	Active Large Production	P	2,7
EOCW-W	EAST ORANGE COUNTY WATER DIST.	800		315	450	Active Large Production	P	2,7
LKVG-YL	EASTLAKE VILLAGE HOA	124		50	124	Other Active Production		2,3
ESWA-4	EASTSIDE WATER ASSOC.	560		240	520	Active Small Production		2,7
EDGW-SA	EDINGER WATER ASSOC.	308		0	0	Inactive Production		2
EMA-FVRI	ENVIRONMENTAL MGMT AGENCY	0		0	0	Other Active Production		2,3
ALEN-GG	EUCHARISTIC MISSIONARIES	252		0	0	Other Active Production		2
SAKH-A	F S NURSERY	383		0	0	Other Active Production		2,3
FAIR-SA	FAIRHAVEN MEMORIAL PARK	427		0	0	Inactive Production		2,3
FAIR-SA3	FAIRHAVEN MEMORIAL PARK	520		250	500	Other Active Production		2,3
FAA-LA1	FEDERAL AVAIATION ADMIN.	0		0	0	Other Active Production		2,3
FLWN-CQ2	FOREST LAWN	590		160	560	Other Active Production		2,3
FV-10	FOUNTAIN VALLEY	1100		460	980	Active Large Production	P	2,7
FV-11	FOUNTAIN VALLEY	1027		440	950	Active Large Production	P	2,7
FV-12	FOUNTAIN VALLEY	1230		340	1070	Active Large Production	P	2,7
FV-6	FOUNTAIN VALLEY	1150		370	1110	Active Large Production	P	2,7
FV-8	FOUNTAIN VALLEY	920		312	844	Active Large Production	P	2,7
FV-9	FOUNTAIN VALLEY	1114		415	1070	Active Large Production	P	2,7
W-3791	FOUNTAIN VALLEY	0		0	0	Inactive Production		2
F-10	FULLERTON	1350		460	1290	Active Large Production	P	2,7,8
F-3A	FULLERTON	1295		580	1280	Active Large Production	P	2,7,8
F-4	FULLERTON	415		315	405	Active Large Production	P	2,7,8
F-5	FULLERTON	440		350	400	Active Large Production	P	2,7,8
F-6	FULLERTON	430		340	401	Active Large Production	P	2,7,8
F-7	FULLERTON	434		300	410	Active Large Production	P	2,7,8
F-8	FULLERTON	458		324	402	Active Large Production	P	2,7,8
F-AIRP	FULLERTON	1135		435	1080	Active Large Production	P	2,7
F-CHRI2	FULLERTON	1350		520	1330	Active Large Production	P	2,7,8
F-COYO2	FULLERTON	1517		309	919	Inactive Production	P	2
F-KIM1A	FULLERTON	1243		500	1225	Active Large Production	P	2,7,8
F-KIM2	FULLERTON	652		320	626	Active Large Production	P	2,7,8
GG-16	GARDEN GROVE	1000		304	864	Active Large Production	P	2,7
GG-19	GARDEN GROVE	942		818	892	Active Large Production	P	2,7
GG-20	GARDEN GROVE	960		360	912	Active Large Production	P	2,7
GG-21	GARDEN GROVE	1187		428	1080	Active Large Production	P	2,7
GG-22	GARDEN GROVE	1040		416	1020	Active Large Production	P	2,7
GG-23	GARDEN GROVE	860		474	835	Active Large Production	P	2,7
GG-25	GARDEN GROVE	987		442	850	Active Large Production	P	2,7
GG-26	GARDEN GROVE	1120		470	1060	Active Large Production	P	2,7
GG-27	GARDEN GROVE	1215		520	1160	Active Large Production	P	2,7
GG-28	GARDEN GROVE	328		130	240	Active Large Production	S	2,7
GG-29	GARDEN GROVE	1140		465	1110	Active Large Production	P	2,7
GG-30	GARDEN GROVE	1205		390	1146	Active Large Production	P	2,7
GG-31	GARDEN GROVE	1462		739	1373	Active Large Production	P	2,7
WWGC-SAK3	GARDEN GROVE	206		149	170	Other Active Production	S	2,3
WWGC-SAK4	GARDEN GROVE	272		150	249	Other Active Production		2,3
W-15829	GARDEN GROVE UNIF. SCH. DIST.	209		0	0	Inactive Production		2,3
W-4220	GENERAL SERVICE ADMIN.	900		264	887	Inactive Production		2
W-4224	GENERAL SERVICE ADMIN.	602		378	438	Inactive Production		2,3
W-4226	GENERAL SERVICE ADMIN.	586		271	372	Inactive Production		2,3

List of Wells in OCWD Monitoring Programs

KEY

Aquifer Zone: S=Shallow Aquifer, P=Principal Aquifer, D= Deep Aquifer

Program: 1) monitoring well, 2) production well, 3) irrigation or industrial well, 4) injection well, 5) Mid-Basin Injection well, 6) seawater intrusion monitoring well, 7) well monitored by OCWD for Title 22 compliance, 8) North Basin Groundwater Protection Program wells, 9) South Basin Groundwater Protection Program wells, 10) wells in CASGEM monitoring program

		Bore Depth (ft. bgs)	Casing Sequence	Screened Interval (ft.bgs)			Aquifer Zone	
Well Name	Well Owner			Top	Bottom	Type of Well		Program
W-4856	GENERAL SERVICE ADMIN.	804		247	427	Inactive Production		2
GSWC-HGC6	GOLDEN STATE WATER CO - LA	1295		180	1170	Active Large Production		2
SCWC-ARR1	GOLDEN STATE WATER CO - LA	1026		919	965	Active Small Production		2
SCWC-HGC3	GOLDEN STATE WATER CO - LA	860		110	852	Inactive Production		2
SCWC-HGC4	GOLDEN STATE WATER CO - LA	861		110	856	Inactive Production		2
SCWC-HGCAR	GOLDEN STATE WATER CO - LA	570		121	327	Inactive Production		2
SCWC-HGJ4	GOLDEN STATE WATER CO - LA	890		530	710	Active Large Production		2
SCWC-LKHAW	GOLDEN STATE WATER CO - LA	822		200	796	Active Large Production		2
SCWC-LKMA	GOLDEN STATE WATER CO - LA	885		215	830	Active Large Production		2
SCWC-NWDAC1	GOLDEN STATE WATER CO - LA	380		0	0	Other Active Production		2
SCWC-NWIMP1	GOLDEN STATE WATER CO - LA	0		0	0	Other Active Production		2
SCWC-NWIMP2	GOLDEN STATE WATER CO - LA	399		0	0	Other Active Production		2
SCWC-NWIMP3	GOLDEN STATE WATER CO - LA	890		0	890	Other Active Production		2
W-17720	GOLDEN STATE WATER CO - LA	0		0	0	Other Active Production		2
GSWC-POR1	GOLDEN STATE WATER CO - OC	1129		350	895	Active Large Production	P	2,7
GSWC-SCL5	GOLDEN STATE WATER CO - OC	1416		700	1000	Active Large Production	P	2,7
RHWC-E	GOLDEN STATE WATER CO - OC	945		410	920	Active Large Production	P	2,7
RHWC-W2	GOLDEN STATE WATER CO - OC	954		474	753	Active Large Production	P	2,7
SCWC-CBAL	GOLDEN STATE WATER CO - OC	990		200	770	Active Large Production	P	2,7
SCWC-CSC	GOLDEN STATE WATER CO - OC	600		526	556	Active Large Production	P	2,7
SCWC-CVV	GOLDEN STATE WATER CO - OC	670		524	645	Active Large Production	P	2,7
SCWC-CVV2	GOLDEN STATE WATER CO - OC	1010		480	981	Active Large Production	P	2,7
SCWC-LABL2	GOLDEN STATE WATER CO - OC	708		460	690	Active Large Production	P	2,7
SCWC-LAC3	GOLDEN STATE WATER CO - OC	632		346	593	Active Large Production	P	2,7
SCWC-LAFL	GOLDEN STATE WATER CO - OC	720		300	680	Active Large Production	P	2,7
SCWC-LAHO	GOLDEN STATE WATER CO - OC	520		386	486	Active Large Production	P	2,7
SCWC-LAYT	GOLDEN STATE WATER CO - OC	812		250	800	Active Large Production	P	2,6,7
SCWC-PBF3	GOLDEN STATE WATER CO - OC	496		220	475	Active Large Production	P	2,7,8
SCWC-PBF4	GOLDEN STATE WATER CO - OC	550		275	520	Active Large Production	P	2,7,8
SCWC-PLJ2	GOLDEN STATE WATER CO - OC	505		402	492	Active Large Production	P	2,7,8
SCWC-PRU	GOLDEN STATE WATER CO - OC	837		430	790	Active Large Production	P	2,7
SCWC-SBCH	GOLDEN STATE WATER CO - OC	600		200	570	Active Large Production	P	2,7
SCWC-SCL4	GOLDEN STATE WATER CO - OC	530		294	488	Active Large Production	P	2,7
SCWC-SDAL	GOLDEN STATE WATER CO - OC	562		500	542	Active Large Production	P	2,7
SCWC-SLON	GOLDEN STATE WATER CO - OC	778		0	0	Active Large Production	P	2,7
SCWC-SORG	GOLDEN STATE WATER CO - OC	302		242	286	Active Large Production	P	2,7
SCWC-SSHR	GOLDEN STATE WATER CO - OC	618		520	580	Active Large Production	P	2,7
SCWC-SSYC	GOLDEN STATE WATER CO - OC	568		500	546	Active Large Production	P	2,7
SCWC-YLCO2	GOLDEN STATE WATER CO - OC	504		100	480	Inactive Production		2
GWRC-SFS8	GOLDEN WEST REFINING CO.	0		0	0	Other Active Production		2
GOOD-HB	GOOD SHEPHERD CEMETERY	244		180	218	Other Active Production		2,3,6
ETCH-AL2	GOODWIN MUTUAL WATER CO.	200		85	185	Inactive Production	S	2,3
GRV-RSIR	GREEN RIVER VILLIAGE	85		50	82	Other Active Production		2,3
HALD-BP	HALDOR PLACE MUTUAL WATER	265		0	0	Inactive Production		2
HMEM-COS	HARBOR LAWN MEMORIAL PARK	280		190	200	Monitoring		1,6
HOLY-A	HOLY CROSS CEMETERY	365		334	364	Other Active Production	P	2,3
HOUS-F	HOUSTON AVE. WATER	156		0	0	Other Active Production		2
W-14801	HUGHES AIRCRAFT CO.	155		135	155	Monitoring		1
W-14803	HUGHES AIRCRAFT CO.	165		144	164	Monitoring		1
HB-1	HUNTINGTON BEACH	306		258	297	Inactive Production		2,6
HB-10	HUNTINGTON BEACH	1000		232	942	Active Large Production	P	2,7
HB-12	HUNTINGTON BEACH	807		265	740	Inactive Production		2,6
HB-13	HUNTINGTON BEACH	860		280	810	Active Large Production	P	2,6,7
HB-3A	HUNTINGTON BEACH	738		370	640	Active Large Production	P	2,6,7
HB-4	HUNTINGTON BEACH	826		252	804	Active Large Production	P	2,6,7
HB-5	HUNTINGTON BEACH	830		223	800	Active Large Production	P	2,7
HB-6	HUNTINGTON BEACH	876		246	810	Active Large Production	P	2,7
HB-7	HUNTINGTON BEACH	930		263	879	Active Large Production	P	2,6,7
HB-8	HUNTINGTON BEACH	1172		256	704	Inactive Production	P	2
HB-9	HUNTINGTON BEACH	1010		556	996	Active Large Production	P	2,7
HB-MEA2	HUNTINGTON BEACH	537		480	510	Or Active Production	P	2,3
W-15104	HUNTINGTON BEACH CO.	130		90	125	Inactive Production		2
W-15819	HUNTINGTON BEACH CO.	181		0	0	Inactive Production		2
W-15821	HUNTINGTON BEACH CO.	155		0	0	Inactive Production		2
W-15823	HUNTINGTON BEACH CO.	123		0	0	Inactive Production		2
HUNT-P13	HUNTINGTON CONDO ASSOC.	9		0	9	Monitoring		1
HUNT-P14	HUNTINGTON CONDO ASSOC.	10		0	10	Monitoring		1

List of Wells in OCWD Monitoring Programs

KEY

Aquifer Zone: S=Shallow Aquifer, P=Principal Aquifer, D= Deep Aquifer

Program: 1) monitoring well, 2) production well, 3) irrigation or industrial well, 4) injection well, 5) Mid-Basin Injection well, 6) seawater intrusion monitoring well, 7) well monitored by OCWD for Title 22 compliance, 8) North Basin Groundwater Protection Program wells, 9) South Basin Groundwater Protection Program wells, 10) wells in CASGEM monitoring program

Well Name	Well Owner	Bore Depth (ft. bgs)	Casing Sequence	Screened Interval (ft.bgs)		Type of Well	Aquifer Zone	Program
				Top	Bottom			
HUNT-P7	HUNTINGTON CONDO ASSOC.	19		4	20	Monitoring		1
OCWD-HH2	HUNTINGTON HARBOUR CORP	150		130	140	Monitoring	S	1,6
OCWD-HH3	HUNTINGTON HARBOUR CORP	150		133	143	Monitoring	S	1,6
OCWD-HH4	HUNTINGTON HARBOUR CORP	145		130	140	Monitoring	S	1,6
OCWD-HH5	HUNTINGTON HARBOUR CORP	138		102	112	Monitoring	S	1,6
OCWD-HH6A	HUNTINGTON HARBOUR CORP	55		40	50	Monitoring		1,6
OCWD-HH6B	HUNTINGTON HARBOUR CORP	110		90	100	Monitoring	S	1,6,10
OCWD-HH6C	HUNTINGTON HARBOUR CORP	202		170	180	Monitoring		1,6
HYNS-S1	HYNES ESTATES, INC.	250		0	0	Active Small Production		2,7
HYNS-S2	HYNES ESTATES, INC.	182		162	182	Active Small Production	S	2,7
IWMD-LVM2	INTERGRATED WASTE MGMT. DIST.	248		223	243	Monitoring		1
IWMD-LVM3	INTERGRATED WASTE MGMT. DIST.	253		223	253	Monitoring		1
IWMD-LVM4	INTERGRATED WASTE MGMT. DIST.	247		206	246	Monitoring		1
IWMD-RPM3	INTERGRATED WASTE MGMT. DIST.	101		76	101	Monitoring		1
IWMD-RPM5	INTERGRATED WASTE MGMT. DIST.	102		70	100	Monitoring		1
TIC-108	IRVINE CO.	1045		200	960	Inactive Production	P	2,3
TIC-194	IRVINE CO.	822		562	726	Monitoring	P/D	1,9
TIC-25	IRVINE CO.	790		666	760	Monitoring	P/D	1,10
TIC-50	IRVINE CO.	1488		475	1070	Monitoring		1
TIC-61	IRVINE CO.	762		240	695	Inactive Production	P	2,3
TIC-80	IRVINE CO.	1553		415	1300	Monitoring		1
TIC-99	IRVINE CO.	692		346	650	Monitoring	P	1
W-285	IRVINE CO.	93		37	84	Inactive Production		2,3
ET-1	IRVINE RANCH WATER DIST.	520		220	490	Other Active Production	P	2,3
ET-2	IRVINE RANCH WATER DIST.	1120		280	1080	Other Active Production	P	2,3
IRWD-1	IRVINE RANCH WATER DIST.	2020		410	860	Active Large Production	P	2,7
IRWD-10	IRVINE RANCH WATER DIST.	1040		419	940	Active Large Production	P	2,7
IRWD-107R	IRVINE RANCH WATER DIST.	1060		275	1000	Active Large Production	P	2,7
IRWD-11	IRVINE RANCH WATER DIST.	1300		410	870	Active Large Production	P	2,7
IRWD-110	IRVINE RANCH WATER DIST.	1070		555	1015	Active Large Production	P	2,7
IRWD-115R	IRVINE RANCH WATER DIST.	1136		290	1080	Active Large Production		2,7
IRWD-12	IRVINE RANCH WATER DIST.	1424		580	1040	Active Large Production	P	2,7
IRWD-13	IRVINE RANCH WATER DIST.	1170		410	980	Active Large Production	P	2,7
IRWD-14	IRVINE RANCH WATER DIST.	1015		470	970	Active Large Production	P	2,7
IRWD-15	IRVINE RANCH WATER DIST.	1085		470	990	Active Large Production	P	2,7
IRWD-16	IRVINE RANCH WATER DIST.	1010		406	807	Active Large Production	P	2,7
IRWD-17	IRVINE RANCH WATER DIST.	1019		504	960	Active Large Production	P	2,7
IRWD-18	IRVINE RANCH WATER DIST.	1120		390	1080	Active Large Production	P	2,7
IRWD-2	IRVINE RANCH WATER DIST.	1450		385	855	Active Large Production	P	2,7,9
IRWD-21	IRVINE RANCH WATER DIST.	1223		290	970	Active Large Production	P	2,7,9
IRWD-22	IRVINE RANCH WATER DIST.	1220		300	970	Active Large Production	P	2,7,9
IRWD-3	IRVINE RANCH WATER DIST.	1309		484	1250	Active Large Production	P	2,7,9
IRWD-4	IRVINE RANCH WATER DIST.	1146		440	910	Active Large Production	P	2,7
IRWD-5	IRVINE RANCH WATER DIST.	1075		554	1028	Active Large Production	P	2,7,9
IRWD-52	IRVINE RANCH WATER DIST.	1400		635	1290	Inactive Production		2,7,9
IRWD-6	IRVINE RANCH WATER DIST.	1175		499	1124	Active Large Production	P	2,7,9
IRWD-7	IRVINE RANCH WATER DIST.	2731		359	660	Active Large Production	P	2,7
IRWD-72	IRVINE RANCH WATER DIST.	1192		254	1151	Other Active Production	P	2,3
IRWD-76	IRVINE RANCH WATER DIST.	1055		450	900	Active Large Production	P	2,7
IRWD-77	IRVINE RANCH WATER DIST.	1000		330	980	Active Large Production	P	2,7
IRWD-78R	IRVINE RANCH WATER DIST.	1010		250	730	Other Active Production	P	2,3
IRWD-98	IRVINE RANCH WATER DIST.	355		115	343	Inactive Production	P	2,3
IRWD-C8	IRVINE RANCH WATER DIST.	2065		1080	1982	Active Large Production	D	2,7
IRWD-C9	IRVINE RANCH WATER DIST.	2106		1055	1930	Active Large Production	D	2,7
IRWD-LA1	IRVINE RANCH WATER DIST.	800		200	790	Inactive Production		2
IRWD-LA3	IRVINE RANCH WATER DIST.	800		0	0	Inactive Production		2
IRWD-LA4	IRVINE RANCH WATER DIST.	810		350	790	Inactive Production		2
IRWD-LA5	IRVINE RANCH WATER DIST.	820		350	780	Inactive Production		2
IRWD-LA7	IRVINE RANCH WATER DIST.	1000		430	980	Inactive Production		2
IRWD-LF2	IRVINE RANCH WATER DIST.	808		280	640	Active Large Production		2
IRWD-MICH10	IRVINE RANCH WATER DIST.	0		0	0	Other Active Production		2
IRWD-MICH2	IRVINE RANCH WATER DIST.	0		30	50	Other Active Production		2
IRWD-MICH3	IRVINE RANCH WATER DIST.	0		30	50	Other Active Production		2
IRWD-MICH4	IRVINE RANCH WATER DIST.	0		17	67	Other Active Production		2
IRWD-MICH5	IRVINE RANCH WATER DIST.	0		17	67	Other Active Production		2
IRWD-MICH6	IRVINE RANCH WATER DIST.	0		40	70	Other Active Production		2
IRWD-MICH7	IRVINE RANCH WATER DIST.	0		40	70	Other Active Production		2

List of Wells in OCWD Monitoring Programs

KEY

Aquifer Zone: S=Shallow Aquifer, P=Principal Aquifer, D= Deep Aquifer

Program: 1) monitoring well, 2) production well, 3) irrigation or industrial well, 4) injection well, 5) Mid-Basin Injection well, 6) seawater intrusion monitoring well, 7) well monitored by OCWD for Title 22 compliance, 8) North Basin Groundwater Protection Program wells, 9) South Basin Groundwater Protection Program wells, 10) wells in CASGEM monitoring program

Well Name	Well Owner	Bore Depth (ft. bgs)	Casing Sequence	Screened Interval (ft.bgs)		Type of Well	Aquifer Zone	Program
				Top	Bottom			
IRWD-MICH8	IRVINE RANCH WATER DIST.	0		40	70	Other Active Production		2
IRWD-MICH9	IRVINE RANCH WATER DIST.	0		17	67	Other Active Production		2
IRWD-OPA1	IRVINE RANCH WATER DIST.	1000		390	750	Inactive Production		2,7
TIC-106	IRVINE RANCH WATER DIST.	725		405	715	Other Active Production	P	2,3
TIC-109	IRVINE RANCH WATER DIST.	1145		240	1120	Inactive Production	P	2,3
TIC-112	IRVINE RANCH WATER DIST.	1141		240	1100	Inactive Production	P	2,3
TIC-114	IRVINE RANCH WATER DIST.	1000		300	960	Inactive Production	P	2,3
TIC-55	IRVINE RANCH WATER DIST.	746		300	497	Inactive Production		2,3
TIC-82	IRVINE RANCH WATER DIST.	1145		410	1002	Monitoring	P	1
W-14556	IRVINE RANCH WATER DIST.	0		17	67	Inactive Production		2
ITO-LA	ITO-OZAWA FARMS	860		70	710	Other Active Production		2,3
ITO-LAG3	ITO-OZAWA FARMS	800		170	780	Other Active Production		2,3
JLAW-HB	JANUARY & ELLIS LAW	135		0	0	Inactive Production		2
SAKI-FV	JKS-SF, LLC	450		304	438	Inactive Production		2,3
SULY-OA1	JMI PROPERTIES/SANTIAGO PRTNRS	120		0	0	Other Active Production		2,3
SULY-OA4	JMI PROPERTIES/SANTIAGO PRTNRS	130		0	0	Inactive Production	S	2,3
JWC-NWLEF	JUNIOR WATER CO.	480		416	426	Other Active Production		2
JWC-NWTAD	JUNIOR WATER CO.	614		361	587	Other Active Production		2
W-15825	KAREN STREET WATER CO.	100		0	0	Inactive Production		2
GKAW-FV2	KAWAGUCHI ENTERPRISES û LP	125		120	125	Other Active Production		2
MKAW-FV	KAWAGUCHI ENTERPRISES û LP	225		185	225	Other Active Production	S	2
KAYO-GG	KAYANO FARMS	0		0	0	Inactive Production		2,3
GARD-A	KINDRED COMMUNITY CHURCH	35		0	0	Other Active Production		2,3
KINGK-CE2	KING KELLY MARMILADE CO. INC.	0		0	0	Other Active Production		2
W-18116	KLEINFELDER & ASSOCIATES	250		238	248	Monitoring		1
W-18118	KLEINFELDER & ASSOCIATES	187		176	186	Monitoring		1
W-18120	KLEINFELDER & ASSOCIATES	255		243	253	Monitoring		1
KNOT-BP	KNOTT'S BERRY FARM	447		0	0	Other Active Production		2,3
KNOT-BPBS	KNOTT'S BERRY FARM	730		430	630	Active Small Production	P	2,7
W-14871	KOLL REAL ESTATE	600		0	0	Inactive Production		2,3
LH-2A	LA HABRA	1000		460	950	Active Large Production		2
LH-FS192	LA HABRA	1403		880	1210	Inactive Production		2,10
LH-LBPW	LA HABRA	1000		544	870	Active Large Production		2
LH-PPW	LA HABRA	1290		770	990	Inactive Production		2
LMP-MW	LA HABRA HEIGHTS WATER CO.	593		540	560	Monitoring		1
HALL-O	LA LINDA LLC	280		0	0	Inactive Production		2
LP-CITY	LA PALMA	1516		290	1415	Active Large Production	P	2,7
LP-WALK	LA PALMA	1020		489	919	Active Large Production	P	2,7
LMA-I	LAKES MASTER ASSOC.	0		0	0	Other Active Production		2,3
LW-10	LAKEWOOD	1148		448	471	Active Large Production		2
LW-13A	LAKEWOOD	1120		620	940	Active Large Production		2
LW-15A	LAKEWOOD	1050		470	1030	Active Large Production		2
LW-17	LAKEWOOD	1134		1064	1121	Active Large Production		2
LW-18	LAKEWOOD	1108		1041	1069	Active Large Production		2
LW-22	LAKEWOOD	1500		440	1060	Active Large Production		2
LW-27	LAKEWOOD	990		490	950	Active Large Production		2
LW-2A	LAKEWOOD	656		612	637	Active Large Production		2
LW-4	LAKEWOOD	716		367	388	Active Large Production		2
LW-6	LAKEWOOD	602		224	306	Other Active Production		2,3
LW-8	LAKEWOOD	405		352	380	Active Small Production		2
W-17351	LAKEWOOD	0		0	0	Inactive Production		2
LWPC-LWP1	LAKEWOOD WATER & POWER CO.	870		488	835	Other Active Production		2
LIBM-HB	LIBERTY PARK WATER ASSOC.	160		0	0	Active Small Production		2,6,7
LMC-EW1	LOCKHEED MARTIN CORP.	62		40	60	Other Active Production		2
LMC-EW2	LOCKHEED MARTIN CORP.	62		40	60	Other Active Production		2
LMC-EW3	LOCKHEED MARTIN CORP.	90		58	78	Other Active Production		2
LB-1017	LONG BEACH	875		140	540	Other Active Production		2,3
LB-1017B	LONG BEACH	675		0	0	Monitoring		1
LB-AL13	LONG BEACH	1030		559	902	Active Large Production		2
LB-AL8	LONG BEACH	982		515	978	Active Large Production		2
LB-AL9	LONG BEACH	1152		804	1130	Active Large Production		2
LB-AN201	LONG BEACH	854		507	838	Active Large Production		2
LB-AN204	LONG BEACH	1186		1124	1146	Other Active Production		2,3
LB-AN206	LONG BEACH	1170		300	471	Inactive Production		2
LB-AN26	LONG BEACH	610		364	590	Inactive Production		2
LB-CIT10	LONG BEACH	1020		300	988	Active Large Production		2
LB-CIT7A	LONG BEACH	950		300	898	Active Large Production		2

List of Wells in OCWD Monitoring Programs

KEY

Aquifer Zone: S=Shallow Aquifer, P=Principal Aquifer, D= Deep Aquifer

Program: 1) monitoring well, 2) production well, 3) irrigation or industrial well, 4) injection well, 5) Mid-Basin Injection well, 6) seawater intrusion monitoring well, 7) well monitored by OCWD for Title 22 compliance, 8) North Basin Groundwater Protection Program wells, 9) South Basin Groundwater Protection Program wells, 10) wells in CASGEM monitoring program

Well Name	Well Owner	Bore Depth (ft. bgs)	Casing Sequence	Screened Interval (ft.bgs)		Type of Well	Aquifer Zone	Program
				Top	Bottom			
LB-CIT8	LONG BEACH	1516		310	1039	Active Small Production		2
LB-CIT9	LONG BEACH	850		300	808	Active Large Production		2
LB-COM10	LONG BEACH	900		540	685	Active Large Production		2
LB-COM13	LONG BEACH	1634		310	1539	Active Large Production		2
LB-COM14	LONG BEACH	1110		302	1072	Active Large Production		2
LB-COM15	LONG BEACH	1120		303	1008	Active Large Production		2
LB-COM16	LONG BEACH	1023		300	988	Active Large Production		2
LB-COM17	LONG BEACH	1030		300	988	Active Large Production		2
LB-COM18	LONG BEACH	0		303	988	Active Large Production		2
LB-COM19	LONG BEACH	1700		605	1640	Active Large Production		2
LB-COM20	LONG BEACH	1500		602	1240	Active Large Production		2
LB-COM21	LONG BEACH	1691		640	1370	Active Large Production		2
LB-COM22	LONG BEACH	1512		490	1160	Active Large Production		2
LB-COM23	LONG BEACH	1513		480	1020	Active Large Production		2
LB-COM24	LONG BEACH	1500		540	1411	Active Large Production		2
LB-COM25	LONG BEACH	1508		540	900	Active Large Production		2
LB-COM6A	LONG BEACH	1012		412	980	Monitoring		1
LB-DEV1	LONG BEACH	1017		959	1017	Active Large Production		2
LB-DEV2	LONG BEACH	684		390	684	Inactive Production		2
LB-DEV4	LONG BEACH	1004		400	972	Inactive Production		2
LB-DEV5	LONG BEACH	1016		267	990	Active Large Production		2
LB-DEV9	LONG BEACH	1030		260	1030	Active Large Production		2
LB-NLB11	LONG BEACH	2000		412	1431	Active Large Production		2
LB-NLB12	LONG BEACH	1058		300	1000	Active Large Production		2
LB-NLB4	LONG BEACH	1160		972	1142	Active Large Production		2
LB-NLB8	LONG BEACH	1180		1050	1100	Active Large Production		2
LB-NLB9	LONG BEACH	800		445	720	Active Large Production		2
LB-WIL1A	LONG BEACH	1370		272	1351	Active Large Production		2
LB-WS1A	LONG BEACH	1100		272	1078	Active Large Production		2
W-11412	LONG BEACH	639		458	630	Inactive Production		2,3
W-11460	LONG BEACH	994		0	0	Inactive Production		2
LART-CR2	LOS ALAMITOS RACE TRACT	0		0	0	Active Small Production		2,7
LAC-32LP8X	LOS ANGELES COUNTY	120		105	115	Monitoring		1
LAC-32LP8Z	LOS ANGELES COUNTY	945		325	335	Monitoring		1
LAC-32S9	LOS ANGELES COUNTY	885		189	199	Monitoring		1
LAC-32TP25	LOS ANGELES COUNTY	945		252	262	Monitoring		1
LAC-32U15	LOS ANGELES COUNTY	141		117	133	Monitoring		1
LAC-32V22	LOS ANGELES COUNTY	151		120	135	Monitoring		1
LAC-32VP10	LOS ANGELES COUNTY	210		145	180	Monitoring		1
LAC-32X11	LOS ANGELES COUNTY	196		135	165	Monitoring		1
LAC-32YP43	LOS ANGELES COUNTY	55		42	52	Monitoring		1
LAC-32ZP5	LOS ANGELES COUNTY	155		93	133	Monitoring		1
LAC-33D01	LOS ANGELES COUNTY	453		215	275	Monitoring		1
LAC-33D24	LOS ANGELES COUNTY	750		315	325	Monitoring		1
LAC-33DP22	LOS ANGELES COUNTY	825		210	220	Monitoring		1
LAC-33G	LOS ANGELES COUNTY	119		43	103	Injection		4
LAC-33G36	LOS ANGELES COUNTY	525		338	348	Monitoring		1
LAC-33G9	LOS ANGELES COUNTY	147		120	140	Monitoring		1
LAC-33GJ	LOS ANGELES COUNTY	140		52	115	Monitoring		1
LAC-33HP13	LOS ANGELES COUNTY	123		88	103	Monitoring		1
LAC-33J	LOS ANGELES COUNTY	134		66	126	Injection		4
LAC-33JL	LOS ANGELES COUNTY	147		52	137	Monitoring		1
LAC-33KP42	LOS ANGELES COUNTY	86		63	73	Monitoring		1
LAC-33L	LOS ANGELES COUNTY	144		56	136	Injection		4
LAC-33L23	LOS ANGELES COUNTY	405		349	359	Monitoring		1
LAC-33L30	LOS ANGELES COUNTY	73		50	65	Monitoring		1
LAC-33N	LOS ANGELES COUNTY	164		58	148	Injection		4
LAC-33N21	LOS ANGELES COUNTY	497		460	485	Monitoring		1
LAC-33NQ	LOS ANGELES COUNTY	177		60	160	Monitoring		1
LAC-33Q	LOS ANGELES COUNTY	174		69	164	Injection		4
LAC-33Q1	LOS ANGELES COUNTY	58		28	44	Injection		4
LAC-33Q15V	LOS ANGELES COUNTY	232		210	220	Monitoring		1
LAC-33Q15W	LOS ANGELES COUNTY	296		273	283	Monitoring		1
LAC-33Q15X	LOS ANGELES COUNTY	390		346	356	Monitoring		1
LAC-33Q9	LOS ANGELES COUNTY	223		115	145	Monitoring		1
LAC-33S	LOS ANGELES COUNTY	207		73	194	Injection		4
LAC-33S1	LOS ANGELES COUNTY	63		25	45	Injection		4

List of Wells in OCWD Monitoring Programs

KEY

Aquifer Zone: S=Shallow Aquifer, P=Principal Aquifer, D= Deep Aquifer

Program: 1) monitoring well, 2) production well, 3) irrigation or industrial well, 4) injection well, 5) Mid-Basin Injection well, 6) seawater intrusion monitoring well, 7) well monitored by OCWD for Title 22 compliance, 8) North Basin Groundwater Protection Program wells, 9) South Basin Groundwater Protection Program wells, 10) wells in CASGEM monitoring program

Well Name	Well Owner	Bore Depth (ft. bgs)	Casing Sequence	Screened Interval (ft.bgs)		Type of Well	Aquifer Zone	Program
				Top	Bottom			
LAC-33S18U	LOS ANGELES COUNTY	101		73	83	Monitoring		1
LAC-33S18V	LOS ANGELES COUNTY	295		231	241	Monitoring		1
LAC-33S18W	LOS ANGELES COUNTY	300		273	283	Monitoring		1
LAC-33S18X	LOS ANGELES COUNTY	405		357	367	Monitoring		1
LAC-33S20	LOS ANGELES COUNTY	514		476	486	Monitoring		1
LAC-33S40	LOS ANGELES COUNTY	527		477	507	Monitoring		1
LAC-33S43	LOS ANGELES COUNTY	615		341	362	Monitoring		1
LAC-33S52	LOS ANGELES COUNTY	393		290	350	Monitoring		1
LAC-33ST	LOS ANGELES COUNTY	195		140	185	Monitoring		1
LAC-33T	LOS ANGELES COUNTY	214		89	199	Injection		4
LAC-33T125	LOS ANGELES COUNTY	487		426	466	Monitoring		1
LAC-33T13U	LOS ANGELES COUNTY	87		63	73	Monitoring		1
LAC-33T13V	LOS ANGELES COUNTY	237		210	220	Monitoring		1
LAC-33T13W	LOS ANGELES COUNTY	294		273	283	Monitoring		1
LAC-33T13X	LOS ANGELES COUNTY	405		336	346	Monitoring		1
LAC-33T15	LOS ANGELES COUNTY	420		341	351	Monitoring		1
LAC-33T29U	LOS ANGELES COUNTY	83		63	73	Monitoring		1
LAC-33T29X	LOS ANGELES COUNTY	405		357	367	Monitoring		1
LAC-33T29Z	LOS ANGELES COUNTY	1926		664	705	Monitoring		1
LAC-33T3	LOS ANGELES COUNTY	141		45	90	Monitoring		1
LAC-33T4	LOS ANGELES COUNTY	330		281	306	Monitoring		1
LAC-33T9U	LOS ANGELES COUNTY	50		25	40	Monitoring		1
LAC-33T9V	LOS ANGELES COUNTY	190		133	158	Monitoring		1
LAC-33T9W	LOS ANGELES COUNTY	200		179	189	Monitoring		1
LAC-33T9X	LOS ANGELES COUNTY	885		273	283	Monitoring		1
LAC-33T9Y	LOS ANGELES COUNTY	400		378	388	Monitoring		1
LAC-33TP13U	LOS ANGELES COUNTY	79		46	66	Monitoring		1
LAC-33TP24U	LOS ANGELES COUNTY	55		30	43	Monitoring		1
LAC-33TP24Y	LOS ANGELES COUNTY	109		63	88	Monitoring		1
LAC-33U	LOS ANGELES COUNTY	254		98	238	Injection		4
LAC-33U11V	LOS ANGELES COUNTY	210		194	204	Monitoring		1
LAC-33U11W	LOS ANGELES COUNTY	295		273	283	Monitoring		1
LAC-33U11X	LOS ANGELES COUNTY	405		357	367	Monitoring		1
LAC-33U3	LOS ANGELES COUNTY	143		70	125	Injection		4
LAC-33UP05	LOS ANGELES COUNTY	83		63	73	Monitoring		1
LAC-33UP34	LOS ANGELES COUNTY	61		53	60	Monitoring		1
LAC-33UP3X	LOS ANGELES COUNTY	120		94	105	Monitoring		1
LAC-33UP3Y	LOS ANGELES COUNTY	169		151	161	Monitoring		1
LAC-33UP3Z	LOS ANGELES COUNTY	1720		378	399	Monitoring		1
LAC-33UV	LOS ANGELES COUNTY	308		213	262	Monitoring		1
LAC-33V	LOS ANGELES COUNTY	294		119	269	Injection		4
LAC-33VP14U1	LOS ANGELES COUNTY	27		23	27	Monitoring		1
LAC-33VP14U2	LOS ANGELES COUNTY	84		79	83	Monitoring		1
LAC-33VP14U3	LOS ANGELES COUNTY	50		40	50	Monitoring		1
LAC-33VP15P	LOS ANGELES COUNTY	100		57	82	Other Active Production		2
LAC-33VP22Z1	LOS ANGELES COUNTY	150		127	137	Monitoring		1
LAC-33VP22Z2	LOS ANGELES COUNTY	780		255	265	Monitoring		1
LAC-33VP46	LOS ANGELES COUNTY	80		61	71	Monitoring		1
LAC-33VP8	LOS ANGELES COUNTY	163		105	145	Monitoring		1
LAC-33W	LOS ANGELES COUNTY	420		120	390	Injection		4
LAC-33W11	LOS ANGELES COUNTY	508		427	482	Monitoring		1,6
LAC-33W54	LOS ANGELES COUNTY	83		40	70	Monitoring		1
LAC-33WP14	LOS ANGELES COUNTY	108		57	87	Monitoring		1
LAC-33WP17	LOS ANGELES COUNTY	78		45	65	Monitoring		1
LAC-33WX	LOS ANGELES COUNTY	448		379	423	Monitoring		1
LAC-33WXU	LOS ANGELES COUNTY	74		45	60	Monitoring		1
LAC-33X	LOS ANGELES COUNTY	452		170	430	Injection		4
LAC-33X10	LOS ANGELES COUNTY	517		425	475	Monitoring		1,6
LAC-33X20U	LOS ANGELES COUNTY	110		85	95	Monitoring		1,6
LAC-33X20W	LOS ANGELES COUNTY	325		294	304	Monitoring		1,6
LAC-33X20X	LOS ANGELES COUNTY	415		377	387	Monitoring		1,6
LAC-33X20Y	LOS ANGELES COUNTY	645		483	493	Monitoring		1,6
LAC-33XY	LOS ANGELES COUNTY	475		409	451	Monitoring		1
LAC-33Y	LOS ANGELES COUNTY	475		218	457	Injection		4
LAC-33Y10	LOS ANGELES COUNTY	125		75	115	Monitoring		1,6
LAC-33Y42U	LOS ANGELES COUNTY	105		89	95	Monitoring		1,6
LAC-33Y42X	LOS ANGELES COUNTY	660		362	372	Monitoring		1,6

List of Wells in OCWD Monitoring Programs

KEY

Aquifer Zone: S=Shallow Aquifer, P=Principal Aquifer, D= Deep Aquifer

Program: 1) monitoring well, 2) production well, 3) irrigation or industrial well, 4) injection well, 5) Mid-Basin Injection well, 6) seawater intrusion monitoring well, 7) well monitored by OCWD for Title 22 compliance, 8) North Basin Groundwater Protection Program wells, 9) South Basin Groundwater Protection Program wells, 10) wells in CASGEM monitoring program

Well Name	Well Owner	Bore Depth (ft. bgs)	Casing Sequence	Screened Interval (ft.bgs)		Type of Well	Aquifer Zone	Program
				Top	Bottom			
LAC-33YP35	LOS ANGELES COUNTY	103		73	83	Monitoring		1
LAC-33YZ	LOS ANGELES COUNTY	467		408	451	Monitoring		1
LAC-33Z	LOS ANGELES COUNTY	484		206	461	Injection		4
LAC-33Z2	LOS ANGELES COUNTY	499		310	444	Injection		4
LAC-33ZP1T	LOS ANGELES COUNTY	146		116	135	Monitoring		1
LAC-33ZP1U	LOS ANGELES COUNTY	90		62	85	Monitoring		1
LAC-33ZP1X	LOS ANGELES COUNTY	360		336	346	Monitoring		1
LAC-34D	LOS ANGELES COUNTY	494		219	474	Injection		4
LAC-34D01	LOS ANGELES COUNTY	83		73	83	Monitoring		1
LAC-34DG	LOS ANGELES COUNTY	477		405	450	Monitoring		1,6
LAC-34DP6	LOS ANGELES COUNTY	477		415	445	Monitoring		1
LAC-34EP13	LOS ANGELES COUNTY	363		305	335	Monitoring		1
LAC-34EP23	LOS ANGELES COUNTY	108		48	88	Monitoring		1
LAC-34EP48	LOS ANGELES COUNTY	735		255	265	Monitoring		1
LAC-34EV	LOS ANGELES COUNTY	288		145	250	Injection		4
LAC-34EY	LOS ANGELES COUNTY	488		410	455	Injection		4
LAC-34F	LOS ANGELES COUNTY	487		410	450	Injection		4
LAC-34F5T	LOS ANGELES COUNTY	185		140	170	Monitoring		1,6
LAC-34F5V	LOS ANGELES COUNTY	242		195	225	Monitoring		1
LAC-34F5W	LOS ANGELES COUNTY	288		235	275	Monitoring		1
LAC-34F5X	LOS ANGELES COUNTY	372		300	360	Monitoring		1
LAC-34F5Y	LOS ANGELES COUNTY	482		415	455	Monitoring		1
LAC-34FP13V	LOS ANGELES COUNTY	120		95	105	Monitoring		1
LAC-34FP13X	LOS ANGELES COUNTY	315		193	203	Monitoring		1
LAC-34FP40	LOS ANGELES COUNTY	68		45	55	Monitoring		1
LAC-34FX	LOS ANGELES COUNTY	489		410	450	Injection		4
LAC-34G	LOS ANGELES COUNTY	475		285	350	Injection		4
LAC-34G2V	LOS ANGELES COUNTY	280		140	250	Injection		4
LAC-34G2Y	LOS ANGELES COUNTY	489		405	445	Injection		4
LAC-34GH	LOS ANGELES COUNTY	479		415	455	Monitoring		1,6
LAC-34H	LOS ANGELES COUNTY	490		405	445	Injection		4
LAC-34HJX	LOS ANGELES COUNTY	368		315	345	Monitoring		1
LAC-34HJY	LOS ANGELES COUNTY	503		410	440	Monitoring		1,6
LAC-34HP17	LOS ANGELES COUNTY	90		55	75	Monitoring		1
LAC-34HP17P	LOS ANGELES COUNTY	95		51	76	Other Active Production		2
LAC-34HP18P	LOS ANGELES COUNTY	206		145	175	Other Active Production		2
LAC-34J	LOS ANGELES COUNTY	456		270	315	Injection		4
LAC-34JL	LOS ANGELES COUNTY	440		385	420	Monitoring		1,6
LAC-34JP12	LOS ANGELES COUNTY	109		43	93	Monitoring		1
LAC-34L	LOS ANGELES COUNTY	420		146	400	Injection		4
LAC-34LP1U	LOS ANGELES COUNTY	88		67	77	Monitoring		1
LAC-34LP1V	LOS ANGELES COUNTY	210		166	176	Monitoring		1
LAC-34LP1Z	LOS ANGELES COUNTY	900		609	619	Monitoring		1
LAC-34NP16	LOS ANGELES COUNTY	0		41	71	Monitoring		1
LAC-34QP22	LOS ANGELES COUNTY	91		55	80	Monitoring		1
LAC-34SP22P	LOS ANGELES COUNTY	95		52	77	Other Active Production		2
LAC-34VP18	LOS ANGELES COUNTY	85		48	73	Monitoring		1
LAC-35SP24U	LOS ANGELES COUNTY	83		59	69	Monitoring		1
LAC-35SP24Z1	LOS ANGELES COUNTY	180		157	167	Monitoring		1
LAC-35SP24Z2	LOS ANGELES COUNTY	825		210	220	Monitoring		1
LAC-35VP32Z1	LOS ANGELES COUNTY	213		189	199	Monitoring		1
LAC-35VP32Z2	LOS ANGELES COUNTY	855		483	493	Monitoring		1
LAC-36WP80	LOS ANGELES COUNTY	870		293	303	Monitoring		1
LAC-PZ1	LOS ANGELES COUNTY	16		10	16	Monitoring		1
LAC-PZ2	LOS ANGELES COUNTY	14		0	0	Monitoring		1
LAC-PZ3	LOS ANGELES COUNTY	16		0	0	Monitoring		1
LAC-PZ4	LOS ANGELES COUNTY	25		14	22	Monitoring		1
LAC-PZ5	LOS ANGELES COUNTY	64		33	49	Monitoring		1
LXMS-A	LYON CHRISTMAS TREE FARMS	240		0	0	Inactive Production		2,3
MAGM-GG	MAGNOLIA MEMORIAL PARK	168		0	0	Other Active Production		2,3
MNEE-A	MALLONEE	400		0	0	Inactive Production		2,3
HMW-01	MANHEIM CA (COX ENTERPRISES)	75		55	75	Monitoring	S	1
HMW-02	MANHEIM CA (COX ENTERPRISES)	72		52	72	Monitoring		1
HMW-03	MANHEIM CA (COX ENTERPRISES)	50		30	50	Monitoring		1
HMW-04	MANHEIM CA (COX ENTERPRISES)	47		27	47	Monitoring		1
W-3789	MARDEN SUSCO PIPE SUPPLY CO.	0		0	0	Inactive Production		2
USMC-01MW101	MARINE CORPS AIR STATION	159		118	148	Monitoring		1

List of Wells in OCWD Monitoring Programs

KEY

Aquifer Zone: S=Shallow Aquifer, P=Principal Aquifer, D= Deep Aquifer

Program: 1) monitoring well, 2) production well, 3) irrigation or industrial well, 4) injection well, 5) Mid-Basin Injection well, 6) seawater intrusion monitoring well, 7) well monitored by OCWD for Title 22 compliance, 8) North Basin Groundwater Protection Program wells, 9) South Basin Groundwater Protection Program wells, 10) wells in CASGEM monitoring program

		Bore Depth	Casing	Screened Interval (ft.bgs)			Aquifer	
Well Name	Well Owner	(ft. bgs)	Sequence	Top	Bottom	Type of Well	Zone	Program
USMC-01MW102	MARINE CORPS AIR STATION	142		95	135	Monitoring		1
USMC-01MW201	MARINE CORPS AIR STATION	77		27	57	Monitoring		1
USMC-02NEW01	MARINE CORPS AIR STATION	143		115	135	Monitoring		1
USMC-02NEW07	MARINE CORPS AIR STATION	150		103	143	Monitoring		1
USMC-02NEW11	MARINE CORPS AIR STATION	81		45	65	Monitoring		1
USMC-02NEW12	MARINE CORPS AIR STATION	256		209	249	Monitoring		1
USMC-02NEW13	MARINE CORPS AIR STATION	107		60	100	Monitoring		1
USMC-02NEW14	MARINE CORPS AIR STATION	111		40	105	Monitoring		1
USMC-02NEW15	MARINE CORPS AIR STATION	70		25	65	Monitoring		1
USMC-02NEW16	MARINE CORPS AIR STATION	70		25	65	Monitoring		1
USMC-02NEW2	MARINE CORPS AIR STATION	105		75	95	Monitoring		1
USMC-02NEW8A	MARINE CORPS AIR STATION	111		84	104	Monitoring		1
USMC-02UGMW25	MARINE CORPS AIR STATION	84		55	75	Monitoring		1
USMC-05NEW1	MARINE CORPS AIR STATION	210		163	203	Monitoring		1
USMC-16MPE1	MARINE CORPS AIR STATION	194		146	191	Monitoring		1
USMC-16MW1	MARINE CORPS AIR STATION	183		155	180	Monitoring		1
USMC-16MW10	MARINE CORPS AIR STATION	199		165	195	Monitoring		1
USMC-16MW11	MARINE CORPS AIR STATION	182		160	180	Monitoring	S	1
USMC-16MW12	MARINE CORPS AIR STATION	180		160	180	Monitoring		1
USMC-16MW13	MARINE CORPS AIR STATION	181		160	180	Monitoring		1
USMC-16MW14	MARINE CORPS AIR STATION	199		185	195	Monitoring		1
USMC-16MW15	MARINE CORPS AIR STATION	182		160	180	Monitoring		1
USMC-16MW16	MARINE CORPS AIR STATION	201		190	200	Monitoring		1
USMC-16MW2	MARINE CORPS AIR STATION	185		153	178	Monitoring	S	1
USMC-16MW3	MARINE CORPS AIR STATION	185		158	183	Monitoring		1
USMC-16MW4	MARINE CORPS AIR STATION	196		155	190	Monitoring		1
USMC-16MW5	MARINE CORPS AIR STATION	196		155	190	Monitoring		1
USMC-16MW7	MARINE CORPS AIR STATION	194		145	190	Monitoring		1
USMC-16MW8	MARINE CORPS AIR STATION	189		165	183	Monitoring		1
USMC-16MW9	MARINE CORPS AIR STATION	187		165	183	Monitoring		1
USMC-17NEW1	MARINE CORPS AIR STATION	233		186	226	Monitoring		1
USMC-17NEW2	MARINE CORPS AIR STATION	131		83	123	Monitoring		1
USMC-24EX10	MARINE CORPS AIR STATION	165		115	160	Monitoring		1
USMC-24EX11	MARINE CORPS AIR STATION	222		135	180	Monitoring		1
USMC-24EX12A	MARINE CORPS AIR STATION	252		115	160	Monitoring		1
USMC-24EX12B	MARINE CORPS AIR STATION	225		165	210	Monitoring		1
USMC-24EX12C	MARINE CORPS AIR STATION	272		220	260	Monitoring		1
USMC-24EX13A	MARINE CORPS AIR STATION	172		110	160	Monitoring		1
USMC-24EX13B	MARINE CORPS AIR STATION	213		165	205	Monitoring		1
USMC-24EX13C	MARINE CORPS AIR STATION	282		230	270	Monitoring		1
USMC-24EX14	MARINE CORPS AIR STATION	195		115	185	Monitoring		1
USMC-24EX2	MARINE CORPS AIR STATION	215		109	209	Other Active Production		2
USMC-24EX20B	MARINE CORPS AIR STATION	210		107	205	Other Active Production		2
USMC-24EX3	MARINE CORPS AIR STATION	186		0	0	Monitoring		1
USMC-24EX30B1	MARINE CORPS AIR STATION	158		105	150	Monitoring		1
USMC-24EX30B2	MARINE CORPS AIR STATION	156		105	150	Monitoring		1
USMC-24EX30B3	MARINE CORPS AIR STATION	182		170	175	Monitoring		1
USMC-24EX4	MARINE CORPS AIR STATION	195		104	190	Other Active Production		2
USMC-24EX40B2	MARINE CORPS AIR STATION	156		106	106	Monitoring		1
USMC-24EX5	MARINE CORPS AIR STATION	160		104	154	Other Active Production		2
USMC-24EX50B1	MARINE CORPS AIR STATION	156		105	150	Monitoring		1
USMC-24EX50B2	MARINE CORPS AIR STATION	156		105	150	Monitoring		1
USMC-24EX6	MARINE CORPS AIR STATION	178		0	0	Monitoring		1
USMC-24EX60B1	MARINE CORPS AIR STATION	160		106	151	Monitoring		1
USMC-24EX60B2	MARINE CORPS AIR STATION	158		105	150	Monitoring		1
USMC-24EX60B3	MARINE CORPS AIR STATION	225		218	223	Monitoring		1
USMC-24EX9	MARINE CORPS AIR STATION	214		120	200	Monitoring		1
USMC-24IN03	MARINE CORPS AIR STATION	169		91	160	Injection		4
USMC-24IN20B1	MARINE CORPS AIR STATION	300		194	271	Injection		4
USMC-24MW10AB	MARINE CORPS AIR STATION	143		130	140	Monitoring	S	1
USMC-24MW10CD	MARINE CORPS AIR STATION	245		230	240	Monitoring		1
USMC-24MW11AB	MARINE CORPS AIR STATION	145		130	140	Monitoring	S	1
USMC-24MW11CD	MARINE CORPS AIR STATION	240		210	220	Monitoring		1
USMC-24MW12AB	MARINE CORPS AIR STATION	140		127	137	Monitoring	S	1
USMC-24MW12CD	MARINE CORPS AIR STATION	231		203	213	Monitoring		1
USMC-24MW13AB	MARINE CORPS AIR STATION	124		111	121	Monitoring	S	1
USMC-24MW13CD	MARINE CORPS AIR STATION	228		212	222	Monitoring		1

List of Wells in OCWD Monitoring Programs

KEY

Aquifer Zone: S=Shallow Aquifer, P=Principal Aquifer, D= Deep Aquifer

Program: 1) monitoring well, 2) production well, 3) irrigation or industrial well, 4) injection well, 5) Mid-Basin Injection well, 6) seawater intrusion monitoring well, 7) well monitored by OCWD for Title 22 compliance, 8) North Basin Groundwater Protection Program wells, 9) South Basin Groundwater Protection Program wells, 10) wells in CASGEM monitoring program

		Bore Depth (ft. bgs)	Casing Sequence	Screened Interval (ft.bgs)			Aquifer Zone	
Well Name	Well Owner			Top	Bottom	Type of Well		Program
USMC-24MW14AB	MARINE CORPS AIR STATION	129		115	125	Monitoring	S	1
USMC-24MW14CD	MARINE CORPS AIR STATION	223		211	221	Monitoring		1
USMC-24MW15AB	MARINE CORPS AIR STATION	137		125	135	Monitoring	S	1
USMC-24MW15CD	MARINE CORPS AIR STATION	236		220	230	Monitoring		1
USMC-24MW16	MARINE CORPS AIR STATION	340		80	300	Multiport Monitoring		1
USMC-24MW17	MARINE CORPS AIR STATION	340		75	310	Multiport Monitoring		1
USMC-24MW5	MARINE CORPS AIR STATION	181		140	168	Monitoring		1
USMC-24MW6	MARINE CORPS AIR STATION	195		170	190	Monitoring		1
USMC-24MW7	MARINE CORPS AIR STATION	208		120	200	Monitoring		1
USMC-24MW8	MARINE CORPS AIR STATION	380		105	350	Multiport Monitoring		1
USMC-24MW9AB	MARINE CORPS AIR STATION	151		140	150	Monitoring	S	1
USMC-24MW9CD	MARINE CORPS AIR STATION	243		230	240	Monitoring		1
USMC-24NEW1	MARINE CORPS AIR STATION	260		225	245	Monitoring		1
USMC-24NEW4	MARINE CORPS AIR STATION	160		108	148	Monitoring	S	1
USMC-24NEW5	MARINE CORPS AIR STATION	262		230	250	Monitoring		1
USMC-24NEW6	MARINE CORPS AIR STATION	193		165	185	Monitoring		1
USMC-24NEW7	MARINE CORPS AIR STATION	174		118	158	Monitoring		1
USMC-24NEW8	MARINE CORPS AIR STATION	170		122	162	Monitoring	S	1
USMC-DW135	MARINE CORPS AIR STATION	135		115	135	Monitoring	S	1
USMC-DW250	MARINE CORPS AIR STATION	254		215	250	Monitoring		1
USMC-DW350	MARINE CORPS AIR STATION	353		310	350	Monitoring		1
USMC-DW450	MARINE CORPS AIR STATION	454		414	450	Monitoring		1
USMC-DW540	MARINE CORPS AIR STATION	541		490	540	Monitoring		1
USMC-MP06	MARINE CORPS AIR STATION	500		105	455	Multiport Monitoring		1
USMC-MP08	MARINE CORPS AIR STATION	500		61	449	Multiport Monitoring		1
USMC-MP09	MARINE CORPS AIR STATION	500		59	463	Multiport Monitoring		1
USMC-MP10	MARINE CORPS AIR STATION	1202		218	1011	Multiport Monitoring		1
USMC-MW01A	MARINE CORPS AIR STATION	500		466	486	Monitoring		1
USMC-MW01B	MARINE CORPS AIR STATION	421		396	416	Monitoring		1
USMC-MW01C	MARINE CORPS AIR STATION	358		330	350	Monitoring		1
USMC-MW01D	MARINE CORPS AIR STATION	270		242	262	Monitoring		1
USMC-MW01E	MARINE CORPS AIR STATION	233		205	225	Monitoring		1
USMC-MW02A	MARINE CORPS AIR STATION	500		462	482	Monitoring		1
USMC-MW02C	MARINE CORPS AIR STATION	386		358	378	Monitoring		1
USMC-MW02D	MARINE CORPS AIR STATION	319		294	314	Monitoring		1
USMC-MW02E	MARINE CORPS AIR STATION	253		198	233	Monitoring		1
USMC-MW03A	MARINE CORPS AIR STATION	471		370	390	Monitoring		1
USMC-MW03B	MARINE CORPS AIR STATION	310		280	300	Monitoring		1
USMC-MW03C	MARINE CORPS AIR STATION	250		222	242	Monitoring		1
USMC-MW03E	MARINE CORPS AIR STATION	172		124	164	Monitoring	S	1
USMC-MW04A	MARINE CORPS AIR STATION	421		286	306	Monitoring		1
USMC-MW04B	MARINE CORPS AIR STATION	421		190	210	Monitoring		1
USMC-MW05A	MARINE CORPS AIR STATION	500		462	482	Monitoring		1
USMC-MW05B	MARINE CORPS AIR STATION	364		321	341	Monitoring		1
USMC-MW05C	MARINE CORPS AIR STATION	500		225	245	Monitoring		1
USMC-MW05D	MARINE CORPS AIR STATION	147		83	133	Monitoring		1
USMC-MW05E	MARINE CORPS AIR STATION	160		80	130	Monitoring		1
USMC-MW07	MARINE CORPS AIR STATION	90		25	65	Monitoring		1
USMC-MW100	MARINE CORPS AIR STATION	179		131	171	Monitoring		1
USMC-MW100A	MARINE CORPS AIR STATION	138		93	132	Monitoring		1
USMC-MW101	MARINE CORPS AIR STATION	140		90	130	Monitoring		1
USMC-MW101A	MARINE CORPS AIR STATION	105		68	98	Monitoring		1
USMC-MW103	MARINE CORPS AIR STATION	499		395	495	Monitoring		1
USMC-MW19A	MARINE CORPS AIR STATION	500		448	468	Monitoring		1
USMC-MW19B	MARINE CORPS AIR STATION	425		400	420	Monitoring		1
USMC-MW19C	MARINE CORPS AIR STATION	500		257	277	Monitoring		1
USMC-MW19D	MARINE CORPS AIR STATION	500		150	170	Monitoring	S	1
USMC-MW19E	MARINE CORPS AIR STATION	148		98	138	Monitoring		1
USMC-MW23	MARINE CORPS AIR STATION	115		64	104	Monitoring	S	1
USMC-MW24	MARINE CORPS AIR STATION	80		51	71	Monitoring		1
USMC-MW25	MARINE CORPS AIR STATION	84		55	75	Monitoring		1
USMC-MW29	MARINE CORPS AIR STATION	120		95	135	Monitoring		1
USMC-MW29A	MARINE CORPS AIR STATION	115		75	100	Monitoring		1
USMC-MW31	MARINE CORPS AIR STATION	153		105	145	Monitoring	S	1
USMC-MW37	MARINE CORPS AIR STATION	137		89	130	Monitoring		1
USMC-MW39	MARINE CORPS AIR STATION	276		230	270	Monitoring		1
USMC-MW398-01	MARINE CORPS AIR STATION	231		198	228	Monitoring		1

List of Wells in OCWD Monitoring Programs

KEY

Aquifer Zone: S=Shallow Aquifer, P=Principal Aquifer, D= Deep Aquifer

Program: 1) monitoring well, 2) production well, 3) irrigation or industrial well, 4) injection well, 5) Mid-Basin Injection well, 6) seawater intrusion monitoring well, 7) well monitored by OCWD for Title 22 compliance, 8) North Basin Groundwater Protection Program wells, 9) South Basin Groundwater Protection Program wells, 10) wells in CASGEM monitoring program

Well Name	Well Owner	Bore Depth (ft. bgs)	Casing Sequence	Screened Interval (ft.bgs) Top	Bottom	Type of Well	Aquifer Zone	Program
USMC-MW398-02	MARINE CORPS AIR STATION	231		199	229	Monitoring		1
USMC-MW398-03	MARINE CORPS AIR STATION	242		208	238	Monitoring		1
USMC-MW398-04	MARINE CORPS AIR STATION	232		201	231	Monitoring		1
USMC-MW398-05	MARINE CORPS AIR STATION	230		197	227	Monitoring		1
USMC-MW398-06	MARINE CORPS AIR STATION	228		196	226	Monitoring		1
USMC-MW398-08	MARINE CORPS AIR STATION	233		200	230	Monitoring		1
USMC-MW398-09	MARINE CORPS AIR STATION	242		190	240	Monitoring		1
USMC-MW398-10	MARINE CORPS AIR STATION	260		200	250	Monitoring		1
USMC-MW398-11	MARINE CORPS AIR STATION	267		200	250	Monitoring		1
USMC-MW398-12	MARINE CORPS AIR STATION	7		190	240	Monitoring		1
USMC-MW398-13	MARINE CORPS AIR STATION	245		193	243	Monitoring		1
USMC-MW398-13D	MARINE CORPS AIR STATION	301		251	301	Monitoring		1
USMC-MW398-14	MARINE CORPS AIR STATION	242		192	242	Monitoring		1
USMC-MW398-15	MARINE CORPS AIR STATION	249		199	249	Monitoring		1
USMC-MW398-16	MARINE CORPS AIR STATION	247		194	244	Monitoring		1
USMC-MW398-17	MARINE CORPS AIR STATION	241		189	239	Monitoring		1
USMC-MW398-18	MARINE CORPS AIR STATION	267		194	244	Monitoring		1
USMC-MW398-19	MARINE CORPS AIR STATION	252		202	252	Monitoring		1
USMC-MW398-20	MARINE CORPS AIR STATION	253		201	251	Monitoring		1
USMC-MW398-21	MARINE CORPS AIR STATION	254		193	243	Monitoring		1
USMC-MW398-22	MARINE CORPS AIR STATION	162		120	160	Monitoring		1
USMC-MW398-23	MARINE CORPS AIR STATION	160		120	160	Monitoring		1
USMC-MW398-24	MARINE CORPS AIR STATION	162		120	160	Monitoring		1
USMC-MW398-25	MARINE CORPS AIR STATION	254		201	251	Monitoring		1
USMC-MW398-26	MARINE CORPS AIR STATION	253		202	252	Monitoring		1
USMC-MW398-27	MARINE CORPS AIR STATION	0		202	252	Monitoring		1
USMC-MW40	MARINE CORPS AIR STATION	275		220	260	Monitoring		1
USMC-MW41	MARINE CORPS AIR STATION	228		182	222	Monitoring		1
USMC-MW41A	MARINE CORPS AIR STATION	194		145	185	Monitoring		1
USMC-MW43	MARINE CORPS AIR STATION	200		150	190	Monitoring		1
USMC-MW43B	MARINE CORPS AIR STATION	143		100	141	Monitoring		1
USMC-MW45	MARINE CORPS AIR STATION	169		117	157	Monitoring		1
USMC-MW47	MARINE CORPS AIR STATION	169		116	156	Monitoring		1
USMC-MW48	MARINE CORPS AIR STATION	140		95	135	Monitoring		1
USMC-MW48A	MARINE CORPS AIR STATION	111		74	104	Monitoring		1
USMC-MW50	MARINE CORPS AIR STATION	168		120	160	Monitoring		1
USMC-MW51	MARINE CORPS AIR STATION	172		125	165	Monitoring		1
USMC-MW52	MARINE CORPS AIR STATION	228		182	222	Monitoring		1
USMC-MW56	MARINE CORPS AIR STATION	140		92	132	Monitoring		1
USMC-MW57	MARINE CORPS AIR STATION	93		63	83	Monitoring		1
USMC-MW58	MARINE CORPS AIR STATION	86		69	89	Monitoring		1
USMC-MW59	MARINE CORPS AIR STATION	99		69	89	Monitoring		1
USMC-MW63	MARINE CORPS AIR STATION	281		235	237	Monitoring		1
USMC-MW64	MARINE CORPS AIR STATION	294		245	285	Monitoring		1
USMC-MW64A	MARINE CORPS AIR STATION	255		210	250	Monitoring		1
USMC-MW65X	MARINE CORPS AIR STATION	279		230	270	Monitoring		1
USMC-MW65XA	MARINE CORPS AIR STATION	249		201	236	Monitoring		1
USMC-MW66	MARINE CORPS AIR STATION	305		250	290	Monitoring		1
USMC-MW66A	MARINE CORPS AIR STATION	235		190	230	Monitoring		1
USMC-MW67	MARINE CORPS AIR STATION	245		187	227	Monitoring		1
USMC-MW67A	MARINE CORPS AIR STATION	195		150	190	Monitoring		1
USMC-MW68	MARINE CORPS AIR STATION	308		190	210	Monitoring		1
USMC-MW68A	MARINE CORPS AIR STATION	194		147	187	Monitoring		1
USMC-MW70	MARINE CORPS AIR STATION	172		125	165	Monitoring		1
USMC-MW71	MARINE CORPS AIR STATION	163		115	155	Monitoring		1
USMC-MW72	MARINE CORPS AIR STATION	159		90	130	Monitoring		1
USMC-MW73	MARINE CORPS AIR STATION	140		90	130	Monitoring		1
USMC-MW74	MARINE CORPS AIR STATION	140		90	130	Monitoring		1
USMC-MW75	MARINE CORPS AIR STATION	150		114	154	Monitoring		1
USMC-MW77	MARINE CORPS AIR STATION	145		150	170	Monitoring	S	1
USMC-MW79	MARINE CORPS AIR STATION	166		118	158	Monitoring		1
USMC-MW81	MARINE CORPS AIR STATION	223		176	216	Monitoring		1
USMC-MW82	MARINE CORPS AIR STATION	270		235	255	Monitoring		1
USMC-MW90	MARINE CORPS AIR STATION	145		95	135	Monitoring		1
USMC-MW91	MARINE CORPS AIR STATION	160		110	150	Monitoring		1
USMC-PS1	MARINE CORPS AIR STATION	123		102	122	Monitoring		1
USMC-PS2	MARINE CORPS AIR STATION	135		103	133	Monitoring		1

List of Wells in OCWD Monitoring Programs

KEY

Aquifer Zone: S=Shallow Aquifer, P=Principal Aquifer, D= Deep Aquifer

Program: 1) monitoring well, 2) production well, 3) irrigation or industrial well, 4) injection well, 5) Mid-Basin Injection well, 6) seawater intrusion monitoring well, 7) well monitored by OCWD for Title 22 compliance, 8) North Basin Groundwater Protection Program wells, 9) South Basin Groundwater Protection Program wells, 10) wells in CASGEM monitoring program

		Bore Depth	Casing	Screened Interval (ft.bgs)			Aquifer	
Well Name	Well Owner	(ft. bgs)	Sequence	Top	Bottom	Type of Well	Zone	Program
USMC-PS3	MARINE CORPS AIR STATION	123		102	122	Monitoring		1
USMC-PS3A	MARINE CORPS AIR STATION	111		70	105	Monitoring		1
USMC-PS4	MARINE CORPS AIR STATION	123		98	118	Monitoring		1
USMC-PS5	MARINE CORPS AIR STATION	124		106	126	Monitoring	S	1
USMC-PS6	MARINE CORPS AIR STATION	155		130	150	Monitoring		1
USMC-PS7	MARINE CORPS AIR STATION	129		106	126	Monitoring		1
USMC-PS8	MARINE CORPS AIR STATION	145		125	145	Monitoring	S	1
USMC-RW1	MARINE CORPS AIR STATION	504		430	470	Monitoring		1
USMC-RW2	MARINE CORPS AIR STATION	475		270	310	Monitoring		1
USMC-RW3	MARINE CORPS AIR STATION	403		370	390	Monitoring		1
USMC-RW4	MARINE CORPS AIR STATION	86		65	85	Monitoring		1
USMC-SGU1	MARINE CORPS AIR STATION	217		96	206	Other Active Production		2
USMC-SGU10	MARINE CORPS AIR STATION	230		99	199	Other Active Production		2
USMC-SGU11	MARINE CORPS AIR STATION	231		106	216	Other Active Production		2
USMC-SGU12	MARINE CORPS AIR STATION	228		99	219	Other Active Production		2
USMC-SGU13	MARINE CORPS AIR STATION	228		98	218	Other Active Production		2
USMC-SGU14	MARINE CORPS AIR STATION	237		106	226	Other Active Production		2
USMC-SGU15	MARINE CORPS AIR STATION	229		99	219	Other Active Production		2
USMC-SGU16	MARINE CORPS AIR STATION	236		105	185	Other Active Production		2
USMC-SGU17	MARINE CORPS AIR STATION	236		105	180	Other Active Production		2
USMC-SGU18	MARINE CORPS AIR STATION	235		106	226	Other Active Production		2
USMC-SGU19	MARINE CORPS AIR STATION	246		111	231	Other Active Production		2
USMC-SGU2	MARINE CORPS AIR STATION	219		100	170	Other Active Production		2
USMC-SGU20	MARINE CORPS AIR STATION	239		111	231	Other Active Production		2
USMC-SGU21	MARINE CORPS AIR STATION	234		104	194	Other Active Production		2
USMC-SGU22	MARINE CORPS AIR STATION	227		99	219	Other Active Production		2
USMC-SGU23	MARINE CORPS AIR STATION	230		99	219	Other Active Production		2
USMC-SGU24	MARINE CORPS AIR STATION	234		99	224	Other Active Production		2
USMC-SGU25	MARINE CORPS AIR STATION	235		99	224	Other Active Production		2
USMC-SGU26	MARINE CORPS AIR STATION	235		160	225	Other Active Production		2
USMC-SGU27	MARINE CORPS AIR STATION	165		90	155	Other Active Production		2
USMC-SGU28	MARINE CORPS AIR STATION	220		146	211	Other Active Production		2
USMC-SGU29	MARINE CORPS AIR STATION	155		81	146	Other Active Production		2
USMC-SGU3	MARINE CORPS AIR STATION	225		99	114	Other Active Production		2
USMC-SGU30	MARINE CORPS AIR STATION	230		151	221	Other Active Production		2
USMC-SGU31	MARINE CORPS AIR STATION	149		70	140	Other Active Production		2
USMC-SGU32	MARINE CORPS AIR STATION	217		140	205	Other Active Production		2
USMC-SGU33	MARINE CORPS AIR STATION	154		70	145	Other Active Production		2
USMC-SGU34	MARINE CORPS AIR STATION	220		145	210	Other Active Production		2
USMC-SGU35	MARINE CORPS AIR STATION	155		75	145	Other Active Production		2
USMC-SGU36	MARINE CORPS AIR STATION	250		90	240	Other Active Production		2
USMC-SGU37	MARINE CORPS AIR STATION	250		90	240	Other Active Production		2
USMC-SGU38	MARINE CORPS AIR STATION	250		95	240	Other Active Production		2
USMC-SGU39	MARINE CORPS AIR STATION	200		90	190	Other Active Production		2
USMC-SGU4	MARINE CORPS AIR STATION	219		99	209	Other Active Production		2
USMC-SGU5	MARINE CORPS AIR STATION	215		96	206	Other Active Production		2
USMC-SGU6	MARINE CORPS AIR STATION	228		100	200	Other Active Production		2
USMC-SGU7	MARINE CORPS AIR STATION	230		104	224	Other Active Production		2
USMC-SGU8	MARINE CORPS AIR STATION	231		100	210	Other Active Production		2
USMC-SGU9	MARINE CORPS AIR STATION	228		98	218	Other Active Production		2
USMC-TF1MW1	MARINE CORPS AIR STATION	150		109	149	Monitoring		1
USMC-TF2MW1	MARINE CORPS AIR STATION	164		120	160	Monitoring		1
USMC-TF2MW4	MARINE CORPS AIR STATION	161		120	160	Monitoring		1
MSG-BP10L	MCCOLL SITE GROUP	274		247	257	Monitoring	S	1,10
MKSSN-SA	MCKESSON WATER PRODUCTION. CO.	272		160	260	Other Active Production		2,3
W-2048	MEL MACK CO.	358		112	150	Inactive Production		2
ABBY-A	MELROSE ABBEY FUNERAL CENTER	250		0	0	Other Active Production		2,3
MVCC-COSD1	MESA VERDE COUNTRY CLUB	200		0	0	Other Active Production		2,3,6
MVCC-COSD2	MESA VERDE COUNTRY CLUB	462		200	450	Other Active Production	P	2,3,6
MVCC-COSD3	MESA VERDE COUNTRY CLUB	460		200	450	Other Active Production	P	2,3,6
MCWD-11	MESA WATER DIST.	1060		330	1000	Active Large Production	P	2,7
MCWD-1B	MESA WATER DIST.	612		305	580	Active Large Production	P	2,6,7
MCWD-2	MESA WATER DIST.	670		300	650	Monitoring	P	1
MCWD-3B	MESA WATER DIST.	610		242	572	Active Large Production	P	2,6,7
MCWD-3BM	MESA WATER DIST.	1006		880	920	Monitoring	P	1,6
MCWD-5	MESA WATER DIST.	980		400	940	Active Large Production	P	2,6,7
MCWD-6	MESA WATER DIST.	1093		310	1025	Active Large Production	P	2,6,7

List of Wells in OCWD Monitoring Programs

KEY

Aquifer Zone: S=Shallow Aquifer, P=Principal Aquifer, D= Deep Aquifer

Program: 1) monitoring well, 2) production well, 3) irrigation or industrial well, 4) injection well, 5) Mid-Basin Injection well, 6) seawater intrusion monitoring well, 7) well monitored by OCWD for Title 22 compliance, 8) North Basin Groundwater Protection Program wells, 9) South Basin Groundwater Protection Program wells, 10) wells in CASGEM monitoring program

Well Name	Well Owner	Bore Depth (ft. bgs)	Casing Sequence	Screened Interval (ft.bgs)		Type of Well	Aquifer Zone	Program
				Top	Bottom			
MCWD-7	MESA WATER DIST.	830		363	753	Active Large Production	P	2,6,7
MCWD-8	MESA WATER DIST.	626		300	572	Inactive Production	P	2,6,7
MCWD-8M	MESA WATER DIST.	1000		870	880	Monitoring	P	1,6
MCWD-9	MESA WATER DIST.	625		350	580	Active Large Production	P	2,6,7
W-12133	METROPOLITAN WATER DIST.	400		0	0	Cathodic Protection		9
MIDC-2	MIDWAY CITY MUTUAL WATER CO.	420		228	420	Active Small Production		2,7
MISQ-FV	MILE SQUARE PARK	300		0	0	Other Active Production		2,3
W-11192	MONITORINGTANA LAND CO.	981		870	916	Inactive Production		2
W-14809	MUTUAL WATER CO.	225		0	0	Inactive Production		2,3
W-14811	MUTUAL WATER CO.	265		0	0	Inactive Production		2,3
NATR-TW1	NATURE CONSERVANCY	150		20	150	Other Active Production		2,3
NVLR-LAG1	NAVAL RECREATION STATION	546		478	524	Other Active Production		2,3
NVLR-LAH1	NAVAL RECREATION STATION	836		0	0	Other Active Production		2,3
NVLR-LAN1	NAVAL RECREATION STATION	634		580	620	Inactive Production		2,3
NVLW-4010	NAVAL WEAPONS STATION	59		45	55	Monitoring		1
NVLW-4012	NAVAL WEAPONS STATION	59		45	55	Monitoring		1
NVLW-4013	NAVAL WEAPONS STATION	58		45	55	Monitoring		1
NVLW-4014	NAVAL WEAPONS STATION	59		30	40	Monitoring		1
NVLW-4016	NAVAL WEAPONS STATION	58		42	52	Monitoring		1
NVLW-4018	NAVAL WEAPONS STATION	62		50	60	Monitoring		1
NVLW-4020	NAVAL WEAPONS STATION	62		50	60	Monitoring		1
NVLW-4021	NAVAL WEAPONS STATION	62		51	61	Monitoring		1
NVLW-7001	NAVAL WEAPONS STATION	33		20	30	Monitoring		1
NVLW-7002	NAVAL WEAPONS STATION	32		20	30	Monitoring		1
NVLW-7003	NAVAL WEAPONS STATION	32		20	30	Monitoring		1
NVLW-7004	NAVAL WEAPONS STATION	62		49	59	Monitoring		1
NVLW-7005	NAVAL WEAPONS STATION	62		50	60	Monitoring		1
NVLW-7006	NAVAL WEAPONS STATION	62		50	60	Monitoring		1
NVLW-7007	NAVAL WEAPONS STATION	62		50	60	Monitoring		1
NVLW-7008	NAVAL WEAPONS STATION	111		96	105	Monitoring	S	1
NVLW-7009	NAVAL WEAPONS STATION	175		160	169	Monitoring		1
NVLW-7010	NAVAL WEAPONS STATION	41		30	40	Monitoring		1
NVLW-7011	NAVAL WEAPONS STATION	102		80	100	Monitoring	S	1
NVLW-7012	NAVAL WEAPONS STATION	115		100	110	Monitoring		1
NVLW-7013	NAVAL WEAPONS STATION	108		95	105	Monitoring	S	1
NVLW-7014	NAVAL WEAPONS STATION	187		160	170	Monitoring		1
NVLW-7015	NAVAL WEAPONS STATION	179		161	170	Monitoring		1
NVLW-7016	NAVAL WEAPONS STATION	110		95	105	Monitoring	S	1
NVLW-7017	NAVAL WEAPONS STATION	42		30	40	Monitoring		1
NVLW-7018	NAVAL WEAPONS STATION	102		80	100	Monitoring	S	1
NVLW-7019	NAVAL WEAPONS STATION	42		30	40	Monitoring		1
NVLW-7020	NAVAL WEAPONS STATION	0		19	29	Monitoring		1
NVLW-7021	NAVAL WEAPONS STATION	172		150	170	Monitoring		1
NVLW-7022	NAVAL WEAPONS STATION	32		20	30	Monitoring		1
NVLW-7023	NAVAL WEAPONS STATION	132		110	130	Monitoring		1
NVLW-7024	NAVAL WEAPONS STATION	27		15	25	Monitoring		1
NVLW-7025	NAVAL WEAPONS STATION	62		50	60	Monitoring	S	1
NVLW-7027	NAVAL WEAPONS STATION	36		26	36	Monitoring		1
NVLW-7028	NAVAL WEAPONS STATION	62		50	60	Monitoring	S	1
NVLW-7031	NAVAL WEAPONS STATION	145		130	140	Monitoring		1
NVLW-7032	NAVAL WEAPONS STATION	110		95	105	Monitoring		1
NVLW-7033	NAVAL WEAPONS STATION	170		155	165	Monitoring		1
NVLW-7034	NAVAL WEAPONS STATION	60		46	56	Monitoring		1
NVLW-7035	NAVAL WEAPONS STATION	103		90	100	Monitoring	S	1
NVLW-7036	NAVAL WEAPONS STATION	170		150	160	Monitoring		1
NVLW-7037	NAVAL WEAPONS STATION	112		89	109	Monitoring		1
NVLW-7038	NAVAL WEAPONS STATION	102		80	100	Monitoring	S	1
NVLW-7039	NAVAL WEAPONS STATION	159		143	153	Monitoring		1
NVLW-7040	NAVAL WEAPONS STATION	160		140	150	Monitoring		1
NVLW-7041	NAVAL WEAPONS STATION	146		133	143	Monitoring	S	1
NVLW-7042	NAVAL WEAPONS STATION	151		136	146	Monitoring	S	1
NVLW-7043	NAVAL WEAPONS STATION	150		136	146	Monitoring	S	1
NVLW-7044	NAVAL WEAPONS STATION	158		123	143	Monitoring	S	1
NVLW-7045	NAVAL WEAPONS STATION	157		135	155	Monitoring	S	1
NVLW-7046	NAVAL WEAPONS STATION	107		85	105	Monitoring		1
NVLW-70POC02	NAVAL WEAPONS STATION	0		190	201	Monitoring		1,6
NVLW-70POC03	NAVAL WEAPONS STATION	205		190	200	Monitoring		1,6

List of Wells in OCWD Monitoring Programs

KEY

Aquifer Zone: S=Shallow Aquifer, P=Principal Aquifer, D= Deep Aquifer

Program: 1) monitoring well, 2) production well, 3) irrigation or industrial well, 4) injection well, 5) Mid-Basin Injection well, 6) seawater intrusion monitoring well, 7) well monitored by OCWD for Title 22 compliance, 8) North Basin Groundwater Protection Program wells, 9) South Basin Groundwater Protection Program wells, 10) wells in CASGEM monitoring program

Well Name	Well Owner	Bore Depth (ft. bgs)	Casing Sequence	Screened Interval (ft.bgs)		Type of Well	Aquifer Zone	Program
				Top	Bottom			
NVLW-70POC04	NAVAL WEAPONS STATION	210		195	206	Monitoring		1,6
NVLW-EW7001	NAVAL WEAPONS STATION	33		20	30	Inactive Production		2
NVLW-EW7003	NAVAL WEAPONS STATION	130		95	120	Inactive Production		2
NVLW-RDO1	NAVAL WEAPONS STATION	110		65	105	Monitoring		1
NVLW-RDO2	NAVAL WEAPONS STATION	110		65	105	Monitoring		1
NVLW-RDO3A	NAVAL WEAPONS STATION	31		20	30	Monitoring		1
NVLW-RDO3B	NAVAL WEAPONS STATION	107		65	105	Monitoring		1
NVLW-RDO4	NAVAL WEAPONS STATION	112		65	105	Monitoring		1
NVLW-RDO5	NAVAL WEAPONS STATION	107		65	105	Monitoring		1
NVLW-RDO6A	NAVAL WEAPONS STATION	109		95	105	Monitoring		1
NVLW-RDO6B	NAVAL WEAPONS STATION	145		130	140	Monitoring		1
NVLW-SB2	NAVAL WEAPONS STATION	424		207	407	Inactive Production		2,3,6
NVLW-SB6	NAVAL WEAPONS STATION	802		548	655	Inactive Production	P	2
BYNT-YLSE	NEFF RANCH, LTD	90		34	70	Other Active Production		2,3
NB-DOLD	NEWPORT BEACH	824		399	729	Active Large Production	P	2,7
NB-DOLS	NEWPORT BEACH	385		201	356	Active Large Production	P	2,7
NB-TAMD	NEWPORT BEACH	758		395	690	Active Large Production	P	2,7
NB-TAMS	NEWPORT BEACH	390		170	360	Active Large Production	P	2,7
NBGC-GA10	NEWPORT BEACH GOLF COURSE	65		32	62	Monitoring	S	1,6
NBGC-MW2	NEWPORT BEACH GOLF COURSE	65		35	65	Monitoring		1
NBGC-MW3	NEWPORT BEACH GOLF COURSE	65		35	65	Monitoring		1
NBGC-NB	NEWPORT BEACH GOLF COURSE	498		192	218	Other Active Production		2,3,6
NDW-1	NIAGARA DRINKING WATER	510		270	500	Inactive Production		2,9
COCA-A	NOR-CAL BEVERAGE CO. INC.	654		0	0	Inactive Production		2,3,8
NCS-NO2	NORCO COMMUNITY SERVICES	114		47	114	Other Active Production		2
GRGC-CO1	O.C. FLOOD CONTROL DIST.	96		34	67	Other Active Production		2,3
GRGC-COR1	O.C. FLOOD CONTROL DIST.	92		34	61	Other Active Production		2,3
GRGC-YL14	O.C. FLOOD CONTROL DIST.	0		0	0	Other Active Production		2,3
GRGC-YL15	O.C. FLOOD CONTROL DIST.	0		0	0	Other Active Production		2,3
GRGC-YL16	O.C. FLOOD CONTROL DIST.	0		0	0	Other Active Production		2,3
GRGC-YL4	O.C. FLOOD CONTROL DIST.	0		0	0	Other Active Production		2,3
GRGC-YL9	O.C. FLOOD CONTROL DIST.	0		0	0	Other Active Production		2,3
GRGC-YLA1	O.C. FLOOD CONTROL DIST.	0		0	0	Other Active Production		2,3
W-3763	O.C. FLOOD CONTROL DIST.	610		144	385	Inactive Production		2
W-629	O.C. FLOOD CONTROL DIST.	267		81	256	Monitoring		1
W-638	O.C. FLOOD CONTROL DIST.	176		71	162	Monitoring		1
VECT-GG	O.C. VECTOR CNT. DIST.	224		0	0	Other Active Production		2,3
BSOA-I	OC COUNCIL BOY SCOUTS/ANAHEIM	0		100	200	Other Active Production		2,3
W-19059	OC WASTE MANAGEMENT	60		27	57	Monitoring		1
OVWC-HB	OCEAN VIEW MUTUAL WATER	180		0	0	Inactive Production		2,6
ABS-1	OCWD	286	MP1	25	35	Multiport Monitoring	P	1
ABS-1	OCWD	286	MP2	75	85	Multiport Monitoring	P	1
ABS-1	OCWD	286	MP3	255	265	Multiport Monitoring	P	1
ABS-2	OCWD	180		155	165	Monitoring	S	1
AM-1	OCWD	140		97	115	Monitoring	S	1
AM-10	OCWD	300		217	235	Monitoring	S	1
AM-11	OCWD	278		218	240	Monitoring	P	1
AM-12	OCWD	299		210	225	Monitoring	S	1
AM-13	OCWD	279		252	270	Monitoring	P	1
AM-14	OCWD	321		297	315	Monitoring	P	1,8
AM-15	OCWD	320		300	317	Monitoring	P	1,8
AM-15A	OCWD	231		214	220	Monitoring	S	1,8
AM-16	OCWD	320		300	315	Monitoring	P	1,8
AM-16A	OCWD	227		215	222	Monitoring		1,8
AM-17	OCWD	320		290	308	Monitoring	P	1,8
AM-18	OCWD	320		291	309	Monitoring	P	1,8
AM-18A	OCWD	232		208	215	Monitoring		1,8
AM-19	OCWD	240		217	225	Monitoring		1
AM-19A	OCWD	127		115	123	Monitoring	S	1
AM-2	OCWD	160		87	100	Monitoring	S	1
AM-20	OCWD	397		361	379	Monitoring	P	1
AM-20A	OCWD	268		250	258	Monitoring		1
AM-21	OCWD	269		250	258	Monitoring		1
AM-21A	OCWD	179		157	165	Monitoring	S	1
AM-22	OCWD	356		339	353	Monitoring	P	1,8
AM-22A	OCWD	239		216	224	Monitoring		1,8
AM-23	OCWD	351		330	347	Monitoring	P	1,8

List of Wells in OCWD Monitoring Programs

KEY

Aquifer Zone: S=Shallow Aquifer, P=Principal Aquifer, D= Deep Aquifer

Program: 1) monitoring well, 2) production well, 3) irrigation or industrial well, 4) injection well, 5) Mid-Basin Injection well, 6) seawater intrusion monitoring well, 7) well monitored by OCWD for Title 22 compliance, 8) North Basin Groundwater Protection Program wells, 9) South Basin Groundwater Protection Program wells, 10) wells in CASGEM monitoring program

Well Name	Well Owner	Bore Depth (ft. bgs)	Casing Sequence	Screened Interval (ft.bgs)		Type of Well	Aquifer Zone	Program
				Top	Bottom			
AM-24	OCWD	378		335	350	Monitoring	P	1,8
AM-24A	OCWD	305		279	294	Monitoring		1,8
AM-25	OCWD	365		340	358	Monitoring	P	1,8
AM-25A	OCWD	217		188	195	Monitoring	S	1,8
AM-26	OCWD	388		377	383	Monitoring	P	1
AM-27	OCWD	337		287	305	Monitoring	P	1
AM-28	OCWD	398		358	376	Monitoring		1
AM-29	OCWD	365		340	358	Monitoring	P	1,8
AM-29A	OCWD	96		75	95	Monitoring		1,8
AM-3	OCWD	115		91	107	Monitoring	S	1,10
AM-30	OCWD	375		349	367	Monitoring	P	1,8
AM-30A	OCWD	398		152	159	Monitoring	S	1,8
AM-31	OCWD	358		335	353	Monitoring	P	1,8
AM-31A	OCWD	360		162	170	Monitoring	S	1,8
AM-32	OCWD	398		335	353	Monitoring	P	1,8
AM-33	OCWD	378		354	372	Monitoring	P	1,8
AM-33A	OCWD	238		206	221	Monitoring		1,8
AM-34	OCWD	354		317	335	Monitoring	P	1
AM-34A	OCWD	271		252	260	Monitoring		1
AM-35	OCWD	400		332	350	Monitoring	P	1
AM-36	OCWD	398		369	387	Monitoring	P	1
AM-37	OCWD	378		349	367	Monitoring	P	1
AM-38	OCWD	358		316	334	Monitoring	P	1
AM-39	OCWD	192		168	188	Monitoring		1,8
AM-39A	OCWD	140		115	135	Monitoring	S	1,8
AM-4	OCWD	300		187	205	Monitoring	S	1
AM-40	OCWD	193		175	190	Monitoring		1,8
AM-40A	OCWD	168		145	165	Monitoring	S	1,8
AM-41	OCWD	200		190	200	Monitoring		1,8
AM-41A	OCWD	167		156	166	Monitoring	S	1,8
AM-42	OCWD	198		180	190	Monitoring		1,8
AM-42A	OCWD	135		115	130	Monitoring	S	1,8
AM-43	OCWD	100		80	100	Monitoring		1
AM-44	OCWD	162		140	160	Monitoring	S	1
AM-44A	OCWD	90		78	88	Monitoring		1
AM-45	OCWD	133		102	132	Monitoring	S	1,8
AM-46	OCWD	130		94	124	Monitoring	S	1
AM-47	OCWD	290		227	242	Monitoring	P	1,8
AM-47A	OCWD	170		160	170	Monitoring	S	1,8
AM-48	OCWD	312		270	300	Monitoring	P	1,8
AM-48A	OCWD	152		116	146	Monitoring	S	1,8
AM-49	OCWD	160		120	150	Monitoring	S	1,8
AM-5	OCWD	250		230	245	Monitoring	P	1
AM-50	OCWD	170		140	150	Monitoring	S	1
AM-51	OCWD	130		105	125	Monitoring	S	1
AM-51A	OCWD	80		50	70	Monitoring		1
AM-5A	OCWD	182		168	175	Monitoring	S	1
AM-6	OCWD	300		232	250	Monitoring	P	1
AM-7	OCWD	296		210	225	Monitoring	S	1
AM-8	OCWD	300		268	285	Monitoring	S	1,8
AM-9	OCWD	317		285	303	Monitoring	S	1,8
AMD-1	OCWD	1511	MP1	104	114	Multiport Monitoring	S/P/D	1,10
AMD-1	OCWD	1511	MP2	135	145	Multiport Monitoring	S/P/D	1,10
AMD-1	OCWD	1511	MP3	180	190	Multiport Monitoring	S/P/D	1,10
AMD-1	OCWD	1511	MP4	246	256	Multiport Monitoring	S/P/D	1,10
AMD-1	OCWD	1511	MP5	330	340	Multiport Monitoring	S/P/D	1,10
AMD-1	OCWD	1511	MP6	384	394	Multiport Monitoring	S/P/D	1,10
AMD-1	OCWD	1511	MP7	524	534	Multiport Monitoring	S/P/D	1,10
AMD-1	OCWD	1511	MP8	760	770	Multiport Monitoring	S/P/D	1,10
AMD-1	OCWD	1511	MP8	1038	1048	Multiport Monitoring	S/P/D	1,10
AMD-1	OCWD	1511	MP10	1390	1400	Multiport Monitoring	S/P/D	1,10
AMD-10	OCWD	1510		934	954	Monitoring	P	1
AMD-11	OCWD	1510		906	926	Monitoring	P	1
AMD-12	OCWD	1020		940	960	Monitoring	P	1
AMD-2	OCWD	1508	MP1	156	166	Multiport Monitoring	S/P/D	1
AMD-2	OCWD	1508	MP2	260	270	Multiport Monitoring	S/P/D	1
AMD-2	OCWD	1508	MP3	384	394	Multiport Monitoring	S/P/D	1

List of Wells in OCWD Monitoring Programs

KEY

Aquifer Zone: S=Shallow Aquifer, P=Principal Aquifer, D= Deep Aquifer

Program: 1) monitoring well, 2) production well, 3) irrigation or industrial well, 4) injection well, 5) Mid-Basin Injection well, 6) seawater intrusion monitoring well, 7) well monitored by OCWD for Title 22 compliance, 8) North Basin Groundwater Protection Program wells, 9) South Basin Groundwater Protection Program wells, 10) wells in CASGEM monitoring program

Well Name	Well Owner	Bore Depth (ft. bgs)	Casing Sequence	Screened Interval (ft.bgs)		Type of Well	Aquifer Zone	Program
				Top	Bottom			
AMD-2	OCWD	1508	MP4	510	520	Multiport Monitoring	S/P/D	1
AMD-2	OCWD	1508	MP5	658	668	Multiport Monitoring	S/P/D	1
AMD-2	OCWD	1508	MP6	820	830	Multiport Monitoring	S/P/D	1
AMD-2	OCWD	1508	MP7	1012	1022	Multiport Monitoring	S/P/D	1
AMD-2	OCWD	1508	MP8	1150	1160	Multiport Monitoring	S/P/D	1
AMD-2	OCWD	1508	MP9	1290	1300	Multiport Monitoring	S/P/D	1
AMD-2	OCWD	1508	MP10	1440	1450	Multiport Monitoring	S/P/D	1
AMD-3	OCWD	1416	MP1	66	76	Multiport Monitoring	S/P	1,8,10
AMD-3	OCWD	1416	MP2	134	144	Multiport Monitoring	S/P	1,8,10
AMD-3	OCWD	1416	MP3	210	220	Multiport Monitoring	S/P	1,8,10
AMD-3	OCWD	1416	MP4	360	370	Multiport Monitoring	S/P	1,8,10
AMD-3	OCWD	1416	MP5	480	490	Multiport Monitoring	S/P	1,8,10
AMD-3	OCWD	1416	MP6	570	580	Multiport Monitoring	S/P	1,8,10
AMD-3	OCWD	1416	MP7	820	830	Multiport Monitoring	S/P	1,8,10
AMD-3	OCWD	1416	MP8	920	930	Multiport Monitoring	S/P	1,8,10
AMD-3	OCWD	1416	MP9	1170	1180	Multiport Monitoring	S/P	1,8,10
AMD-3	OCWD	1416	MP10	1282	1292	Multiport Monitoring	S/P	1,8,10
AMD-4	OCWD	1515	MP1	204	214	Multiport Monitoring	S/P/D	1,8
AMD-4	OCWD	1515	MP2	295	305	Multiport Monitoring	S/P/D	1,8
AMD-4	OCWD	1515	MP3	380	390	Multiport Monitoring	S/P/D	1,8
AMD-4	OCWD	1515	MP4	560	570	Multiport Monitoring	S/P/D	1,8
AMD-4	OCWD	1515	MP5	700	710	Multiport Monitoring	S/P/D	1,8
AMD-4	OCWD	1515	MP6	790	800	Multiport Monitoring	S/P/D	1,8
AMD-4	OCWD	1515	MP7	935	945	Multiport Monitoring	S/P/D	1,8
AMD-4	OCWD	1515	MP8	1055	1065	Multiport Monitoring	S/P/D	1,8
AMD-4	OCWD	1515	MP9	1120	1130	Multiport Monitoring	S/P/D	1,8
AMD-4	OCWD	1515	MP10	1265	1275	Multiport Monitoring	S/P/D	1,8
AMD-4	OCWD	1515	MP11	1405	1415	Multiport Monitoring	S/P/D	1,8
AMD-5	OCWD	1495	MP1	100	110	Multiport Monitoring	S/P/D	1
AMD-5	OCWD	1495	MP2	200	210	Multiport Monitoring	S/P/D	1
AMD-5	OCWD	1495	MP3	300	310	Multiport Monitoring	S/P/D	1
AMD-5	OCWD	1495	MP4	414	424	Multiport Monitoring	S/P/D	1
AMD-5	OCWD	1495	MP5	495	505	Multiport Monitoring	S/P/D	1
AMD-5	OCWD	1495	MP6	640	650	Multiport Monitoring	S/P/D	1
AMD-5	OCWD	1495	MP7	750	760	Multiport Monitoring	S/P/D	1
AMD-5	OCWD	1495	MP8	920	930	Multiport Monitoring	S/P/D	1
AMD-5	OCWD	1495	MP9	1025	1035	Multiport Monitoring	S/P/D	1
AMD-5	OCWD	1495	MP10	1210	1220	Multiport Monitoring	S/P/D	1
AMD-5	OCWD	1495	MP11	1320	1330	Multiport Monitoring	S/P/D	1
AMD-5	OCWD	1495	MP12	1420	1430	Multiport Monitoring	S/P/D	1
AMD-6	OCWD	1528	MP1	110	120	Multiport Monitoring	S/P	1
AMD-6	OCWD	1528	MP2	150	160	Multiport Monitoring	S/P	1
AMD-6	OCWD	1528	MP3	220	230	Multiport Monitoring	S/P	1
AMD-6	OCWD	1528	MP4	275	285	Multiport Monitoring	S/P	1
AMD-6	OCWD	1528	MP5	370	380	Multiport Monitoring	S/P	1
AMD-6	OCWD	1528	MP6	495	505	Multiport Monitoring	S/P	1
AMD-6	OCWD	1528	MP7	620	630	Multiport Monitoring	S/P	1
AMD-6	OCWD	1528	MP8	710	720	Multiport Monitoring	S/P	1
AMD-6	OCWD	1528	MP9	790	800	Multiport Monitoring	S/P	1
AMD-6	OCWD	1528	MP10	900	910	Multiport Monitoring	S/P	1
AMD-6	OCWD	1528	MP11	1090	1100	Multiport Monitoring	S/P	1
AMD-6	OCWD	1528	MP12	1260	1270	Multiport Monitoring	S/P	1
AMD-6	OCWD	1528	MP13	1405	1415	Multiport Monitoring	S/P	1
AMD-7	OCWD	1520	MP1	120	130	Multiport Monitoring	S/P/D	1,10
AMD-7	OCWD	1520	MP2	220	230	Multiport Monitoring	S/P/D	1,10
AMD-7	OCWD	1520	MP3	270	280	Multiport Monitoring	S/P/D	1,10
AMD-7	OCWD	1520	MP4	310	320	Multiport Monitoring	S/P/D	1,10
AMD-7	OCWD	1520	MP5	370	380	Multiport Monitoring	S/P/D	1,10
AMD-7	OCWD	1520	MP6	470	480	Multiport Monitoring	S/P/D	1,10
AMD-7	OCWD	1520	MP7	578	588	Multiport Monitoring	S/P/D	1,10
AMD-7	OCWD	1520	MP8	690	700	Multiport Monitoring	S/P/D	1,10
AMD-7	OCWD	1520	MP9	805	815	Multiport Monitoring	S/P/D	1,10
AMD-7	OCWD	1520	MP10	930	940	Multiport Monitoring	S/P/D	1,10
AMD-7	OCWD	1520	MP11	1070	1080	Multiport Monitoring	S/P/D	1,10
AMD-7	OCWD	1520	MP12	1165	1175	Multiport Monitoring	S/P/D	1,10
AMD-7	OCWD	1520	MP13	1295	1305	Multiport Monitoring	S/P/D	1,10
AMD-7	OCWD	1520	MP14	1420	1430	Multiport Monitoring	S/P/D	1,10

List of Wells in OCWD Monitoring Programs

KEY

Aquifer Zone: S=Shallow Aquifer, P=Principal Aquifer, D= Deep Aquifer

Program: 1) monitoring well, 2) production well, 3) irrigation or industrial well, 4) injection well, 5) Mid-Basin Injection well, 6) seawater intrusion monitoring well, 7) well monitored by OCWD for Title 22 compliance, 8) North Basin Groundwater Protection Program wells, 9) South Basin Groundwater Protection Program wells, 10) wells in CASGEM monitoring program

Well Name	Well Owner	Bore Depth (ft. bgs)	Casing Sequence	Screened Interval (ft.bgs)		Type of Well	Aquifer Zone	Program
				Top	Bottom			
AMD-8	OCWD	2080	MP1	78	88	Multiport Monitoring	S/P/D	1
AMD-8	OCWD	2080	P2	178	188	Multiport Monitoring	S/P/D	1
AMD-8	OCWD	2080	MP3	314	324	Multiport Monitoring	S/P/D	1
AMD-8	OCWD	2080	MP4	524	534	Multiport Monitoring	S/P/D	1
AMD-8	OCWD	2080	MP5	660	670	Multiport Monitoring	S/P/D	1
AMD-8	OCWD	2080	MP6	760	770	Multiport Monitoring	S/P/D	1
AMD-8	OCWD	2080	MP7	856	866	Multiport Monitoring	S/P/D	1
AMD-8	OCWD	2080	MP8	1000	1010	Multiport Monitoring	S/P/D	1
AMD-8	OCWD	2080	MP9	1160	1170	Multiport Monitoring	S/P/D	1
AMD-8	OCWD	2080	MP10	1286	1296	Multiport Monitoring	S/P/D	1
AMD-8	OCWD	2080	MP11	1450	1460	Multiport Monitoring	S/P/D	1
AMD-8	OCWD	2080	MP12	1564	1574	Multiport Monitoring	S/P/D	1
AMD-8	OCWD	2080	MP13	1760	1770	Multiport Monitoring	S/P/D	1
AMD-8	OCWD	2080	MP14	1944	1954	Multiport Monitoring	S/P/D	1
AMD-8	OCWD	2080	MP15	2010	2020	Multiport Monitoring	S/P/D	1
AMD-9	OCWD	1163		896	916	Monitoring	S/P	1
BPM-1	OCWD	2211	MP1	128	138	Multiport Monitoring	S/P/D	1,10
BPM-1	OCWD	2211	MP2	248	258	Multiport Monitoring	S/P/D	1,10
BPM-1	OCWD	2211	MP3	456	466	Multiport Monitoring	S/P/D	1,10
BPM-1	OCWD	2211	MP4	612	622	Multiport Monitoring	S/P/D	1,10
BPM-1	OCWD	2211	MP5	776	786	Multiport Monitoring	S/P/D	1,10
BPM-1	OCWD	2211	MP6	886	896	Multiport Monitoring	S/P/D	1,10
BPM-1	OCWD	2211	MP7	1036	1046	Multiport Monitoring	S/P/D	1,10
BPM-1	OCWD	2211	MP8	1264	1274	Multiport Monitoring	S/P/D	1,10
BPM-1	OCWD	2211	MP9	1388	1398	Multiport Monitoring	S/P/D	1,10
BPM-1	OCWD	2211	MP10	1498	1508	Multiport Monitoring	S/P/D	1,10
BPM-1	OCWD	2211	MP11	1684	1694	Multiport Monitoring	S/P/D	1,10
BPM-1	OCWD	2211	MP12	1800	1810	Multiport Monitoring	S/P/D	1,10
BPM-1	OCWD	2211	MP13	1930	1940	Multiport Monitoring	S/P/D	1,10
BPM-1	OCWD	2211	MP14	2105	2115	Multiport Monitoring	S/P/D	1,10
BPM-2	OCWD	2227	MP1	180	190	Multiport Monitoring	S/P/D	1,10
BPM-2	OCWD	2227	MP2	336	346	Multiport Monitoring	S/P/D	1,10
BPM-2	OCWD	2227	MP3	494	504	Multiport Monitoring	S/P/D	1,10
BPM-2	OCWD	2227	MP4	580	590	Multiport Monitoring	S/P/D	1,10
BPM-2	OCWD	2227	MP5	774	784	Multiport Monitoring	S/P/D	1,10
BPM-2	OCWD	2227	MP6	900	910	Multiport Monitoring	S/P/D	1,10
BPM-2	OCWD	2227	MP7	1024	1034	Multiport Monitoring	S/P/D	1,10
BPM-2	OCWD	2227	MP8	1240	1250	Multiport Monitoring	S/P/D	1,10
BPM-2	OCWD	2227	MP9	1364	1374	Multiport Monitoring	S/P/D	1,10
BPM-2	OCWD	2227	MP10	1490	1500	Multiport Monitoring	S/P/D	1,10
BPM-2	OCWD	2227	MP11	1610	1620	Multiport Monitoring	S/P/D	1,10
BPM-2	OCWD	2227	MP12	1760	1770	Multiport Monitoring	S/P/D	1,10
BPM-2	OCWD	2227	MP13	1928	1938	Multiport Monitoring	S/P/D	1,10
BPM-2	OCWD	2227	MP14	2070	2080	Multiport Monitoring	S/P/D	1,10
BPM-2	OCWD	2227	MP15	2170	2180	Multiport Monitoring	S/P/D	1,10
CB-1	OCWD	1543	MP1	76	86	Multiport Monitoring	S/P/D	1,8
CB-1	OCWD	1543	MP2	140	150	Multiport Monitoring	S/P/D	1,8
CB-1	OCWD	1543	MP3	440	450	Multiport Monitoring	S/P/D	1,8
CB-1	OCWD	1543	MP4	659	669	Multiport Monitoring	S/P/D	1,8
CB-1	OCWD	1543	MP5	870	880	Multiport Monitoring	S/P/D	1,8
CB-1	OCWD	1543	MP6	1050	1060	Multiport Monitoring	S/P/D	1,8
CB-1	OCWD	1543	MP7	1190	1200	Multiport Monitoring	S/P/D	1,8
CB-1	OCWD	1543	MP8	1329	1339	Multiport Monitoring	S/P/D	1,8
CB-1	OCWD	1543	MP9	1460	1470	Multiport Monitoring	S/P/D	1,8
COSM-1	OCWD	2000	MP1	90	100	Multiport Monitoring	S/P/D	1,6,10
COSM-1	OCWD	2000	MP2	152	162	Multiport Monitoring	S/P/D	1,6,10
COSM-1	OCWD	2000	MP3	270	280	Multiport Monitoring	S/P/D	1,6,10
COSM-1	OCWD	2000	MP4	350	360	Multiport Monitoring	S/P/D	1,6,10
COSM-1	OCWD	2000	MP5	450	460	Multiport Monitoring	S/P/D	1,6,10
COSM-1	OCWD	2000	MP6	540	550	Multiport Monitoring	S/P/D	1,6,10
COSM-1	OCWD	2000	MP7	620	630	Multiport Monitoring	S/P/D	1,6,10
COSM-1	OCWD	2000	MP8	720	730	Multiport Monitoring	S/P/D	1,6,10
COSM-1	OCWD	2000	MP9	850	860	Multiport Monitoring	S/P/D	1,6,10
COSM-1	OCWD	2000	MP10	980	990	Multiport Monitoring	S/P/D	1,6,10
COSM-1	OCWD	2000	MP11	1100	1110	Multiport Monitoring	S/P/D	1,6,10
COSM-1	OCWD	2000	MP12	1212	1222	Multiport Monitoring	S/P/D	1,6,10
COSM-1	OCWD	2000	MP13	1432	1442	Multiport Monitoring	S/P/D	1,6,10

List of Wells in OCWD Monitoring Programs

KEY

Aquifer Zone: S=Shallow Aquifer, P=Principal Aquifer, D= Deep Aquifer

Program: 1) monitoring well, 2) production well, 3) irrigation or industrial well, 4) injection well, 5) Mid-Basin Injection well, 6) seawater intrusion monitoring well, 7) well monitored by OCWD for Title 22 compliance, 8) North Basin Groundwater Protection Program wells, 9) South Basin Groundwater Protection Program wells, 10) wells in CASGEM monitoring program

		Bore Depth	Casing	Screened Interval (ft.bgs)			Aquifer	
Well Name	Well Owner	(ft. bgs)	Sequence	Top	Bottom	Type of Well	Zone	Program
COSM-1	OCWD	2000	MP14	1594	1604	Multiport Monitoring	S/P/D	1,6,10
COSM-1	OCWD	2000	MP15	1760	1770	Multiport Monitoring	S/P/D	1,6,10
COSM-2	OCWD	1142	MP1	58	68	Multiport Monitoring	S/P	1,6
COSM-2	OCWD	1142	MP2	113	123	Multiport Monitoring	S/P	1,6
COSM-2	OCWD	1142	MP3	198	208	Multiport Monitoring	S/P	1,6
COSM-2	OCWD	1142	MP4	307	317	Multiport Monitoring	S/P	1,6
COSM-2	OCWD	1142	MP5	406	416	Multiport Monitoring	S/P	1,6
COSM-2	OCWD	1142	MP6	540	550	Multiport Monitoring	S/P	1,6
COSM-2	OCWD	1142	MP7	649	659	Multiport Monitoring	S/P	1,6
COSM-2	OCWD	1142	MP8	757	767	Multiport Monitoring	S/P	1,6
COSM-2	OCWD	1142	MP9	886	896	Multiport Monitoring	S/P	1,6
COSM-2	OCWD	1142	MP10	1051	1061	Multiport Monitoring	S/P	1,6
FFS-1	OCWD	1490	MP1	180	190	Multiport Monitoring	S/P/D	1,8,10
FFS-1	OCWD	1490	MP2	360	370	Multiport Monitoring	S/P/D	1,8,10
FFS-1	OCWD	1490	MP3	529	539	Multiport Monitoring	S/P/D	1,8,10
FFS-1	OCWD	1490	MP4	819	829	Multiport Monitoring	S/P/D	1,8,10
FFS-1	OCWD	1490	MP5	1059	1069	Multiport Monitoring	S/P/D	1,8,10
FFS-1	OCWD	1490	MP6	1159	1169	Multiport Monitoring	S/P/D	1,8,10
FFS-1	OCWD	1490	MP7	1299	1309	Multiport Monitoring	S/P/D	1,8,10
FFS-1	OCWD	1490	MP7	1419	1429	Multiport Monitoring	S/P/D	1,8,10
FM-1	OCWD	359		348	356	Monitoring	P	1,8
FM-10	OCWD	250		215	235	Monitoring	P	1,8
FM-10A	OCWD	183		151	171	Monitoring	S	1,8
FM-11	OCWD	280		236	256	Monitoring	P	1,8
FM-11A	OCWD	162		134	154	Monitoring	S	1,8
FM-12	OCWD	241		206	226	Monitoring	P	1,8
FM-12A	OCWD	162		135	155	Monitoring	S	1,8
FM-13	OCWD	243		210	230	Monitoring	P	1,8
FM-13A	OCWD	173		140	160	Monitoring	S	1,8
FM-14	OCWD	277		234	254	Monitoring	P	1,8
FM-14A	OCWD	182		147	167	Monitoring	S	1,8
FM-15	OCWD	261		218	238	Monitoring	P	1,8
FM-15A	OCWD	160		120	140	Monitoring	S	1,8
FM-16	OCWD	282		248	268	Monitoring	P	1,8
FM-16A	OCWD	160		125	145	Monitoring	S	1,8
FM-17	OCWD	280		250	270	Monitoring	P	1,8
FM-18	OCWD	367		224	244	Monitoring	P	1,8
FM-18A	OCWD	160		121	151	Monitoring	S	1,8
FM-19A	OCWD	145		115	135	Monitoring	S	1,8
FM-19B	OCWD	270		230	260	Monitoring		1,8
FM-19C	OCWD	399		365	385	Monitoring	P	1,8
FM-1A	OCWD	197		164	172	Monitoring	S	1,8
FM-2	OCWD	352		320	338	Monitoring	P	1,8
FM-20	OCWD	290		221	241	Monitoring	P	1,8
FM-20A	OCWD	160		130	150	Monitoring	S	1,8
FM-21	OCWD	286		260	270	Monitoring	P	1,8
FM-21A	OCWD	169		140	160	Monitoring	S	1,8
FM-22	OCWD	290		242	262	Monitoring	P	1,8
FM-22A	OCWD	180		150	170	Monitoring	S	1,8
FM-23	OCWD	290		234	249	Monitoring	P	1,8
FM-23A	OCWD	155		128	143	Monitoring	S	1,8
FM-24	OCWD	302		271	291	Monitoring	P	1,8
FM-24A	OCWD	200		154	174	Monitoring	S	1,8
FM-25	OCWD	160		132	152	Monitoring	S	1,8
FM-26	OCWD	155		145	155	Monitoring	S	1,8
FM-27	OCWD	125		105	125	Monitoring	S	1,8
FM-2A	OCWD	237		226	234	Monitoring		1,8
FM-3	OCWD	298		257	263	Monitoring	P	1,8
FM-4	OCWD	355		327	345	Monitoring	P	1,8
FM-4A	OCWD	170		142	160	Monitoring	S	1,8
FM-5	OCWD	142		121	141	Monitoring	S	1,8
FM-6	OCWD	405		150	310	Monitoring	S	1,10
FM-7	OCWD	205		187	197	Monitoring		1,8
FM-7A	OCWD	172		160	170	Monitoring	S	1,8
FM-8	OCWD	150		114	134	Monitoring	S	1,8
FM-9	OCWD	260		220	240	Monitoring	P	1,8
FM-9A	OCWD	240		166	186	Monitoring	S	1,8

List of Wells in OCWD Monitoring Programs

KEY

Aquifer Zone: S=Shallow Aquifer, P=Principal Aquifer, D= Deep Aquifer

Program: 1) monitoring well, 2) production well, 3) irrigation or industrial well, 4) injection well, 5) Mid-Basin Injection well, 6) seawater intrusion monitoring well, 7) well monitored by OCWD for Title 22 compliance, 8) North Basin Groundwater Protection Program wells, 9) South Basin Groundwater Protection Program wells, 10) wells in CASGEM monitoring program

Well Name	Well Owner	Bore Depth (ft. bgs)	Casing Sequence	Screened Interval (ft.bgs)		Type of Well	Aquifer Zone	Program
				Top	Bottom			
FVM-1	OCWD	2000	MP1	134	145	Multiport Monitoring	S/P/D	1,10
FVM-1	OCWD	2000	MP3	172	182	Multiport Monitoring	S/P/D	1,10
FVM-1	OCWD	2000	MP3	220	230	Multiport Monitoring	S/P/D	1,10
FVM-1	OCWD	2000	MP4	360	370	Multiport Monitoring	S/P/D	1,10
FVM-1	OCWD	2000	MP5	450	460	Multiport Monitoring	S/P/D	1,10
FVM-1	OCWD	2000	MP6	500	510	Multiport Monitoring	S/P/D	1,10
FVM-1	OCWD	2000	MP7	560	570	Multiport Monitoring	S/P/D	1,10
FVM-1	OCWD	2000	MP8	630	640	Multiport Monitoring	S/P/D	1,10
FVM-1	OCWD	2000	MP9	810	820	Multiport Monitoring	S/P/D	1,10
FVM-1	OCWD	2000	MP10	894	904	Multiport Monitoring	S/P/D	1,10
FVM-1	OCWD	2000	MP11	1000	1010	Multiport Monitoring	S/P/D	1,10
FVM-1	OCWD	2000	MP12	1120	1130	Multiport Monitoring	S/P/D	1,10
FVM-1	OCWD	2000	MP13	1175	1185	Multiport Monitoring	S/P/D	1,10
FVM-1	OCWD	2000	MP14	1230	1240	Multiport Monitoring	S/P/D	1,10
FVM-1	OCWD	2000	MP15	1320	1330	Multiport Monitoring	S/P/D	1,10
FVM-1	OCWD	2000	MP16	1492	1502	Multiport Monitoring	S/P/D	1,10
FVM-1	OCWD	2000	MP17	1582	1592	Multiport Monitoring	S/P/D	1,10
FVM-1	OCWD	2000	MP18	1834	1844	Multiport Monitoring	S/P/D	1,10
GGM-1	OCWD	2086	MP1	150	160	Multiport Monitoring	S/P/D	1,10
GGM-1	OCWD	2086	MP2	300	310	Multiport Monitoring	S/P/D	1,10
GGM-1	OCWD	2086	MP3	464	474	Multiport Monitoring	S/P/D	1,10
GGM-1	OCWD	2086	MP4	550	560	Multiport Monitoring	S/P/D	1,10
GGM-1	OCWD	2086	MP5	740	750	Multiport Monitoring	S/P/D	1,10
GGM-1	OCWD	2086	MP6	825	835	Multiport Monitoring	S/P/D	1,10
GGM-1	OCWD	2086	MP7	950	960	Multiport Monitoring	S/P/D	1,10
GGM-1	OCWD	2086	MP8	1070	1080	Multiport Monitoring	S/P/D	1,10
GGM-1	OCWD	2086	MP9	1260	1270	Multiport Monitoring	S/P/D	1,10
GGM-1	OCWD	2086	MP10	1515	1525	Multiport Monitoring	S/P/D	1,10
GGM-1	OCWD	2086	MP11	1650	1660	Multiport Monitoring	S/P/D	1,10
GGM-1	OCWD	2086	MP12	1768	1778	Multiport Monitoring	S/P/D	1,10
GGM-1	OCWD	2086	MP13	2008	2018	Multiport Monitoring	S/P/D	1,10
GGM-2	OCWD	2057	MP1	212	222	Multiport Monitoring	S/P/D	1
GGM-2	OCWD	2057	MP2	294	304	Multiport Monitoring	S/P/D	1
GGM-2	OCWD	2057	MP3	460	470	Multiport Monitoring	S/P/D	1
GGM-2	OCWD	2057	MP4	715	725	Multiport Monitoring	S/P/D	1
GGM-2	OCWD	2057	MP5	950	960	Multiport Monitoring	S/P/D	1
GGM-2	OCWD	2057	MP6	1045	1055	Multiport Monitoring	S/P/D	1
GGM-2	OCWD	2057	MP7	1145	1155	Multiport Monitoring	S/P/D	1
GGM-2	OCWD	2057	MP8	1250	1260	Multiport Monitoring	S/P/D	1
GGM-2	OCWD	2057	MP	1485	1495	Multiport Monitoring	S/P/D	1
GGM-2	OCWD	2057	MP10	1625	1635	Multiport Monitoring	S/P/D	1
GGM-2	OCWD	2057	MP11	1740	1750	Multiport Monitoring	S/P/D	1
GGM-2	OCWD	2057	MP12	1900	1910	Multiport Monitoring	S/P/D	1
GGM-2	OCWD	2057	MP13	1990	2000	Multiport Monitoring	S/P/D	1
GGM-3	OCWD	2020	MP1	195	205	Multiport Monitoring	S/P	1
GGM-3	OCWD	2020	MP2	310	320	Multiport Monitoring	S/P	1
GGM-3	OCWD	2020	MP3	545	555	Multiport Monitoring	S/P	1
GGM-3	OCWD	2020	MP4	640	650	Multiport Monitoring	S/P	1
GGM-3	OCWD	2020	MP5	837	847	Multiport Monitoring	S/P	1
GGM-3	OCWD	2020	MP6	1004	1014	Multiport Monitoring	S/P	1
GGM-3	OCWD	2020	MP7	1104	1114	Multiport Monitoring	S/P	1
GGM-3	OCWD	2020	MP8	1274	1284	Multiport Monitoring	S/P	1
GGM-3	OCWD	2020	MP9	1539	1549	Multiport Monitoring	S/P	1
GGM-3	OCWD	2020	MP10	1680	1690	Multiport Monitoring	S/P	1
GGM-3	OCWD	2020	MP11	1780	1790	Multiport Monitoring	S/P	1
GGM-3	OCWD	2020	MP12	1950	1960	Multiport Monitoring	S/P	1
HBM-1	OCWD	2013	MP1	90	100	Multiport Monitoring	S/P/D	1,10
HBM-1	OCWD	2013	MP2	190	200	Multiport Monitoring	S/P/D	1,10
HBM-1	OCWD	2013	MP3	320	330	Multiport Monitoring	S/P/D	1,10
HBM-1	OCWD	2013	MP4	482	492	Multiport Monitoring	S/P/D	1,10
HBM-1	OCWD	2013	MP5	560	570	Multiport Monitoring	S/P/D	1,10
HBM-1	OCWD	2013	MP6	700	710	Multiport Monitoring	S/P/D	1,10
HBM-1	OCWD	2013	MP7	920	930	Multiport Monitoring	S/P/D	1,10
HBM-1	OCWD	2013	MP8	1034	1044	Multiport Monitoring	S/P/D	1,10
HBM-1	OCWD	2013	MP9	1126	1136	Multiport Monitoring	S/P/D	1,10
HBM-1	OCWD	2013	MP10	1348	1358	Multiport Monitoring	S/P/D	1,10
HBM-1	OCWD	2013	MP11	1460	1470	Multiport Monitoring	S/P/D	1,10

List of Wells in OCWD Monitoring Programs

KEY

Aquifer Zone: S=Shallow Aquifer, P=Principal Aquifer, D= Deep Aquifer

Program: 1) monitoring well, 2) production well, 3) irrigation or industrial well, 4) injection well, 5) Mid-Basin Injection well, 6) seawater intrusion monitoring well, 7) well monitored by OCWD for Title 22 compliance, 8) North Basin Groundwater Protection Program wells, 9) South Basin Groundwater Protection Program wells, 10) wells in CASGEM monitoring program

Well Name	Well Owner	Bore Depth (ft. bgs)	Casing Sequence	Screened Interval (ft.bgs)		Type of Well	Aquifer Zone	Program
				Top	Bottom			
HBM-1	OCWD	2013	MP12	1540	1550	Multiport Monitoring	S/P/D	1,10
HBM-1	OCWD	2013	MP13	1640	1650	Multiport Monitoring	S/P/D	1,10
HBM-1	OCWD	2013	MP14	1930	1940	Multiport Monitoring	S/P/D	1,10
HBM-2	OCWD	1010	MP1	110	120	Multiport Monitoring	S/P	1,6,10
HBM-2	OCWD	1010	MP2	160	170	Multiport Monitoring	S/P	1,6,10
HBM-2	OCWD	1010	MP3	245	255	Multiport Monitoring	S/P	1,6,10
HBM-2	OCWD	1010	MP4	305	315	Multiport Monitoring	S/P	1,6,10
HBM-2	OCWD	1010	MP5	360	370	Multiport Monitoring	S/P	1,6,10
HBM-2	OCWD	1010	MP6	445	455	Multiport Monitoring	S/P	1,6,10
HBM-2	OCWD	1010	MP7	520	530	Multiport Monitoring	S/P	1,6,10
HBM-2	OCWD	1010	MP8	570	580	Multiport Monitoring	S/P	1,6,10
HBM-2	OCWD	1010	MP9	675	685	Multiport Monitoring	S/P	1,6,10
HBM-2	OCWD	1010	MP10	735	745	Multiport Monitoring	S/P	1,6,10
HBM-2	OCWD	1010	MP11	845	855	Multiport Monitoring	S/P	1,6,10
HBM-2	OCWD	1010	MP12	925	935	Multiport Monitoring	S/P	1,6,10
HBM-4	OCWD	830	MP1	75	85	Multiport Monitoring	S/P	1,6
HBM-4	OCWD	830	MP2	120	130	Multiport Monitoring	S/P	1,6
HBM-4	OCWD	830	MP3	180	190	Multiport Monitoring	S/P	1,6
HBM-4	OCWD	830	MP4	230	240	Multiport Monitoring	S/P	1,6
HBM-4	OCWD	830	MP5	295	305	Multiport Monitoring	S/P	1,6
HBM-4	OCWD	830	MP6	350	360	Multiport Monitoring	S/P	1,6
HBM-4	OCWD	830	MP7	415	425	Multiport Monitoring	S/P	1,6
HBM-4	OCWD	830	MP8	550	560	Multiport Monitoring	S/P	1,6
HBM-4	OCWD	830	MP9	690	700	Multiport Monitoring	S/P	1,6
HBM-5	OCWD	1019	MP3	70	90	Multiport Monitoring	S/P	1,6
HBM-5	OCWD	1019	MP1	70	90	Multiport Monitoring	S/P	1,6
HBM-5	OCWD	1019	MP2	70	90	Multiport Monitoring	S/P	1,6
HBM-5	OCWD	1019	MP4	125	135	Multiport Monitoring	S/P	1,6
HBM-5	OCWD	1019	MP5	170	180	Multiport Monitoring	S/P	1,6
HBM-5	OCWD	1019	MP6	215	225	Multiport Monitoring	S/P	1,6
HBM-5	OCWD	1019	MP7	245	255	Multiport Monitoring	S/P	1,6
HBM-5	OCWD	1019	MP8	270	280	Multiport Monitoring	S/P	1,6
HBM-6	OCWD	800	MP1	52	62	Multiport Monitoring	S/P	1,6,10
HBM-6	OCWD	800	MP2	84	94	Multiport Monitoring	S/P	1,6,10
HBM-6	OCWD	800	MP3	108	118	Multiport Monitoring	S/P	1,6,10
HBM-6	OCWD	800	MP4	214	224	Multiport Monitoring	S/P	1,6,10
HBM-6	OCWD	800	MP5	263	273	Multiport Monitoring	S/P	1,6,10
HBM-6	OCWD	800	MP6	294	304	Multiport Monitoring	S/P	1,6,10
HBM-6	OCWD	800	MP7	506	516	Multiport Monitoring	S/P	1,6,10
HBM-6	OCWD	800	MP8	576	586	Multiport Monitoring	S/P	1,6,10
IDM-1	OCWD	1123	MP1	85	95	Multiport Monitoring	S/P/D	1,10
IDM-1	OCWD	1123	MP2	270	280	Multiport Monitoring	S/P/D	1,10
IDM-1	OCWD	1123	MP3	335	345	Multiport Monitoring	S/P/D	1,10
IDM-1	OCWD	1123	MP4	435	445	Multiport Monitoring	S/P/D	1,10
IDM-1	OCWD	1123	MP5	630	640	Multiport Monitoring	S/P/D	1,10
IDM-1	OCWD	1123	MP6	700	710	Multiport Monitoring	S/P/D	1,10
IDM-1	OCWD	1123	MP7	760	770	Multiport Monitoring	S/P/D	1,10
IDM-1	OCWD	1123	MP8	875	885	Multiport Monitoring	S/P/D	1,10
IDM-1	OCWD	1123	MP9	990	1000	Multiport Monitoring	S/P/D	1,10
IDM-1	OCWD	1123	MP10	1050	1060	Multiport Monitoring	S/P/D	1,10
IDM-2	OCWD	1487	MP1	126	136	Multiport Monitoring	S/P/D	1,9,10
IDM-2	OCWD	1487	MP2	234	244	Multiport Monitoring	S/P/D	1,9,10
IDM-2	OCWD	1487	MP3	284	294	Multiport Monitoring	S/P/D	1,9,10
IDM-2	OCWD	1487	MP4	352	362	Multiport Monitoring	S/P/D	1,9,10
IDM-2	OCWD	1487	MP5	492	502	Multiport Monitoring	S/P/D	1,9,10
IDM-2	OCWD	1487	MP6	612	622	Multiport Monitoring	S/P/D	1,9,10
IDM-2	OCWD	1487	MP7	710	720	Multiport Monitoring	S/P/D	1,9,10
IDM-2	OCWD	1487	MP8	886	896	Multiport Monitoring	S/P/D	1,9,10
IDM-2	OCWD	1487	MP9	1050	1060	Multiport Monitoring	S/P/D	1,9,10
IDM-2	OCWD	1487	MP10	1178	1188	Multiport Monitoring	S/P/D	1,9,10
IDM-2	OCWD	1487	M0-11	1256	1266	Multiport Monitoring	S/P/D	1,9,10
IDM-2	OCWD	1487	M012	1400	1410	Multiport Monitoring	S/P/D	1,9,10
IDM-3	OCWD	704		652	672	Monitoring	S/P	1
IDM-4	OCWD	726		654	674	Monitoring	S/P	1
IDP-1	OCWD	708		121	681	Injection		4
IDP-2R	OCWD	680		300	340	Monitoring	S/P	1
IDP-3	OCWD	602		125	505	Monitoring		1

List of Wells in OCWD Monitoring Programs

KEY

Aquifer Zone: S=Shallow Aquifer, P=Principal Aquifer, D= Deep Aquifer

Program: 1) monitoring well, 2) production well, 3) irrigation or industrial well, 4) injection well, 5) Mid-Basin Injection well, 6) seawater intrusion monitoring well, 7) well monitored by OCWD for Title 22 compliance, 8) North Basin Groundwater Protection Program wells, 9) South Basin Groundwater Protection Program wells, 10) wells in CASGEM monitoring program

Well Name	Well Owner	Bore Depth (ft. bgs)	Casing Sequence	Screened Interval (ft.bgs)		Type of Well	Aquifer Zone	Program
				Top	Bottom			
KBS-1	OCWD	244		209	219	Monitoring	S/P	1
KBS-2	OCWD	303	MP1	96	106	Multiport Monitoring	S/P	1
KBS-2	OCWD	303	MP2	210	220	Multiport Monitoring	S/P	1
KBS-3	OCWD	92		80	90	Monitoring		1
KBS-4	OCWD	160		138	158	Monitoring	S	1
KBS-4A	OCWD	92		80	90	Monitoring		1
LAM-1	OCWD	2211	MP1	70	80	Multiport Monitoring	S/P/D	1,10
LAM-1	OCWD	2211	MP2	220	230	Multiport Monitoring	S/P/D	1,10
LAM-1	OCWD	2211	MP3	270	280	Multiport Monitoring	S/P/D	1,10
LAM-1	OCWD	2211	MP4	470	480	Multiport Monitoring	S/P/D	1,10
LAM-1	OCWD	2211	MP5	570	580	Multiport Monitoring	S/P/D	1,10
LAM-1	OCWD	2211	MP6	830	840	Multiport Monitoring	S/P/D	1,10
LAM-1	OCWD	2211	MP7	992	1002	Multiport Monitoring	S/P/D	1,10
LAM-1	OCWD	2211	MP8	1070	1080	Multiport Monitoring	S/P/D	1,10
LAM-1	OCWD	2211	MP9	1150	1160	Multiport Monitoring	S/P/D	1,10
LAM-1	OCWD	2211	MP10	1250	1260	Multiport Monitoring	S/P/D	1,10
LAM-1	OCWD	2211	MP11	1494	1504	Multiport Monitoring	S/P/D	1,10
LAM-1	OCWD	2211	MP12	1610	1620	Multiport Monitoring	S/P/D	1,10
MBI-1	OCWD	1239		530	1190	Injection		4,5
MCAS-1	OCWD	620	MP1	60	70	Multiport Monitoring	S/P	1
MCAS-1	OCWD	620	MP2	150	160	Multiport Monitoring	S/P	1
MCAS-1	OCWD	620	MP3	210	220	Multiport Monitoring	S/P	1
MCAS-1	OCWD	620	MP4	270	280	Multiport Monitoring	S/P	1
MCAS-1	OCWD	620	MP5	330	340	Multiport Monitoring	S/P	1
MCAS-1	OCWD	620	MP6	450	460	Multiport Monitoring	S/P	1
MCAS-1	OCWD	620	MP7	540	550	Multiport Monitoring	S/P	1
MCAS-10	OCWD	389		347	377	Monitoring	P	1
MCAS-2	OCWD	680	MP1	40	50	Multiport Monitoring	S/P	1
MCAS-2	OCWD	680	MP2	130	140	Multiport Monitoring	S/P	1
MCAS-2	OCWD	680	MP3	200	210	Multiport Monitoring	S/P	1
MCAS-2	OCWD	680	MP4	370	380	Multiport Monitoring	S/P	1
MCAS-2	OCWD	680	MP5	420	430	Multiport Monitoring	S/P	1
MCAS-2	OCWD	680	MP6	490	500	Multiport Monitoring	S/P	1
MCAS-2	OCWD	680	MP7	550	560	Multiport Monitoring	S/P	1
MCAS-2	OCWD	680	MP8	620	630	Multiport Monitoring	S/P	1
MCAS-3	OCWD	603	MP1	80	90	Multiport Monitoring	S/P	1,10
MCAS-3	OCWD	603	MP2	160	170	Multiport Monitoring	S/P	1,10
MCAS-3	OCWD	603	MP3	220	230	Multiport Monitoring	S/P	1,10
MCAS-3	OCWD	603	MP4	340	350	Multiport Monitoring	S/P	1,10
MCAS-3	OCWD	603	MP5	420	430	Multiport Monitoring	S/P	1,10
MCAS-3	OCWD	603	MP6	490	500	Multiport Monitoring	S/P	1,10
MCAS-4	OCWD	317		181	238	Monitoring	S/P	1
MCAS-5A	OCWD	159		120	130	Monitoring	S	1
MCAS-6	OCWD	455		167	222	Monitoring	S	1
MCAS-7	OCWD	1297	MP1	90	100	Multiport Monitoring	S/P	1,10
MCAS-7	OCWD	1297	MP2	190	200	Multiport Monitoring	S/P	1,10
MCAS-7	OCWD	1297	MP3	350	360	Multiport Monitoring	S/P	1,10
MCAS-7	OCWD	1297	MP4	440	450	Multiport Monitoring	S/P	1,10
MCAS-7	OCWD	1297	MP5	510	520	Multiport Monitoring	S/P	1,10
MCAS-7	OCWD	1297	MP6	800	810	Multiport Monitoring	S/P	1,10
MCAS-7	OCWD	1297	MP7	910	920	Multiport Monitoring	S/P	1,10
MCAS-7	OCWD	1297	MP8	980	990	Multiport Monitoring	S/P	1,10
MCAS-7	OCWD	1297	MP9	1100	1110	Multiport Monitoring	S/P	1,10
MCAS-8	OCWD	437		392	410	Monitoring	P	1
MCAS-9	OCWD	450		372	445	Monitoring	P	1
MSP-10P	OCWD	59		40	50	Monitoring		1
MSP-10T	OCWD	211		70	140	Monitoring		1
OCWD-33Z11	OCWD	527		435	485	Monitoring		1,6
OCWD-34F10	OCWD	490		420	460	Monitoring		1,6
OCWD-34H25	OCWD	490		410	465	Monitoring		1
OCWD-34H5	OCWD	480		405	455	Monitoring		1,6
OCWD-34L10	OCWD	478		405	450	Monitoring		1,6
OCWD-34LS	OCWD	400		340	380	Monitoring		1,6
OCWD-34N21	OCWD	494		424	464	Monitoring		1,6
OCWD-34NP7	OCWD	312		225	300	Monitoring		1,6
OCWD-34S	OCWD	380		312	347	Injection		4
OCWD-34T01	OCWD	375		290	345	Monitoring		1,6

List of Wells in OCWD Monitoring Programs

KEY

Aquifer Zone: S=Shallow Aquifer, P=Principal Aquifer, D= Deep Aquifer

Program: 1) monitoring well, 2) production well, 3) irrigation or industrial well, 4) injection well, 5) Mid-Basin Injection well, 6) seawater intrusion monitoring well, 7) well monitored by OCWD for Title 22 compliance, 8) North Basin Groundwater Protection Program wells, 9) South Basin Groundwater Protection Program wells, 10) wells in CASGEM monitoring program

				Screened Interval (ft.bgs)				
Well Name	Well Owner	Bore Depth (ft. bgs)	Casing Sequence	Top	Bottom	Type of Well	Aquifer Zone	Program
OCWD-34U8	OCWD	424		359	384	Monitoring		1,6
OCWD-34V	OCWD	320		260	300	Injection		4
OCWD-34V20	OCWD	456		387	417	Monitoring		1,6
OCWD-34VZX	OCWD	199		147	177	Monitoring		1,6
OCWD-34VZY	OCWD	265		215	235	Monitoring		1,6
OCWD-34WP5	OCWD	212		165	180	Monitoring		1,6
OCWD-34X40	OCWD	450		333	358	Monitoring	S	1,6
OCWD-34Z	OCWD	191		110	150	Injection		4
OCWD-35DP5	OCWD	130		92	107	Monitoring		1,6
OCWD-35E01X	OCWD	98		65	85	Monitoring		1,6
OCWD-35E01Y	OCWD	343		105	125	Monitoring		1,6
OCWD-35F	OCWD	168		80	115	Injection		4
OCWD-35F20	OCWD	300		235	265	Monitoring		1,6
OCWD-35FP21	OCWD	85		36	71	Monitoring		1,6
OCWD-35G	OCWD	182		80	145	Injection		4
OCWD-35H11	OCWD	230		200	220	Monitoring	S	1,6
OCWD-35H12	OCWD	300		137	147	Monitoring		1,6
OCWD-35H1X	OCWD	257		131	171	Injection		4
OCWD-35H1Y	OCWD	271		215	237	Injection		4
OCWD-35H2	OCWD	260		112	241	Injection		4
OCWD-35J1	OCWD	271		190	240	Monitoring		1,6
OCWD-35J1Y	OCWD	378		264	294	Monitoring		1,6
OCWD-35K1	OCWD	275		193	243	Monitoring		1,6
OCWD-35K1V	OCWD	112		90	110	Monitoring		1,6
OCWD-35K1Y	OCWD	395		366	386	Monitoring		1,6
OCWD-35KP12	OCWD	87		47	67	Monitoring		1
OCWD-35N01	OCWD	101		80	85	Monitoring	S	1,6
OCWD-35T9	OCWD	1020		390	411	Monitoring		1,6
OCWD-36FP14Z1	OCWD	150		115	125	Monitoring		1,6
OCWD-36FP14Z2	OCWD	705		357	367	Monitoring		1,6
OCWD-36FP1X	OCWD	160		136	146	Monitoring		1
OCWD-36FP1Z	OCWD	1020		504	514	Monitoring	P	1,6
OCWD-7	OCWD	48		28	48	Monitoring		1
OCWD-AIR1	OCWD	1518		1375	1460	Monitoring	S/P	1,10
OCWD-ALK	OCWD	320		217	317	Other Active Production		2,3
OCWD-AN1	OCWD	115		35	115	Monitoring		1
OCWD-AN2	OCWD	119		35	115	Monitoring		1
OCWD-BESS	OCWD	302		172	189	Other Active Production	S	2,3
OCWD-BIO1	OCWD	124		25	115	Inactive Production	S	2
OCWD-BP1	OCWD	40		20	40	Monitoring		1
OCWD-BP2	OCWD	70		50	70	Monitoring		1
OCWD-BP3	OCWD	205		185	205	Monitoring	S	1
OCWD-BP4	OCWD	180		140	180	Monitoring	S	1
OCWD-BP5	OCWD	240		147	167	Monitoring	S	1
OCWD-BP6	OCWD	245		148	168	Monitoring	S	1
OCWD-BP7	OCWD	270		148	168	Monitoring	S	1
OCWD-BS10	OCWD	906		595	605	Monitoring	S/P	1,6
OCWD-BS103A	OCWD	16		10	15	Monitoring		1,6
OCWD-BS105A	OCWD	12		6	11	Monitoring		1,6
OCWD-BS11	OCWD	741		580	590	Monitoring	S/P	1,6
OCWD-BS15	OCWD	105		60	70	Monitoring		1,6
OCWD-BS16	OCWD	95		60	80	Monitoring	S	1,6
OCWD-BS16A	OCWD	24		16	21	Monitoring		1,6
OCWD-BS18	OCWD	95		72	82	Monitoring	S	1,6
OCWD-BS18A	OCWD	17		11	16	Monitoring		1,6
OCWD-BS19	OCWD	100		63	83	Monitoring	S	1,6
OCWD-BS20A	OCWD	27		6	11	Monitoring		1
OCWD-BS20B	OCWD	85		71	81	Monitoring	S	1,6
OCWD-BS21	OCWD	0		0	0	Monitoring	S	1,6
OCWD-CTG1	OCWD	1330		1060	1220	Monitoring	S/P/D	1,10
OCWD-CTG5	OCWD	1600		1040	1120	Monitoring	P/D	1
OCWD-CTK1	OCWD	1444		1260	1315	Monitoring	P/D	1
OCWD-D1	OCWD	926		780	880	Other Active Production	P	2,3
OCWD-D3	OCWD	1050		560	1000	Other Active Production	P	2,3
OCWD-D4	OCWD	1033		531	979	Other Active Production	P	2,3
OCWD-D5	OCWD	1050		597	1005	Inactive Production		2,3
OCWD-EW1	OCWD	324		160	295	Inactive Production		2,8

List of Wells in OCWD Monitoring Programs

KEY

Aquifer Zone: S=Shallow Aquifer, P=Principal Aquifer, D= Deep Aquifer

Program: 1) monitoring well, 2) production well, 3) irrigation or industrial well, 4) injection well, 5) Mid-Basin Injection well, 6) seawater intrusion monitoring well, 7) well monitored by OCWD for Title 22 compliance, 8) North Basin Groundwater Protection Program wells, 9) South Basin Groundwater Protection Program wells, 10) wells in CASGEM monitoring program

Well Name	Well Owner	Bore Depth (ft. bgs)	Casing Sequence	Screened Interval (ft.bgs)		Type of Well	Aquifer Zone	Program
				Top	Bottom			
OCWD-EW2	OCWD	230		130	196	Inactive Production	S	2,8
OCWD-EW2A	OCWD	207		122	188	Inactive Production	S	2,8
OCWD-EW3	OCWD	270		150	249	Inactive Production		2,8
OCWD-EW3A	OCWD	0		0	0	Inactive Production	S	2,8
OCWD-EW4	OCWD	275		130	255	Inactive Production	S	2,8
OCWD-FBM1	OCWD	140		38	138	Monitoring	S	1
OCWD-FBM2	OCWD	140		39	139	Monitoring	S	1
OCWD-FBR1	OCWD	100		30	90	Injection		4
OCWD-FC1	OCWD	185		165	185	Monitoring	P	1
OCWD-FC2	OCWD	115		95	115	Monitoring	S	1
OCWD-FH1	OCWD	140		120	140	Monitoring	S	1
OCWD-GA1	OCWD	45		30	40	Monitoring		1
OCWD-GA2	OCWD	45		30	40	Monitoring	S	1,6
OCWD-GA3	OCWD	45		30	40	Monitoring		1
OCWD-GA4	OCWD	45		30	40	Monitoring		1
OCWD-GA5	OCWD	45		30	40	Monitoring		1
OCWD-GA6	OCWD	45		30	40	Monitoring		1
OCWD-GA7	OCWD	45		30	40	Monitoring		1,9
OCWD-GA9	OCWD	30		19	29	Monitoring		1
OCWD-HBM5A	OCWD	22		16	21	Monitoring		1
OCWD-HBM6A	OCWD	17		11	16	Monitoring		1
OCWD-I1	OCWD	407		365	400	Injection		4
OCWD-I10	OCWD	330		305	330	Injection		4
OCWD-I11	OCWD	310		200	225	Injection		4
OCWD-I12	OCWD	320		290	310	Injection		4
OCWD-I13	OCWD	315		280	305	Injection		4
OCWD-I14	OCWD	310		265	300	Injection		4
OCWD-I15	OCWD	295		262	285	Injection		4
OCWD-I16	OCWD	308		245	285	Injection		4
OCWD-I17	OCWD	309		250	275	Injection		4
OCWD-I18	OCWD	315		260	275	Injection		4
OCWD-I19	OCWD	292		235	270	Injection		4
OCWD-I2	OCWD	402		350	390	Injection		4
OCWD-I20	OCWD	275		240	265	Injection		4
OCWD-I21	OCWD	265		230	250	Injection		4
OCWD-I22	OCWD	306		250	275	Injection		4
OCWD-I23	OCWD	325		215	255	Injection		4
OCWD-I24	OCWD	720		420	605	Injection	P	4
OCWD-I25	OCWD	662		120	320	Injection		4
OCWD-I26A	OCWD	220		60	195	Injection	S	4
OCWD-I26B	OCWD	430		271	400	Injection		4
OCWD-I26C	OCWD	697		476	660	Injection	P	4
OCWD-I27A	OCWD	171		78	148	Injection	S	4
OCWD-I27B	OCWD	280		211	261	Injection		4
OCWD-I27C	OCWD	592		355	420	Injection	P	4
OCWD-I27M1	OCWD	23		17	22	Monitoring		1
OCWD-I28A	OCWD	163		80	140	Injection	S	4
OCWD-I28B	OCWD	258		185	235	Injection		4
OCWD-I28C	OCWD	698		360	460	Injection	P	4
OCWD-I28M1	OCWD	24		19	24	Monitoring		1
OCWD-I29A	OCWD	156		90	120	Injection	S	4
OCWD-I29B	OCWD	275		200	250	Injection		4
OCWD-I29C	OCWD	515		365	475	Injection	P	4
OCWD-I3	OCWD	380		340	380	Injection		4
OCWD-I30A	OCWD	187		95	160	Injection	S	4
OCWD-I30B	OCWD	322		230	295	Injection		4
OCWD-I30C	OCWD	708		425	650	Injection	P	4
OCWD-I31A	OCWD	192		90	165	Injection	S	4
OCWD-I31B	OCWD	321		235	295	Injection		4
OCWD-I31C	OCWD	688		440	590	Injection	P	4
OCWD-I32A	OCWD	181		90	155	Injection	S	4
OCWD-I32B	OCWD	326		226	295	Injection		4
OCWD-I32C	OCWD	703		425	670	Injection	P	4
OCWD-I33A	OCWD	183		61	156	Injection	S	4
OCWD-I34A	OCWD	160		60	135	Injection	S	4
OCWD-I35A	OCWD	155		60	115	Injection	S	4

List of Wells in OCWD Monitoring Programs

KEY

Aquifer Zone: S=Shallow Aquifer, P=Principal Aquifer, D= Deep Aquifer

Program: 1) monitoring well, 2) production well, 3) irrigation or industrial well, 4) injection well, 5) Mid-Basin Injection well, 6) seawater intrusion monitoring well, 7) well monitored by OCWD for Title 22 compliance, 8) North Basin Groundwater Protection Program wells, 9) South Basin Groundwater Protection Program wells, 10) wells in CASGEM monitoring program

Well Name	Well Owner	Bore Depth (ft. bgs)	Casing Sequence	Screened Interval (ft.bgs)		Type of Well	Aquifer Zone	Program
				Top	Bottom			
OCWD-I36A	OCWD	143		60	110	Injection	S	4
OCWD-I4	OCWD	360		330	355	Injection		4
OCWD-I5	OCWD	365		320	345	Injection		4
OCWD-I6	OCWD	355		315	335	Injection		4
OCWD-I7	OCWD	345		315	336	Injection		4
OCWD-I8	OCWD	335		300	325	Injection		4
OCWD-I9	OCWD	340		300	330	Injection		4
OCWD-KB1	OCWD	200		180	200	Monitoring	S	1
OCWD-LB1	OCWD	177		148	168	Monitoring	S	1
OCWD-LB2	OCWD	65		15	30	Monitoring		1
OCWD-LB3	OCWD	175		145	165	Monitoring	S	1
OCWD-LB4	OCWD	130		78	88	Monitoring	S	1
OCWD-LV1	OCWD	155		135	155	Monitoring	S	1
OCWD-M1	OCWD	123		75	110	Monitoring	S	1,6
OCWD-M10	OCWD	336		280	305	Monitoring	S	1
OCWD-M10A	OCWD	17		11	16	Monitoring		1
OCWD-M11	OCWD	310		260	290	Monitoring	S	1
OCWD-M12	OCWD	400		330	350	Monitoring	S	1
OCWD-M13	OCWD	400		360	395	Monitoring	S	1
OCWD-M13A	OCWD	21		16	21	Monitoring		1
OCWD-M14A	OCWD	360		200	300	Monitoring	S	1
OCWD-M14B	OCWD	360		320	340	Monitoring		1
OCWD-M15A	OCWD	340		195	290	Monitoring	S	1
OCWD-M15B	OCWD	340		310	335	Monitoring		1
OCWD-M16	OCWD	337		295	315	Monitoring	S	1
OCWD-M17A	OCWD	360		330	345	Monitoring	S	1
OCWD-M17B	OCWD	360		210	305	Monitoring		1
OCWD-M18	OCWD	358		310	335	Monitoring		1
OCWD-M19	OCWD	285		215	265	Monitoring	S	1
OCWD-M2	OCWD	162		85	150	Monitoring	S	1,6
OCWD-M20	OCWD	278		255	270	Monitoring	S	1
OCWD-M21	OCWD	355		320	340	Monitoring	S	1
OCWD-M22	OCWD	348		230	270	Monitoring	S	1
OCWD-M23A	OCWD	337		190	260	Monitoring		1
OCWD-M23B	OCWD	337		295	320	Monitoring		1
OCWD-M24	OCWD	330		290	310	Monitoring	S	1
OCWD-M25	OCWD	200		65	185	Monitoring	S	1,6
OCWD-M26	OCWD	151		70	135	Monitoring	S	1,6,10
OCWD-M26A	OCWD	16		11	16	Monitoring		1,6
OCWD-M27	OCWD	127		60	110	Monitoring	S	1,6
OCWD-M27A	OCWD	22		11	16	Monitoring		1,6
OCWD-M28	OCWD	161		80	145	Monitoring	S	1,6
OCWD-M2A	OCWD	25		17	22	Monitoring		1
OCWD-M30	OCWD	128		90	110	Monitoring	S	1,6
OCWD-M31	OCWD	180		82	162	Monitoring	S	1,6
OCWD-M36	OCWD	340		290	300	Monitoring	S	1,6
OCWD-M37	OCWD	368		338	348	Monitoring	S	1,6
OCWD-M38	OCWD	700		516	526	Monitoring	S/P	1,6
OCWD-M39	OCWD	622		250	270	Monitoring	P	1,6
OCWD-M4	OCWD	352		295	330	Monitoring	S	1,6
OCWD-M40	OCWD	900		330	520	Monitoring	S/P	1,6
OCWD-M41	OCWD	450		370	390	Monitoring	S/P	1,6
OCWD-M42	OCWD	645		608	628	Monitoring	S/P	1,6
OCWD-M43	OCWD	695		520	540	Monitoring	P	1,6
OCWD-M44	OCWD	502		295	305	Monitoring	S/P	1,6
OCWD-M44A	OCWD	125		100	125	Monitoring		1,6
OCWD-M45	OCWD	1014		780	790	Monitoring	S/P	1
OCWD-M46	OCWD	1035		890	910	Monitoring	P	1
OCWD-M46A	OCWD	391		350	370	Monitoring		1
OCWD-M47	OCWD	1010		940	960	Monitoring	P	1
OCWD-M48	OCWD	505		470	480	Monitoring	S/P	1,6
OCWD-M49A	OCWD	24		16	21	Monitoring		1,6
OCWD-M49B	OCWD	85		56	81	Monitoring		1,6
OCWD-M5	OCWD	325		285	305	Monitoring	S	1,6
OCWD-M50	OCWD	25		16	21	Monitoring		1,6
OCWD-M51A	OCWD	43		28	38	Monitoring		1,6
OCWD-M51B	OCWD	130		75	105	Monitoring		1,6

List of Wells in OCWD Monitoring Programs

KEY

Aquifer Zone: S=Shallow Aquifer, P=Principal Aquifer, D= Deep Aquifer

Program: 1) monitoring well, 2) production well, 3) irrigation or industrial well, 4) injection well, 5) Mid-Basin Injection well, 6) seawater intrusion monitoring well, 7) well monitored by OCWD for Title 22 compliance, 8) North Basin Groundwater Protection Program wells, 9) South Basin Groundwater Protection Program wells, 10) wells in CASGEM monitoring program

		Bore Depth (ft. bgs)	Casing Sequence	Screened Interval (ft.bgs)			Aquifer Zone	
Well Name	Well Owner			Top	Bottom	Type of Well		Program
OCWD-M52A	OCWD	61		46	56	Monitoring		1,6
OCWD-M52B	OCWD	150		120	140	Monitoring		1,6
OCWD-M52C	OCWD	237		210	230	Monitoring	P	1,6
OCWD-M52D	OCWD	460		330	350	Monitoring	P	1,6
OCWD-M53A	OCWD	38		22	32	Monitoring		1,6
OCWD-M53B	OCWD	132		115	125	Monitoring	S	1,6
OCWD-M53C	OCWD	229		208	218	Monitoring		1,6
OCWD-M54B	OCWD	150		105	125	Monitoring		1,6
OCWD-M6A	OCWD	305		260	285	Monitoring	S	1,6
OCWD-M6B	OCWD	305		185	235	Monitoring		1,6
OCWD-M7A	OCWD	293		190	220	Monitoring	S	1,6
OCWD-M7B	OCWD	293		240	260	Monitoring		1,6
OCWD-M8	OCWD	346		275	310	Monitoring	S	1,6
OCWD-M9	OCWD	311		250	295	Monitoring	S	1,6
OCWD-MRSH	OCWD	540		199	219	Monitoring	P	1,6
OCWD-P1	OCWD	197		64	179	Monitoring	S	1,6
OCWD-P10	OCWD	150		90	130	Monitoring	S	1,6
OCWD-P2	OCWD	186		56	174	Monitoring	S	1
OCWD-P3	OCWD	181		66	166	Monitoring	S	1,6
OCWD-P4	OCWD	163		70	150	Monitoring	S	1,6
OCWD-P6	OCWD	178		85	150	Monitoring	S	1,6
OCWD-P7	OCWD	149		80	135	Monitoring	S	1,6
OCWD-PD3A	OCWD	11		4	9	Monitoring		1
OCWD-PD3B	OCWD	22		15	20	Monitoring		1
OCWD-PD6A	OCWD	10		3	8	Monitoring		1
OCWD-PD6B	OCWD	22		15	20	Monitoring		1
OCWD-PDE4	OCWD	0		30	213	Monitoring		1
OCWD-PDHQ	OCWD	180		100	180	Other Active Production		2
OCWD-PZ6	OCWD	32		10	30	Monitoring		1
OCWD-PZ8	OCWD	32		10	30	Monitoring		1
OCWD-RVW1	OCWD	80		67	77	Monitoring	S	1
OCWD-RVW1A	OCWD	50		39	49	Monitoring		1
OCWD-SA22R	OCWD	350		310	330	Monitoring	S/P	1,6
OCWD-T2	OCWD	380		300	360	Monitoring	S/P	1,6
OCWD-T3	OCWD	180		110	170	Monitoring	S	1,6
OCWD-T4	OCWD	178		68	168	Monitoring	S	1,6
OCWD-T5	OCWD	396		285	295	Monitoring	S	1,6
OCWD-W1	OCWD	398		0	0	Monitoring		1
OCWD-YLR1	OCWD	51		35	40	Monitoring	S	1
OCWD-YLR2	OCWD	51		32	37	Monitoring	S	1
OCWD-YLR3	OCWD	51		31	36	Monitoring	S	1
OM-1	OCWD	245		217	235	Monitoring		1
OM-2	OCWD	250		211	219	Monitoring		1
OM-2A	OCWD	135		118	125	Monitoring	S	1
OM-4	OCWD	253		221	230	Monitoring		1
OM-4A	OCWD	122		112	117	Monitoring	S	1
OM-6	OCWD	251		196	204	Monitoring		1
OM-8	OCWD	320		285	293	Monitoring		1
OM-8A	OCWD	180		156	164	Monitoring	S	1
SAM-1	OCWD	215		191	196	Monitoring	S	1,9
SAM-2	OCWD	220		204	214	Monitoring	S	1,9
SAM-3	OCWD	225		198	208	Monitoring	S	1,9
SAM-4	OCWD	210		185	195	Monitoring	S	1,9
SAM-5	OCWD	205		182	192	Monitoring	S	1,9
SAM-6	OCWD	205		176	186	Monitoring	S	1,9
SAR-1	OCWD	1530	MP1	150	170	Multiport Monitoring	S/P/D	1,10
SAR-1	OCWD	1530	MP2	290	300	Multiport Monitoring	S/P/D	1,10
SAR-1	OCWD	1530	MP3	320	330	Multiport Monitoring	S/P/D	1,10
SAR-1	OCWD	1530	MP4	360	370	Multiport Monitoring	S/P/D	1,10
SAR-1	OCWD	1530	MP5	510	530	Multiport Monitoring	S/P/D	1,10
SAR-1	OCWD	1530	MP6	580	590	Multiport Monitoring	S/P/D	1,10
SAR-1	OCWD	1530	MP7	820	840	Multiport Monitoring	S/P/D	1,10
SAR-1	OCWD	1530	MP8	890	900	Multiport Monitoring	S/P/D	1,10
SAR-1	OCWD	1530	MP9	910	920	Multiport Monitoring	S/P/D	1,10
SAR-1	OCWD	1530	MP10	1010	1020	Multiport Monitoring	S/P/D	1,10
SAR-1	OCWD	1530	MP11	1110	1120	Multiport Monitoring	S/P/D	1,10
SAR-1	OCWD	1530	MP12	1280	1290	Multiport Monitoring	S/P/D	1,10

List of Wells in OCWD Monitoring Programs

KEY

Aquifer Zone: S=Shallow Aquifer, P=Principal Aquifer, D= Deep Aquifer

Program: 1) monitoring well, 2) production well, 3) irrigation or industrial well, 4) injection well, 5) Mid-Basin Injection well, 6) seawater intrusion monitoring well, 7) well monitored by OCWD for Title 22 compliance, 8) North Basin Groundwater Protection Program wells, 9) South Basin Groundwater Protection Program wells, 10) wells in CASGEM monitoring program

Well Name	Well Owner	Bore Depth (ft. bgs)	Casing Sequence	Screened Interval (ft.bgs)		Type of Well	Aquifer Zone	Program
				Top	Bottom			
SAR-1	OCWD	1530	MP13	1370	1380	Multiport Monitoring	S/P/D	1,10
SAR-1	OCWD	1530	MP14	1441	1451	Multiport Monitoring	S/P/D	1,10
SAR-10	OCWD	1150		1100	1115	Monitoring	P	1,5
SAR-11	OCWD	1214		1100	1110	Monitoring	P	1,5
SAR-2	OCWD	1520	MP1	140	150	Multiport Monitoring	S/P/D	1
SAR-2	OCWD	1520	MP2	270	280	Multiport Monitoring	S/P/D	1
SAR-2	OCWD	1520	MP3	310	320	Multiport Monitoring	S/P/D	1
SAR-2	OCWD	1520	MP4	470	480	Multiport Monitoring	S/P/D	1
SAR-2	OCWD	1520	MP5	610	620	Multiport Monitoring	S/P/D	1
SAR-2	OCWD	1520	MP6	740	750	Multiport Monitoring	S/P/D	1
SAR-2	OCWD	1520	MP7	880	890	Multiport Monitoring	S/P/D	1
SAR-2	OCWD	1520	MP8	980	990	Multiport Monitoring	S/P/D	1
SAR-2	OCWD	1520	MP9	1020	1030	Multiport Monitoring	S/P/D	1
SAR-2	OCWD	1520	MP10	1100	1110	Multiport Monitoring	S/P/D	1
SAR-2	OCWD	1520	MP11	1230	1240	Multiport Monitoring	S/P/D	1
SAR-2	OCWD	1520	MP12	1350	1360	Multiport Monitoring	S/P/D	1
SAR-3	OCWD	1494	MP1	160	170	Multiport Monitoring	S/P/D	1,10
SAR-3	OCWD	1494	MP2	230	240	Multiport Monitoring	S/P/D	1,10
SAR-3	OCWD	1494	MP3	410	420	Multiport Monitoring	S/P/D	1,10
SAR-3	OCWD	1494	MP4	510	520	Multiport Monitoring	S/P/D	1,10
SAR-3	OCWD	1494	MP5	640	650	Multiport Monitoring	S/P/D	1,10
SAR-3	OCWD	1494	MP6	770	780	Multiport Monitoring	S/P/D	1,10
SAR-3	OCWD	1494	MP7	950	960	Multiport Monitoring	S/P/D	1,10
SAR-3	OCWD	1494	MP8	1070	1080	Multiport Monitoring	S/P/D	1,10
SAR-3	OCWD	1494	MP9	1195	1205	Multiport Monitoring	S/P/D	1,10
SAR-3	OCWD	1494	MP10	1265	1275	Multiport Monitoring	S/P/D	1,10
SAR-3	OCWD	1494	MP11	1390	1400	Multiport Monitoring	S/P/D	1,10
SAR-4	OCWD	1520	MP1	115	125	Multiport Monitoring	S/P/D	1
SAR-4	OCWD	1520	MP2	320	330	Multiport Monitoring	S/P/D	1
SAR-4	OCWD	1520	MP3	470	480	Multiport Monitoring	S/P/D	1
SAR-4	OCWD	1520	MP4	590	600	Multiport Monitoring	S/P/D	1
SAR-4	OCWD	1520	MP5	730	740	Multiport Monitoring	S/P/D	1
SAR-4	OCWD	1520	MP6	860	870	Multiport Monitoring	S/P/D	1
SAR-4	OCWD	1520	MP7	970	980	Multiport Monitoring	S/P/D	1
SAR-4	OCWD	1520	MP8	1060	1070	Multiport Monitoring	S/P/D	1
SAR-4	OCWD	1520	MP9	1160	1170	Multiport Monitoring	S/P/D	1
SAR-4	OCWD	1520	MP10	1395	1405	Multiport Monitoring	S/P/D	1
SAR-5	OCWD	1964	MP1	80	90	Multiport Monitoring	S/P/D	1
SAR-5	OCWD	1964	MP2	170	180	Multiport Monitoring	S/P/D	1
SAR-5	OCWD	1964	MP3	360	370	Multiport Monitoring	S/P/D	1
SAR-5	OCWD	1964	MP4	616	626	Multiport Monitoring	S/P/D	1
SAR-5	OCWD	1964	MP5	760	770	Multiport Monitoring	S/P/D	1
SAR-5	OCWD	1964	MP6	940	950	Multiport Monitoring	S/P/D	1
SAR-5	OCWD	1964	MP7	1080	1090	Multiport Monitoring	S/P/D	1
SAR-5	OCWD	1964	MP8	1190	1200	Multiport Monitoring	S/P/D	1
SAR-5	OCWD	1964	MP9	1290	1300	Multiport Monitoring	S/P/D	1
SAR-5	OCWD	1964	MP10	1540	1550	Multiport Monitoring	S/P/D	1
SAR-5	OCWD	1964	MP11	1730	1740	Multiport Monitoring	S/P/D	1
SAR-5	OCWD	1964	MP12	1820	1830	Multiport Monitoring	S/P/D	1
SAR-6	OCWD	1574	MP1	200	210	Multiport Monitoring	P	1
SAR-6	OCWD	1574	MP2	360	370	Multiport Monitoring	P	1
SAR-6	OCWD	1574	MP3	470	480	Multiport Monitoring	P	1
SAR-6	OCWD	1574	MP4	574	584	Multiport Monitoring	P	1
SAR-6	OCWD	1574	MP5	700	710	Multiport Monitoring	P	1
SAR-6	OCWD	1574	MP6	780	790	Multiport Monitoring	P	1
SAR-6	OCWD	1574	MP7	1080	1090	Multiport Monitoring	P	1
SAR-6	OCWD	1574	MP8	1180	1190	Multiport Monitoring	P	1
SAR-6	OCWD	1574	MP9	1270	1280	Multiport Monitoring	P	1
SAR-6	OCWD	1574	MP10	1500	1510	Multiport Monitoring	P	1
SAR-7	OCWD	1483	MP1	110	120	Multiport Monitoring	S/P	1
SAR-7	OCWD	1483	MP2	170	180	Multiport Monitoring	S/P	1
SAR-7	OCWD	1483	MP3	310	320	Multiport Monitoring	S/P	1
SAR-7	OCWD	1483	MP4	440	450	Multiport Monitoring	S/P	1
SAR-7	OCWD	1483	MP5	604	614	Multiport Monitoring	S/P	1
SAR-7	OCWD	1483	MP6	740	750	Multiport Monitoring	S/P	1
SAR-7	OCWD	1483	MP7	856	866	Multiport Monitoring	S/P	1
SAR-7	OCWD	1483	MP8	1190	1200	Multiport Monitoring	S/P	1

List of Wells in OCWD Monitoring Programs

KEY

Aquifer Zone: S=Shallow Aquifer, P=Principal Aquifer, D= Deep Aquifer

Program: 1) monitoring well, 2) production well, 3) irrigation or industrial well, 4) injection well, 5) Mid-Basin Injection well, 6) seawater intrusion monitoring well, 7) well monitored by OCWD for Title 22 compliance, 8) North Basin Groundwater Protection Program wells, 9) South Basin Groundwater Protection Program wells, 10) wells in CASGEM monitoring program

Well Name	Well Owner	Bore Depth (ft. bgs)	Casing Sequence	Screened Interval (ft.bgs)		Type of Well	Aquifer Zone	Program
				Top	Bottom			
SAR-7	OCWD	1483	MP9	1350	1360	Multiport Monitoring	S/P	1
SAR-8	OCWD	267	MP1	34	44	Multiport Monitoring	S	1
SAR-8	OCWD	267	MP2	84	94	Multiport Monitoring	S	1
SAR-8	OCWD	267	MP3	150	160	Multiport Monitoring	S	1
SAR-9	OCWD	2008	MP1	148	160	Multiport Monitoring	S/P/D	1,10
SAR-9	OCWD	2008	MP2	236	248	Multiport Monitoring	S/P/D	1,10
SAR-9	OCWD	2008	MP3	406	418	Multiport Monitoring	S/P/D	1,10
SAR-9	OCWD	2008	MP4	488	500	Multiport Monitoring	S/P/D	1,10
SAR-9	OCWD	2008	MP5	604	616	Multiport Monitoring	S/P/D	1,10
SAR-9	OCWD	2008	MP6	724	736	Multiport Monitoring	S/P/D	1,10
SAR-9	OCWD	2008	MP7	872	884	Multiport Monitoring	S/P/D	1,10
SAR-9	OCWD	2008	MP8	1068	1080	Multiport Monitoring	S/P/D	1,10
SAR-9	OCWD	2008	MP9	1258	1270	Multiport Monitoring	S/P/D	1,10
SAR-9	OCWD	2008	MP10	1473	1484	Multiport Monitoring	S/P/D	1,10
SAR-9	OCWD	2008	MP11	1567	1578	Multiport Monitoring	S/P/D	1,10
SAR-9	OCWD	2008	MP12	1719	1730	Multiport Monitoring	S/P/D	1,10
SAR-9	OCWD	2008	MP13	1815	1826	Multiport Monitoring	S/P/D	1,10
SAR-9	OCWD	2008	MP14	1889	1900	Multiport Monitoring	S/P/D	1,10
SBM-1	OCWD	2023	MP1	74	84	Multiport Monitoring	S/P/D	1,6,10
SBM-1	OCWD	2023	MP2	144	154	Multiport Monitoring	S/P/D	1,6,10
SBM-1	OCWD	2023	MP3	240	250	Multiport Monitoring	S/P/D	1,6,10
SBM-1	OCWD	2023	MP4	370	380	Multiport Monitoring	S/P/D	1,6,10
SBM-1	OCWD	2023	MP5	510	520	Multiport Monitoring	S/P/D	1,6,10
SBM-1	OCWD	2023	MP6	696	706	Multiport Monitoring	S/P/D	1,6,10
SBM-1	OCWD	2023	MP7	910	920	Multiport Monitoring	S/P/D	1,6,10
SBM-1	OCWD	2023	MP8	1250	1260	Multiport Monitoring	S/P/D	1,6,10
SC-1	OCWD	720	MP1	44	54	Multiport Monitoring	S/P	1
SC-1	OCWD	720	MP2	90	100	Multiport Monitoring	S/P	1
SC-1	OCWD	720	MP3	150	160	Multiport Monitoring	S/P	1
SC-1	OCWD	720	MP4	194	204	Multiport Monitoring	S/P	1
SC-1	OCWD	720	MP5	294	304	Multiport Monitoring	S/P	1
SC-1	OCWD	720	MP6	390	400	Multiport Monitoring	S/P	1
SC-2	OCWD	879	MP1	46	56	Multiport Monitoring	S/P	1
SC-2	OCWD	879	MP2	94	104	Multiport Monitoring	S/P	1
SC-2	OCWD	879	MP3	146	156	Multiport Monitoring	S/P	1
SC-2	OCWD	879	MP4	190	200	Multiport Monitoring	S/P	1
SC-2	OCWD	879	MP5	248	258	Multiport Monitoring	S/P	1
SC-2	OCWD	879	MP6	300	310	Multiport Monitoring	S/P	1
SC-3	OCWD	1500	MP1	224	234	Multiport Monitoring	P/D	1
SC-3	OCWD	1500	MP2	410	420	Multiport Monitoring	P/D	1
SC-3	OCWD	1500	MP3	576	586	Multiport Monitoring	P/D	1
SC-3	OCWD	1500	MP4	710	720	Multiport Monitoring	P/D	1
SC-3	OCWD	1500	MP5	1018	1028	Multiport Monitoring	P/D	1
SC-3	OCWD	1500	MP6	1150	1160	Multiport Monitoring	P/D	1
SC-3	OCWD	1500	MP7	1230	1240	Multiport Monitoring	P/D	1
SC-3	OCWD	1500	MP8	1370	1380	Multiport Monitoring	P/D	1
SC-3	OCWD	1500	MP9	1460	1470	Multiport Monitoring	P/D	1
SC-4	OCWD	1498	MP1	100	111	Multiport Monitoring	S/P/D	1,10
SC-4	OCWD	1498	MP2	198	209	Multiport Monitoring	S/P/D	1,10
SC-4	OCWD	1498	MP3	268	279	Multiport Monitoring	S/P/D	1,10
SC-4	OCWD	1498	MP4	391	402	Multiport Monitoring	S/P/D	1,10
SC-4	OCWD	1498	MP5	482	493	Multiport Monitoring	S/P/D	1,10
SC-4	OCWD	1498	MP6	572	583	Multiport Monitoring	S/P/D	1,10
SC-4	OCWD	1498	MP7	658	669	Multiport Monitoring	S/P/D	1,10
SC-4	OCWD	1498	MP8	827	838	Multiport Monitoring	S/P/D	1,10
SC-4	OCWD	1498	MP9	1078	1089	Multiport Monitoring	S/P/D	1,10
SC-5	OCWD	1500	MP1	123	133	Multiport Monitoring	S/P/D	1,10
SC-5	OCWD	1500	MP2	196	206	Multiport Monitoring	S/P/D	1,10
SC-5	OCWD	1500	MP3	290	300	Multiport Monitoring	S/P/D	1,10
SC-5	OCWD	1500	MP4	468	478	Multiport Monitoring	S/P/D	1,10
SC-5	OCWD	1500	MP5	667	677	Multiport Monitoring	S/P/D	1,10
SC-5	OCWD	1500	MP6	804	814	Multiport Monitoring	S/P/D	1,10
SC-5	OCWD	1500	MP7	932	942	Multiport Monitoring	S/P/D	1,10
SC-5	OCWD	1500	MP8	1020	1030	Multiport Monitoring	S/P/D	1,10
SC-5	OCWD	1500	MP9	1234	1244	Multiport Monitoring	S/P/D	1,10
SC-5	OCWD	1500	MP10	1426	1436	Multiport Monitoring	S/P/D	1,10
SC-6	OCWD	2213	MP1	90	100	Multiport Monitoring	S/P/D	1

List of Wells in OCWD Monitoring Programs

KEY

Aquifer Zone: S=Shallow Aquifer, P=Principal Aquifer, D= Deep Aquifer

Program: 1) monitoring well, 2) production well, 3) irrigation or industrial well, 4) injection well, 5) Mid-Basin Injection well, 6) seawater intrusion monitoring well, 7) well monitored by OCWD for Title 22 compliance, 8) North Basin Groundwater Protection Program wells, 9) South Basin Groundwater Protection Program wells, 10) wells in CASGEM monitoring program

Well Name	Well Owner	Bore Depth (ft. bgs)	Casing Sequence	Screened Interval (ft.bgs)		Type of Well	Aquifer Zone	Program
				Top	Bottom			
SC-6	OCWD	2213	MP2	200	210	Multiport Monitoring	S/P/D	1
SC-6	OCWD	2213	MP3	300	310	Multiport Monitoring	S/P/D	1
SC-6	OCWD	2213	MP4	540	550	Multiport Monitoring	S/P/D	1
SC-6	OCWD	2213	MP5	785	795	Multiport Monitoring	S/P/D	1
SC-6	OCWD	2213	MP6	960	970	Multiport Monitoring	S/P/D	1
SC-6	OCWD	2213	MP7	1120	1130	Multiport Monitoring	S/P/D	1
SC-6	OCWD	2213	MP8	1325	1335	Multiport Monitoring	S/P/D	1
SC-6	OCWD	2213	MP9	1460	1470	Multiport Monitoring	S/P/D	1
SC-6	OCWD	2213	MP10	1540	1550	Multiport Monitoring	S/P/D	1
SC-6	OCWD	2213	MP11	1680	1690	Multiport Monitoring	S/P/D	1
SC-6	OCWD	2213	MP12	1890	1900	Multiport Monitoring	S/P/D	1
SC-6	OCWD	2213	MP13	2025	2035	Multiport Monitoring	S/P/D	1
SC-6	OCWD	2213	MP14	2115	2125	Multiport Monitoring	S/P/D	1
SCS-1	OCWD	313	MP1	24	34	Multiport Monitoring	S/P	1
SCS-1	OCWD	313	MP2	90	100	Multiport Monitoring	S/P	1
SCS-1	OCWD	313	MP3	142	152	Multiport Monitoring	S/P	1
SCS-1	OCWD	313	MP4	178	188	Multiport Monitoring	S/P	1
SCS-1	OCWD	313	MP5	220	230	Multiport Monitoring	S/P	1
SCS-1	OCWD	313	MP6	295	305	Multiport Monitoring	S/P	1
SCS-10	OCWD	230		206	216	Monitoring		1
SCS-11	OCWD	405		384	394	Monitoring	S	1
SCS-12	OCWD	405		275	285	Monitoring	S	1
SCS-13	OCWD	200		180	190	Monitoring		1
SCS-2	OCWD	401	MP1	134	145	Multiport Monitoring	S/P	1,10
SCS-2	OCWD	401	MP2	174	185	Multiport Monitoring	S/P	1,10
SCS-2	OCWD	401	MP3	212	223	Multiport Monitoring	S/P	1,10
SCS-2	OCWD	401	MP4	260	270	Multiport Monitoring	S/P	1,10
SCS-2	OCWD	401	MP5	325	335	Multiport Monitoring	S/P	1,10
SCS-3	OCWD	52		31	42	Monitoring		1
SCS-4	OCWD	50		21	32	Monitoring		1
SCS-5	OCWD	51		22	43	Monitoring		1
SCS-6	OCWD	154		147	153	Monitoring	S	1
SCS-7	OCWD	142		125	141	Monitoring	S	1
SCS-8	OCWD	130		108	129	Monitoring	S	1
SCS-9	OCWD	205		153	173	Monitoring	S	1
SCS-B1	OCWD	43		18	43	Monitoring		1
SCS-B2	OCWD	29		19	29	Monitoring		1
SCS-B3	OCWD	26		16	26	Monitoring		1
TIC-67	OCWD	902		245	900	Monitoring	P	1
W-14659	OCWD	27		12	27	Monitoring		1
WBS-2A	OCWD	177	MP1	50	60	Multiport Monitoring	S	1
WBS-2A	OCWD	177	MP2	90	100	Multiport Monitoring	S	1
WBS-2A	OCWD	177	MP3	135	145	Multiport Monitoring	S	1
WBS-3R	OCWD	256	MP1	75	85	Monitoring	S	1
WBS-3R	OCWD	256	MP2	215	225	Monitoring	S	1
WBS-4	OCWD	295		55	220	Multiport Monitoring	S/P	1,10
WMM-1	OCWD	2015	MP1	109	119	Multiport Monitoring	S/P/D	1
WMM-1	OCWD	2015	MP2	359	369	Multiport Monitoring	S/P/D	1
WMM-1	OCWD	2015	MP3	480	490	Multiport Monitoring	S/P/D	1
WMM-1	OCWD	2015	MP4	600	610	Multiport Monitoring	S/P/D	1
WMM-1	OCWD	2015	MP5	740	750	Multiport Monitoring	S/P/D	1
WMM-1	OCWD	2015	MP6	810	820	Multiport Monitoring	S/P/D	1
WMM-1	OCWD	2015	MP7	889	899	Multiport Monitoring	S/P/D	1
WMM-1	OCWD	2015	MP8	980	990	Multiport Monitoring	S/P/D	1
WMM-1	OCWD	2015	MP9	1060	1070	Multiport Monitoring	S/P/D	1
WMM-1	OCWD	2015	MP10	1210	1220	Multiport Monitoring	S/P/D	1
WMM-1	OCWD	2015	MP11	1309	1319	Multiport Monitoring	S/P/D	1
WMM-1	OCWD	2015	MP12	1364	1374	Multiport Monitoring	S/P/D	1
WMM-1	OCWD	2015	MP13	1430	1440	Multiport Monitoring	S/P/D	1
WMM-1	OCWD	2015	MP14	1565	1575	Multiport Monitoring	S/P/D	1
WMM-1	OCWD	2015	MP15	1619	1629	Multiport Monitoring	S/P/D	1
WMM-1	OCWD	2015	MP16	1740	1750	Multiport Monitoring	S/P/D	1
WMM-1	OCWD	2015	MP17	1800	1810	Multiport Monitoring	S/P/D	1
WMM-1	OCWD	2015	MP18	1940	1950	Multiport Monitoring	S/P/D	1
O-1	ORANGE	500		236	416	Inactive Production		2
O-15	ORANGE	506		200	492	Active Large Production	P	2,7
O-18	ORANGE	714		372	574	Active Large Production	P	2,7

List of Wells in OCWD Monitoring Programs

KEY

Aquifer Zone: S=Shallow Aquifer, P=Principal Aquifer, D= Deep Aquifer

Program: 1) monitoring well, 2) production well, 3) irrigation or industrial well, 4) injection well, 5) Mid-Basin Injection well, 6) seawater intrusion monitoring well, 7) well monitored by OCWD for Title 22 compliance, 8) North Basin Groundwater Protection Program wells, 9) South Basin Groundwater Protection Program wells, 10) wells in CASGEM monitoring program

		Bore Depth (ft. bgs)	Casing Sequence	Screened Interval (ft.bgs)			Aquifer Zone	
Well Name	Well Owner			Top	Bottom	Type of Well		Program
O-19	ORANGE	1060		444	1014	Active Large Production	P	2,7
O-20	ORANGE	1210		400	1130	Active Large Production	P	2,7
O-21	ORANGE	1366		482	1252	Active Large Production	P	2,7
O-22	ORANGE	1282		342	802	Active Large Production	P	2,7
O-23	ORANGE	958		370	640	Active Large Production	P	2,7
O-24	ORANGE	826		420	800	Active Large Production	P	2,7
O-25	ORANGE	993		430	885	Active Large Production	P	2,7
O-26	ORANGE	1210		460	1170	Active Large Production	P	2,7
O-27	ORANGE	960		425	890	Inactive Production		2,7
O-3	ORANGE	216		207	216	Active Large Production		2,7
O-4	ORANGE	726		280	711	Active Large Production	P	2,7
O-5	ORANGE	751		156	723	Active Large Production		2,7
O-8	ORANGE	870		570	850	Active Large Production	P	2,7
O-9	ORANGE	910		546	888	Active Large Production	P	2,7
OASI-SA	ORANGE COAST PLUMBING	326		226	288	Inactive Production		2
EMA-AH5	ORANGE COUNTY	84		0	0	Other Active Production		2,3
TIC-73	ORANGE COUNTY	926		324	915	Inactive Production		2,3
CEM2-A	ORANGE COUNTY CEMETERY DIST.	401		0	0	Other Active Production		2,3,8
NVLW-SB	ORANGE COUNTY PRODUCTIONUCE LLC	430		200	420	Other Active Production		2,3
RUIZ-5A1	ORANGE COUNTY PRODUCTIONUCE LLC	0		0	0	Other Active Production		2,3
RUIZ-5A3	ORANGE COUNTY PRODUCTIONUCE LLC	425		210	390	Other Active Production		2,3
RUIZ-6F1	ORANGE COUNTY PRODUCTIONUCE LLC	426		210	390	Other Active Production		2,3,6
OWOD-GG	ORANGEWOOD ACADEMY	180		159	179	Other Active Production	S	2,3
PSCI-AM14	PACIFIC SCIENTIFIC	118		93	113	Other Active Production		2
PSCI-AM21	PACIFIC SCIENTIFIC	116		95	116	Other Active Production		2
PSCI-AM22	PACIFIC SCIENTIFIC	119		99	119	Other Active Production		2
PSCI-AM25	PACIFIC SCIENTIFIC	115		69	114	Other Active Production		2
PSCI-AM26	PACIFIC SCIENTIFIC	120		69	114	Other Active Production		2
PSCI-AM31	PACIFIC SCIENTIFIC	114		68	113	Other Active Production		2
PSCI-AM32R	PACIFIC SCIENTIFIC	116		70	115	Monitoring		1
PSCI-AM33	PACIFIC SCIENTIFIC	115		7	114	Other Active Production		2
PSCI-AM34	PACIFIC SCIENTIFIC	114		102	112	Other Active Production		2
PSCI-AM35	PACIFIC SCIENTIFIC	115		7	112	Other Active Production		2
PSCI-AM36	PACIFIC SCIENTIFIC	115		9	114	Other Active Production		2
PSCI-AM37	PACIFIC SCIENTIFIC	114		102	112	Or Active Production		2
PSCI-AM38	PACIFIC SCIENTIFIC	114		69	113	Or Active Production		2
PSCI-AM39	PACIFIC SCIENTIFIC	115		69	113	Or Active Production		2
PSCI-AM40	PACIFIC SCIENTIFIC	127		109	124	Monitoring		1
PSCI-AM41	PACIFIC SCIENTIFIC	116		109	114	Monitoring		1
PSCI-AM6	PACIFIC SCIENTIFIC	115		103	113	Monitoring		1
PSCI-AT1	PACIFIC SCIENTIFIC	146		129	144	Monitoring		1
PAGE-F	PAGE AVE. MUTUAL WATER CO.	378		186	364	Active Small Production		2,7,8
PLMW-A	PALM MUTUAL WATER CO.	280		0	0	Inactive Production		2,3
PLMD-HB	PALMDALE-CEDAR WATER ASSOC.	180		0	0	Inactive Production		2
PUSD-LB	PARAMOUNT UNIFIED SCHOOL DIST.	155		126	139	Other Active Production		2
W-3767	PARK STANTON PLACE	131		0	0	Inactive Production		2,3
PWC-29H	PARK WATER CO.	462		388	409	Inactive Production		2
PWC-6G	PARK WATER CO.	854		421	807	Other Active Production		2
W-15063	PARKVIEW MUTUAL WATER CO.	250		0	0	Inactive Production		2
PAUL-COS	PAULARINO WATER ASSOC.	450		0	0	Inactive Production		2
PINE-O	PINE WATER CO.	0		0	0	Inactive Production		2
PIRT-HB	PIRATE WATER CO.	156		0	0	Other Active Production		2,6
W-17527	POWERLINE OIL CO.	0		0	0	Inactive Production		2,3
SNDR-SA	PRIVATE	1030		930	990	Other Active Production	D	2,3,9
SHAF-WM	PRIVATE	125		0	0	Other Active Production		2
ANDR-A	PRIVATE	82		0	0	Other Active Production		2
ANNA-O	PRIVATE	0		0	0	Other Active Production		2
ARAK-WM	PRIVATE	0		0	0	Other Active Production		2
BLSO-SA	PRIVATE	100		0	0	Inactive Production		2,3
BOIS-A	PRIVATE	235		0	0	Other Active Production		2
BSBY-GG	PRIVATE	148		0	0	Other Active Production		2
BXBY-SB	PRIVATE	305		150	290	Other Active Production		2,3
CALL-FV	PRIVATE	214		0	0	Other Active Production		2,3
CO-8	PRIVATE	221		0	0	Other Active Production		2,3
CO-9	PRIVATE	250		144	234	Other Active Production		2,3
COOP-SA	PRIVATE	138		0	0	Inactive Production		2
COUR-HBB2	PRIVATE	138		0	0	Inactive Production		2

List of Wells in OCWD Monitoring Programs

KEY

Aquifer Zone: S=Shallow Aquifer, P=Principal Aquifer, D= Deep Aquifer

Program: 1) monitoring well, 2) production well, 3) irrigation or industrial well, 4) injection well, 5) Mid-Basin Injection well, 6) seawater intrusion monitoring well, 7) well monitored by OCWD for Title 22 compliance, 8) North Basin Groundwater Protection Program wells, 9) South Basin Groundwater Protection Program wells, 10) wells in CASGEM monitoring program

Well Name	Well Owner	Bore Depth (ft. bgs)	Casing Sequence	Screened Interval (ft.bgs)		Type of Well	Aquifer Zone	Program
				Top	Bottom			
COUR-HBB3	PRIVATE	226		120	216	Inactive Production		2,3
CREST-BR	PRIVATE	530		187	523	Other Active Production		2,3
CULBK-CE1	PRIVATE	0		0	0	Other Active Production		2
DAVI-O	PRIVATE	185		0	0	Other Active Production		2
DETT-BP	PRIVATE	0		0	0	Inactive Production		2
DOSS-BP	PRIVATE	0		0	0	Inactive Production		2
ECKH-A	PRIVATE	260		0	0	Or Active Production		2
ENCS-GG	PRIVATE	155		0	0	Inactive Production		2,3
FAVI-C	PRIVATE	130		0	0	Inactive Production		2
GHAV-GG	PRIVATE	200		168	188	Other Active Production	S	2,3
GORD-LW	PRIVATE	0		0	0	Other Active Production		2
GRNT-CE	PRIVATE	0		0	0	Other Active Production		2
HNCK-C	PRIVATE	90		0	0	Inactive Production		2,3
HOWD-A	PRIVATE	217		0	0	Inactive Production		2
HTCH-WM	PRIVATE	120		0	0	Inactive Production		2
HUNTZ-SA	PRIVATE	146		100	145	Other Active Production		2,3
ICHI-HB	PRIVATE	128		0	0	Other Active Production		2
JAME-CO	PRIVATE	376		192	250	Other Active Production		2
KNAS-S	PRIVATE	205		0	0	Other Active Production		2
KUBO-FV	PRIVATE	133		122	132	Other Active Production		2
LCRO-FV	PRIVATE	0		0	0	Other Active Production		2
MCGA-A	PRIVATE	0		0	0	Other Active Production		2
MCGN-BP1	PRIVATE	260		50	255	Other Active Production	S	2
MKSN-WM	PRIVATE	137		127	137	Inactive Production		2
MONITORINGG-O	PRIVATE	480		80	480	Other Active Production		2,3
MONITORINGT-A	PRIVATE	110		0	0	Other Active Production		2
MSER-A	PRIVATE	100		0	0	Other Active Production		2
MSSM-A	PRIVATE	135		0	0	Inactive Production		2
NAKM-A	PRIVATE	120		0	0	Inactive Production		2
NAKT-BP	PRIVATE	110		0	0	Other Active Production		2
NESL-GG	PRIVATE	0		0	0	Other Active Production		2
NORT-A	PRIVATE	0		0	0	Inactive Production		2
NVLW-SB3	PRIVATE	680		0	0	Other Active Production	P	2,3
PEAR-GG	PRIVATE	143		0	0	Inactive Production		2
PEIR-A	PRIVATE	137		0	0	Inactive Production		2
PTCK-SA	PRIVATE	300		0	0	Inactive Production		2,3
PURS-SB	PRIVATE	252		0	0	Other Active Production		2,3,6
RMW-SFS	PRIVATE	540		0	0	Other Active Production		2
RWLM-GG	PRIVATE	132		0	0	Other Active Production		2
SAND-BP	PRIVATE	70		0	0	Inactive Production		2
SANZ-C	PRIVATE	84		76	83	Other Active Production	S	2
SCHN-GG	PRIVATE	144		0	0	Other Active Production		2
SINC-C	PRIVATE	130		0	0	Inactive Production		2
SWAN-C	PRIVATE	185		0	0	Inactive Production		2
TAOR-A	PRIVATE	254		0	0	Inactive Production		2
VGNA-A	PRIVATE	165		0	0	Inactive Production		2,3
W-10699	PRIVATE	141		0	0	Inactive Production		2
W-10894	PRIVATE	365		357	364	Inactive Production		2
W-11104	PRIVATE	320		230	300	Inactive Production		2
W-12745	PRIVATE	270		0	0	Inactive Production		2
W-12753	PRIVATE	250		0	0	Inactive Production		2
W-12791	PRIVATE	80		0	0	Inactive Production		2
W-12819	PRIVATE	0		0	0	Inactive Production		2
W-1311	PRIVATE	345		0	345	Inactive Production		2
W-13112	PRIVATE	935		701	933	Inactive Production		2
W-13118	PRIVATE	600		343	575	Inactive Production		2,3
W-13207	PRIVATE	260		0	0	Inactive Production		2
W-13285	PRIVATE	130		0	0	Inactive Production		2
W-14805	PRIVATE	170		0	0	Inactive Production		2,3
W-15791	PRIVATE	0		0	0	Inactive Production		2,3
W-15793	PRIVATE	0		0	0	Inactive Production		2,3
W-15803	PRIVATE	0		0	0	Inactive Production		2,3
W-15817	PRIVATE	158		0	0	Inactive Production		2
W-15857	PRIVATE	100		0	0	Inactive Production		2
W-15880	PRIVATE	97		0	0	Inactive Production		2,3
W-15962	PRIVATE	450		0	0	Inactive Production		2,3
W-16004	PRIVATE	165		0	0	Inactive Production		2

List of Wells in OCWD Monitoring Programs

KEY

Aquifer Zone: S=Shallow Aquifer, P=Principal Aquifer, D= Deep Aquifer

Program: 1) monitoring well, 2) production well, 3) irrigation or industrial well, 4) injection well, 5) Mid-Basin Injection well, 6) seawater intrusion monitoring well, 7) well monitored by OCWD for Title 22 compliance, 8) North Basin Groundwater Protection Program wells, 9) South Basin Groundwater Protection Program wells, 10) wells in CASGEM monitoring program

Well Name	Well Owner	Bore Depth (ft. bgs)	Casing Sequence	Screened Interval (ft.bgs)		Type of Well	Aquifer Zone	Program
				Top	Bottom			
W-18700	PRIVATE	300		200	300	Other Active Production		2,3
W-19049	PRIVATE	340		60	260	Other Active Production		2,3
W-19051	PRIVATE	430		180	400	Other Active Production		2,3
W-19053	PRIVATE	440		360	440	Other Active Production		2
W-19055	PRIVATE	360		140	360	Other Active Production		2,3
W-20906	PRIVATE	0		0	0	Inactive Production		2,3
W-2268	PRIVATE	226		140	190	Inactive Production	S	2,3
W-2447	PRIVATE	180		157	178	Inactive Production	S	2,3
W-3063	PRIVATE	310		292	300	Inactive Production		2,3
W-376	PRIVATE	370		290	370	Inactive Production		2
W-3765	PRIVATE	0		0	0	Inactive Production		2
W-3795	PRIVATE	0		0	0	Inactive Production		2,3
W-428	PRIVATE	311		0	0	Inactive Production		2,10
W-432	PRIVATE	300		117	137	Inactive Production	S	2,10
W-5304	PRIVATE	0		0	0	Inactive Production		2
W-5306	PRIVATE	292		0	0	Inactive Production		2
W-615	PRIVATE	374		188	364	Inactive Production		2,3
W-6523	PRIVATE	175		0	0	Inactive Production		2
W-702	PRIVATE	324		294	318	Inactive Production		2,3
W-7040	PRIVATE	192		0	0	Inactive Production		2,3
W-7046	PRIVATE	257		0	0	Inactive Production	S	2
W-830	PRIVATE	200		191	200	Inactive Production		2
W-856	PRIVATE	406		271	401	Inactive Production		2
W-860	PRIVATE	348		0	0	Inactive Production		2
W-9172	PRIVATE	98		50	97	Inactive Production		2
W-9180	PRIVATE	200		0	0	Inactive Production		2
WALL-A	PRIVATE	45		16	45	Other Active Production		2
WARN-WHNY	PRIVATE	0		0	0	Inactive Production		2,3
WLMS-A	PRIVATE	0		0	0	Other Active Production		2
WMIL-WM	PRIVATE	300		260	300	Inactive Production		2
WMIL-WM2	PRIVATE	650		150	640	Other Active Production		2
WRNE-WTOM	PRIVATE	0		0	0	Other Active Production		2
NOBL-O	R.J. NOBLE CO.	476		290	474	Other Active Production	P	2
FURU-HB	RAINBOW DISPOSAL	150		0	0	Other Active Production		2,6
W-4152	RAINBOW DISPOSAL	202		142	178	Inactive Production		2
RAY-MW06	RAYON CO.	191		150	190	Monitoring		1
RAY-MW09	RAYON CO.	194		152	192	Monitoring		1
RAY-MW16	RAYON CO.	180		149	179	Monitoring		1
RAY-MW17	RAYON CO.	204		173	193	Monitoring		1
RAY-MW21	RAYON CO.	238		212	232	Monitoring		1
RAY-MW23	RAYON CO.	236		215	235	Monitoring		1
RAY-MW24	RAYON CO.	338		310	330	Monitoring	D	1
RAY-MW25	RAYON CO.	805		449	480	Monitoring	D	1
RAY-MW26	RAYON CO.	805		459	499	Monitoring	P	1
RAY-MW27	RAYON CO.	550		475	515	Monitoring	P	1
RAY-MW28	RAYON CO.	425		335	375	Monitoring	P	1
RAY-MW29	RAYON CO.	266		200	240	Monitoring	P	1
RAY-MW30	RAYON CO.	635		596	616	Monitoring	P	1
RAY-MW31	RAYON CO.	1100		946	996	Monitoring	P	1
RAY-MW32	RAYON CO.	1153		1070	1100	Monitoring	P/D	1
RAY-MW33	RAYON CO.	1080		980	1020	Monitoring	P	1
RAY-MW34A	RAYON CO.	290		220	280	Monitoring		1
RAY-MW34B	RAYON CO.	540		486	536	Monitoring	P	1
RAY-MW34C	RAYON CO.	709		556	576	Monitoring	P	1
RAY-MW35	RAYON CO.	1104		990	1040	Monitoring	P	1
RAY-MW36	RAYON CO.	1030		934	994	Monitoring	P	1
RAY-MW37	RAYON CO.	916		770	820	Monitoring	P	1
RAY-MW39	RAYON CO.	1080		982	1012	Monitoring	P	1
RAY-MW40	RAYON CO.	1040		930	970	Monitoring	P	1
RAY-P07	RAYON CO.	117		108	130	Monitoring	S	1
RAY-P09	RAYON CO.	130		110	130	Monitoring	S	1
RIDG-O	RIDGELINE PERATIONS, INC.	63		55	60	Inactive Production		2
RVGC-SA	RIVER VIEW GOLF	300		156	216	Other Active Production		2,3
ROBSN-YL1	ROBERTSON READY MIX	67		21	65	Inactive Production		2,3
RCA-AR	ROMAN CATHOLIC ARCHBISHOP-LA	0		0	0	Other Active Production		2
W-8813	S FARGO BANK, INC.	13		3	13	Monitoring		1
SAKI-SAJ3	SAKIOKA & SONS, ROY K.	463		0	0	Other Active Production		2,3,9

List of Wells in OCWD Monitoring Programs

KEY

Aquifer Zone: S=Shallow Aquifer, P=Principal Aquifer, D= Deep Aquifer

Program: 1) monitoring well, 2) production well, 3) irrigation or industrial well, 4) injection well, 5) Mid-Basin Injection well, 6) seawater intrusion monitoring well, 7) well monitored by OCWD for Title 22 compliance, 8) North Basin Groundwater Protection Program wells, 9) South Basin Groundwater Protection Program wells, 10) wells in CASGEM monitoring program

		Bore Depth	Casing	Screened Interval (ft.bgs)			Aquifer	
Well Name	Well Owner	(ft. bgs)	Sequence	Top	Bottom	Type of Well	Zone	Program
SAKI-SAJ1	SAKIOKA FARMS	187		0	0	Inactive Production		2,9
SA-16	SANTA ANA	978		305	950	Active Large Production	P	2,7
SA-18	SANTA ANA	654		245	623	Active Large Production	P	2,7
SA-20	SANTA ANA	981		390	940	Active Large Production	P	2,7
SA-21	SANTA ANA	986		400	960	Active Large Production	P	2,7
SA-24	SANTA ANA	688		352	654	Active Large Production	P	2,7
SA-26	SANTA ANA	1186		330	1140	Active Large Production	P	2,7,9
SA-27	SANTA ANA	1152		396	1140	Active Large Production	P	2,7
SA-28	SANTA ANA	1200		250	980	Active Large Production	P	2,7
SA-29	SANTA ANA	1090		450	1050	Active Large Production	P	2,7
SA-30	SANTA ANA	989		440	900	Active Large Production	P	2,7
SA-31	SANTA ANA	1310		465	1240	Active Large Production	P	2,7
SA-32	SANTA ANA	1060		307	1030	Inactive Production	P	2,7
SA-33	SANTA ANA	1080		425	935	Active Large Production	P	2,7
SA-34	SANTA ANA	1000		370	520	Active Large Production	P	2,7
SA-35	SANTA ANA	1520		429	1480	Active Large Production	P	2,7
SA-36	SANTA ANA	1510		570	1290	Active Large Production	P	2,7
SA-37	SANTA ANA	1560		348	1480	Active Large Production	P	2,7
SA-38	SANTA ANA	1510		400	1270	Active Large Production	P	2,7
SA-39	SANTA ANA	1350		590	1290	Active Large Production	P	2,7
SA-40	SANTA ANA	1335		550	1305	Active Large Production	P	2,7
SA-41	SANTA ANA	1010		525	978	Active Large Production	P	2,7
SA-7	SANTA ANA	960		426	907	Inactive Production		2
W-12903	SANTA ANA	423		0	0	Inactive Production		2
SACC-SA	SANTA ANA COUNTRY CLUB	536		205	406	Other Active Production	P	2,3,6
SAVI-16	SANTA ANA VALLEY IRRIGATION CO	752		262	825	Inactive Production		2,3
SFE-2	SANTA FE ENERGY CO.	294		0	0	Inactive Production		2,3
SFE-3	SANTA FE ENERGY CO.	205		0	0	Inactive Production		2,3
SFE-4	SANTA FE ENERGY CO.	180		0	0	Inactive Production		2,3
SFS-12	SANTA FE SPRINGS	1556		940	1430	Active Large Production		2
SFS-2	SANTA FE SPRINGS	1250		336	1218	Other Active Production		2,3
SAVS-ASC	SAVANNA SCHOOL DIST.	1301		0	0	Other Active Production		2,3
SB-BC	SEAL BEACH	1050		370	1020	Active Large Production	P	2,7
SB-BEV	SEAL BEACH	920		400	800	Active Large Production	P	2,6,7
SB-LAM	SEAL BEACH	1200		360	1170	Active Large Production	P	2,7
SB-LEI	SEAL BEACH	840		420	840	Active Large Production	P	2,6,7
SID-3	SERRANO WATER DIST.	604		296	584	Active Large Production	P	2,7
SID-4	SERRANO WATER DIST.	650		290	520	Active Large Production	P	2,7
SWD-5	SERRANO WATER DIST.	750		310	720	Active Large Production	P	2,7
SCC-D1	SERVICE CHEMICAL	124		113	123	Monitoring		1,9
W-15094	SHELL OIL CO.	104		58	95	Inactive Production		2
W-15098	SHELL OIL CO.	350		0	0	Inactive Production		2
W-15100	SHELL OIL CO.	115		80	115	Inactive Production		2
W-2507	SHELL OIL CO.	437		230	340	Inactive Production		2
W-2523	SHELL OIL CO.	115		70	100	Inactive Production		2
W-2505	SIGNAL OIL AND GAS	121		76	104	Inactive Production		2,3
W-9170	SIGNAL OIL AND GAS	92		80	90	Inactive Production		2
RODE-A	SILICON SALVAGE	218		178	208	Other Active Production	S	2
SILV-YL	SILVERADO CONSTRUCTORS	78		40	66	Other Active Production	S	2,3,10
W-3783	SO. CA EDISON	458		0	0	Inactive Production		2,9
SMWC-BF4	SOMERSET MUTUAL WATER CO.	1070		0	0	Other Active Production		2
SMWC-BFFWR	SOMERSET MUTUAL WATER CO.	1076		0	0	Active Small Production		2
W-13380	SOMERSET MUTUAL WATER CO.	875		0	0	Inactive Production		2
FOND-A	SOURCE REFRIGERATION	250		0	0	Inactive Production		2
MIYA-BP	SOURN CA EDISON	400		0	0	Inactive Production		2,3
SCE-DASUB	SOURN CA EDISON	0		0	0	Other Active Production		2
SCE-LBDM	SOURN CA EDISON	366		100	347	Inactive Production		2,3
SCE-LBSG	SOURN CA EDISON	340		190	340	Inactive Production		2,3
SCE-YLCS	SOURN CA EDISON	104		5	103	Inactive Production	S	2,3,10
TIC-127	SOURN CA EDISON	134		0	0	Monitoring	S	1
TIC-140	SOURN CA EDISON	787		0	0	Monitoring		1
W-13195	SOURN CA EDISON	527		0	0	Inactive Production		2,3
W-15807	SOURN CA EDISON	150		0	0	Inactive Production		2,3
W-15874	SOURN CA EDISON	188		0	0	Inactive Production		2
SCGC-I	SOURN CA GAS CO.	300		0	0	Other Active Production		2,3
SCGC-O	SOURN CA GAS CO.	405		0	0	Other Active Production		2,3
W-11198	SOURN SERVICE CO., LTD.	952		716	948	Other Active Production		2,3

List of Wells in OCWD Monitoring Programs

KEY

Aquifer Zone: S=Shallow Aquifer, P=Principal Aquifer, D= Deep Aquifer

Program: 1) monitoring well, 2) production well, 3) irrigation or industrial well, 4) injection well, 5) Mid-Basin Injection well, 6) seawater intrusion monitoring well, 7) well monitored by OCWD for Title 22 compliance, 8) North Basin Groundwater Protection Program wells, 9) South Basin Groundwater Protection Program wells, 10) wells in CASGEM monitoring program

Well Name	Well Owner	Bore Depth (ft. bgs)	Casing Sequence	Screened Interval (ft.bgs)		Type of Well	Aquifer Zone	Program
				Top	Bottom			
SCSH-SA1	SOUTH COAST SHORE HOA	450		280	430	Other Active Production		2,3
SMID-D4	SOUTH MIDWAY CITY WATER CO.	142		0	0	Inactive Production		2
SMID-D5	SOUTH MIDWAY CITY WATER CO.	630		300	600	Active Small Production		2,7
SPRK-SA	SPARKLETTS DRINKING WATER CORP	246		154	212	Other Active Production		2,3
W-8292	SPRAYON PRODUCTIONUCTS	105		80	98	Monitoring		1
W-8294	SPRAYON PRODUCTIONUCTS	101		80	100	Monitoring		1
W-8296	SPRAYON PRODUCTIONUCTS	99		70	90	Monitoring		1
W-3801	STATE OF CA	725		254	407	Inactive Production		2,3
STEP-A	STEPAN CO.	275		210	275	Other Active Production		2,3,8
SWS-26B7	SUBURBAN WATER SYSTEMS	820		0	0	Inactive Production		2,3
SWS-409W3	SUBURBAN WATER SYSTEMS	1460		540	1420	Active Large Production		2
SWS-410W1	SUBURBAN WATER SYSTEMS	1312		617	1237	Other Active Production		2
ANGS-HBM3	TERMO PETROLEUM	1510		146	1440	Multiport Monitoring		1
TEX-W1	TEXACO, INC.	30		5	30	Monitoring		1
W-8805	TEXACO, INC.	45		15	45	Monitoring		1
W-8807	TEXACO, INC.	45		15	45	Monitoring		1
W-8809	TEXACO, INC.	45		15	45	Monitoring		1
W-8811	TEXACO, INC.	45		15	45	Monitoring		1
W-8815	TEXACO, INC.	35		25	35	Monitoring		1
W-18289	TOSCO MARKETING CO.	150		120	150	Monitoring		1
W-18291	TOSCO MARKETING CO.	140		105	140	Monitoring		1
W-18293	TOSCO MARKETING CO.	140		105	140	Monitoring		1
T868-S1	TRACT 868 MUTUAL WATER CO.	200		0	0	Inactive Production		2
T868-S2	TRACT 868 MUTUAL WATER CO.	0		0	0	Inactive Production		2
TREE-SA	TREESWEET PRODUCTIONUCT CO.	416		150	398	Inactive Production		2,3
TLLC-F2	TRUE LOVE LURAN CHURCH	350		190	350	Other Active Production		2,3,8
T-17S1	TUSTIN	375		200	311	Inactive Production		2
T-17S2	TUSTIN	1003		310	490	Inactive Production		2
T-17S4	TUSTIN	520		200	480	Active Large Production	P	2,7
T-BENE	TUSTIN	627		290	590	Inactive Production	P	2
T-COLU	TUSTIN	1470		560	1160	Active Large Production	P	2,7
T-ED	TUSTIN	1492		500	840	Inactive Production		2,7
T-LIVI	TUSTIN	617		300	617	Inactive Production		2
T-MS3	TUSTIN	630		300	630	Active Large Production	P	2,7
T-MS4	TUSTIN	1180		330	880	Active Large Production	P	2,7
T-NEWP	TUSTIN	375		234	267	Active Large Production	S	2,7
T-PANK	TUSTIN	614		323	614	Inactive Production	P	2,9
T-PAS	TUSTIN	1260		440	1225	Active Large Production	P	2,7
T-PROS	TUSTIN	630		270	630	Active Large Production	P	2,7
T-TUST	TUSTIN	827		306	776	Active Large Production	P	2,7
T-VNBG	TUSTIN	1129		480	900	Active Large Production	P	2,7
T-WALN	TUSTIN	1191		397	995	Active Large Production	P	2,7,9
T-YORB	TUSTIN	863		385	850	Inactive Production	P	2
USGS-NAWQA1	U.S. GEOLOGICAL SURVEY	24		14	24	Monitoring		1
USGS-NAWQA10	U.S. GEOLOGICAL SURVEY	24		14	19	Monitoring		1
USGS-NAWQA11	U.S. GEOLOGICAL SURVEY	49		39	44	Monitoring		1
USGS-NAWQA12	U.S. GEOLOGICAL SURVEY	24		14	19	Monitoring		1
USGS-NAWQA13	U.S. GEOLOGICAL SURVEY	34		24	29	Monitoring		1
USGS-NAWQA14	U.S. GEOLOGICAL SURVEY	74		69	74	Monitoring		1
USGS-NAWQA15	U.S. GEOLOGICAL SURVEY	39		29	34	Monitoring		1
USGS-NAWQA16	U.S. GEOLOGICAL SURVEY	44		34	39	Monitoring		1
USGS-NAWQA17	U.S. GEOLOGICAL SURVEY	19		9	14	Monitoring		1
USGS-NAWQA18	U.S. GEOLOGICAL SURVEY	29		19	24	Monitoring		1
USGS-NAWQA19	U.S. GEOLOGICAL SURVEY	19		9	14	Monitoring		1
USGS-NAWQA2	U.S. GEOLOGICAL SURVEY	21		10	15	Monitoring		1
USGS-NAWQA20	U.S. GEOLOGICAL SURVEY	0		14	19	Monitoring		1
USGS-NAWQA21	U.S. GEOLOGICAL SURVEY	24		14	19	Monitoring		1
USGS-NAWQA22	U.S. GEOLOGICAL SURVEY	144		134	139	Monitoring		1
USGS-NAWQA23	U.S. GEOLOGICAL SURVEY	34		24	29	Monitoring		1
USGS-NAWQA24	U.S. GEOLOGICAL SURVEY	49		34	39	Monitoring		1
USGS-NAWQA25	U.S. GEOLOGICAL SURVEY	19		9	19	Monitoring		1
USGS-NAWQA26	U.S. GEOLOGICAL SURVEY	29		19	24	Monitoring		1
USGS-NAWQA27	U.S. GEOLOGICAL SURVEY	19		9	19	Monitoring		1
USGS-NAWQA28	U.S. GEOLOGICAL SURVEY	19		9	19	Monitoring		1
USGS-NAWQA29	U.S. GEOLOGICAL SURVEY	19		9	19	Monitoring		1
USGS-NAWQA3	U.S. GEOLOGICAL SURVEY	21		12	17	Monitoring		1
USGS-NAWQA30	U.S. GEOLOGICAL SURVEY	19		9	19	Monitoring		1

List of Wells in OCWD Monitoring Programs

KEY

Aquifer Zone: S=Shallow Aquifer, P=Principal Aquifer, D= Deep Aquifer

Program: 1) monitoring well, 2) production well, 3) irrigation or industrial well, 4) injection well, 5) Mid-Basin Injection well, 6) seawater intrusion monitoring well, 7) well monitored by OCWD for Title 22 compliance, 8) North Basin Groundwater Protection Program wells, 9) South Basin Groundwater Protection Program wells, 10) wells in CASGEM monitoring program

		Bore Depth	Casing	Screened Interval (ft.bgs)			Aquifer	
Well Name	Well Owner	(ft. bgs)	Sequence	Top	Bottom	Type of Well	Zone	Program
USGS-NAWQA31	U.S. GEOLOGICAL SURVEY	24		14	19	Monitoring		1
USGS-NAWQA4	U.S. GEOLOGICAL SURVEY	24		14	19	Monitoring		1
USGS-NAWQA5	U.S. GEOLOGICAL SURVEY	20		10	15	Monitoring		1
USGS-NAWQA5	U.S. GEOLOGICAL SURVEY	20		10	15	Monitoring		9
USGS-NAWQA6	U.S. GEOLOGICAL SURVEY	20		10	15	Monitoring		1
USGS-NAWQA7	U.S. GEOLOGICAL SURVEY	29		19	24	Monitoring		1
USGS-NAWQA8	U.S. GEOLOGICAL SURVEY	23		13	18	Monitoring		1
USGS-NAWQA9	U.S. GEOLOGICAL SURVEY	29		19	24	Monitoring		1
UOC-B8	UNION OIL CO.	79		60	75	Inactive Production		2,3
UOC-B9	UNION OIL CO.	79		60	75	Inactive Production		2,3
COS-PLAZ	UNKNOWN	779		0	0	Monitoring	P	1
W-14764	UNKNOWN	0		0	0	Inactive Production		2
W-18102	UNKNOWN	130		110	130	Monitoring		1
W-3629	UNKNOWN	162		0	0	Inactive Production		2,3
W-8298	UNKNOWN	115		0	0	Monitoring		1
W-8300	UNKNOWN	85		0	0	Monitoring		1
W-8304	UNKNOWN	49		0	0	Monitoring		1
W-8306	UNKNOWN	85		0	0	Monitoring		1
W-8308	UNKNOWN	182		0	0	Monitoring		1
W-18607	UNOCAL BIRCH HILLS	130		25	130	Other Active Production		2
W-18609	UNOCAL BIRCH HILLS	0		25	120	Monitoring		1
W-18611	UNOCAL BIRCH HILLS	120		25	120	Monitoring		1
W-18613	UNOCAL BIRCH HILLS	120		45	120	Injection		4
W-18615	UNOCAL BIRCH HILLS	120		45	120	Injection		4
W-18617	UNOCAL BIRCH HILLS	120		45	120	Injection		4
W-18637	UNOCAL BIRCH HILLS	120		45	120	Injection		4
W-18639	UNOCAL BIRCH HILLS	120		45	120	Injection		4
W-18641	UNOCAL BIRCH HILLS	120		45	120	Injection		4
MTSN-SA	VERSAILLES ON LAKE APT	914		0	0	Other Active Production		2,3
CRES-A	VICTORY BAPTIST CHURCH	541		485	525	Active Small Production		2,7
A1-HB	VILLAGE NURSERIES	305		188	300	Other Active Production		2,3
W-13235	VIRGINIA COUNTRY CLUB	1285		915	1010	Monitoring		1
CATH-S	W. CARINE ST. MUT. WTR. CO.	170		0	0	Other Active Production		2,3
DISN-AE1	WALT DISNEY PRODUCTIONS	400		0	0	Inactive Production		2,3
DISN-AH1	WALT DISNEY PRODUCTIONS	0		0	0	Inactive Production		2,3
FUJS-A	WALT DISNEY PRODUCTIONS	642		446	628	Inactive Production		2,3
W-846	WALT DISNEY PRODUCTIONS	325		0	0	Inactive Production		2
WRD-CERRITOS-1	WATER REPLENISHMENT DIST.	1221		1155	1175	Monitoring		1
WRD-CERRITOS-2	WATER REPLENISHMENT DIST.	1504		1350	1370	Monitoring		1
WRD-LAKEWOOD-1A	WATER REPLENISHMENT DIST.	1020		989	1009	Monitoring		1
WRD-LAKEWOOD-1B	WATER REPLENISHMENT DIST.	172		140	160	Monitoring		1
WRD-LAKEWOOD-2	WATER REPLENISHMENT DIST.	2160		1960	2000	Monitoring		1
WRD-LAMIRADA-1	WATER REPLENISHMENT DIST.	1257		1130	1150	Monitoring		1
WRD-LONGBEACH-1	WATER REPLENISHMENT DIST.	1495		1430	1450	Monitoring		1,6
WRD-LONGBEACH-6	WATER REPLENISHMENT DIST.	1550		1490	1510	Monitoring		1
WRD-LONGBEACH-8	WATER REPLENISHMENT DIST.	1515		1435	1455	Monitoring		1
WRD-NORWALK-1	WATER REPLENISHMENT DIST.	1432		1400	1420	Monitoring		1
WRD-NORWALK-2	WATER REPLENISHMENT DIST.	1502		1460	1480	Monitoring		1
WRD-SEALBEACH-1	WATER REPLENISHMENT DIST.	1505		1345	1365	Monitoring	S/P/D	1,6
WRD-WHITTIER-1A	WATER REPLENISHMENT DIST.	1298		1180	1200	Monitoring		1
WRD-WHITTIER-1B	WATER REPLENISHMENT DIST.	640		600	620	Monitoring		1
WM-107A	WESTMINSTER	1040		350	980	Active Large Production	P	2,7
WM-11	WESTMINSTER	820		325	790	Active Large Production	P	2,7
WM-125	WESTMINSTER	930		374	860	Active Large Production	P	2,6,7
WM-3	WESTMINSTER	365		285	365	Active Large Production	P	2,7
WM-4	WESTMINSTER	1209		345	1125	Active Large Production	P	2,7
WM-6	WESTMINSTER	694		176	660	Active Large Production		2,7
WM-75A	WESTMINSTER	1041		410	996	Active Large Production	P	2,7
WM-RES1	WESTMINSTER	920		390	880	Active Large Production	P	2,7
WM-RES2	WESTMINSTER	960		340	937	Active Large Production	P	2,6,7
WM-SC4	WESTMINSTER	454		425	454	Active Large Production	P	2,7
WMEM-WE	WESTMINSTER MEMORIAL PARK	149		0	0	Inactive Production		2,3
WMEM-WPAR	WESTMINSTER MEMORIAL PARK	614		140	599	Inactive Production		2,3
WMEM-WW	WESTMINSTER MEMORIAL PARK	488		95	442	Other Active Production		2,3
WHS-CHS40	WHITTIER UNION H.S. DIST.	836		0	0	Inactive Production		2
WHS-SH550	WHITTIER UNION H.S. DIST.	804		228	780	Active Small Production		2
W-14807	WILLIAM LYON CO	490		0	0	Inactive Production		2

List of Wells in OCWD Monitoring Programs

KEY

Aquifer Zone: S=Shallow Aquifer, P=Principal Aquifer, D= Deep Aquifer

Program: 1) monitoring well, 2) production well, 3) irrigation or industrial well, 4) injection well, 5) Mid-Basin Injection well, 6) seawater intrusion monitoring well, 7) well monitored by OCWD for Title 22 compliance, 8) North Basin Groundwater Protection Program wells, 9) South Basin Groundwater Protection Program wells, 10) wells in CASGEM monitoring program

				Screened Interval (ft.bgs)				
Well Name	Well Owner	Bore Depth (ft. bgs)	Casing Sequence	Top	Bottom	Type of Well	Aquifer Zone	Program
WOOD-INLK	WOODBRIDGE VILL HOMEOWNER ASSN	910		370	890	Inactive Production	P	2,3
WOOD-ISLK	WOODBRIDGE VILL HOMEOWNER ASSN	845		210	800	Inactive Production	P	2,3
YLCC-35C2	YORBA LINDA COUNTRY CLUB	425		388	404	Inactive Production		2,3
YLCC-35C4	YORBA LINDA COUNTRY CLUB	510		188	472	Other Active Production		2,3
YLCC-35F3	YORBA LINDA COUNTRY CLUB	460		130	450	Other Active Production		2,3
YLWD-1	YORBA LINDA WATER DIST.	427		90	340	Active Large Production		2,7
YLWD-10	YORBA LINDA WATER DIST.	465		90	406	Active Large Production		2,7
YLWD-11	YORBA LINDA WATER DIST.	547		149	514	Active Large Production		2,7
YLWD-12	YORBA LINDA WATER DIST.	544		80	498	Active Large Production		2,7
YLWD-15	YORBA LINDA WATER DIST.	213		133	198	Active Large Production	S	2,7
YLWD-18	YORBA LINDA WATER DIST.	1050		250	570	Active Large Production	P	2,7
YLWD-19	YORBA LINDA WATER DIST.	611		280	581	Active Large Production	P	2,7
YLWD-20	YORBA LINDA WATER DIST.	600		225	570	Active Large Production	P	2,7
YLWD-5	YORBA LINDA WATER DIST.	395		90	340	Active Large Production		2,7
YLWD-7	YORBA LINDA WATER DIST.	361		137	259	Active Large Production		2,7

Irvine Ranch
WATER DISTRICT

Basin 8-1 Alternative

South East
Management Area

Prepared by: Irvine Ranch Water District

In collaboration with: El Toro Water District and
City of Orange

January 1, 2017

Irvine Ranch
WATER DISTRICT

Basin 8-1 Alternative

South East Management Area

CERTIFIED HYDROGEOLOGIST
THOMAS E.
HARDER
No: 588
STATE OF CALIFORNIA

Thomas Harder

Thomas Harder, P.G., C.HG.

Thomas Harder & Co.
1260 N. Hancock Street, Suite 109
Anaheim, CA 92807

Prepared for the Department of Water Resources, pursuant to Water Code §10733.6(b)(3)

January 1, 2017

Table of Contents

Figure

Table

SECTION 1. EXECUTIVE SUMMARY

The South East Management Area consists of several small, fringe areas located south east of the Orange County Management Area that overlie portions of Irvine Ranch Water District (IRWD), El Toro Water District (ETWD) and the City of Orange service areas. Figure 1-1 shows the boundary of each South East Management Area agency along with the Orange County Water District (OCWD). Table 1-1 shows the area associated with each agency within the South East Management Area. The South East Management Area represents approximately 4.4 percent of the total area of Basin 8-1.

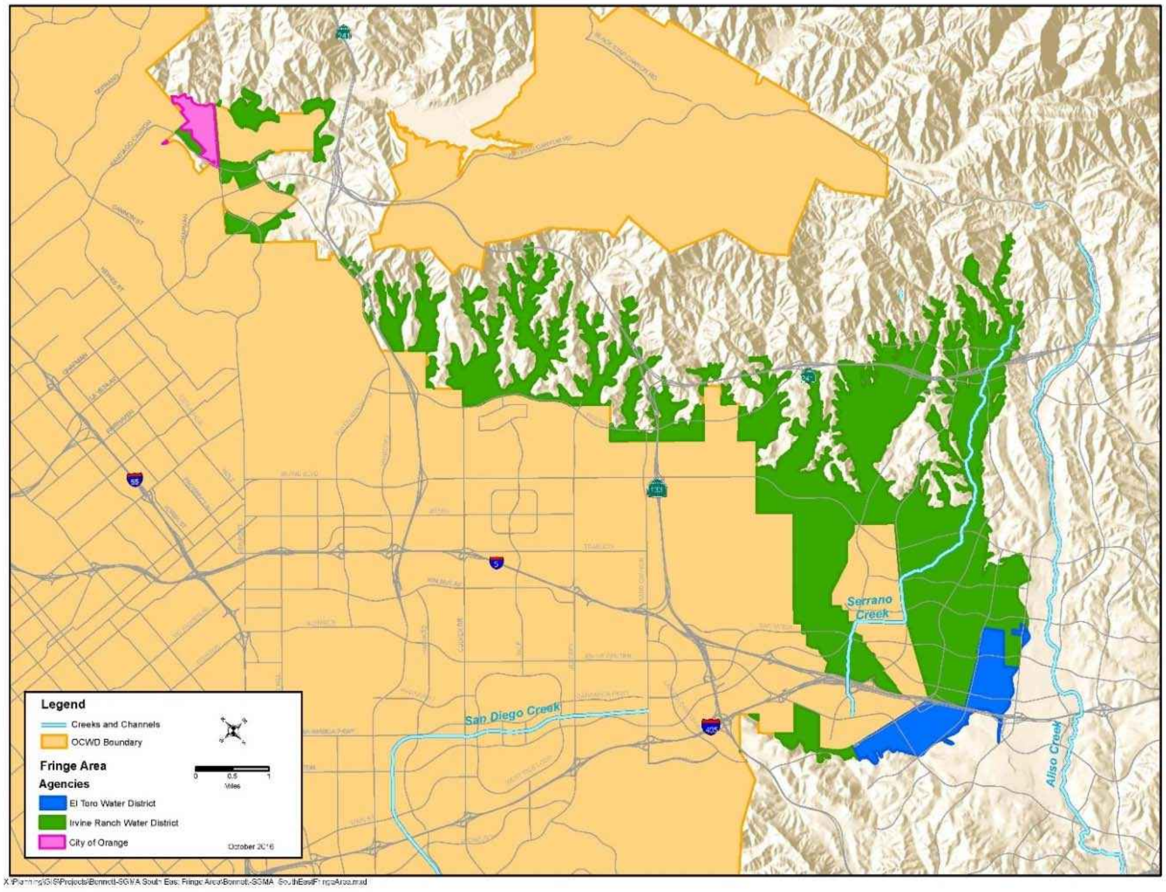


Figure 1-1: Agencies in the South East Management Area

Table 1-1 List of Agencies in South East Management Area and Area Covered

Agency	Area (acres)
Irvine Ranch Water District	8,870
El Toro Water District	762
City of Orange	134
Total Area	9,766

Water resources in the South East Management Area include Serrano Creek, numerous smaller tributaries and groundwater. Serrano Creek provides surface waters that flow into and/or out of the IRWD's Lake Forest portion of the South East Management Area (Boyle, 2002).

The only groundwater production in the South East Management Area has historically been from six wells located in the city of Lake Forest, within IRWD's service area. Currently only one well is active with an average production of about 125 acre-feet per year over the last 10 years. Imported water from the Metropolitan Water District of Southern California is the primary water supply source for the entire South East Management Area. Groundwater production within the South East Management Area represents less than 2 percent of the potable water supply for IRWD's Lake Forest area and less than 0.2 percent of IRWD's 2015 potable supply. And despite several recent years of significant drought, groundwater production in this area has approximately remained the same. Due to the relatively low yield of the Aquifer in the South East Management Area, groundwater production is expected to remain a relatively insignificant water supply source for the area.

The six wells within IRWD's Lake Forest portion of the South East Management Area are currently used for monitoring groundwater levels and water quality on a monthly basis. Because groundwater production is minimal throughout the year, there are no other programs in the South East Management Area responsible for managing or monitoring groundwater resources.

The Sustainability Goal for the South East Management Area is to recognize it is a small part of the larger OCWD management area whose groundwater levels and water quality will be monitored to assure that conditions do not lead to significant and unreasonable (1) lowering of groundwater levels, (2) reduction in storage, (3) water quality degradation, (4) inelastic land subsidence or (5) unreasonable adverse effect on surface water resources

SECTION 2. AGENCY INFORMATION

2.1 HISTORY OF AGENCIES IN SOUTH EAST BASIN MANAGEMENT AREA

As shown in Figure 1-1, the South East Management Area contains portions of IRWD, ETWD and the City of Orange. The South East Management Area was developed in 2016 in collaboration with OCWD, an agency responsible for managing groundwater in Basin 8-1 within OCWD's boundaries. In compliance with the Sustainable Groundwater Management Act (SGMA), the South East Management Area represents the Basin 8-1 areas located southeast and outside of the OCWD boundaries. As agencies within the South East Management Area of Basin 8-1, IRWD, ETWD and the City of Orange have the option to participate in an Alternative to a Groundwater Sustainability Plan (GSP) for Basin 8-1.

The Lake Forest portion of IRWD's South East Management Area was formerly owned and operated by the Los Alisos Water District (LAWD). In 2001 when LAWD consolidated with IRWD the former District became known as the Los Alisos System of IRWD.

2.2 GOVERNANCE AND MANAGEMENT STRUCTURE

As described later in this section, groundwater withdrawals in the South East Management Area are relatively minor. As a result, there is currently no need to establish formal groundwater governance or management via GSA formation in the South East Management Area. However, groundwater production, level and quality data will be collected and reported to DWR, and coordinated with OCWD and La Habra, in compliance with SGMA.

2.3 LEGAL AUTHORITY

The Orange County Well Ordinance (County Ordinance No. 2607) requires that a permit be obtained prior to the construction or destruction of any well. In unincorporated areas and in twenty-nine of thirty-four Orange County cities, the Orange County Health Officer is responsible for enforcement of the well ordinance. In the remaining five cities (Anaheim, Buena Park, Fountain Valley, Orange and San Clemente), well ordinances are enforced by city personnel.

The SGMA allows local agencies to participate in the development of an Alternative to a GSP in accordance with Water Code § 10733.6. As defined by SGMA (Water Code 10721(n), "Local Agency" means a local public agency that has water supply, water management, or land use responsibilities within a groundwater basin), and therefore IRWD, ETWD and City of Orange are all "local agencies" for purposes of SGMA within those areas of their respective jurisdictions that overlie the Basin 8-1. The legal authority for IRWD, ETWD and the City of Orange to participate in the groundwater plan for the South East Management Area is as follows:

IRWD: IRWD's participation in the South East Management Area is within IRWD's legal authority as a Special District formed under the California Water District Code in 1961 that has water supply authority within a portion of the South East Management Area.

ETWD: ETWD's participation in the South East Management Area is within ETWD's legal authority as a Special District formed under the California Water District Code in 1960 that has water supply authority within a portion of the South East Management Area.

City of Orange: The City of Orange is a local municipality within the South East Management Area. Orange's participation in the South East Management Area is within Orange's legal authority as the City is the permitted water supplier as approved by the State of California to supply water for domestic purposes within the City's water service area.

2.4 BUDGET

The budget required to monitor and report groundwater information for the South East Management Area has not been defined. As part of its standard operations, IRWD regularly collects and maintains information on its groundwater production, groundwater levels and water quality testing. Currently, there is no groundwater production in ETWD or City of Orange areas of the South East Management Area, therefore these agencies would not be responsible for monitoring and reporting groundwater information.

SECTION 3. MANAGEMENT AREA DESCRIPTION

3.1 SOUTH EAST SERVICE AREA

The South East Management Area is located in the south east portion of the Coastal Plain of Orange County Groundwater Basin (Basin 8-1). A geologic map of the major geologic formations in the area taken from the U.S. Geological Survey is presented in Figure 3-1.

IRWD: The areas associated with IRWD's portion of the South East Management Area can be broadly broken into two groups; northern and southern. The northern portion is dominated by steep mountain tributaries that contain quaternary alluvium and terrace deposits beneath ephemeral streams that discharge directly to the OCWD Management Area. The southern, or Lake Forest portion, consists of quaternary alluvium, quaternary terrace deposits and the Capistrano formation. These deposits are drained by Serrano Creek, an ephemeral stream that discharges to the OCWD Management Area. Studies referenced in this South East Management Area describe IRWD's southern Lake Forest portion of the South East Management Area.

ETWD: No studies have been performed on the ETWD portion of the South East Management Area.

City of Orange: No studies have been performed on the City of Orange portion of the South East Management Area

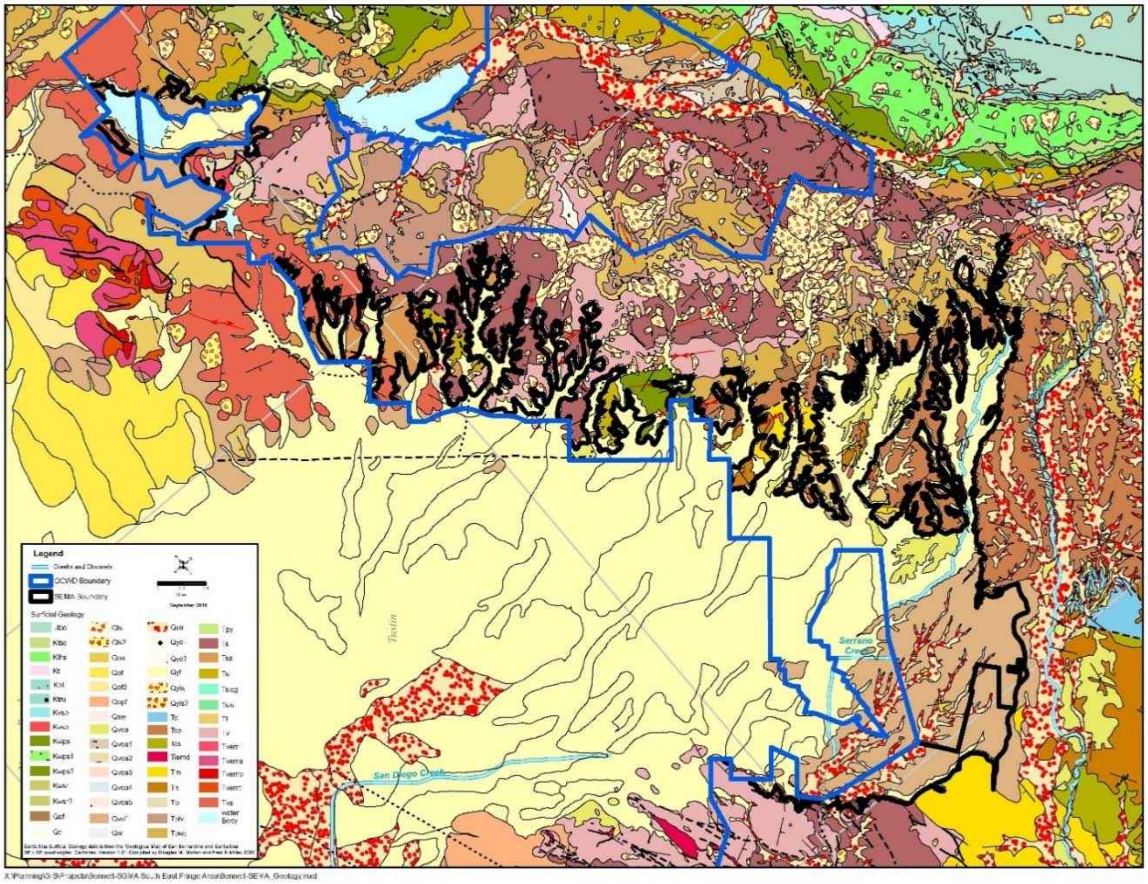


Figure 3-1: Geologic Location Map

3.1.1 Jurisdictional Boundaries

As described in Section 2 and shown in Figure 1-1, there are three jurisdictional agencies within the South East Management Area: IRWD, ETWD and the City of Orange. The western boundary of the South East Management Area is the south-eastern boundary of the OCWD Management Area. The South East Management Area's eastern boundary is the edge of Basin 8-1 as defined by the DWR Bulletin 118.

3.1.2 Land Use Designations

Land use designations for the South East Management Area have been consolidated into three major groups as follows:

1. Residential (single family, multi-family),
2. Commercial (commercial/industrial/mixed use), and
3. Open Space (open space/rights-of-way/water bodies).

As presented in Figure 3-2, IRWD's portion of the South East Management Area is primarily made up of Residential and Commercial land use types. The ETWD's portion is primarily residential, and the City of Orange is primarily Open Space.

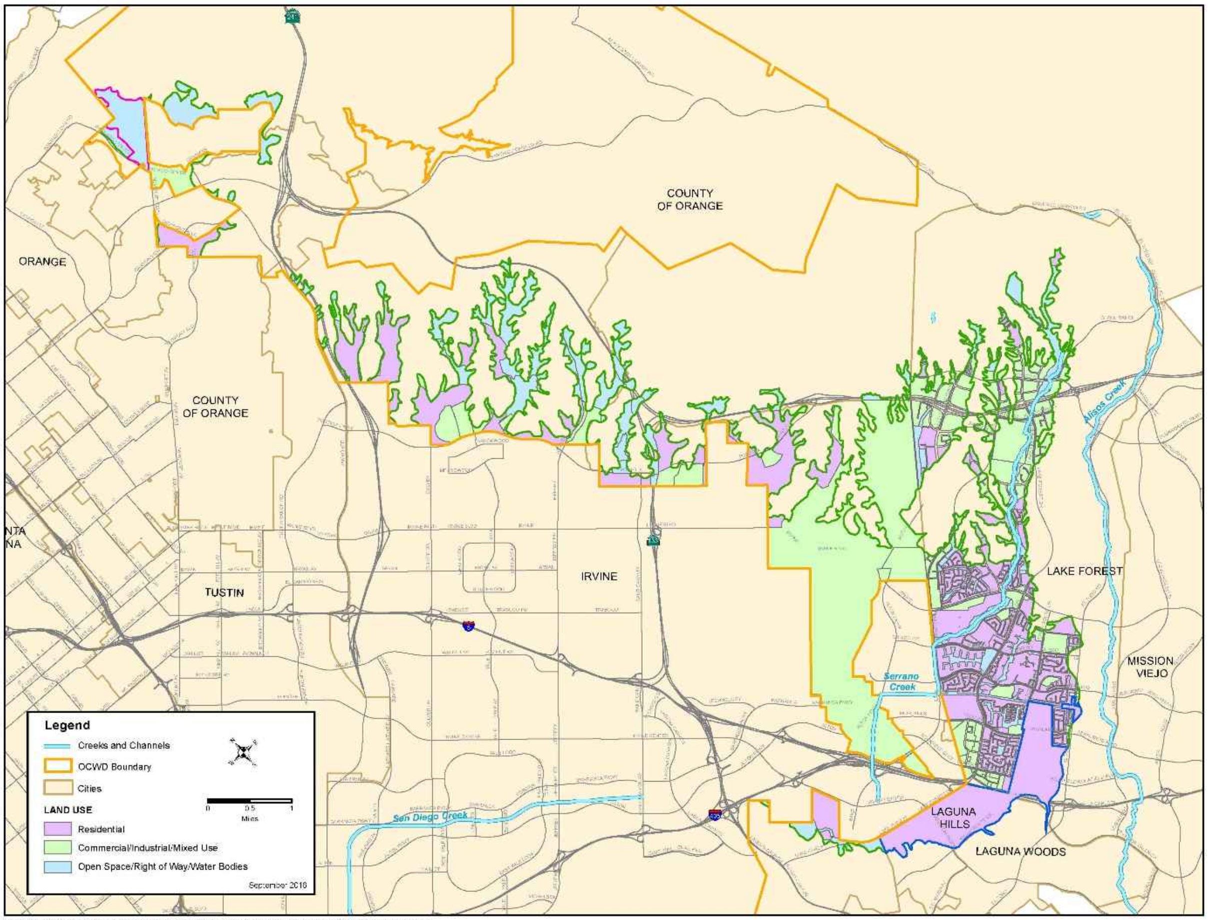
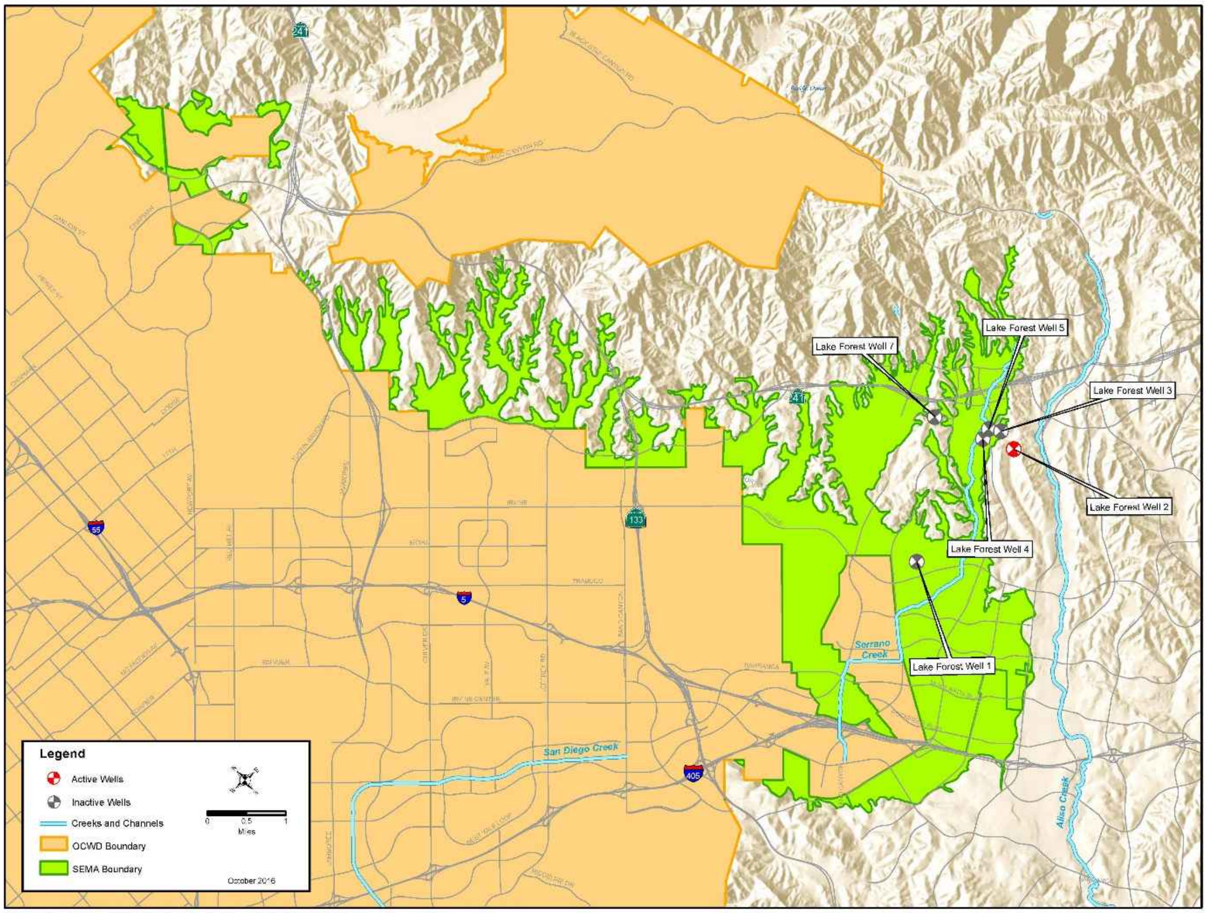


Figure 3-2: Land Use Designations

3.2 GROUNDWATER CONDITIONS

There is relatively little existing, or potential, groundwater development within the South East Management Area. Historically, IRWD's Lake Forest portion of the South East Management Area has had limited, inconsistent groundwater production from six existing wells, of which, only LF-2, is currently operational. Figure 3-3 shows the locations of the constructed wells within the South East Management Area.



X:\Planning\GIS\Projects\Bennett-SGMA South East Fringe Area\Bennett-SGMA_SouthEastFringeAreaWells.mxd

Figure 3-3: Groundwater Production Wells (Active and Inactive)

3.2.1 Groundwater Levels

The range of observed groundwater levels in the South East Management Area from 2012 to 2015 are summarized in Table 3-1 by agency. As shown, no groundwater level data exists in the ETWD and City of Orange portions of the South East Management Area. Historic and estimated groundwater levels from 1991 to 2015 for IRWD's Lake Forest wells are shown in Figure 3-4 where observed data are shown as points connected with solid lines and data estimated by correlation with the CASGEM well MCAS-3/MP2 is shown as a dashed line. Current monthly groundwater levels from IRWD's Lake Forest wells for 2015 to 2016 are shown in Figure 3-5.

Table 3-1: Observed Groundwater Levels 2012-2015

Agency	From (ft-bgs)	To (ft-bgs)
IRWD	17	168
ETWD	N/A	N/A
City of Orange	N/A	N/A

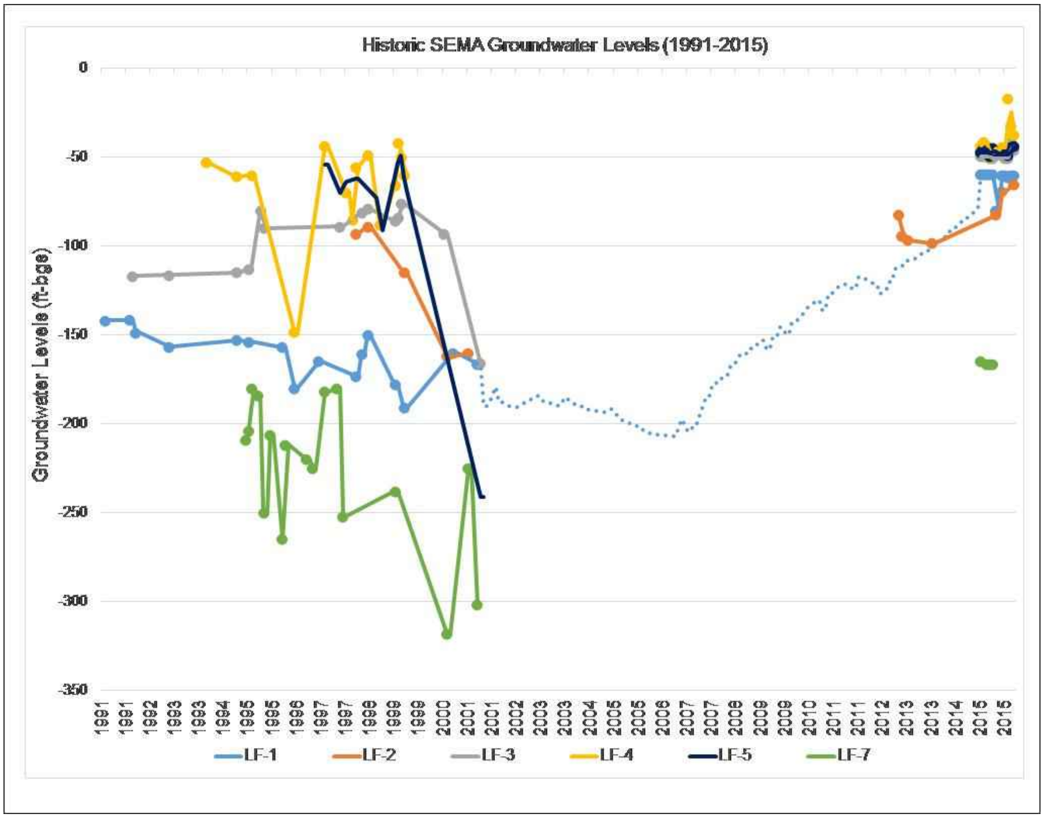


Figure 3-4: Historic Groundwater Levels, 1991-2015

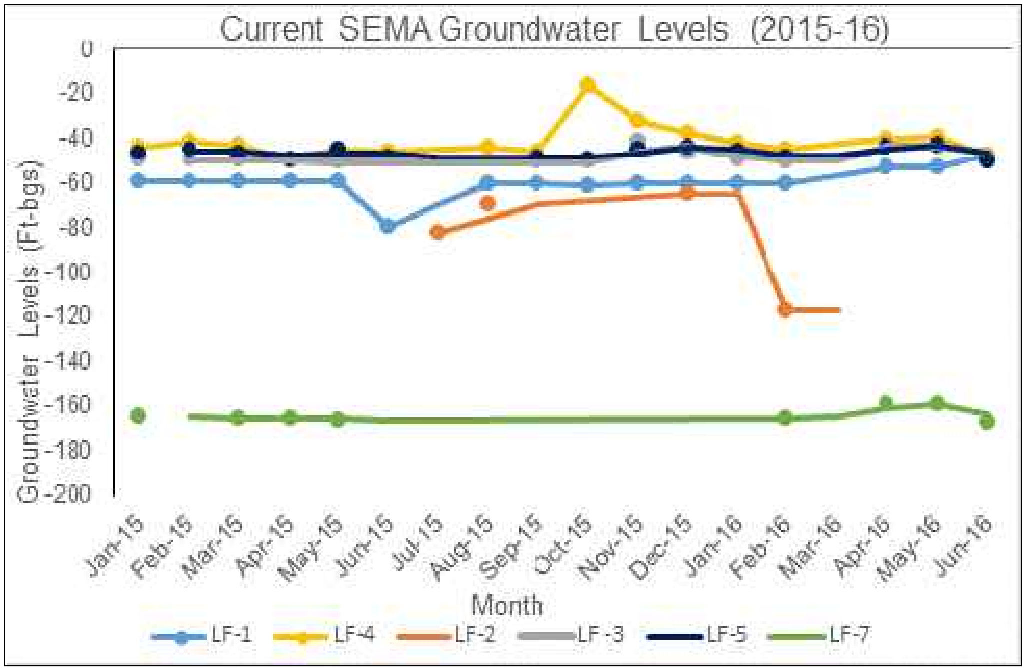


Figure 3-5: Current Groundwater Levels, 2015-16

3.2.2 Regional Pumping Patterns

Table 3-2 summarizes information on all the wells that are known to exist within the South East Management Area by agency. As presented, well design flows range from 125 to 350 gallons per minute (gpm) and well depths range from 675 to 1,000 feet below ground surface (ft-bgs).

Table 3-2: Wells and Flow Data

Agency	Well	State Well No.	System	Status	Design Flow (gpm)	Drilled	Depth (ft-bgs)	Perforated Intervals (ft)
IRWD	LF-1	06S/08W-15A00	Nonpotable	Inactive	300	1989	800	200-790
IRWD	LF-2	06S/08W-12Q02	Potable	Active	300	1957, *redrilled 2010*	675	200-675
IRWD	LF-3	06S/08W-12J01	Potable	Inactive	350	1950	800	270-395; 400-785
IRWD	LF-4	06S/08W-12L02	Nonpotable	Inactive	200	1993	810	350-470 510-790
IRWD	LF-5	06S/08W-12A01	Nonpotable	Inactive	140	1997	800	350-780
IRWD	LF-7	06S/08W-12E00	Potable	Inactive	125	1994	1000	430-980
ETWD	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
City of Orange	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Table 3-3 summarizes average annual pumping from 2006 – 2015 within the South East Management Area by agency. As shown, no groundwater development exists in the ETWD and City of Orange portions of the South East Management Area. In IRWD's portion of the South East Management Area only one well (LF-2) is currently active. Over the last 10 years, LF-2's annual pumping ranged from 0 acre-feet to 436 acre-feet and averaged approximately 125 acre-feet.

Table 3-3: Annual Pumping Average 2006-2015

Agency	Average Annual Production (AF/yr)
IRWD	125
ETWD	0
City of Orange	0
Total	**125**

Historical groundwater development within IRWD's portion of the South East Management Area has been limited to six wells in the Lake Forest region. However, only one well, LF-2, is currently operating. Due to the relatively low yield of these wells, IRWD considers production from these wells as a supplemental supply and does not rely on these wells to meet its firm demands.

Representative monthly pumping patterns for IRWD's LF-2 well are presented in Figure 3-6. As shown, monthly values vary considerably from one year to the next and have consisted of either: year round pumping, partial year pumping (5-7 months), or minimal pumping (0-2 months). Figure 3-7 shows a history of the total annual pumping for IRWD's LF-2 well from 2006 to 2015.

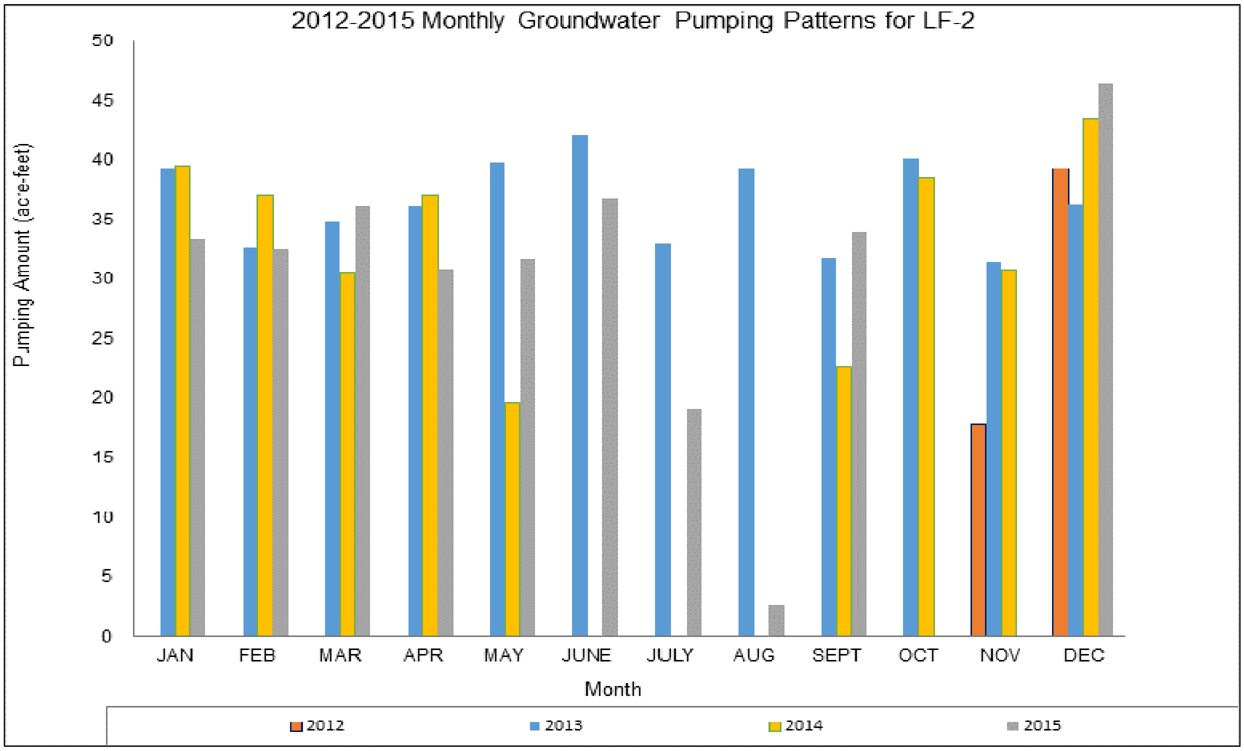


Figure 3-6: Monthly Groundwater Pumping Pattern in Well LF-2, 2012-2015

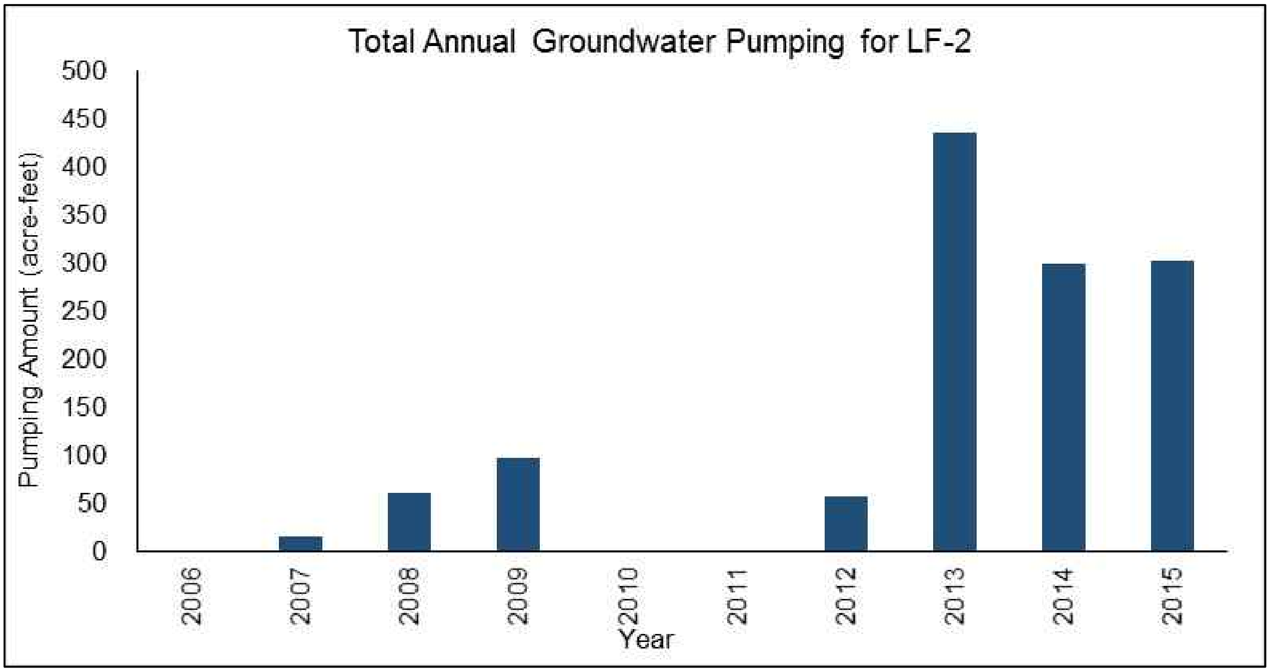


Figure 3-7: Total Annual Pumping for Well LF-2, 2006-2015

3.2.3 Groundwater Storage Data

Groundwater storage data for the South East Management Area are limited to IRWD's southern Lake Forest area. Based on available data, the total storage capacity within the South East Management Area is approximately 360,000 acre-feet: about 350,000 acre-feet in the IRWD's southern Lake Forest portion and about 11,000 acre-feet in the northern portion. The Lake Forest estimate includes the formation thicknesses at each well and an estimate of the aquifer's specific yield. The northern portion is estimated to contain approximately 11,000 acre-feet based on an estimated depth and specific yield of this region. To put this storage capacity into context, the total estimated storage within the OCWD Management Area is over 66 million acre-feet.

3.2.4 Groundwater Quality Conditions

Historically, only three of the six IRWD Lake Forest wells were permitted for potable use as the other three Lake Forest wells have had elevated levels of iron, manganese (Mn), electrical conductivity (EC) and total dissolved solids (TDS). Recent groundwater quality data for the South East Managementg Area which includes results for arsenic (As) is presented in Table 3-4. As presented, no other water quality data exists for the ETWD and City of Orange areas within the South East Management Area.

Table 3-4: Groundwater Quality in Selected Wells

Agency	Well Name	Well Use	Date Range	Avg TDS (#)[1] (mg/L)	Avg As (ug/L)	Avg Mn (mg/L)
IRWD	LF-2	Production	2011-2015	593	0.035	25.5
IRWD	LF-1	Production	1961-2000	>500 (21)		
IRWD	LF-4	Production	1993-2000	>500 (12)		
IRWD	LF-5	Production	1997-2001	>500 (5)		
IRWD	LF-3	Production	1991-1998	>500 (12)		
IRWD	LF-7	Production	1994-2001	<500 (12)		
City of Orange	N/A	N/A	N/A	N/A	N/A	N/A
ETWD	N/A	N/A	N/A	N/A	N/A	N/A

1 # = Number of Samples

3.2.5 Land Subsidence

No known land subsidence issues are known to exist in the South East Management Area.

3.2.6 Groundwater and Surface Water Interactions and Groundwater Dependent Ecosystems

IRWD’s Lake Forest portion of the South East Management Area contains quaternary alluvium and terrace deposits that interact with and are drained by Serrano Creek. Serrano Creek is an intermittent stream that only flows during the rainy season following storm events. As a result, there are no groundwater dependent ecosystems present.

SECTION 4. WATER BUDGET

No groundwater development exists in the ETWD and City of Orange portions of the South East Management Area. In IRWD's Lake Forest portion of the South East Management Area only one well (LF-2) is currently operational. IRWD's LF-2 groundwater production is dependent upon infiltration from ephemeral creeks, precipitation and incidental recharge from irrigation. From 2006-2015, LF-2's annual pumping ranged from 0 acre-feet to 436 acre-feet and averaged 125 acre-feet. An average annual groundwater budget for the South East Management Area for the last 10 years is presented in Table 4-1. The development of individual components in the average annual groundwater budget are described in the following subsections.

4.1 BUDGET COMPONENTS

No groundwater development exists in the ETWD and City of Orange portions of the South East Management Area. For IRWD's Lake Forest portion of the South East Management Area, the components of the groundwater budget are presented in Table 4-1 and described below.

Table 4-1: Average Annual Groundwater Budget

Item	**Total (acre-feet)**
Recharge	2,935
Total Inflow	2,935
Groundwater Production	125
Subsurface Outflow	2,810
Total Outflow	2,935
Change in Storage	0

4.1.1 Recharge

Recharge includes infiltration from ephemeral creeks, precipitation and incidental recharge from irrigation. It was estimated to equal the total outflow as summarized in Table 4-1.

4.1.2 Groundwater Production

Groundwater production was taken from measured records by IRWD as summarized in Table 4-1.

4.1.3 Subsurface Outflow

Subsurface outflow was estimated to equal the subsurface inflow to the OCWD Management Area from foothills into the Irvine subbasin prorated by the fraction of that area located in the South East Management Area as summarized in Table 4-1.

4.2 CHANGES IN GROUNDWATER STORAGE

As presented in Section 4.1, groundwater pumping in the South East Management Area is relatively minor and averages only 125 acre-feet per year over the last 10 years. In addition, Section 3.2 indicates historic groundwater levels from 1991 to 2015 have been highly variable without any undesirable results. Groundwater levels are currently at or above historical high levels despite recent increased groundwater production and multiple years of below normal precipitation. These conditions indicate groundwater storage changes within the South East Management Area are within an acceptable range.

4.3 WATER YEAR TYPE

The water year type has little impact on the water budget in the South East Management Area given the minimal changes in groundwater levels observed through time

4.4 ESTIMATE OF SUSTAINABLE YIELD

As shown in Table 4-1 and described in Section 3.2, average annual groundwater production over the last 10 years has ranged from 0 acre-feet to 436 acre-feet and has averaged approximately 125 acre-feet without significant reductions in groundwater elevations. However, the recent years are considered relatively dry and the sustainable yield of the South East Management Area may be significantly greater than the 10-year average under normal and wet hydrologic cycles. Based upon the limited groundwater resources in the area it is unlikely demands would ever rise to the level of straining the water budget of the area. In terms of sustainable yield, it is more appropriate to look at the South East Management Area as part of the larger OCWD Management Area.

4.5 CURRENT, HISTORICAL, AND PROJECTED WATER BUDGET

No groundwater development exists in the ETWD and City of Orange portions of the South East Management Area. In IRWD's Lake Forest portion of the South East Management Area, a 2002 study by Boyle Engineering Corporation and a 2015 study by Dudek were performed in order to assess the potential for development of two future wells, LF-6 and LF-8, as well as the redrilling of existing inactive wells. A capital project for the design, construction and equipping of LF-1 is included in IRWD's 2016-17 capital budget. IRWD has no near term plans to drill wells LF-6 and LF-8. In 2000, its last active year, LF-1 pumped about 230 acre-feet. Over the last 10 years LF-2's annual pumping has ranged from 0 acre-feet to 436 acre-feet and averaged about 125 acre-feet. It is expected that when LF-1 is redrilled, groundwater production from IRWD's southern portion of the South East Management Area could increase significantly. Water produced from LF-1 could be used to provide supply to the nearby lake which currently is supplied by untreated imported water. Water produced could also potentially be pumped and conveyed to the Baker Water Treatment Plant for treatment if needed (Dudek, 2015). Due to the consistently lower yields from the aquifer in this area, it is expected that additional production from LF-1 will continue to be considered supplemental, and therefore insignificant in terms of IRWD's overall water supply for its Lake Forest area.

SECTION 5. WATER RESOURCE MONITORING PROGRAMS

5.1 OVERVIEW

This section describes surface and groundwater monitoring programs in the South East Management Area

5.2 GROUNDWATER MONITORING PROGRAMS

No groundwater development exists in the ETWD and City of Orange portions of the South East Management Area. In IRWD's Lake Forest portion of the South East Management Area six wells (both active and inactive) have been, and will continue to be, used to monitor the groundwater levels on a monthly basis. Section 3.2.1 provides information on the South East Management Area groundwater levels, and Figure 3-3 shows the locations of the Lake Forest wells within the South East Management Area.

5.3 OTHER MONITORING PROGRAMS

IRWD monitors groundwater quality in LF-2 as required by the California Code of Regulation (Title 22) and California Division of Drinking Water, Santa Ana District.

SECTION 6. WATER RESOURCE MANAGEMENT PROGRAMS

IRWD works with ETWD and City of Orange on plans for groundwater development within the South East Management Area and updates demand projections and the water budget accordingly.

IRWD: The compilation of land use data is the basis for IRWD’s water resource planning including its portion of the South East Management Area. Per IRWD’s 2015 Urban Water Management Plan (UWMP), the land use data obtained from multiple jurisdictions in IRWD’s service area is used in conjunction with IRWD’s applied water use factors in order to estimate water requirements.

ETWD: ETWD’s water resource planning is based on the 2015 UWMP demand projections. Regional demands are forecasted by the Municipal Water District of Orange County and are then tailored to ETWD’s service area using available data for land use, population, and economic growth, intermixed with a trajectory of conservation, which includes both additional future passive measures and active measures.

City of Orange: The City of Orange’s current UWMP (2015) provides the basis for water resource planning in Orange’s water service area. The UWMP, in conjunction with applicable water use factors, form the basis for any potential water use estimates required for potential planning use in the service area.

SECTION 7. NOTICE AND COMMUNICATION

There are three agencies within the South East Management Area, as follows:

- IRWD
- ETWD
- City of Orange

On May 30, 2016 a meeting was held with representatives from IRWD, ETWD, City of Orange and OCWD to discuss SGMA compliance via an Alternative to a GSP and the designation of IRWD as the lead agency for the South East Management Area. Draft copies of this South East Management Area plan were provided to ETWD and the City of Orange for review on September 15 and October 3, 2016.

The public was notified of this South East Management Area plan when it was presented to each agencies' governing body. Additional public notice and communication of this plan was provided by OCWD prior to its public meeting of its Board of Directors on December 14, 2016.

SECTION 8. SUSTAINABLE MANAGEMENT APPROACH

The Sustainable management approach for the South East Management Area is to continue monitoring groundwater levels and water quality to assure that conditions do not lead to significant and unreasonable (1) lowering of groundwater levels, (2) reduction in storage, (3) water quality degradation, (4) inelastic land subsidence or (5) unreasonable adverse effect on surface water resources.

SECTION 9. SUSTAINABLE MANAGEMENT RELATED TO GROUNDWATER LEVELS

9.1 HISTORY

As shown on Figure 3-4 historic groundwater levels in the IRWD's Lake Forest portion of the South East Management Area have been variable but have recovered to historical highs. Because existing groundwater pumping in the South East Management Area is relatively minor groundwater levels are expected to remain relatively steady in the future.

9.2 MONITORING OF GROUNDWATER LEVELS

Groundwater levels are currently monitored monthly in the six wells located in IRWD's Lake Forest portion of the South East Management Area. Because existing groundwater use is relatively minor the existing level of groundwater monitoring is expected to continue in the future.

9.3 DEFINITION OF SIGNIFICANT AND UNREASONABLE LOWERING OF GROUNDWATER LEVELS

No long-term reduction in groundwater levels in the South East Management Area are expected to occur.

9.4 DETERMINATION OF MINIMUM THRESHOLDS

Determination of a minimum threshold for groundwater levels has not been determined since no undesirable effects due to ground water levels have occurred in the past and are not foreseen in the future. Nevertheless, IRWD's Lake Forest well monitoring program is expected to continue to monitor water levels and groundwater quality in the future. If water levels start to show a consistent, long term decline and undesirable results are observed then minimum thresholds may be established.

SECTION 10. SUSTAINABLE MANAGEMENT RELATED TO BASIN STORAGE

No groundwater development exists in the ETWD and City of Orange portions of the South East Management Area. The total volume of groundwater storage in IRWD's portion of the South East Management Area has been estimated to be approximately 360,000 acre-feet (see Section 3.2.3).

10.1 DEFINITION OF SIGNIFICANT AND UNREASONABLE REDUCTION IN STORAGE

No significant long-term reduction in groundwater storage is expected to occur in the South East Management Area because of the limited groundwater use. However, a decline in groundwater storage may be determined unreasonable if one more of the following occurred:

1. Significant loss of well production capacity.
2. Degradation of water quality that significantly impacts the use of groundwater.

10.2 DETERMINATION OF MINIMUM THRESHOLDS

A minimum threshold for the reduction of groundwater storage in the South East Management Area is not anticipated since no undesirable effects have occurred in the past and are not foreseen in the future. Nevertheless, IRWD's Lake Forest monitoring program continuously tracks water levels and groundwater quality. If water levels show a consistent decline, IRWD's Lake Forest monitoring program would be expanded to examine any potential impacts and action would be taken to identify minimum thresholds as appropriate.

SECTION 11. SUSTAINABLE MANAGEMENT RELATED TO WATER QUALITY

No groundwater development exists in the ETWD and City of Orange portions of the South East Management Area. Groundwater quality in IRWD's portion of the South East Management Area is affected by the quality of recharge from Serrano Creek and precipitation and incidental recharge from irrigation.

11.1 DEFINITION OF SIGNIFICANT AND UNREASONABLE DEGREDATION OF WATER QUALITY

There are three elements that must be considered when evaluating the impact of groundwater quality degradation.

The first element is considering the causal nexus between groundwater management activities and groundwater quality. For example, groundwater contamination due to improper handling of toxic materials impacts groundwater quality; however, this water quality degradation is not caused by groundwater management activities.

The second element is the beneficial uses of the groundwater and water quality regulations, such as Maximum Contaminant Levels (MCLs) and other potable water quality requirements.

The third element that must be considered is the volume of groundwater impacted by groundwater quality degradation. If small volumes are negatively affected that don't materially affect the use of the aquifer or basin for its existing beneficial uses, then this would not represent a significant and unreasonable degradation of water quality. However, if the impacted volume grows, then it could reach a level that it becomes significant and unreasonable.

When considering all three elements, the definition of significant and unreasonable degradation of water quality is defined as degradation of groundwater quality in the South East Management Area to the extent that a significant volume of groundwater becomes unusable for its designated beneficial uses.

11.2 DETERMINATION OF MINIMUM THRESHOLDS

The minimum thresholds for groundwater quality are exceedances of Maximum Contaminant Levels (MCLs) or other applicable regulatory limits that are directly attributable to groundwater management actions in the South East Management Area that prevents the use of groundwater for its designated beneficial uses.

SECTION 12. SUSTAINABLE MANAGEMENT RELATED TO SEAWATER INTRUSION

The South East Management Area is located far from the ocean and thus there is no reason to consider the potential impact of seawater intrusion in this management area.

SECTION 13. SUSTAINABLE MANAGEMENT RELATED TO LAND SUBSIDENCE

Subsidence is not an issue for the South East Management Area given the following:

1. Minimal groundwater development exists in the South East Management Area.
2. The presence of shale and sandstone bedrock underlying the alluvial aquifer.
3. The alluvial aquifer is relatively thin and comprised mainly of sand and gravel with little clay.
4. Steady groundwater and storage levels.
5. Low risk of substantial groundwater level declines due to a minimal amount of groundwater production.

SECTION 14. SUSTAINABLE MANAGEMENT RELATED TO GROUNDWATER DEPLETIONS IMPACTING SURFACE WATER

Existing groundwater use in the South East Management Area is relatively minor (see section 4.1.1) and the surface streams and creeks are ephemeral. Therefore, there is no need for a program to manage groundwater depletions that may impact surface water.

SECTION 15. PROTOCOLS FOR MODIFYING MONITORING PROGRAMS

Protocols for modifying monitoring programs are based on changes from historical conditions or changes in water quality that begin to approach or exceed regulatory limits.

15.1 ESTABLISHMENT OF PROTOCOLS FOR WATER QUALITY

Changes in the South East Management Area water quality sampling program can be triggered by one or more of the following:

1. A change or anticipated change in water quality regulations;
2. A constituent in a sample approaches or exceeds a regulatory water quality limit or Maximum Contaminant Level, notification level, or first time detection of a constituent;
3. Analysis of water quality trends.

15.2 ESTABLISHMENT OF PROTOCOLS FOR GROUNDWATER ELEVATIONS/STORAGE

Because it is desirable to use the same well to obtain water level records over long periods of time it is rare that changes are made to an existing groundwater level monitoring program. The most common reason a well is dropped from a monitoring program is that it is no longer available. If this occurs, IRWD will evaluate the nearest similar well or the need to construct a replacement well and add it to the monitoring program as appropriate.

The frequency of groundwater level monitoring in IRWD’s Lake Forest portion of the South East Management Area is monthly and historic water levels tend to be relatively consistent (see Figure 3-4). Therefore, the monitoring frequency may be reduced in the future. However, if water levels start to change and storage levels start to decline, then the frequency of groundwater level monitoring would likely return to a monthly frequency.

SECTION 16. PROCESS TO EVALUATE NEW PROJECTS

When new projects are proposed within the South East Management Area, the agency proposing the project will be responsible for preparing a CEQA document to ensure alternatives have been evaluated and any significant and unreasonable results are mitigated.

SECTION 17. REFERENCES

Following are references and technical studies for the South East Management Area.

- Groundwater Supply Evaluation for the Los Alisos System Phase 1, July 2002, Boyle Engineering Corporation.
- Lake Forest Groundwater Conveyance Analysis Results (Dudek, November 5, 2015).
- Geohydrology and Acritical-Recharge Potential of the Irvine Area Orange County, California (J. A. Singer, January 8, 1973).
- Ground Water Management, Irvine Area, Orange County, California (Harvey O. Banks, Consulting Engineer, Inc.).
- Communication with OCWD. Email dated November 28, 2016.

Basin 8-1 Alternative

Santa Ana Canyon Management Area

Prepared by: Orange County Water District

In collaboration with: Cities of Anaheim, Chino Hills, Yorba Linda, Corona; Yorba Linda Water District; Counties of Orange and Riverside

January 1, 2017

Basin 8-1 Alternative

Santa Ana Canyon Management Area

PROFESSIONAL GEOLOGIST
ADAM
SCOTT
HUTCHINSON
No.6638
Exp 2/28/17
STATE OF CALIFORNIA

Adam Hutchinson, P.G., C.Hg.

Recharge Planning Manager
Orange County Water District
18700 Ward Street
Fountain Valley, CA 92708

Prepared for the Department of Water Resources, pursuant to Water Code §10733.6(b)(3)

January 1, 2017

Table of Contents

Figure

Table

SECTION 1. EXECUTIVE SUMMARY

The Santa Ana Canyon Management Area covers the easternmost extent of the Department of Water Resources (DWR) Basin 8-1, Coastal Plain of Orange County Groundwater Basin. This Management Area is created for this Alternative (under 23 CCR 354.20) because of the unique characteristics of the Santa Ana Canyon and the appropriateness of developing different management objectives and strategies for this portion of the Basin. These different objectives and management approaches, as described in this Section, account for the significant differences in groundwater use, geology, aquifer characteristics, and other factors which distinguish Santa Ana Canyon from other portions of the Basin. Figure 1-1 shows the extent of the Santa Ana Canyon Management Area and the agencies with jurisdiction in the Santa Ana Canyon Management Area. Table 1-1 lists the agencies shown on Figure 1-1.

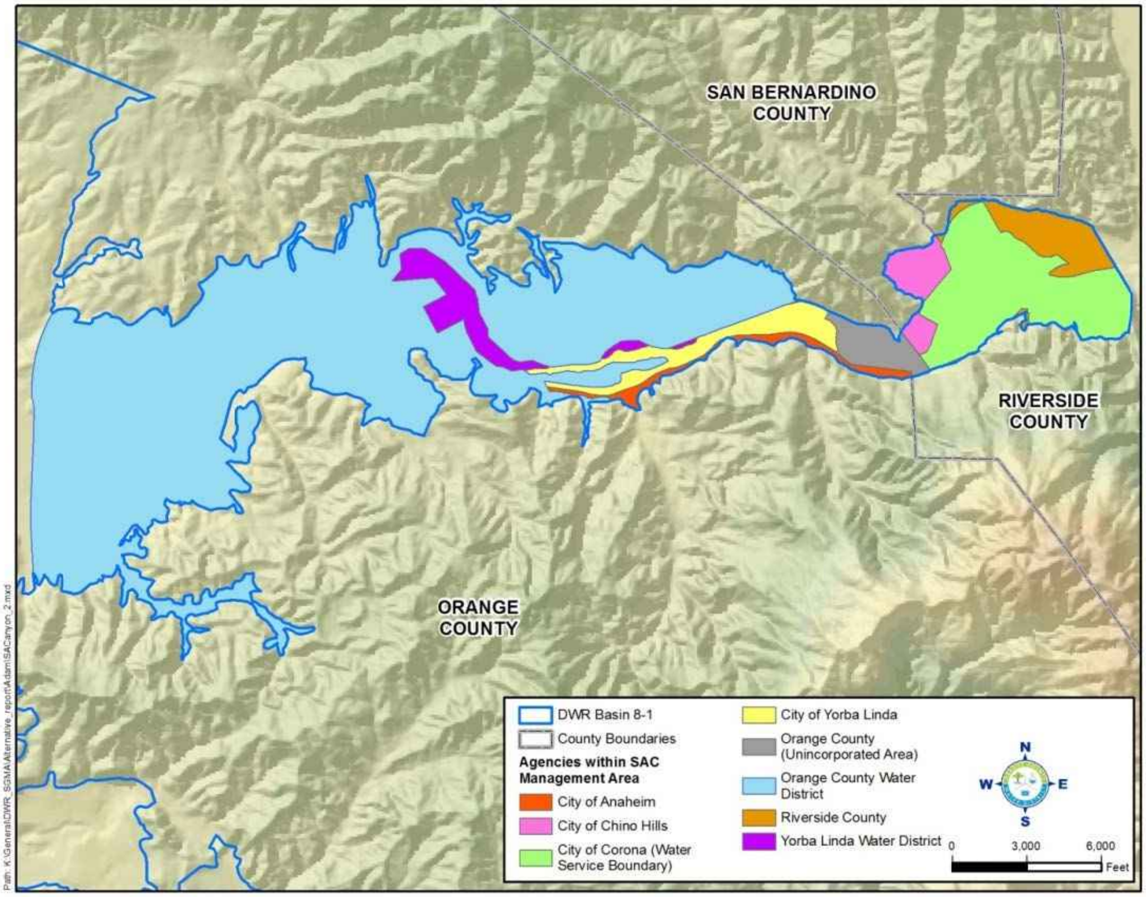


Figure 1-1: Agencies in the Santa Ana Canyon Management Area

The water resources in the Santa Ana Canyon Management Area include the Santa Ana River and limited groundwater. Groundwater is primarily located in a thin alluvial aquifer that is 90 to 100 feet thick and is a combination of infiltrated Santa Ana River water and subsurface inflow from the adjacent foothills. Groundwater production from the alluvial aquifer is primarily used for irrigation but some is also used for potable purposes. Groundwater production represents one to two percent of the total available water supply to the Santa Ana Canyon Management Area due to the significantly larger flow of the Santa Ana River as shown on Table 1-2. Even under projected dry conditions, groundwater production is expected to be less than four percent of the total available water supply.

Table 1-1: Agencies in Santa Ana Canyon Management Area

Agency
City of Anaheim
City of Chino Hills
City of Yorba Linda
City of Corona Water Service Area
Orange County Water District
County of Orange
Riverside County
Yorba Linda Water District

Table 1-2: Water Budget, 10-Year Average (2006-15) and Dry-Year Condition

Flow Component	10-Yr Avg: 2006-15 (afy)	Dry-Year Condition (afy)
Santa Ana River Base Flow	100,400	44,000
Santa Ana River Storm Flow	72,300	11,300
Subsurface Inflow	5,000	5,000
TOTAL INFLOW	**177,700**	**60,300**
Santa Ana River Base Flow	98,820	42,030
Santa Ana River Storm Flow	72,300	11,300
Evapotranspiration	740	740
Groundwater Production	1,840	2,230
Subsurface Outflow	4,000	4,000
TOTAL OUTFLOW	**177,700**	**60,300**

Per the monitoring discussed in Section 5, groundwater levels in the Santa Ana Canyon Management Area are relatively stable, having been consistently 20 to 30 feet below ground surface since 1991, indicating that the supply of subsurface inflow and surface water from the Santa Ana River is more than sufficient to sustain local groundwater production. Groundwater quality is suitable for irrigation and potable uses. Native groundwater from the surrounding foothills tends to have naturally elevated total dissolved solids (TDS) and manganese concentrations. Most wells in the canyon appear to produce a blend of infiltrated Santa Ana River water, and native groundwater, with some wells producing more infiltrated Santa Ana River water than others.

OCWD monitors Santa Ana River flow and quality as well as groundwater levels, quality, and production in the Santa Ana Canyon Management Area (see Section 5). Moreover, OCWD has a wide variety of water resource management programs that cover the OCWD Management Area as well as programs in the upper Santa Ana River watershed to address Santa Ana River flow and quality (see Section 6). These programs are important in protecting the quality of the Santa Ana River, which has a significant influence on the groundwater quality in the Santa Ana Canyon Management Area.

The approach to managing the Santa Ana Canyon Management Area is for OCWD, in cooperation with the County of Orange, to continue monitoring sustainable conditions and monitor to ensure that no significant and unreasonable results occur in the future, both in the Santa Ana Canyon portion of the Basin and in the other hydrologically connected portions of the Basin.

Due to the unique conditions documented within the Santa Ana Canyon Management Area, it will not be difficult to prevent conditions that could lead to significant and unreasonable undesirable results due to the low risk of increased groundwater production, little available developable land, and continued high flows of the Santa Ana River relative to the amount of groundwater production. A summary of the applicable undesirable results that must be prevented under SGMA is presented below. A more detailed description of these can be found in Sections 8 to 13.

1. **Water Levels:** Long-term reduction in groundwater levels in the Santa Ana Canyon Management Area are not foreseeable given the high volume of Santa Ana River flow relative to the amount of groundwater production and the high rate at which the shallow groundwater formations recharge as a result of surface flow in the Santa Ana Canyon; however, if an unforeseen long-term reduction in groundwater levels were to occur, water levels could reach a significant and unreasonable level if one or more of the following occurred as a result of reduced groundwater levels:
   a. Loss of significant riparian habitat along the Santa Ana River.
   b. Significant loss of well production capacity (in the Santa Ana Canyon Management Area).
   c. Degradation of water quality that significantly impacts the beneficial uses of groundwater.
2. **Storage:** As with groundwater levels, long-term reduction in groundwater storage in the Santa Ana Canyon Management Area is not projected to occur; however, an unforeseen decline in groundwater storage could reach a significant and unreasonable level if such a decline caused one or more of the following:
   a. Loss of significant riparian habitat along the Santa Ana River.
   b. Significant loss of well production capacity.
   c. Degradation of water quality that significantly impacts the beneficial uses of groundwater.
3. **Water Quality:** The significant and unreasonable degradation of water quality is defined as the degradation of groundwater quality in the Santa Ana Canyon Management Area that is attributable to groundwater production or recharge practices within the Santa Ana

Canyon Management Area that cause a significant volume of groundwater to become unusable for its designated beneficial uses.

4. **Seawater Intrusion:** This does not apply to the Santa Ana Canyon Management Area because this area if far removed from the coastline.
5. **Subsidence:** This does not apply to the Santa Ana Canyon Management Area due to:
    a. The presence of shale and sandstone bedrock underlying the alluvial aquifer.
    b. The alluvial aquifer is thin, generally less than 100 feet, and comprised mainly of sand and gravel with little clay.
    c. Groundwater levels and groundwater storage are stable.
    d. Very low risk of substantial groundwater level declines due to de minimis amount of groundwater production relative to the overall inflow of water to the Santa Ana Canyon Management Area.
6. **Groundwater Depletions Impacting Surface Water:** Due to hydrogeologic conditions and land use limitations, groundwater production in the Santa Ana Canyon Management area has had and is projected to have a de minimis effect on groundwater conditions and flows of surface water through the canyon. Therefore, this factor does not apply to the Santa Ana Canyon Management Area.

SECTION 2. AGENCY INFORMATION

2.1 HISTORY OF AGENCIES IN SANTA ANA CANYON MANAGEMENT AREA

As shown on Figure 2-1, eight agencies have jurisdiction within the Santa Ana Canyon Management Area. The footprint of the various agencies within the Santa Ana Canyon Management Area has evolved over time due to annexations and changes in the sphere of influence (e.g., City of Corona water service area, OCWD annexation). In Fall 2013 OCWD completed annexing a portion of the Yorba Linda Water District (YLWD) and City of Anaheim into OCWD's service area. The annexation was done in response to a request from these agencies to have a portion of their service area included within OCWD's boundaries. Table 2-1 lists the agencies and the approximate area covered by each.

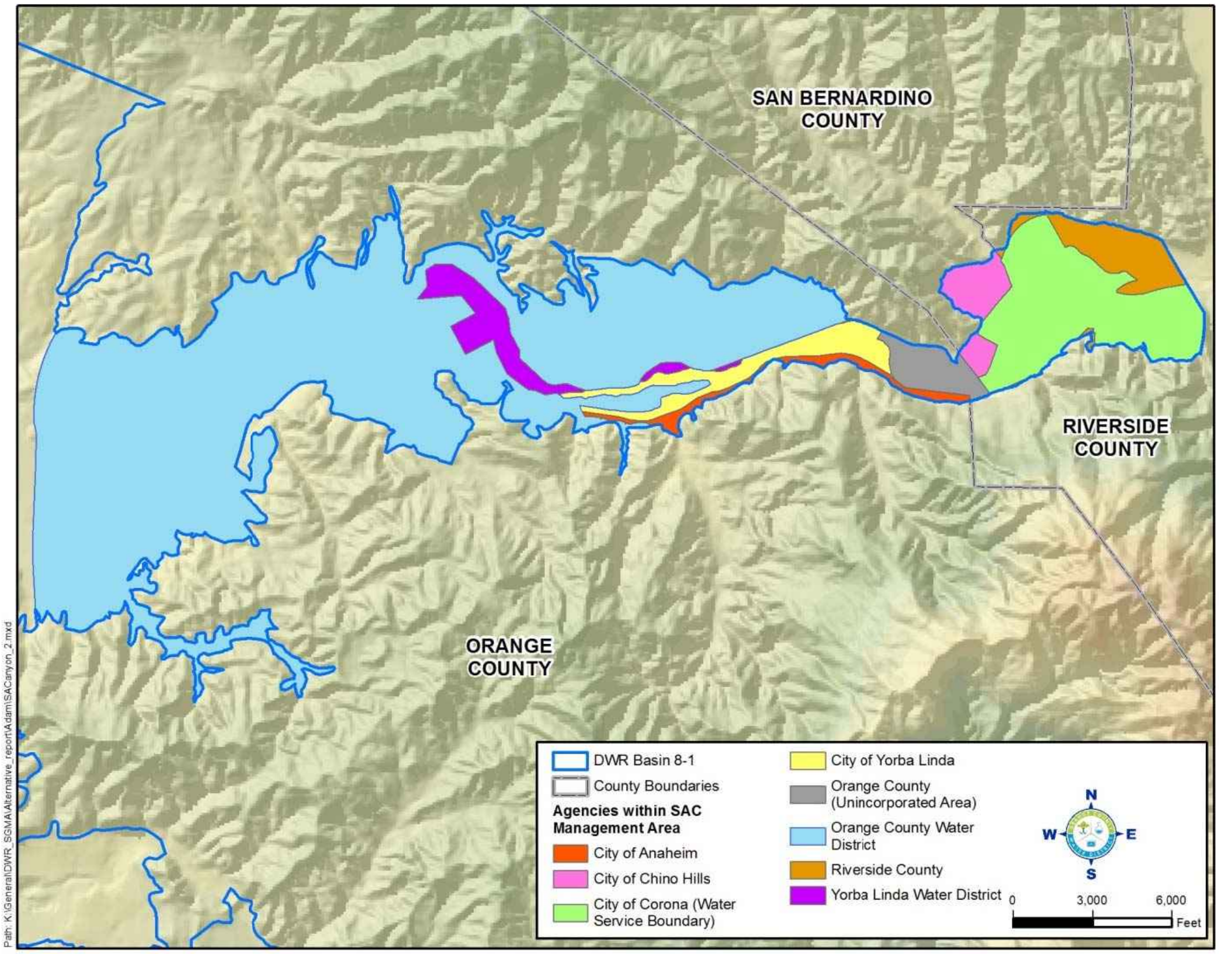


Figure 2-1: Agencies in the Santa Ana Canyon Management Area

Table 2-1: Agencies in Santa Ana Canyon Management Area and Area Covered

Agency	Area Covered (acres)
City of Anaheim	90
City of Chino Hills	130
City of Yorba Linda	220
City of Corona Water Service Area*	660
Orange County Water District	4,310
County of Orange	120
Riverside County	200
Yorba Linda Water District	190
Total Area	**5,920**

*Note that the City of Corona's service area includes areas within the County of Orange.

The Santa Ana Canyon Management Area covers 2.6 percent of Basin 8-1, which has a total area of 223,600 acres or 350 mi^2.

As shown on Figure 2-1 and in Table 2-1, the City of Corona represents the largest water service provider in the Riverside County portion of the Management Area, covering about 660 acres. In this area, Corona provides about 368 acre-feet per year (2015 total) of water to approximately 663 connections, including 639 single family residences, 1 multi-family residence, 17 commercial, and 6 additional connections (including landscape). Water source types include groundwater pumped from the adjacent Temescal Subbasin and treated imported Colorado River water purchased from Metropolitan Water District of Southern California.

2.2 GOVERNANCE AND MANAGEMENT STRUCTURE

There are currently no groundwater withdrawals or plans for withdrawals within the portions of the Santa Ana Canyon Management Area that are overlain by the City of Anaheim, City of Chino Hills, City of Yorba Linda, Riverside County, and the Yorba Linda Water District. Key reasons for the lack of significant production are the lack of demands in these areas, the relatively poor quality of groundwater in the Santa Ana Canyon Management Area, and lack of developable land due to land use limitations. In addition, there are no groundwater withdrawals or plans for withdrawals by the City of Corona; although there are existing groundwater withdrawals within the Corona service area, the wells are owned and operated by the County of Orange for golf course irrigation. As mentioned above, Corona delivers water from sources outside of the Santa Ana Canyon Management Area.

Accordingly, no formal groundwater governance and management structure is needed for the areas in the Santa Ana Canyon Management Area covered by these agencies other than the existing monitoring program that OCWD already carries out in accordance with its authorities under the OCWD Act. The governance and management structure of OCWD is described in the OCWD Management Area part of this report. As will be shown later in this section, groundwater withdrawals by the County of Orange and private users within the Santa Ana

Canyon Management Area are de minimis compared to the overall flow of water through the Santa Ana Canyon Management Area, and they are expected to remain at current sustainable levels. As a result, there is no need for other agencies to establish groundwater governance or management in the Santa Ana Canyon Management Area beyond existing levels of monitoring; however, groundwater production, level and quality data will continue to be collected and reported to DWR by OCWD per CASGEM and SGMA requirements.

2.3 LEGAL AUTHORITY

The legal authority of OCWD is described in the OCWD Management Area part of this report. As described in the OCWD Management Area part of the report, OCWD has obtained water rights from the State Water Resources Control Board (SWRCB) to all of the flows in the Santa Ana River arriving at Prado Dam. As a result, any future groundwater production within the Santa Ana Canyon Management Area would be reviewed by OCWD and the SWRCB to ensure it does not interfere with OCWD's existing water rights. Moreover, though outside of OCWD's boundaries, OCWD currently monitors portions of Santa Ana Canyon pursuant to its authority under Section 2, subparagraphs 5, 6, 7 and 14, of the OCWD Act.

The Orange County Well Ordinance (County Ordinance No. 2607) requires that a permit be obtained from Orange County prior to the construction or destruction of any well. In unincorporated areas and in 29 of 34 Orange County cities, the Orange County Health Officer is responsible for enforcement of the well ordinance. In the remaining five cities (Anaheim, Buena Park, Fountain Valley, Orange and San Clemente), well ordinances are enforced by city personnel. Any plans for wells in areas covered by Riverside and San Bernardino Counties would be reviewed by OCWD to ensure they did not interfere with OCWD's rights to Santa Ana River flows.

2.4 BUDGET

OCWD's costs for data collection within the Santa Ana Canyon Management Area are contained within OCWD's budget for data collection in the OCWD Management Area, which is presented in the OCWD Management Area portion of this report. The only future costs that will be incurred by the County of Orange are related to collecting production data from wells used to irrigate the County-owned Green River Golf Course. The other agencies within the Santa Ana Canyon Management Area will not incur any additional costs to comply with this Section of the Alternative since no further monitoring other that already undertaken by OCWD and Orange County is believed needed in order to prevent undesirable results from occurring. As a result, an estimated budget for other agencies has not been defined for the Santa Ana Canyon Management Area due to the minimal nature of the effort to collect and report groundwater production, level and water quality data.

SECTION 3. MANAGEMENT AREA DESCRIPTION

3.1 SANTA ANA CANYON MANAGEMENT AREA

The Santa Ana Canyon is a narrow east-west trending canyon between the Santa Ana Mountains to the south and the Chino Hills to the north near the intersection of Orange, San Bernardino and Riverside Counties. As shown on Figure 3-1, a key feature is the Santa Ana River, which is southern California's longest coastal river, extending 96 miles from its headwaters in the San Bernardino Mountains to the Pacific Ocean with a watershed that covers over 2,600 square miles. Just upstream of the Santa Ana Canyon is Prado Dam, which was constructed by the US Army Corps of Engineers in 1941 to reduce flood risks to Orange County.

The canyon has been infilled by Quaternary age (2.6M years to present) alluvial deposits of the Santa Ana River. The adjacent Chino Hills and Santa Ana Mountains are composed of various older consolidated sedimentary, igneous and metamorphic rocks. The water resources in the Santa Ana Canyon Management Area include the Santa Ana River and groundwater. Groundwater occurs in the alluvial deposits under generally unconfined conditions and is sourced from a combination of Santa Ana River recharge and subsurface inflow from the adjacent Chino Hills and Santa Ana Mountains. The DWR Basin 8-1 boundary in the Santa Ana Canyon follows the trace of the alluvial deposits as shown on Figure 3-2. In 2016, portions of the previous basin 8-1 boundary were revised by DWR at the request of OCWD to more closely align with the recent geologic mapping of the alluvial deposits.

The Santa Ana Canyon Management Area covers the area of alluvial deposits in the Santa Ana Canyon east of Imperial Highway (Hwy 90), as shown on Figure 3-3. Imperial Highway was selected as the western boundary of the Santa Ana Canyon Management Area because this is where the groundwater basin transitions from a relatively thin alluvial aquifer to a deep multi-layered alluvial basin. Moreover, Imperial Highway is the approximate boundary of OCWD's groundwater flow model, allowing subsurface outflows from the entire Santa Ana Canyon Management Area to be readily quantified for purposes of the water budget and monitoring groundwater in storage.

Previously published reports indicated that the alluvial deposits in Santa Ana Canyon ranged from 90 to 100 feet thick (USGS, 1964). To further characterize the alluvial deposits in the Santa Ana Canyon, all available well logs were reviewed and two cross-sections were developed. Figure 3-4 shows the cross-section locations and the wells used to develop the cross sections. Figure 3-5 presents cross-sections A-A' and B-B'. As shown on Figure 3-5, the thickness of the alluvial deposits in the Santa Ana Canyon are consistent with those reported by the USGS (1964).

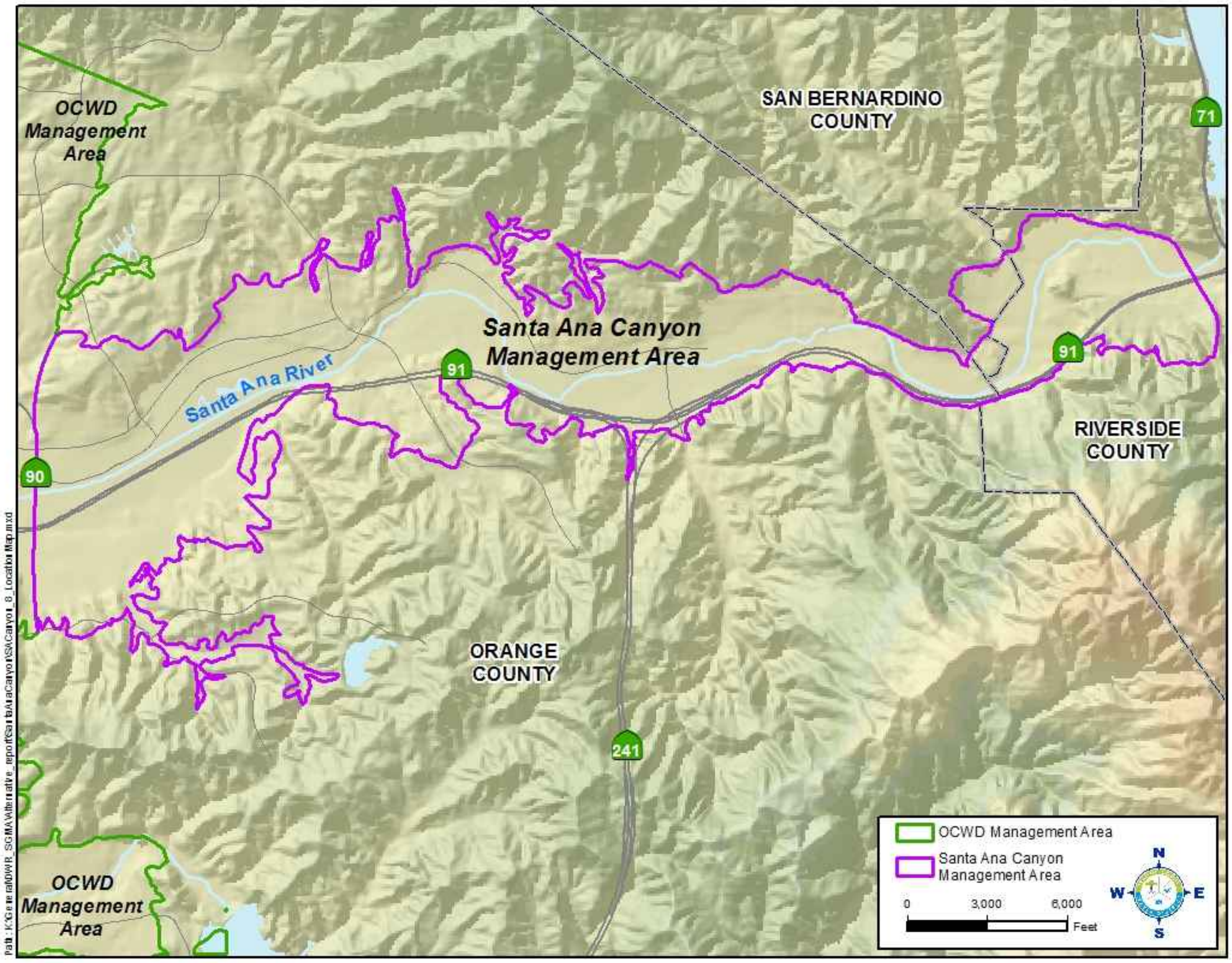


Figure 3-1: Boundaries of Santa Ana Canyon Management Area

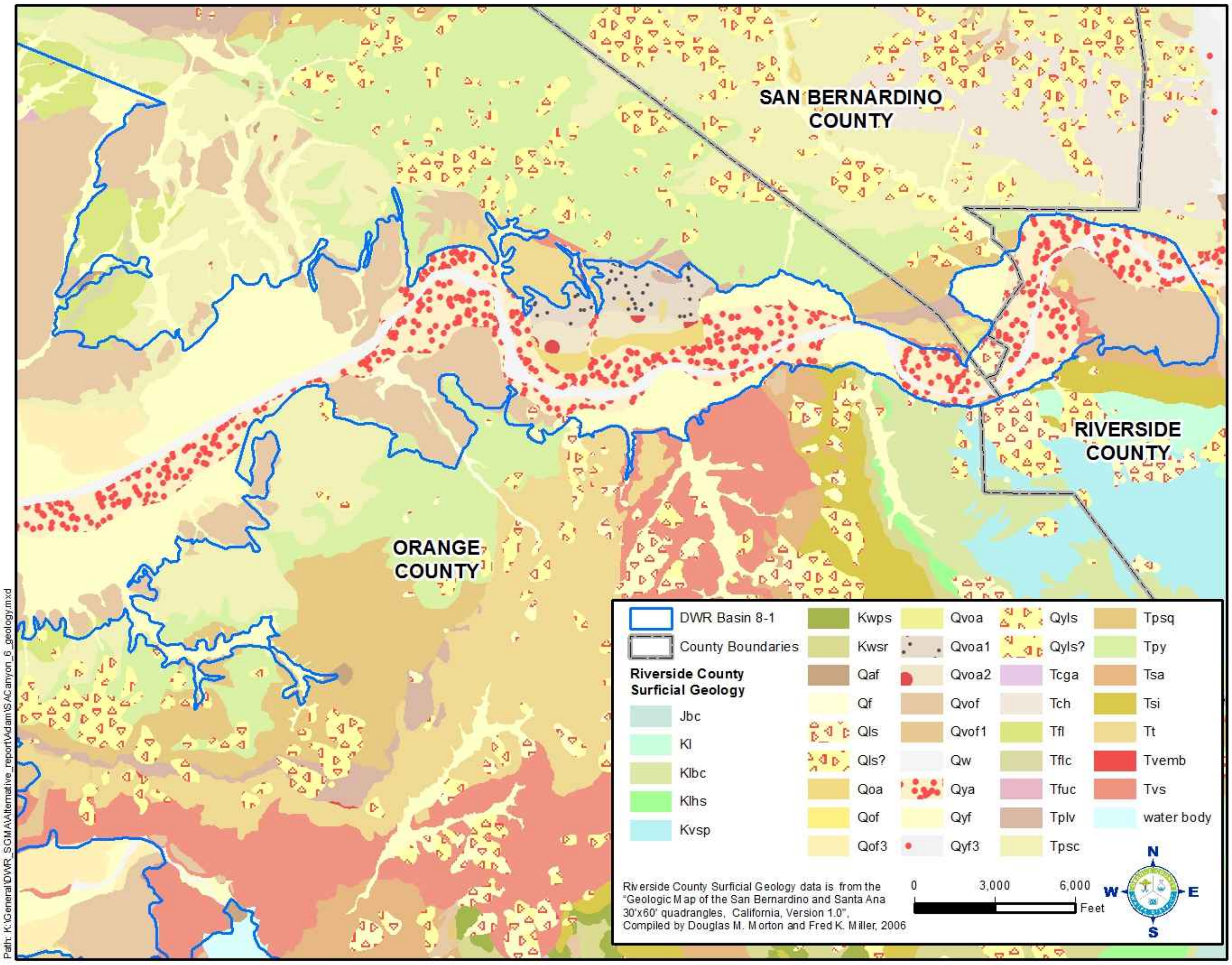


Figure 3-2: Geology

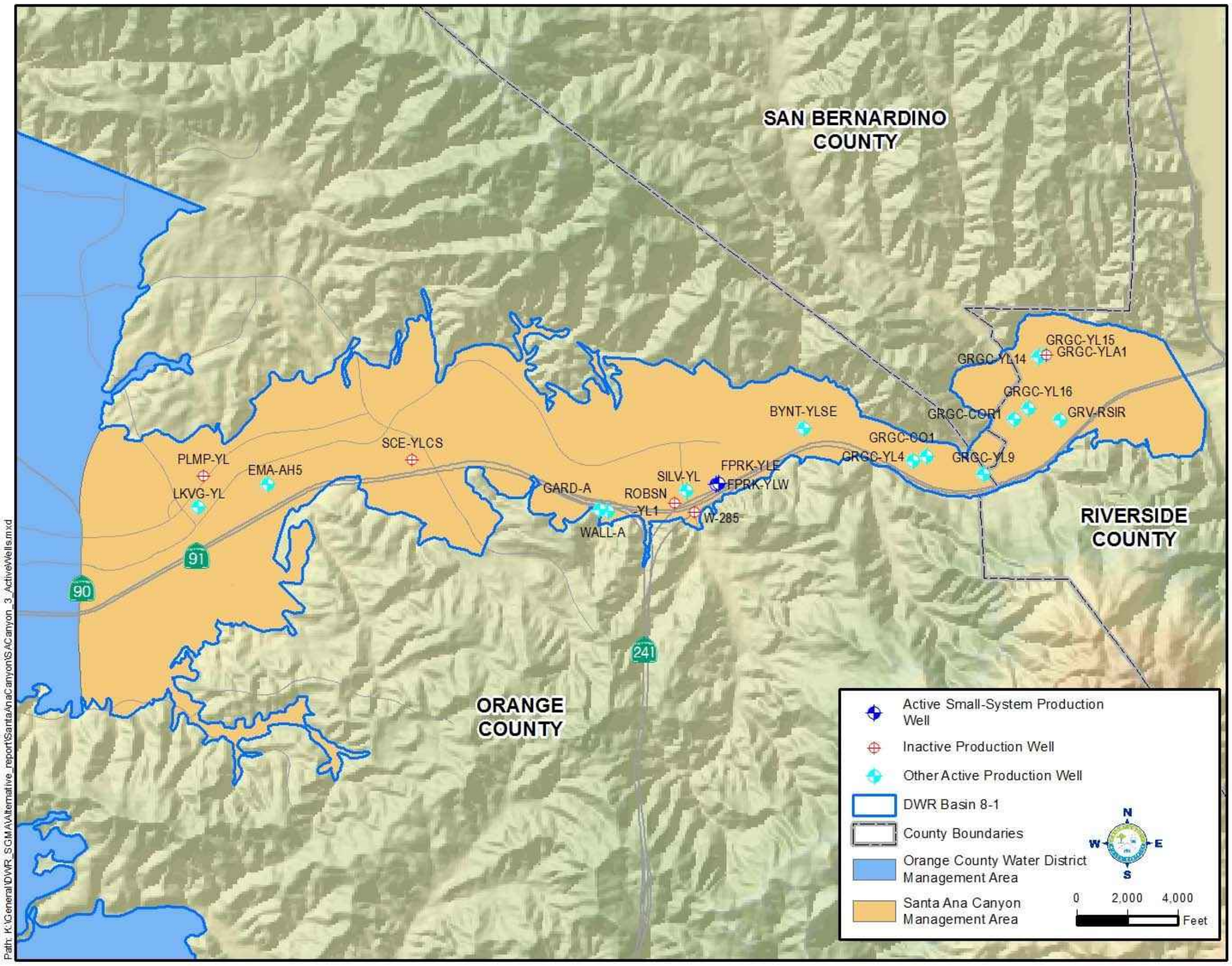


Figure 3-3: Groundwater Production Wells (Active and Inactive)

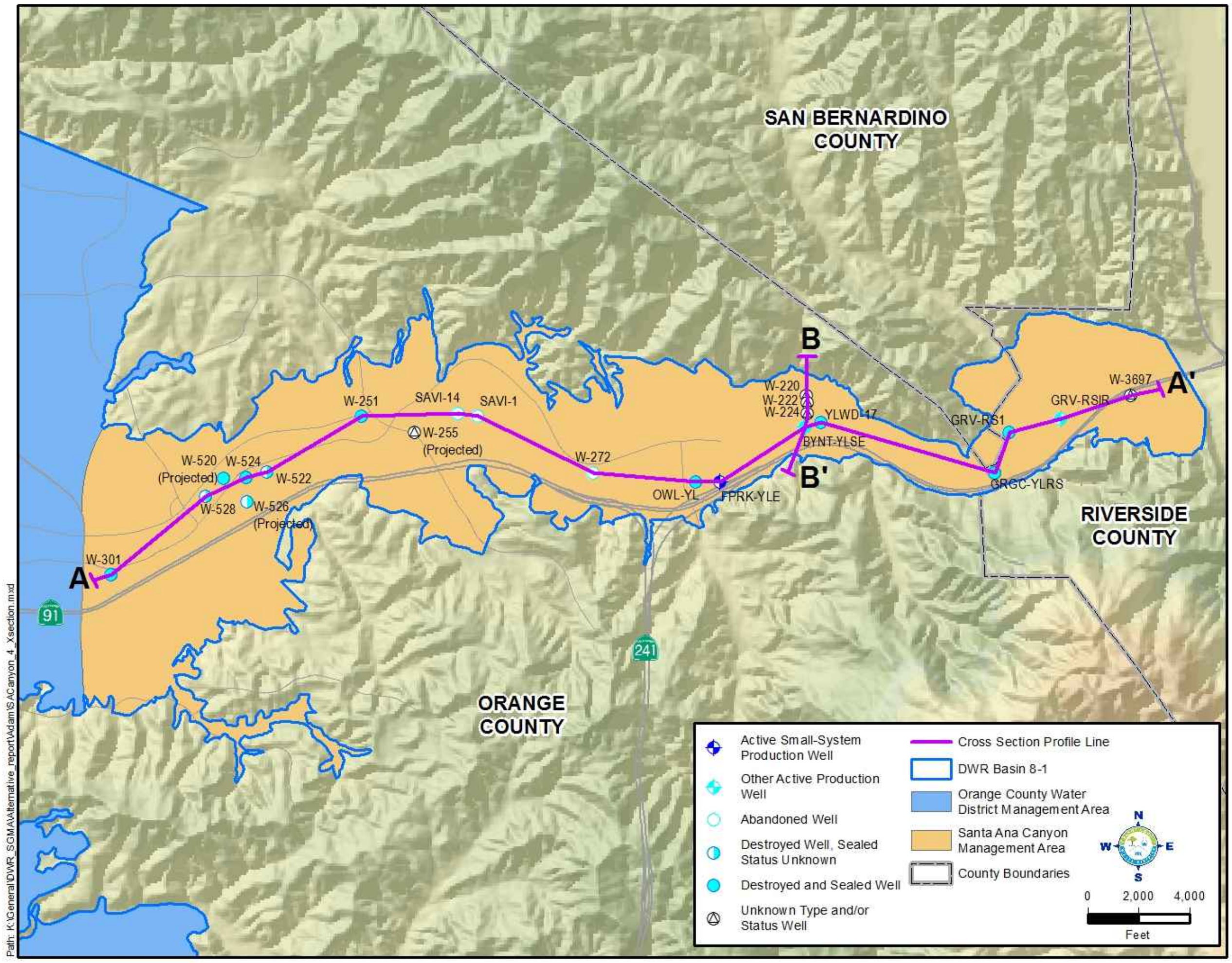


Figure 3-4:Cross-Section Locations

3.1.1 Jurisdictional Boundaries

As described in Section 2, there are eight agencies with jurisdiction in the Santa Ana Canyon Management Area as shown on Figure 2-1. The western boundary of the Santa Ana Canyon Management Area is parallel to Imperial Highway and is within OCWD's jurisdiction.

3.1.2 Existing Land Use Designations

As described in the OCWD Management Area part of this report, much of the land use in Orange County is urban. The Santa Ana Canyon Management Area has some dedicated open-space due to the presence of the Santa Ana River and adjacent floodplain and the Chino Hills State Park, located in the far northeastern portion of the Santa Ana Canyon Management Area. The Green River Golf Club owned by the County of Orange covers approximately 220 acres along the river near the intersections of Orange, Riverside, and San Bernardino counties.

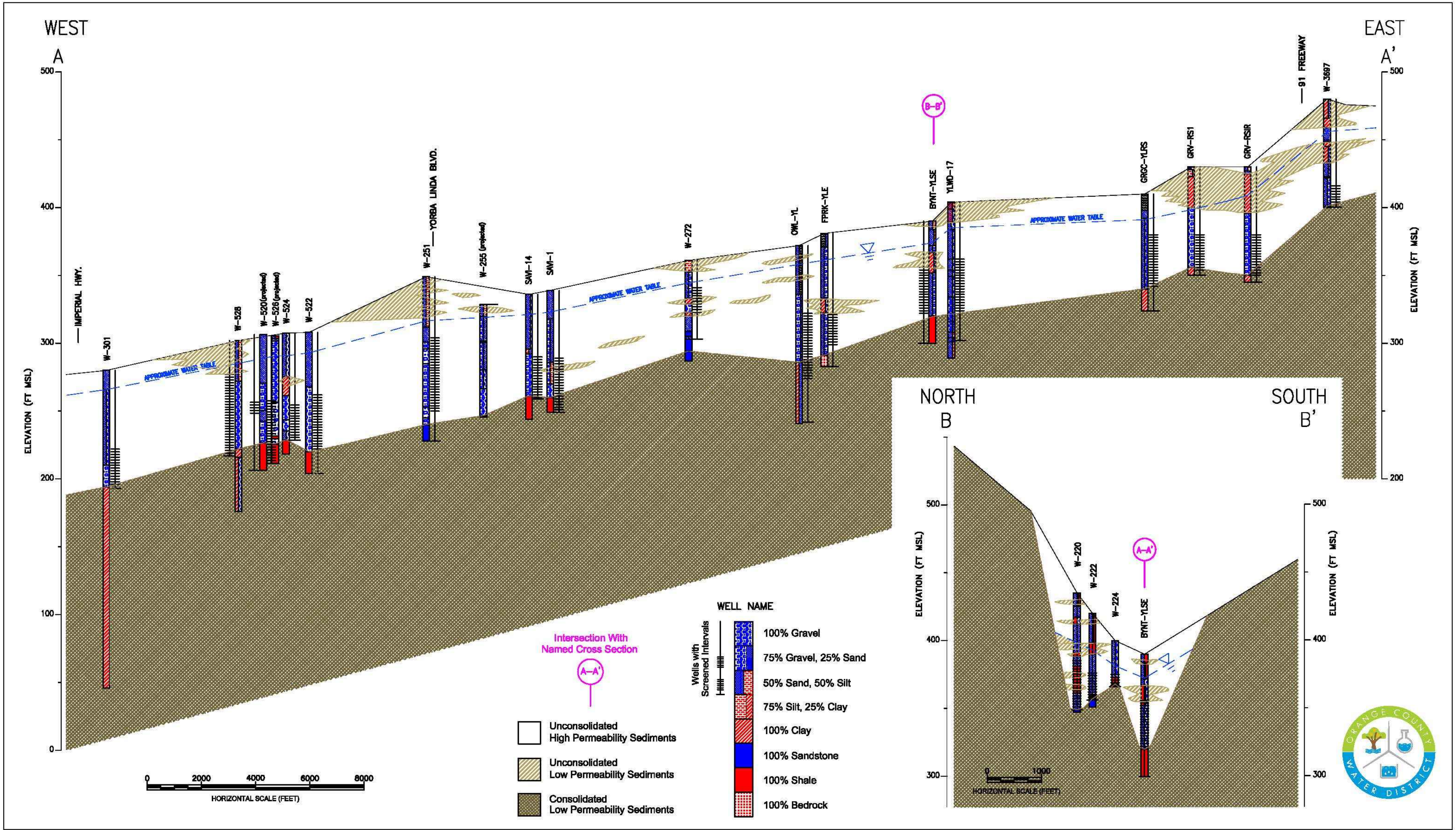
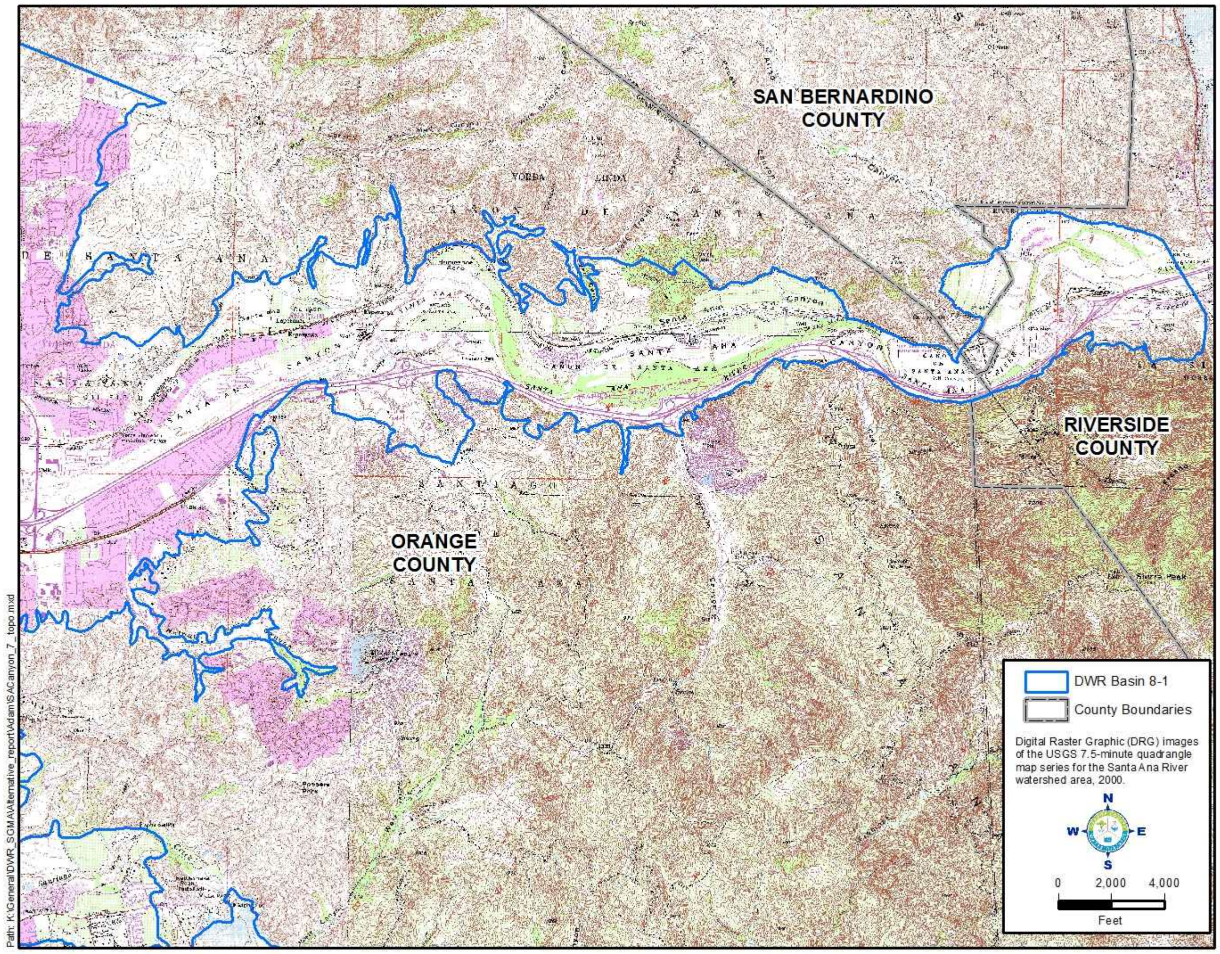


FIGURE 3-5: HYDROGEOLOGIC CROSS SECTION ALONG THE SANTA ANA RIVER BELOW PRADO DAM

Figure 3-6 shows the land uses in the Santa Ana Canyon Management Area as shown by the USGS topographic map of the area. Note that the areas shaded in purple are urbanized areas. There has been additional development in the area since the map was prepared in 2000; however, much of it is outside of the Santa Ana Canyon Management Area in the surrounding foothills.



Digital Raster Graphic (DRG) images of the USGS 7.5-minute quadrangle map series for the Santa Ana River watershed area, 2000.

Path: K:\General\DWR_SGMA\Alternative_report\Adam\SACanyon_7_topo.mxd

Figure 3-6: Land Uses

3.2 GROUNDWATER CONDITIONS

Groundwater within the Santa Ana Canyon Management Area occurs in a narrow canyon within a relatively thin alluvial aquifer that is less than 100 feet thick in most places (see Figure 3-5).

3.2.1 Groundwater Elevation

Groundwater elevations in the Santa Ana Canyon Management Area tend to be stable. Hydrographs from four wells show that water levels vary over a narrow range as shown on Figure 3-7. Well locations are shown on Figure 3-3 and cover the eastern (GRV-RSIR), south-central (FPRK-YLE/SILV-YL, and western (SCE-YLCS) areas of the Santa Ana Canyon Management Area. Maximum high water levels in many wells were recorded in 2004, which was a record-breaking wet year with very high sustained flows in the Santa Ana River. Low water levels appear to be primarily related to short term local pumping. For all four wells, groundwater is approximately 20 to 30 feet below ground surface in the vicinity of the wells. Since the Santa Ana River channel is incised in some areas by 10 to 15 feet below the surrounding area, the depth to groundwater is even lower directly beneath the river channel.

The consistent, stable nature of groundwater elevations in the Santa Ana Canyon Management Area shows that aquifer is generally full, which is consistent with the finding that here are no measurable losses of flows between upstream Prado Dam and OCWD's diversion to its recharge system just below Imperial Highway.

OCWD, in cooperation with the County of Orange, will begin collecting groundwater elevation data in 2017 at selected wells at the Green River Golf Course to complement existing groundwater elevation monitoring data. Note that wells SILV-YL and SCE-YLCS are monitored for the CASGEM program.

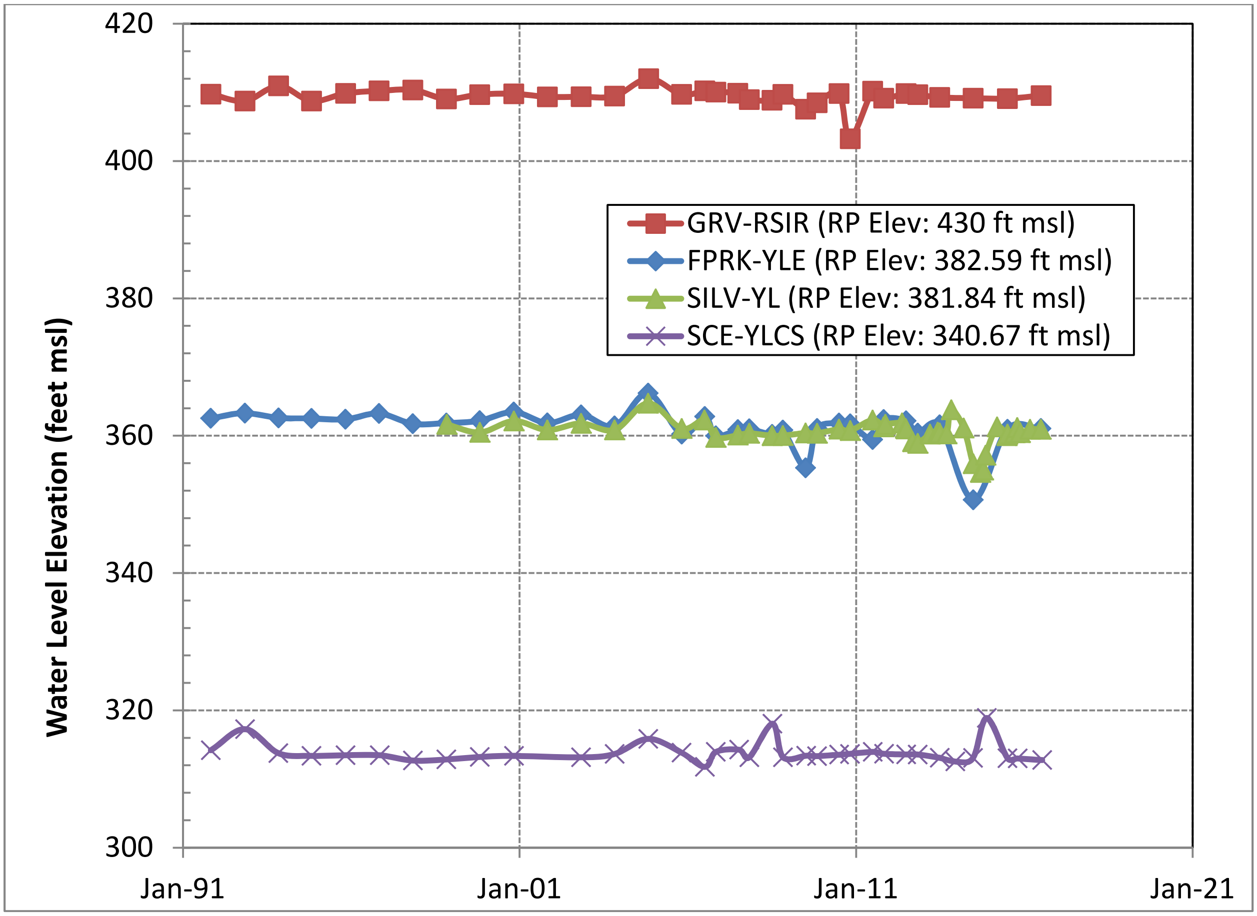


Figure 3-7: Water Level Hydrographs of Selected Wells

3.2.2 Groundwater Beneficial Uses and Regional Pumping Patterns

The Santa Ana Canyon Management Area is within the Santa Ana Region of the California Water Boards and is subject to the Santa Ana Region Basin Plan (January 24, 2014; updated July, 2014). The Basin Plan designates zones related to groundwater management. The Santa Ana Canyon Management Area is included in the Orange County Management Zone. Within this Zone, groundwater has been designated for municipal, agricultural, and industrial (service supply and process) beneficial uses. Currently, local groundwater provides primarily irrigation supply with some residential drinking water (RV Park) and domestic uses.

There are 18 wells that can withdraw groundwater within the Santa Ana Canyon Management Area as shown on Figure 3-2; however, some of the wells shown are not currently being used. Groundwater production at many of the wells is metered and reported to OCWD by the well owners. Eight of the wells are owned by the County of Orange to supply irrigation water to the Green River Golf Course. Even though some of these wells are metered, individual meter readings have not historically been collected by County staff. It is estimated that total production to supply the golf course is approximately 1,000 acre-feet per year (Personal Communication, Merrie Weinstock, County of Orange). The County of Orange will be installing flow meters on wells that are not currently metered and will begin obtaining monthly measurements of production from each well in the near future.

An irrigation well owned by Neff Ranch (BYNT-YLSE) was recently annexed into OCWD’s service area. A request has been sent to the owner to register this well and begin to report production as required by the OCWD Act. An estimate of current production is based on the irrigation of 21 acres of mature orange groves.

As shown on Table 3-1, total groundwater production within the Santa Ana Canyon Management Area over the last 10 years is estimated to range from 1,475 to 2,234 acre-feet per year and averaging 1,839 acre-feet per year. Table 3-1 lists the production wells, meter status, and 10-year average production for wells located within the Santa Ana Canyon Management Area.

Prior to 2012, the City of Corona also owned and operated a local production well in the Santa Ana Canyon Management Area. The well, referred to as Well 18, was located in a field northwest of the 91 Freeway and Prado Road and was reportedly drilled in 1984 to an approximate total depth of 86 feet. Although historical production records are incomplete, Well 18 was apparently pumped over several years for supplemental local water supply prior to being officially destroyed in 2012.

Table 3-1: Production Wells, Flow-Meter Status, and 10-Year Average Production

Well Name	**Well Use**	**Owner**	**Metered**	**10-Yr Avg 2006-15 (afy)**	**Max (af)**	**Min (af)**	**Notes**
BYNT-YLSE	IR	Neff Ranch, Ltd	No	53	53	53	Estimated use, 21 acres of orange groves, meter install requested
EMA-AH5	IR	County Of Orange	Yes	76	98	52	
FPRK-YLE	DW/IR	Canyon RV Park	Yes	59	67	41	
FPRK-YLW	DW/IR	Canyon RV Park	Yes	55	67	33	
GARD-A	IR	Kindred Outreach Ministries	No	1	1	1	Minimum reportable volume
GRGC-CO1	IR	OCFCD	Yes	See estimate for Green River Golf Course			Flow meter not in ideal location
GRGC-COR1	IR	OCFCD	Yes				Flow meter not in ideal location
GRGC-YL14	IR	OCFCD	Yes				Inactive
GRGC-YL15	IR	OCFCD	No				Flow meter to be installed
GRGC-YL16	IR	OCFCD	No				Flow meter to be installed
GRGC-YL4	IR	OCFCD	Yes				Inactive
GRGC-YL9	IR	OCFCD	Yes				Inactive
GRGC-YLA1	IR	OCFCD	Yes				
GRV-RSIR	IR	Green River Village	Yes	11	25	5	
LKVG-YL	IR	Eastlake Village HOA	Yes	79	89	60	
ROBSN-YL1	IR	Robertson Ready Mix	Yes	1	6	0	Inactive for 5 yrs, No data for 2006-7.
SILV-YL	IR	County Of Orange	Yes	503	827	229	No data for 2006, CASGEM well
WALL-A	DOM	Wallace, Dick	No	1	1	1	Minimum reportable volume
Total Estimated Green River Golf Course Usage				1,000	1,000	1,000	8 OCFCD wells
Totals				**1,839**	**2,234**	**1,475**	

IR= Irrigation; DW=Drinking Water; DOM=Domestic
OCFCD = Orange County Flood Control District

3.2.3 Groundwater Storage Data

Groundwater storage in Basin 8-1 is estimated at 66 million acre-feet (OCWD, 2007), which does not include the Santa Ana Canyon Management Area. To estimate the amount of storage in the alluvial aquifer within Santa Ana Canyon Management Area, all well data were used and depths to bedrock estimated. The thickness of the alluvial deposits is assumed to be zero at the basin margin. Using a Topo to Raster Interpolation function in ArcGIS, the total volume of alluvial deposits was estimated at 174,000 acre-feet. Assuming a porosity of 25 percent gives a total potential groundwater storage volume of 43,500 acre-feet. The actual volume of groundwater in storage is smaller given that this estimate does not take into account that the depth to groundwater is typically 20 to 30 feet below ground surface.

3.2.4 Groundwater Quality Conditions

Groundwater quality in the Santa Ana Canyon Management Area is generally good and suitable to meet beneficial uses. Groundwater in the Santa Ana Canyon Management Area is a mixture of infiltrated Santa Ana River water and subsurface inflow. As shown on Figure 3-8, total dissolved solids (TDS) concentrations in groundwater range from just under 600 to 2,180 mg/L. Santa Ana River water at Prado Dam is characterized by lower TDS concentrations. Since 1972, the flow-weighted average TDS of Santa Ana River water has ranged from a low of 348 mg/L in 2005 to a high of 728 mg/L in 1981 (Santa Ana River Watermaster Reports). Based on TDS concentrations, some wells appear to primarily produce local groundwater sourced from subsurface inflow along the boundaries of the Santa Ana Canyon Management area, while others, such as FPRK-YLE, FPRK-YLW and SILV-YL, appear to produce a blend of local groundwater and infiltrated Santa Ana River water.

Except for a few detections of arsenic and nitrate, groundwater meets primary drinking water standards; however, all wells produce groundwater that exceeds secondary standards for TDS and manganese. No volatile organic compounds (VOCs), semi-volatile organics, or other contaminants have been detected. Table 3-2 summarizes the available water quality data for TDS and Nitrate (NO_3 as N). Table 3-3 summarizes the available water quality data for arsenic (As) and manganese (Mn). Table 5-1 summarizes the water quality analyses and frequency of testing conducted at wells in the Santa Ana Canyon Management Area.

Table 3-2: TDS and Nitrate (as N) in Selected Wells

Well Name	**Well Use**	**Date Range**	**Avg. TDS**		**Avg. NO3 as N**		**Notes**
			mg/L	# of samples	µg/L	# of samples	
BYNT-YLSE	IR	1969-2016	1,132	6	2.2	7	Exceeded NO3 MCL 1 time in 1969
FPRK-YLE	DW/IR	1988-2016	726	17	2.3	105	
FPRK-YLW	DW/IR	1969-2016	774	25	2.4	74	
GRGC-COR1	IR	2013-2016	1,910	4	0.4	4	
GRV-RSIR	IR	1970-2013	1,487	12	0.13	14	Original well: GRV-RS1(1972-84)
ROBSN-YL1	IR	2001-2004	666	2	1.9	2	
SILV-YL	IR	1995-2007	597	5	1.4	5	
WALL-A	DOM	1968-2014	1,399	4	3.6	3.6	

IR = Irrigation; DW=Drinking Water; DOM=Domestic
TDS Secondary MCL: 500 mg/L

Table 3-3: Arsenic and Manganese in Selected Wells

Well Name	**Well Use**	**Date Range**	**Avg. As**		**Avg. Mn**		**Notes**
			ug/L	# of samples	ug/L	# of samples	
BYNT-YLSE	IR	1969-2016	ND	ND	150	2	
FPRK-YLE	DW/IR	1988-2016	8.3	22	756	45	Exceeded As MCL in 3 samples, Jan-March 2003
FPRK-YLW	DW/IR	1969-2016	4	20	900	45	
GRGC-COR1	IR	2013-2016	NS	NS		NS	
GRV-RSIR	IR	1970-2013	8.2	1	578	6	Original well: GRV-RS1 (1972-84)
ROBSN-YL1	IR	2001-2004	NS			NS	
SILV-YL	IR	1995-2007	NS		350	1	
WALL-A	DOM	1968-2014	NS		200	1	

IR= Irrigation; DW=Drinking Water; DOM=Domestic
ND = Not detected
NS = Not sampled
* Mn Secondary MCL: 50 ug/L.

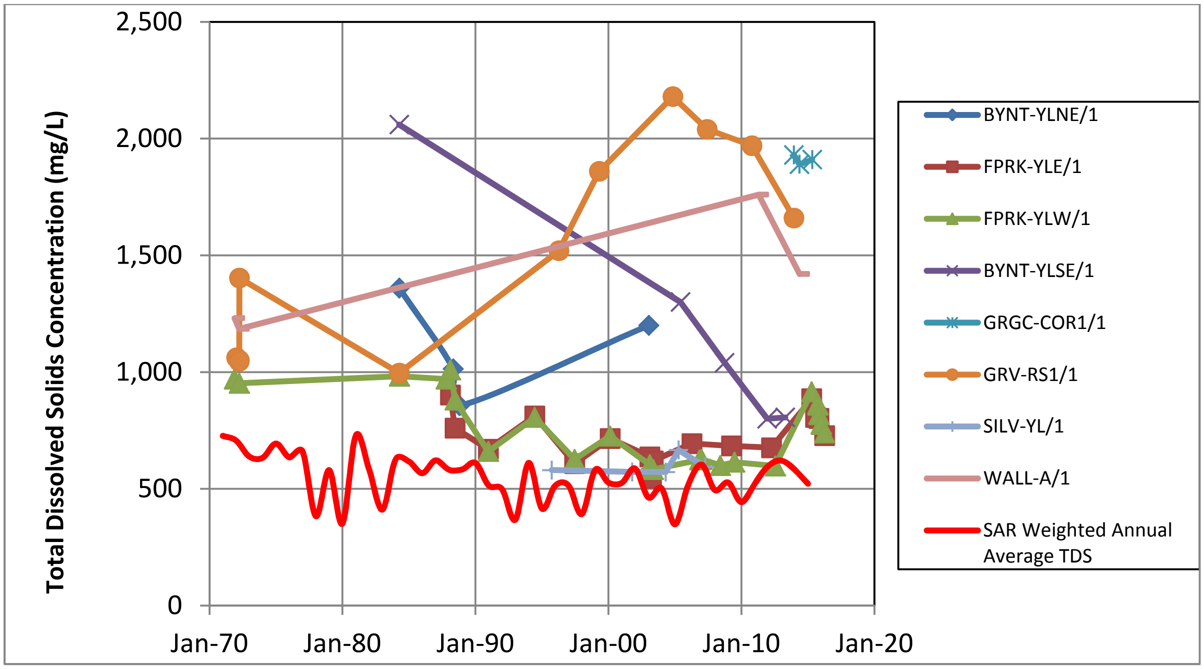


Figure 3-8: TDS Concentrations

3.2.5 Land Subsidence

Land subsidence is monitored within the OCWD Management Area but not within the Santa Ana Canyon Management Area. Subsidence is not an issue for the Santa Ana Canyon Management Area given the following:

1. The presence of shale and sandstone bedrock underlying the alluvial aquifer is not thought to be compressible or subject to inelastic subsidence.
2. The alluvial aquifer is thin, generally less than 100 feet, and comprised mainly of sand and gravel with only minor amounts of clay.
3. Groundwater levels and storage are relatively stable over time.
4. Substantial groundwater level declines are unlikely due to the de minimis amount of groundwater production relative to the overall inflow of water to the Santa Ana Canyon Management Area.

3.2.6 Groundwater and Surface Water Interactions and Groundwater Dependent Ecosystems

Groundwater within the Santa Ana Canyon alluvial aquifer is consistently 20 to 30 feet below ground surface and even less in the incised portions of the Santa Ana River channel. As described in Section 4, Water Budget, the flow of surface water through the canyon dwarfs the documented groundwater production. As a result, groundwater production has a de minimis impact on groundwater conditions and flows of surface water through the canyon. This in turn demonstrates that groundwater production in the Santa Ana Canyon has little to no impact on local groundwater dependent ecosystems in the Santa Ana Canyon Management Area, if any.

SECTION 4. WATER BUDGET

The water budget of the Santa Ana Canyon Management Area is dominated by surface flows of the Santa Ana River with a minor contribution of subsurface inflow, return flows from irrigation, and a small amount of groundwater production. Table 4-1 presents the overall water budget for the Santa Ana Canyon Management Area. This water budget contains both surface water and groundwater components and is not used to analyze change in groundwater storage. The purpose of presenting this water budget is to show the dominance of Santa Ana River flows in the Santa Ana Canyon Management Area.

Table 4-1: Water Budget, 10-Year Average (2006-15)

Flow Component	10-Yr Avg: 2006-15 (afy)	Max (1) (af)	Min (1) (af)
Santa Ana River Base Flow (2)	100,400	147,700	63,500
Santa Ana River Storm Flow (2)	72,300	211,000	18,300
Subsurface Inflow (3)	5,000	5,000	5,000
TOTAL INFLOW	**177,700**	**363,700**	**86,800**
Santa Ana River Base Flow (2)	98,820	145,730	62,280
Santa Ana River Storm Flow (2)	72,300	211,000	18,300
Evapotranspiration (4)	740	740	740
Groundwater Production	1,840	2,230	1,480
Subsurface Outflow (5)	4,000	4,000	4,000
TOTAL OUTFLOW	**177,700**	**363,700**	**86,800**

(1) Note that for Santa Ana River flows, the maximum and minimum base and storm flow years may not occur in the same year. These numbers are for illustrative purposes only.
(2) From Santa Ana River Watermaster Reports (Oct-Sept. Water Year).
(3) Subsurface inflow is estimated and includes irrigation return flow and areal recharge from precipitation.
(4) Evapotranspiration is based on 370 acres of riparian habitat and a usage rate of 2 afy/acre of habitat per Santa Ana River Watermaster Reports.
(5) Subsurface outflow is based on OCWD's calibrated groundwater flow model.

Groundwater level data suggest that groundwater conditions in the Santa Ana Canyon Management Area are essentially at steady state conditions with inflow equaling outflow and no change in groundwater storage. Inflow to the groundwater aquifer includes subsurface inflow and an unquantified amount of infiltrated Santa Ana River water. Outflow includes evapotranspiration, groundwater production and subsurface outflow. Table 4-2 presents the groundwater budget for the Santa Ana Canyon Management Area.

Table 4-2: Groundwater Budget, 10-Year Average (2006-15)

Flow Component	10-Yr Avg: 2006-15 (afy)
Subsurface Inflow (1)	5,000
Infiltrated Santa Ana River Base Flow (2)	1,580
TOTAL INFLOW	**6,580**
Evapotranspiration (3)	740
Groundwater Production	1,840
Subsurface Outflow to OCWD Management Area (4)	4,000
TOTAL OUTFLOW	**6,580**
NET CHANGE	0

(1) Subsurface inflow is estimated and includes irrigation return flow and areal recharge from precipitation.
(2) Estimated infiltration of Santa Ana River base flow to balance outflow.
(3) Evapotranspiration is based on 370 acres of riparian habitat and a usage rate of 2 afy/acre of habitat per Santa Ana River Watermaster Reports.
(4) Subsurface outflow is based on OCWD's calibrated groundwater flow model.

4.1 BUDGET COMPONENTS

The components of the groundwater budget are described below.

4.1.1 Subsurface Inflow/Outflow

During development of OCWD's groundwater flow model, an estimate was made of the inflow to the Santa Ana Canyon Management Area that eventually flowed into the main groundwater basin. The easternmost extent of the groundwater model is at Imperial Highway (SR90), which is also the boundary of the Santa Ana Canyon Management Area with the OCWD Management Area. The outflow estimate is based on the cross-sectional area of the Santa Ana Canyon at Imperial Highway and the average groundwater gradient. This approach yielded an estimated outflow of 4,000 acre-feet per year. During the calibration process it was not necessary to change this estimate and therefore it is assumed to be a reasonable estimate of groundwater outflow from the Santa Ana Canyon Management Area to the main groundwater basin.

Subsurface inflow is a combination of subsurface mountain front recharge, areal recharge from precipitation, and irrigation return flow. It is estimated to be approximately 5,000 afy.

4.1.2 Infiltrated Santa Ana River Base Flow

Water quality data suggests that some of the groundwater produced from wells in the Santa Ana Canyon Management Area is a blend of subsurface inflow and infiltrated Santa Ana River water; however, there is not enough data to determine the relative contribution of each source. For purposes of the groundwater budget, the amount of infiltrated Santa Ana River base flow is the amount necessary to balance the water budget assuming subsurface inflow is 5,000 afy. If the assumed amount of subsurface inflow were to change, the amount of infiltrated Santa Ana River water needed to balance the water budget would change accordingly. Base flow is assumed to be the primary source of supply due to the infrequent nature of storm flows and that groundwater pumping tends to be reduced during the winter months.

4.1.3 Evapotranspiration

Evapotranspiration is assumed to be due to riparian vegetation adjacent to the Santa Ana River. The County of Orange, as part of developing a Habitat Management Plan (HMP), established a baseline of 370 acres of riparian vegetation within the Santa Ana Canyon Management Area (County of Orange, 2016).

The Santa Ana River Watermaster calculates that riparian vegetation consumes approximately 2 afy per acre of vegetated area. Using this approach, the estimated evapotranspiration within the Santa Ana Canyon Management area is estimated to be 740 afy.

4.1.4 Groundwater Production

As described in Section 3.2.2, there are 18 wells that can withdraw groundwater within the Santa Ana Canyon Management Area as shown on Figure 3-3; however, some of the wells shown are not currently being used. Groundwater production from these wells is summarized in Tables 3-1 and 4-1.

4.2 CHANGES IN GROUNDWATER STORAGE

As shown in Figure 3-7, groundwater levels in the Santa Ana Canyon Management Area are stable, indicating that the thin, alluvial aquifer is generally always in a full condition. Therefore, any changes in groundwater storage are small and insignificant.

4.3 WATER YEAR TYPE

The water year type has little impact on the water budget in the Santa Ana Canyon Management Area given the minimal changes in groundwater level observed through time due to the ever present Santa Ana River base flow and subsurface inflow.

4.4 ESTIMATE OF SUSTAINABLE YIELD

As described in Table 4-1, average groundwater production over the last 10 years equates to one percent of the total inflow to the Santa Ana Canyon Management Area. It is clear that the sustainable yield of the Santa Ana Canyon Management Area is much greater than current production levels. Nevertheless, there are no plans for additional wells or groundwater production in the Santa Ana Canyon Management Area and is highly unlikely that groundwater demands would ever rise to the level of changing the water budget of this area significantly. In terms of sustainable yield, it is more appropriate to look at Basin 8-1 as a whole.

4.5 CURRENT, HISTORICAL, AND PROJECTED WATER BUDGET

The current and historical water budget (average over 10 years) is presented in Tables 4-1 and 4-2. A worst-case dry-year water budget is presented in Table 4-3 and is based on the following assumptions:

1. Santa Ana River base flow declines to 44,000 af.
2. Santa Ana River storm flow of only 11,300 af, which equates to the lowest on record (1972) since the Santa Ana River Watermaster started keeping records in 1970.
3. Groundwater production is assumed to be equivalent to the maximum recorded in the period 2006-15, which is 2,230 af.

As shown on Table 4-3, even under dry-year conditions, groundwater production is less than 4 percent of the total water available in the Santa Ana Canyon Management Area. Increases in future production are not likely to be significant given the lack of demands in the area, low well production capacity, availability of imported water sources (such as used in the Corona service area) and relatively poor water quality compared to groundwater in the main OCWD basin.

Table 4-3: Dry-Year Water Budget

Flow Component	Dry-Year Flows (afy)
Santa Ana River Base Flow	44,000
Santa Ana River Storm Flow	11,300
Subsurface Inflow	5,000
TOTAL INFLOW	**60,300**
Santa Ana River Base Flow	42,030
Santa Ana River Storm Flow	11,300
Evapotranspiration	740
Groundwater Production	2,230
Subsurface Outflow	4,000
TOTAL OUTFLOW	**60,300**

SECTION 5. WATER RESOURCE MONITORING PROGRAMS

5.1 OVERVIEW

This section describes OCWD’s surface and groundwater monitoring programs in the Santa Ana Canyon Management Area.

5.2 GROUNDWATER MONITORING PROGRAMS

OCWD monitors groundwater levels, quality and production in the Santa Ana Canyon Management Area. As shown on Figure 5-1, groundwater levels are monitored at six wells, two of which are part of the CASGEM program (SCE-YLCS, and SILV-YL).

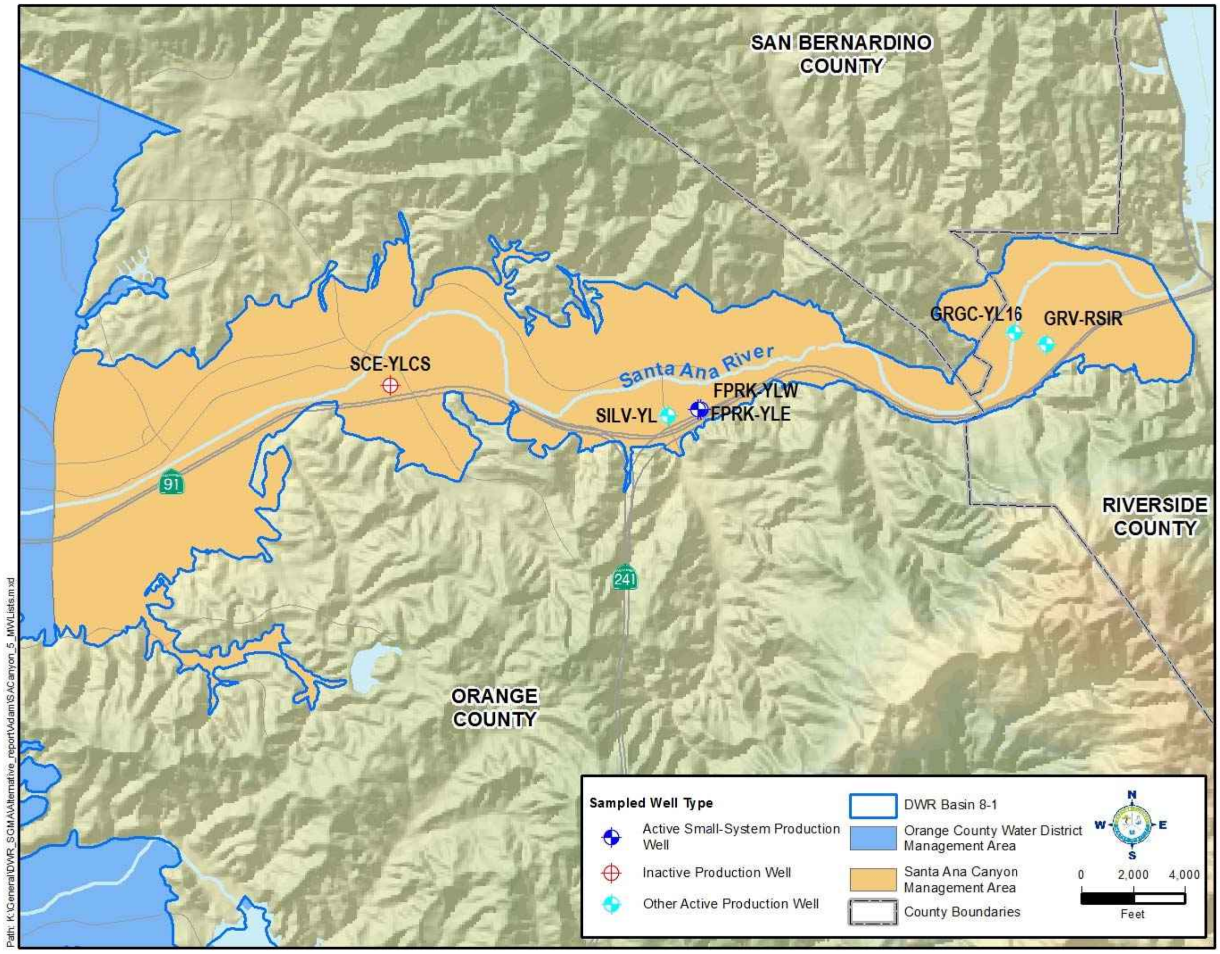


Figure 5-1: Wells Used to Monitor Groundwater Levels

OCWD is collaborating with the County of Orange to collect water levels at selected wells that serve the Green River Golf Course. Data from these wells will be presented in future reports.

For wells within OCWD's boundaries, groundwater production must be reported at a minimum frequency of every 6 months. Groundwater production from the County of Orange's wells that supply the Green River Golf Course will be documented in future reports after meters are installed on all wells and monthly production recorded. It is anticipated that production from all of the wells shown on Table 3-1 will be measured and reported to DWR in future reports.

OCWD also monitors groundwater quality in selected wells in the Santa Ana Canyon Management Area. Table 5-1 lists the wells monitored and the groundwater quality monitoring program each well is part of, which is based on its final use (e.g., irrigation, potable). Wells used for irrigation are sampled every year for volatile organic compounds (VOCs) and every three years for general minerals (major cations and anions), 1,4-dioxane, and perchlorate (ClO_4). The two wells in Featherly Park used for potable supplies are monitored in accordance with drinking water regulations.

Table 5-1: Wells Monitored for Water Quality

Well Name	Water Quality Monitoring Program
BYNT-YLSE EMA-AH5 GARD-A GRGC-CO1 GRGC-COR1 GRGC-YL15 GRGC-YL16 GRGC-YL4 GRV-RSIR LKVG-YL	Annual: Volatile Organic Compounds (VOCs) Every 3 yrs: General Minerals, 1,4-Dioxane, and ClO_4
FPRK-YLE FPRK-YLW	Annual: NO_3, ClO_4, 1,4-Dioxane, Mn, TDS, EC Atrazine/Simazine: every 3 yrs Title 22 Inorganics: every 3 yrs CN: every 9 yrs CrIV: every 3 yrs Radioactivity: every 6 yrs (Gross Alpha, Uranium) Radioactivity: every 9 yrs (Radium 226 & Radium 228)

5.3 OTHER MONITORING PROGRAMS

OCWD monitors the quantity and quality of water in the Santa Ana River just below Prado Dam. The flow of the Santa Ana River below Prado Dam is measured by the USGS at station No. 11074000 (http://waterdata.usgs.gov/ca/nwis/dv/?site_no=11074000). In addition to flow, the USGS measures the electrical conductivity (EC) of the water as well as sampling the water two times per month for TDS. One use of these data is to calculate the flow-weighted average TDS of base and storm flow discharged from Prado Dam (see Figure 3-8). The flow and quality data are collected for the Santa Ana River Watermaster, which was formed to implement the

Stipulated Judgement in the case of Orange County Water District v. City of Chino, et al., Case No. 1172628-County of Orange, entered by the court on April 17, 1969. The most recent watermaster report can be found on OCWD's website at http://www.ocwd.com/media/4247/sar_watermaster_2014-15.pdf. In addition to OCWD, the Santa Ana River Watermaster is comprised of representatives from the Inland Empire Utilities Agency, San Bernardino Valley Municipal Water District, and Western Municipal Water District.

The significance of the 1969 Judgment is that it guarantees a minimum base flow at Prado Dam of 42,000 afy; however, per the terms of the Judgment, the upstream agencies have received (and will continue to receive) credits when base flows exceed of 42,000 af at Prado. With these credits, the required minimum base flow is 34,000 af. As a point of reference, the most recent year base flow in 2014-15 was 63,536 af.

OCWD also closely monitors the quality of water in the Santa Ana River before it is diverted into its recharge system below Imperial Highway. More information about this program can be found in Section 5 of the OCWD Management Area section of this report.

SECTION 6. WATER RESOURCE MANAGEMENT PROGRAMS

OCWD has a wide variety of water resource management programs that cover the main groundwater basin as well as the upper Santa Ana River watershed to address Santa Ana River flow and quality. These programs are important in protecting the quality of the Santa Ana River, which affects groundwater quality in the Santa Ana Canyon Management Area. These programs are described in detail in Section 6 of the OCWD Management Area part of this report. The programs that affect Santa Ana River water quality include:

Groundwater Desalters and the Inland Empire Brineline and Non-Reclaimable Waste Line

Several groundwater desalters have been constructed to reduce the amount of salt buildup in the watershed, which in turn reduces the salinity of the Santa Ana River. The Inland Empire Brine Line (IEBL), formerly called the Santa Ana Regional Interceptor (SARI), built by the Santa Ana Watershed Project Authority (SAWPA), has operated since 1975 to remove salt from the watershed by transporting industrial wastewater and brine produced by desalter operations directly to the Orange County Sanitation District (OCSD) for treatment.

Basin Monitoring Program Task Force

In 1995, a task force of more than 20 water and wastewater resource agencies and local governments, including OCWD, initiated a study to evaluate the impacts to groundwater quality of elevated levels of Total Inorganic Nitrogen (TIN) and TDS in the Santa Ana River watershed. This nearly 10-year effort involved collecting and analyzing data in 25 newly defined groundwater management zones in the watershed to recalculate nitrogen and TDS levels and to establish new water quality objectives. This effort not only protects groundwater quality in the Santa Ana River watershed, it also protects the quality of Santa Ana River water.

Salinity Management and Imported Water Recharge Workgroup

The Salinity Management and Imported Water Recharge Workgroup, in cooperation with the Regional Water Board, implements a cooperative agreement signed in 2008 by water agencies that use imported water for groundwater recharge. The objective of this effort was to evaluate and monitor the long-term impacts of recharging groundwater basins with imported water, which could ultimately impact the quality of Santa Ana River water.

Management of Nitrates

One of the District’s programs to reduce nitrate concentrations in Santa Ana River water is diverting Santa Ana River flows through OCWD’s extensive system of wetlands in the Prado Basin.

OCWD owns and operates the 465-acre constructed Prado Wetlands. The Prado Wetlands are designed to remove nitrogen and other pollutants from the Santa Ana River before the water is diverted from the river in Orange County into OCWD's surface water recharge system. During summer months the wetlands reduce nitrate concentrations (NO_3 as N) from nearly 10 mg/L to 1 to 2 mg/L.

SECTION 7. NOTICE AND COMMUNICATION

There are eight stakeholder agencies within the Santa Ana Canyon Management Area, including the following:

- City of Anaheim
- City of Chino Hills
- City of Yorba Linda
- City of Corona Water Service Area
- Orange County Water District
- County of Orange
- Riverside County
- Yorba Linda Water District

On May 4, 2016, OCWD sent a letter to each of the agencies listed above to let them know about the option to comply with SGMA via an Alternative. The only exception is the City of Yorba Linda, but contact with them was made through representatives from the Yorba Linda Water District.

Multiple meetings were held with agencies that wished to meet and discuss the Basin 8-1 Alternative. All of the agencies contacted have agreed to participate in the Basin 8-1 Alternative.

The agencies taking the lead to prepare sections of the Basin 8-1 Alternative are summarized in Table 7-1.

Table 7-1: Lead Agencies for Preparation of Basin 8-1 Alternative

Agency	Management Area
City of La Habra	La Habra/Brea
OCWD	OCWD
OCWD	Santa Ana Canyon
Irvine Ranch Water District	South East

OCWD presented a schedule to the agencies listed in Table 7-1 by email for development and completion of the Basin 8-1 Alternative. This schedule included taking the draft Basin 8-1 Alternative to OCWD's board and groundwater producers for comment as well as posting the draft Basin 8-1 Alternative on OCWD's website. It was left up to the individual agencies to assess whether or not it was necessary to present the Basin 8-1 Alternative to their governing body or to the public.

SECTION 8. SUSTAINABLE MANAGEMENT APPROACH

The approach to managing the Santa Ana Canyon Management Area is to continue to monitoring sustainable conditions and monitor to ensure that no significant and unreasonable results occur in the future.

SECTION 9. SUSTAINABLE MANAGEMENT RELATED TO GROUNDWATER LEVELS

9.1 HISTORY

As shown on Figure 3-7, groundwater levels in the Santa Ana Canyon Management Area have been steady over the last 25 years. Given the large amount of surface inflow to the Santa Ana Canyon Management Area relative to the amount of groundwater production, groundwater levels are expected to remain steady in the future.

9.2 MONITORING OF GROUNDWATER LEVELS

OCWD monitors groundwater levels at multiple wells in the Santa Ana Canyon Management Area and will continue to do so in the future. Additional wells at the Green River Golf Course will be monitored and reported in the future.

9.3 DEFINITION OF SIGNIFICANT AND UNREASONABLE LOWERING OF GROUNDWATER LEVELS

No long-term reduction in groundwater levels is foreseen in the Santa Ana Canyon Management Area; however, if that were to occur, a decline in groundwater levels could reach a significant and unreasonable level if one more of the following occurred as a result of reduced groundwater levels:

1. Significant and unreasonable loss of significant riparian habitat along the Santa Ana River.
2. Significant and unreasonable loss of well production capacity.
3. Degradation of water quality that significantly impacts the beneficial uses of groundwater.

9.4 DETERMINATION OF MINIMUM THRESHOLDS

It is not possible to determine a minimum threshold at this time since no undesirable effects due to water levels have occurred in the past and are not foreseen. Nevertheless, OCWD’s monitoring program continuously tracks water levels and groundwater quality in the Management Area. If water levels ever started to show a consistent long-term decline, OCWD’s monitoring program would be expanded to examine any potential impacts to riparian habitat, well yields, and groundwater quality. If impacts were observed, action would be taken and minimum thresholds would be evaluated and established as appropriate.

SECTION 10. SUSTAINABLE MANAGEMENT RELATED TO BASIN STORAGE

The total volume of groundwater storage in the OCWD Basin is estimated to be 66 million acre-feet (OCWD, 2007). The total potential storage volume in the Santa Ana Canyon Management Area is estimated to be 43,500 acre-feet (see Section 3.2.3).

10.1 DEFINITION OF SIGNIFICANT AND UNREASONABLE REDUCTION IN STORAGE

As with groundwater levels, no long-term reduction in groundwater storage is foreseen in the Santa Ana Canyon Management Area; however, if that were to occur, a decline in groundwater storage could reach a significant and unreasonable level if one more of the following occurred due to a reduction in storage:

1. Significant and unreasonable loss of riparian habitat along the Santa Ana River.
2. Significant and unreasonable loss of well production capacity.
3. Degradation of water quality that significantly impacts the beneficial uses of groundwater.

10.2 DETERMINATION OF MINIMUM THRESHOLDS

It is not possible to determine a minimum threshold at this time since no undesirable effects due to a change in groundwater storage levels has occurred in the past and are not foreseen in the future. Nevertheless, OCWD's monitoring program continuously tracks water levels, which is a proxy for groundwater storage, and groundwater quality in the Management Area. If water levels ever started to show a consistent long-term decline, OCWD's monitoring program would be expanded to examine any potential impacts to riparian habitat, well yields and groundwater quality. If impacts were observed, action would be taken and minimum thresholds would be evaluated and established as appropriate.

SECTION 11. SUSTAINABLE MANAGEMENT RELATED TO BASIN WATER QUALITY

Groundwater quality in the Santa Ana Canyon Management Area is affected by the quality of Santa Ana River water and subsurface inflow from the surrounding foothills. As mentioned in Section 6, Water Resource Programs, OCWD is involved in multiple programs to protect and improve the quality of water in the Santa Ana River. Groundwater from subsurface inflow contains naturally elevated concentrations of TDS and manganese.

OCWD has an extensive groundwater monitoring program in the Santa Ana Canyon Management Area as described in Section 5, Water Resource Monitoring Programs.

11.1 DEFINITION OF SIGNIFICANT AND UNREASONABLE DEGRADATION OF WATER QUALITY

There are three elements that must be considered when evaluating the impact of groundwater quality degradation.

The first element is considering the causal nexus between groundwater management activities and groundwater quality. For example, if subsurface inflow from the surrounding foothills increases during a wet period, TDS and manganese levels could increase; however, this increase is not caused by groundwater management activities, but by natural causes. The same applies to the quality of Santa Ana River water. Although OCWD is involved in many programs to protect and improve the quality of Santa Ana River water, there could be changes in water quality that are outside of the control of Santa Ana Canyon Management Area stakeholders.

The second element is the beneficial uses of the groundwater and water quality regulations, such as Maximum Contaminant Levels (MCLs) and other potable water quality requirements.

The third element that must be considered is the volume of groundwater impacted by groundwater quality degradation. If small volumes are negatively affected that do not materially affect the use of the aquifer for its existing beneficial uses, then this would not represent a significant and unreasonable degradation of water quality. However, if the impacted volume grows, then it could reach a level that it becomes significant and unreasonable.

When considering all three elements, “significant and unreasonable degradation of water quality” is defined as degradation of groundwater quality in the Santa Ana Canyon Management Area that is attributable to groundwater production or recharge practices and to the extent that a significant volume of groundwater becomes unusable for its designated beneficial uses.

11.2 DETERMINATION OF MINIMUM THRESHOLDS

The minimum thresholds for groundwater quality are exceedances of Maximum Contaminant Levels (MCLs) or other applicable regulatory limits that are directly attributable to groundwater production and recharge practices in the Santa Ana Canyon Management Area that prevents the use of groundwater for its designated beneficial uses.

SECTION 12. SUSTAINABLE MANAGEMENT RELATED TO SEAWATER INTRUSION

The Santa Ana Canyon Management Area is located far from the ocean and thus there is no reason to consider the potential impact of seawater intrusion in this management area.

SECTION 13. SUSTAINABLE MANAGEMENT RELATED TO LAND SUBSIDENCE

Land subsidence is monitored within the OCWD Management Area but not within the Santa Ana Canyon Management Area. Subsidence is not an issue for the Santa Ana Canyon Management Area given the following:

1. The presence of shale and sandstone bedrock underlying the alluvial aquifer is not thought to be sufficiently compressible to cause inelastic subsidence.
2. The alluvial aquifer is thin, generally less than 100 feet, and composed mainly of sand and gravel with only minor amounts of clay.
3. Groundwater levels and storage volumes are stable.
4. Substantial groundwater level declines are highly unlikely due to the de minimis amount of groundwater production relative to the overall inflow of water to the Santa Ana Canyon Management Area.

SECTION 14. MANAGING GROUNDWATER DEPLETIONS IMPACTING SURFACE WATER

The primary surface water feature in the Santa Ana Canyon Management Area is the Santa Ana River. In the Santa Ana Canyon Management Area, the Santa Ana River is a soft-bottomed channel that supports riparian habitat (Figure 14-1). Riparian habitat is dependent on river water released through Prado Dam, which is predominantly treated wastewater discharged in the upper watershed when storm flow is not present.

Groundwater within the Santa Ana Canyon alluvial aquifer is consistently 20 to 30 feet below ground surface and even shallower in the incised portions of the Santa Ana River channel. As described in Section 4, Water Budget, the flow of surface water through the canyon is two orders of magnitude larger than groundwater production. As a result, groundwater production has a de minimis impact on groundwater conditions and the flows of surface water through the canyon. This, in turn, means that groundwater production in the Santa Ana Canyon has a de minimis impact on the groundwater dependent ecosystems in the Santa Ana Canyon Management Area. Therefore, the undesirable result of “depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water due to groundwater conditions occurring throughout the basin” does not apply.

Figure 14-1: Santa Ana River, downstream of Prado Dam

SECTION 15. PROTOCOLS FOR MODIFYING MONITORING PROGRAMS

Protocols for modifying monitoring programs are based on changes from historical conditions or changes in water quality that begin to approach or exceed regulatory limits.

15.1 ESTABLISHMENT OF PROTOCOLS FOR WATER QUALITY

Changes in OCWD water quality sampling program can be triggered by one or more of the following:

1. A recommendation by the Independent Advisory Panel that reviews OCWD use of Santa Ana River water for groundwater recharge and related water quality;
2. A change or anticipated change in water quality regulations;
3. A constituent in a sample approaches or exceeds a regulatory water quality limit or Maximum Contaminant Level, notification level, or first time detection of a constituent;
4. OCWD's monitoring program identifies a variation in historical data that may indicate a statistically significant change in water quality;
5. Analysis of water quality trends conducted by water quality, hydrogeology, or recycled water production staff indicate a need to change monitoring; and,
6. OCWD initiates a special study, such as quantifying the removal of contaminants using treatment wetlands or testing the infiltration rate of a proposed new recharge basin.

15.2 ESTABLISHMENT OF PROTOCOLS FOR GROUNDWATER ELEVATION/STORAGE

Given that it is desirable to obtain water level records over long periods of time at the same well, changes are rarely made to reduce key wells in groundwater level monitoring programs. The most common reason for a change is that a well is destroyed. If this occurs, OCWD will evaluate the nearest similar well or the need to construct a replacement well and add it to the monitoring program as appropriate.

The frequency of groundwater level monitoring in the Santa Ana Canyon Management Area varies from quarterly to annually. This frequency can be modified based on the variability of water level changes observed. In the Santa Ana Canyon Management Area, water levels tend to be consistent (see Figure 3-7), therefore, annual monitoring is generally sufficient. If water levels start to change and storage levels start to decline, then the frequency of groundwater level monitoring would likely increase. This occurrence would also likely precipitate changes to other monitoring programs, such as monitoring the health of the riparian habitat in the Santa Ana Canyon Management Area.

SECTION 16. PROCESS TO EVALUATE NEW PROJECTS

For projects within OCWD, the process described in the OCWD Management Area part of this report applies. If new projects are proposed by others outside of OCWD's boundaries, OCWD would collaborate with the agency proposing the project to ensure that any proposed project would not cause significant and unreasonable results. Moreover, OCWD would review proposed projects through the CEQA process (i.e., reviewing and commenting on draft CEQA documents).

SECTION 17. REFERENCES

County of Orange, 2016. County of Orange, Santa Ana River Canyon and Brush Canyon Habitat Management Areas, 2016 Annual Monitoring Report, June 2016.

OCWD, 2007. Report on Evaluation of Orange County Groundwater Basin Storage and Operational Strategy, February 2007.

USGS, 1964. Geology and Oil Resources of the Eastern Puente Hills Area, Southern California. By D.L. Durham and R.F. Yerkes. USGS Professional Paper 420-B.

ATTACHMENT ONE

DOCUMENTATION OF PUBLIC PARTICIPATION AND AGENCY APPROVALS

OCWD Board of Directors Agenda: October 21, 2015

OCWD Board of Directors Water Issues Committee Agenda: November 9, 2016

OCWD *Hydrospectives* Newsletter: November 2016

OCWD Website Screen Shot of Public Notice for Comments: November 9, 2016

OCWD Groundwater Producers Agenda: November 10, 2016

OCWD Board of Directors Water Issues Committee Agenda: December 14, 2016

OCWD Board of Directors Agenda: December 21, 2016

OCWD Board Resolution

CEQA Notice of Exemption

City of La Habra Letter of Support

AGENDA
REGULAR MEETING BOARD OF DIRECTORS
ORANGE COUNTY WATER DISTRICT
18700 Ward Street, Fountain Valley, CA (714) 378-3200
Wednesday, October 21, 2015 – 5:30 p.m.

PLEDGE OF ALLEGIANCE

ROLL CALL

ITEMS RECEIVED TOO LATE TO BE AGENDIZED

RECOMMENDATION: Adopt resolution determining need to take immediate action on item(s) and that the need for action came to the attention of the District subsequent to the posting of the Agenda (requires two-thirds vote of the Board members present, or, if less than two-thirds of the members are present, a unanimous vote of those members present.)

VISITOR PARTICIPATION

Time has been reserved at this point in the agenda for persons wishing to comment for up to three minutes to the Board of Directors on any item that is not listed on the agenda, but within the subject matter jurisdiction of the District. By law, the Board of Directors is prohibited from taking action on such public comments. As appropriate, matters raised in these public comments will be referred to District staff or placed on the agenda of an upcoming Board meeting.

At this time, members of the public may also offer public comment for up to three minutes on any item on the Consent Calendar. While members of the public may not remove an item from the Consent Calendar for separate discussion, a Director may do so at the request of a member of the public.

CONSENT CALENDAR (ITEMS NOS. 1 - 18)

All matters on the Consent Calendar are to be approved by one motion, without separate discussion on these items, unless a Board member or District staff request that specific items be removed from the Consent Calendar for separate consideration.

1. APPROVAL OF CASH DISBURSEMENTS

   RECOMMENDATION: Ratify/authorize payment of bills

2. APPROVAL OF MINUTES OF BOARD OF DIRECTORS MEETING HELD SEPTEMBER 16, 2015

   RECOMMENDATION: Approve minutes as presented

4) Authorize issuance of Amendment No. 1 to Agreement No. 0916 to CH2M Hill for an amount not to exceed $91,328; and

5) Increase the Alamitos Barrier Improvement Project budget as necessary to incorporate the bid from Best Drilling and Pump, Inc.

20. INFORMATIONAL ITEMS

A. WATER RESOURCES SUMMARY

B. GROUNDWATER REMEDIATION MONTHLY STATUS UPDATE

C. SUSTAINABLE GROUNDWATER MANAGEMENT ACT: COMPLIANCE OPTIONS

D. SANTA ANA WATERSHED PROJECT AUTHORITY ACTIVITIES

E. GROUNDWATER PRODUCER MEETING MINUTES – OCTOBER 14, 2015

F. COMMITTEE/CONFERENCE/MEETING REPORTS

1) Oct 08 – Communication and Legislative Liaison Committee (Chair Sidhu)
Oct 12 – GWRS Steering Committee (Vice Chair Yoh)
Oct 14 – Water Issues Committee (Chair Bilodeau)
Oct 15 – Administration and Finance Issues Committee (Chair Dewane)

2) Reports on Conferences/Meetings Attended at District Expense (at which a quorum of the Board was present)

21. VERBAL REPORTS

- PRESIDENT'S REPORT
- GENERAL MANAGER'S REPORT
- DIRECTORS' REPORTS
- GENERAL COUNSEL REPORT

22. ADJOURNMENT TO CLOSED SESSION

- **CONFERENCE WITH LABOR NEGOTIATORS [Government Code Section 54957.6]**
  OCWD designated representative: Stephanie Dosier
  - ⊙ Employee Organization: Orange County Employee Association

RECONVENE IN OPEN SESSION

23. ADJOURNMENT

AGENDA ITEM SUBMITTAL

Meeting Date: October 21, 2015

To: Board of Directors

From: Mike Markus

Staff Contact: G. Woodside/A. Hutchinson

Budgeted: N/A
Budgeted Amount: N/A
Cost Estimate: N/A
Funding Source: N/A
Program/Line Item No. N/A
General Counsel Approval: N/A
Engineers/Feasibility Report: N/A
CEQA Compliance: N/A

Subject: **SUSTAINABLE GROUNDWATER MANAGEMENT ACT: COMPLIANCE OPTIONS**

SUMMARY

On January 1, 2015, the Sustainable Groundwater Management Act (Act) took effect. This Act requires that all high and medium priority basins, as ranked by the Department of Water Resources (DWR), be sustainably managed. The Act lists OCWD as the exclusive groundwater manager within its statutory boundaries; however, there are additional steps that must be taken to comply with the Act. Currently available options as well as potential future options will be reviewed with the committee.

Attachment(s): Presentation

RECOMMENDATION

Informational

BACKGROUND/ANALYSIS

On September 16, 2014 Governor Brown signed three bills (SB1168, AB1739, and SB1319), which comprise the Sustainable Groundwater Management Act (Act).

The Act requires that all high- and medium- priority basins designated by the Department of Water Resources (DWR) be sustainably managed by 2020 or 2022 depending on basin conditions. In June 2014, DWR published a report on basin prioritization and designated the Coastal Plain of Orange County Groundwater Basin (Basin 8-1) as a medium-priority basin. This was primarily due to heavy reliance on groundwater within the basin and how this was accounted for in the ranking system. It is not an indication that the basin needs to be managed differently.

The Act requires that there be no unmanaged areas within basin boundaries as defined by DWR Bulletin 118 for high- and medium-priority basins. Bulletin 118 basin boundaries are based on hydrogeologic conditions and political boundary lines whenever practical. OCWD overlies much of the Coastal Plain of Orange County Groundwater Basin (Basin 8-1). Figure 1 shows how the Bulletin 118 boundary compares with the

Figure 1
Areas Outside of OCWD Boundary but Within Bulletin 118 Boundary

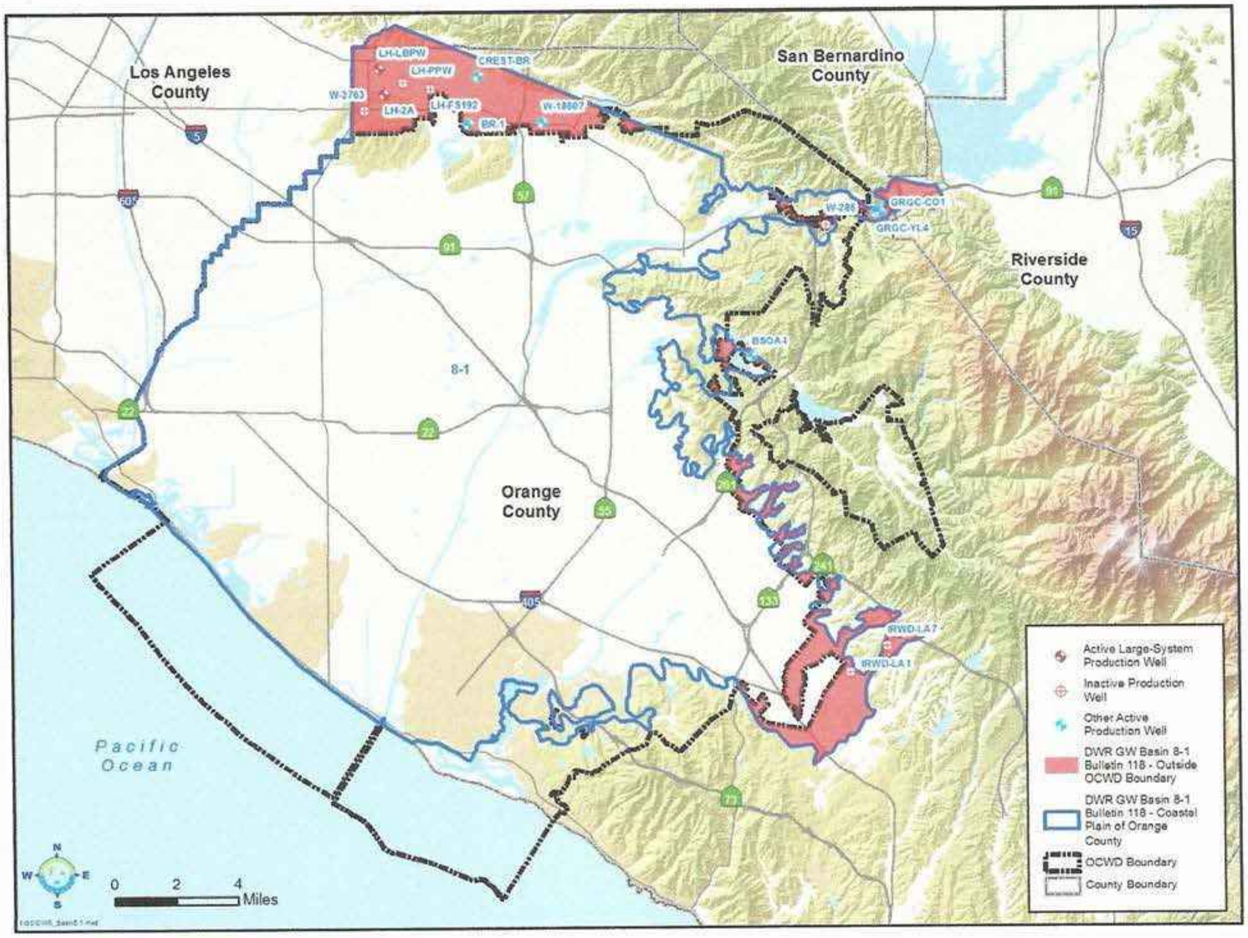


Figure 1 shows how the Bulletin 118 boundary compares with the District's boundary. The red shaded areas are outside of the District's boundary and, per the Act, need to be managed in some fashion. OCWD covers 89 percent of the basin as defined by Bulletin 118. The La Habra area covers 6 percent. The Santa Ana canyon area covers 1 percent and the southern portion covers 4 percent.

District staff worked with the authors of the Act to ensure that special act districts, including OCWD, were listed in the Act as the exclusive groundwater manager within its statutory boundaries. This designation prevents another agency from establishing a Groundwater Sustainability Agency (GSA) within a special district's boundaries. Now that the Act is being implemented and interpreted, compliance options are becoming better defined. At this point, all special act districts must comply with the Act by completing one of two options:

1. Present an Alternative Submittal, which is functionally equivalent to a Groundwater Sustainability Plan.

2. Opting to become a Groundwater Sustainability Agency (GSA) and preparing a Groundwater Sustainability Plan (GSP).

Alternative Submittals

The Department of Water Resources (DWR) is in the process of developing regulations regarding Alternative Submittals, which are described in Water Code Section 10733.6. The key text regarding Alternative Submittals is as follows:

> *10733.6 (a) If a local agency believes that an alternative described in subdivision (b) satisfies the objectives of this part, the local agency may submit the alternative to the department for evaluation and assessment of whether the alternative satisfied the objectives of this part for the* ***basin*** *(emphasis mine).*

One key interpretation is that Alternative Submittals must cover the entire Bulletin 118 basin or sub-basin. Since OCWD's boundaries do not cover the entire Bulletin 118 Basin 8-1 boundary, an Alternative Submittal would have to incorporate areas outside of OCWD (areas shown in red in Figure 1).

Staff has had preliminary discussions with agencies with jurisdiction outside of OCWD's boundaries, including Orange County, Irvine Ranch Water District (IRWD) and the cities of La Habra, Brea and Fullerton. For an Alternative Submittal to work, all of these agencies would have to participate. Orange County and IRWD are amenable to participating in an Alternative Submittal; however, at this time, La Habra and Brea are interested in forming a GSA and submitting a GSP (see below). Staff plans to have additional discussions with these agencies about developing an Alternative Submittal that covers the entire Bulletin 118 basin.

Formation of Groundwater Sustainability Agencies (GSAs)

If a special district, like OCWD, does not cover an entire basin or is not able to submit an Alternative Submittal that covers the entire basin, the only compliance option currently available is to form a GSA and submit a GSP. Staff is currently talking with DWR to see if there are other compliance options available within the scope of the Act that would not require formation of a GSA.

If compliance options within the existing Act are not satisfactory, staff may recommend that the District consider proposing cleanup legislation to allow special districts to prepare Alternative Submittals that cover their jurisdictional areas or other potential changes that allow OCWD to manage the basin without having to become a GSA or to require that GSAs be formed in the areas outside of OCWD's boundaries.

La Habra Groundwater Sustainability Agency (GSA) Formation

The City of La Habra is currently planning to form a Groundwater Sustainability Agency (GSA) that covers the northern portion of the groundwater basin that lies outside OCWD's boundary, which includes Brea and a very small portion of Fullerton (see Figure 1). La

Habra has invited OCWD to be part of a Technical Advisory Committee (TAC) that will provide input on the GSA formation process as well as development of their Groundwater Sustainability Plan (GSP).

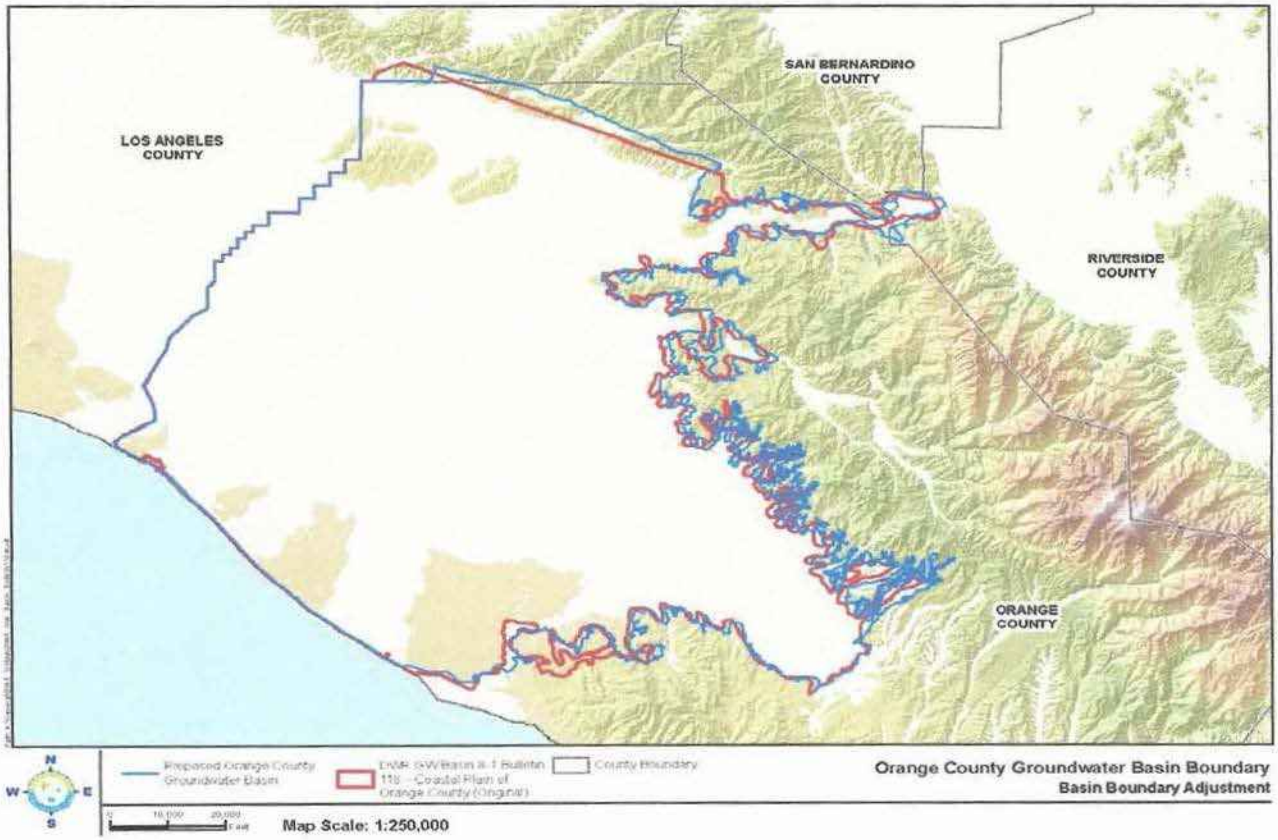
In addition, La Habra has indicated they are planning to request that DWR create a new Bulletin 118 La Habra Basin that is separate and apart from the Coastal Plain of Orange County Groundwater Basin.

Proposed Adjustments to DWR Bulletin 118 Basin Boundaries

The first Bulletin 118 was published in 1975. The boundaries established for the Coastal Plain of Orange County (Basin 8-1) have significant off-sets in some areas from current GIS data. This off-set could be due to distortions caused by digitizing maps created in the 1970s and then projecting them onto current GIS base maps.

To improve the accuracy of the Basin 8-1 boundary, staff reviewed available geologic information and adjusted the boundary as shown on Figure 2. Staff will share these proposed adjustments with La Habra, Orange County and IRWD to obtain their feedback before submitting them to DWR. Because these adjustments are consistent with the original intent of Bulletin 118, they are considered "administrative changes" and are not subject to the boundary change regulations currently being adopted by DWR.

TABLE 2
Current (Red) and Proposed (Blue) Bulletin 118 Boundary, Coastal Plain of Orange County Groundwater Basin (Basin 8-1)



PRIOR RELEVANT BOARD ACTION(S)

10-15-14, M14-160	Direct Staff to Identify Steps for Managing Groundwater Outside of District Boundaries (Sustainable Groundwater Management Act)
08-20-14, M14-119	Adopt Support if Amended Position on State Legislation - SB1168/ AB1739 (Groundwater Management Legislation)
07-16-14, R14-7-104	Adopt Groundwater Management Legislation Policy Principles

AGENDA
WATER ISSUES COMMITTEE MEETING
WITH BOARD OF DIRECTORS *
ORANGE COUNTY WATER DISTRICT

18700 Ward Street, Fountain Valley, CA 92708

Wednesday, November 9, 2016, 8:00 a.m. - Boardroom

* The OCWD Water Issues Committee meeting is noticed as a joint meeting with the Board of Directors for the purpose of strict compliance with the Brown Act and it provides an opportunity for all Directors to hear presentations and participate in discussions. Directors receive no additional compensation or stipend as a result of simultaneously convening this meeting. Items recommended for approval at this meeting will be placed on the **November 16, 2016** Board meeting Agenda for approval.

ROLL CALL

ITEMS RECEIVED TOO LATE TO BE AGENDIZED

RECOMMENDATION: Adopt resolution determining need to take immediate action on item(s) and that the need for action came to the attention of the District subsequent to the posting of the Agenda (requires two-thirds vote of the Board members present, or, if less than two-thirds of the members are present, a unanimous vote of those members present.)

VISITOR PARTICIPATION

Time has been reserved at this point in the agenda for persons wishing to comment for up to three minutes to the Board of Directors on any item that is not listed on the agenda, but within the subject matter jurisdiction of the District. By law, the Board of Directors is prohibited from taking action on such public comments. As appropriate, matters raised in these public comments will be referred to District staff or placed on the agenda of an upcoming Board meeting.

At this time, members of the public may also offer public comment for up to three minutes on any item on the Consent Calendar. While members of the public may not remove an item from the Consent Calendar for separate discussion, a Director may do so at the request of a member of the public.

CONSENT CALENDAR (ITEMS NO. 1 – 7)

All matters on the Consent Calendar are to be approved by one motion, without separate discussion on these items, unless a Board member or District staff request that specific items be removed from the Consent Calendar for separate consideration.

1. MINUTES OF WATER ISSUES COMMITTEE MEETING HELD OCTOBER 12, 2016

RECOMMENDATION: Approve minutes as presented

2. ENCROACHMENT AGREEMENT WITH THE CITY OF FULLERTON FOR THE NORTH BASIN EXTRACTION WELL EW-1 CONNECTION TO SANITARY SEWER PROJECT

RECOMMENDATION: Agendize for November 16 Board meeting: Approve and authorize execution of Encroachment Agreement with the City of Fullerton and provide a deposit to City in the amount of $10,000

3. CONTRACT NO. MBI-2017-1 MID-BASIN INJECTION: CENTENNIAL PARK PROJECT - NOTICE INVITING BIDS AND AGREEMENT TO DDB ENGINEERING FOR PROJECT PERMIT ASSISTANCE

RECOMMENDATION: Agendize for November 16 Board meeting:

1. Authorize publication of Notice Inviting Bids for Contract No. MBI-2017-1, Mid-Basin Injection: Centennial Park; and

2. Authorize issuance of Agreement to DDB Engineering in an amount not to exceed $25,000 for permit consulting services

4. REBUILD GREEN ACRES PROJECT SANTA ANA RESERVOIR EFFLUENT PUMP A01

RECOMMENDATION: Authorize payment to Evans Hydro for an amount not to exceed $16,975 to repair and refurbish Green Acres Project Santa Ana Reservoir Effluent Pump A01

5. REBUILD GREEN ACRES PROJECT HIGH PRESSURE EFFLUENT PUMP A03

RECOMMENDATION: Agendize for November 16 Board meeting: Approve and authorize payment to Pamco Machine for an amount not to exceed $33,832 to repair and refurbish Green Acres Project High Pressure Pump A03

6. REBUILD GREEN ACRES PROJECT INFLUENT PUMP A03

RECOMMENDATION: Agendize for November 16 Board meeting: Approve and authorize Pamco Machine to repair and refurbish Green Acres Project Influent Pump A03, for an amount not to exceed $19,800

7. ANNUAL SANTA ANA RIVER STREAM GAUGING JOINT FUNDING AGREEMENT WITH THE UNITED STATES GEOLOGICAL SURVEY (USGS)

RECOMMENDATION: Agendize for November 16 Board meeting:

1. Approve and authorize execution of Joint Funding Agreement with USGS to conduct flow and quality monitoring of the Santa Ana River below Prado Dam and Santiago Creek at Santa Ana for the period of November 1, 2016 to October 31, 2017; and

2. Authorize payment of $59,372 to the USGS for OCWD’s share of costs for stream flow and quality monitoring services

MATTERS FOR CONSIDERATION

8. OCSD/OCWD JOINT AGREEMENT FOR THE GWRS FINAL EXPANSION PROJECT

RECOMMENDATION: Agendize for November 16 Board meeting: Approve and authorize execution of the Agreement between OCSD and OCWD for each agency’s responsibilities for the GWRS Final Expansion Project, subject to minor changes by legal counsel

9. DRAFT BASIN 8-1 ALTERNATIVE TO COMPLY WITH SUSTAINABLE GROUNDWATER MANAGEMENT ACT

RECOMMENDATION: Provide comments on the draft Basin 8-1 Alternative as appropriate

CHAIR DIRECTION AS TO ITEMS IF ANY TO BE AGENDIZED AS MATTERS FOR CONSIDERATION AT THE NOVEMBER 16 BOARD MEETING

DIRECTORS' ANNOUNCEMENTS/REPORTS

GENERAL MANAGER'S ANNOUNCEMENTS/REPORTS

ADJOURNMENT

AGENDA ITEM SUBMITTAL

Meeting Date: November 9, 2016

To: Board of Directors

From: Mike Markus

Staff Contact: G. Woodside/A. Hutchinson
M. Westropp

Budgeted: N/A
Budgeted Amount: N/A
Cost Estimate: N/A
Funding Source: N/A
Program/Line Item No. N/A
General Counsel Approval: N/A
Engineers/Feasibility Report: N/A
CEQA Compliance: N/A

Subject: **DRAFT BASIN 8-1 ALTERNATIVE TO COMPLY WITH SUSTAINABLE GROUNDWATER MANAGEMENT ACT**

SUMMARY

To comply with the Sustainable Groundwater Management Act, a draft Alternative to a Groundwater Sustainability Plan has been prepared that covers the entirety of the Department of Water Resources Basin 8-1, Coastal Plain of Orange County Groundwater Basin. The draft Basin 8-1 Alternative was prepared by District staff and other stakeholders in Basin 8-1 that are outside of the District's boundary. The Alternative shows that the basin has been sustainably managed.

Attachment(s):

- Presentation
- Draft Basin 8-1 Alternative – (to be posted to www.ocwd.com on 11/08/2016)

RECOMMENDATION

Agendize for November 16 Board meeting: Provide comments on draft Basin 8-1 Alternative as appropriate

BACKGROUND/ANALYSIS

On September 16, 2014 Governor Brown signed three bills (SB1168, AB1739, and SB1319), which comprise the Sustainable Groundwater Management Act (Act).

The Act requires that all high- and medium-priority basins designated by the Department of Water Resources (DWR) be sustainably managed. DWR designated the Coastal Plain of Orange County Groundwater Basin (Basin 8-1) as a medium-priority basin, primarily due to heavy reliance on the basin's groundwater as a source of water supply.

Compliance with the Act can be achieved by one of two options:

1) Forming a Groundwater Sustainability Agency (GSA) and submitting a Groundwater Sustainability Plan (GSP), or
2) Submitting an Alternative to a GSP

Basin 8-1, as defined by DWR, includes areas within and outside of OCWD's service area as shown in Figure 1. Approximately 78 percent of Basin 8-1 is within OCWD's jurisdiction. Areas outside of OCWD include a northern section within the cities of La Habra and Brea, land along the Santa Ana River upstream of Imperial Highway, and land outside of the southern and southeastern OCWD boundary within the jurisdiction of Irvine Ranch Water District, El Toro Water District and the city of Orange. To be eligible to submit an Alternative to a GSP, the entirety of Basin 8-1 must be included in the Alternative and it must be demonstrated that Basin 8-1 has been sustainability managed.

The agencies within Basin 8-1 have agreed to prepare and submit an Alternative to a GSP, which is referred to as the Basin 8-1 Alternative. In accordance with §10733.6(b)(3), the Basin 8-1 Alternative presents an analysis of basin conditions that demonstrates that the basin has operated sustainably over a period of at least 10 years. In fact, Basin 8-1 has been operated sustainably for more than 10 years without experiencing the undesirable results, which are defined by the California Water Code as significant and unreasonable lowering of groundwater levels, reduction in storage, water quality degradation, seawater intrusion, or inelastic land subsidence. Since the basin has been sustainably managed, no new actions are required and the Basin 8-1 Alternative essentially describes the ongoing actions that will continue the sustainable management of the basin.

The Basin 8-1 draft Alternative was jointly prepared by the Orange County Water District (OCWD) and agencies with jurisdiction outside of OCWD's boundaries, including the City of La Habra and the Irvine Ranch Water District (IRWD). Table 1 shows the lead agencies responsible for preparing the sections covering the management areas.

Table 1: Lead Agencies for Preparation of Basin 8-1 Alternative

Agency	Management Area
City of La Habra	La Habra/Brea
OCWD	OCWD
OCWD	Santa Ana Canyon
Irvine Ranch Water District	South East

Other agencies within Basin 8-1 support submission of the Basin 8-1 Alternative and either have participated in preparing the Alternative and/or reviewed the Alternative. These agencies include the cities of Brea, Corona, Orange, and Chino Hills; the Counties of Orange, Riverside, and San Bernardino; Yorba Linda Water District, and El Toro Water District. Pursuant to §10733.2, the Basin 8-1 Alternative has been prepared by or under the direction of a professional geologist or professional engineer.

In the Basin 8-1 Alternative, four management areas were identified as shown in Figure 1. Accordingly, the Basin 8-1 Alternative is organized as follows:

- **Overview**: Provides a map and description of Basin 8-1 and a brief description of the basin management areas.
- **Hydrology of Basin 8-1**: Provides a description of the hydrogeology of Basin 8-1 including a description of the basin, the aquifer systems, fault zones, total basin volume, basin cross-sections, basin characteristics, and general groundwater quality.

- **La Habra-Brea Management Area**
- **OCWD Management Area**
- **South East Management Area**
- **Santa Ana Canyon Management Area**

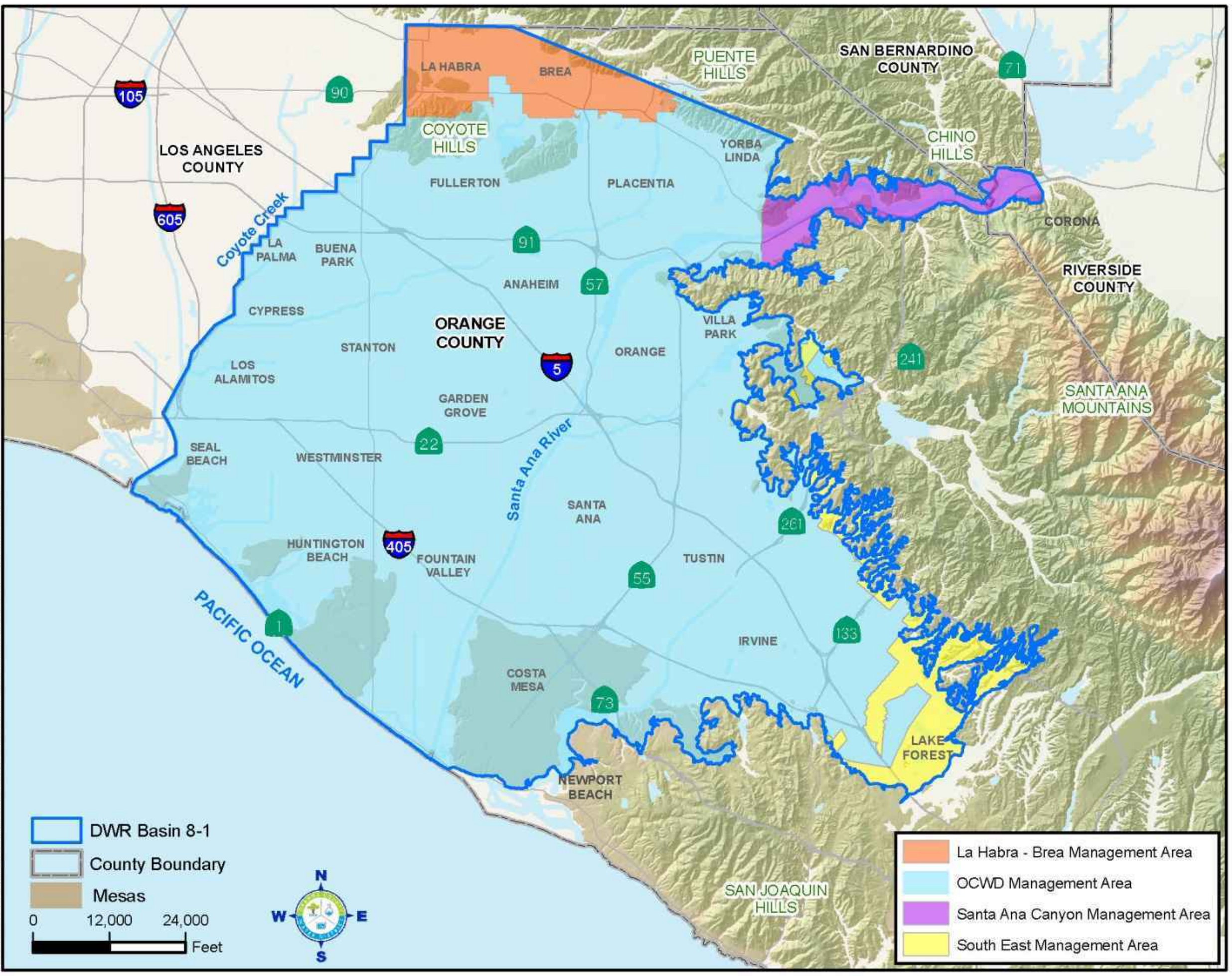
The OCWD Management Area description is based primarily on the information in the OCWD Groundwater Management Plan, which was adopted by the Board in June 2015. The OCWD Management area includes a small portion of the City of Fullerton and unincorporated Orange County that are outside OCWD's boundaries.

The Santa Ana Canyon Management area, which extends eastward into Riverside and San Bernardino Counties, includes the following agencies: OCWD, the cities of Anaheim, Yorba Linda, Chino Hills, Corona, and the counties of Riverside, San Bernardino and Orange.

The Basin 8-1 Alternative is posted on OCWD's website and will also be distributed by the other participating agencies for public review. District staff, La Habra, and IRWD will review the comments submitted on the draft Alternative and prepare the final Basin 8-1 Alternative, which must be submitted to the DWR by the statutory deadline of January 1, 2017.

After the Basin 8-1 Alternative is submitted to DWR, DWR will post on their website to allow for further public review. Once DWR approves the Basin 8-1 Alternative, the lead agencies within each management area will be required to update the Alternative every 5 years.

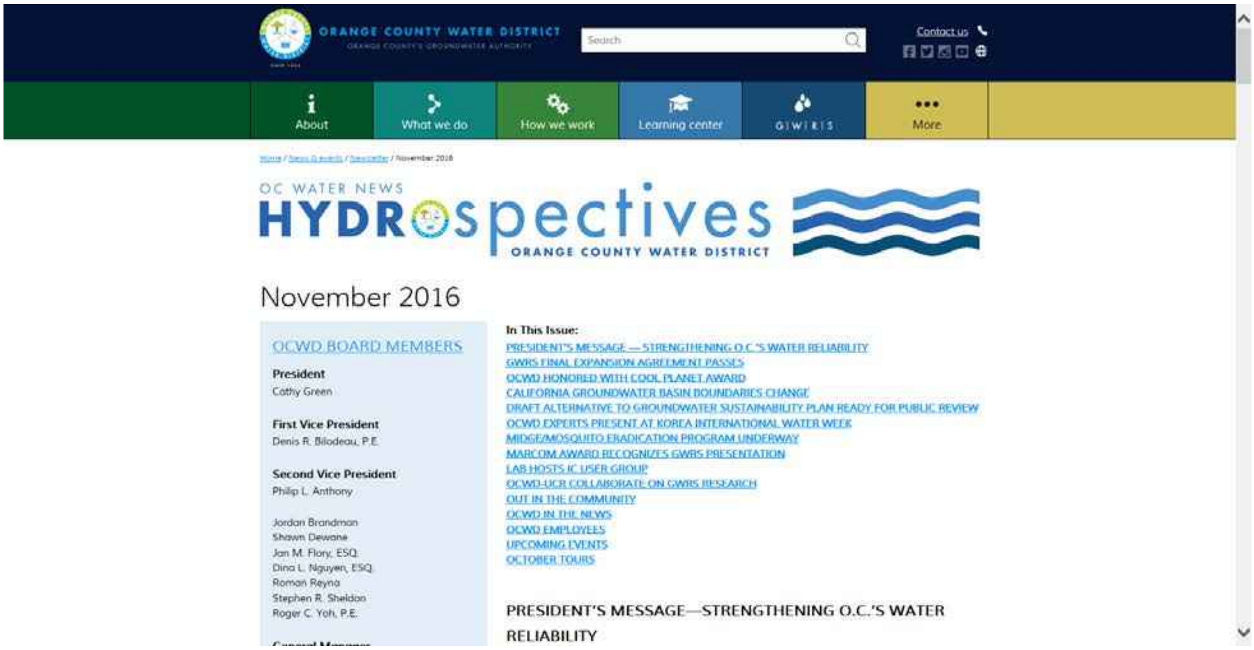
Figure 1
Management Areas in Basin 8-1 Alternative



Path: K:\General\DWR_SGMA\Alternative_report\OCBasin8-1\Fig1-1_OCBasin8-1_Management_Area.mxd

PRIOR RELEVANT BOARD ACTION(S)

10-21-15	Informational Item, Sustainable Groundwater Management Act: Compliance Options
10-15-14, M14-160	Direct Staff to Identify Steps for Managing Groundwater Outside of District Boundaries (Sustainable Groundwater Management Act)
08-20-14, M14-119	Adopt Support if Amended Position on State Legislation - SB1168/ AB1739 (Groundwater Management Legislation)
07-16-14, R14-7-104	Adopt Groundwater Management Legislation Policy Principles



OC WATER NEWS

HYDROspectives

ORANGE COUNTY WATER DISTRICT

November 2016

OCWD BOARD MEMBERS

President
Cathy Green

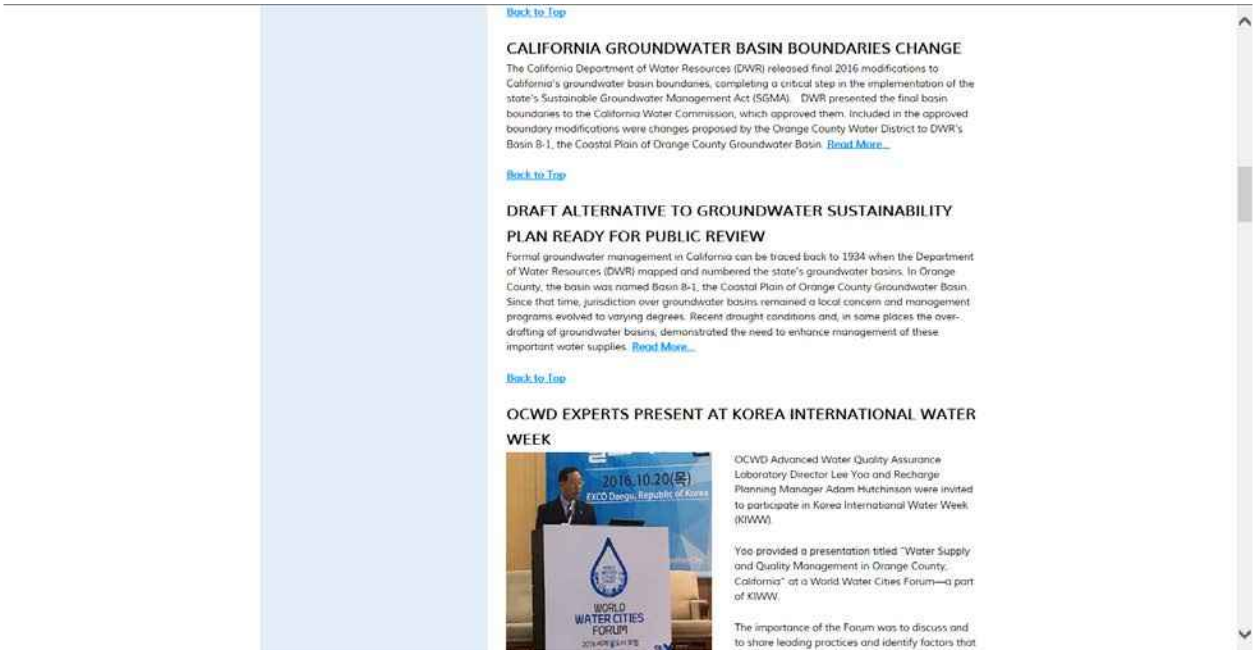
First Vice President
Denis R. Bilodeau, P.E.

Second Vice President
Philip L. Anthony

Jordan Brandman
Shawn Dewane
Jan M. Flory, ESQ.
Dina L. Nguyen, ESQ.
Roman Reyna
Stephen R. Sheldon
Roger C. Yoh, P.E.

In This Issue:

PRESIDENT'S MESSAGE—STRENGTHENING O.C.'S WATER RELIABILITY



Back to Top

CALIFORNIA GROUNDWATER BASIN BOUNDARIES CHANGE

The California Department of Water Resources (DWR) released final 2016 modifications to California's groundwater basin boundaries, completing a critical step in the implementation of the state's Sustainable Groundwater Management Act (SGMA). DWR presented the final basin boundaries to the California Water Commission, which approved them. Included in the approved boundary modifications were changes proposed by the Orange County Water District to DWR's Basin 8-1, the Coastal Plain of Orange County Groundwater Basin. Read More...

Back to Top

DRAFT ALTERNATIVE TO GROUNDWATER SUSTAINABILITY PLAN READY FOR PUBLIC REVIEW

Formal groundwater management in California can be traced back to 1934 when the Department of Water Resources (DWR) mapped and numbered the state's groundwater basins. In Orange County, the basin was named Basin 8-1, the Coastal Plain of Orange County Groundwater Basin. Since that time, jurisdiction over groundwater basins remained a local concern and management programs evolved to varying degrees. Recent drought conditions and, in some places the over-drafting of groundwater basins, demonstrated the need to enhance management of these important water supplies. Read More...

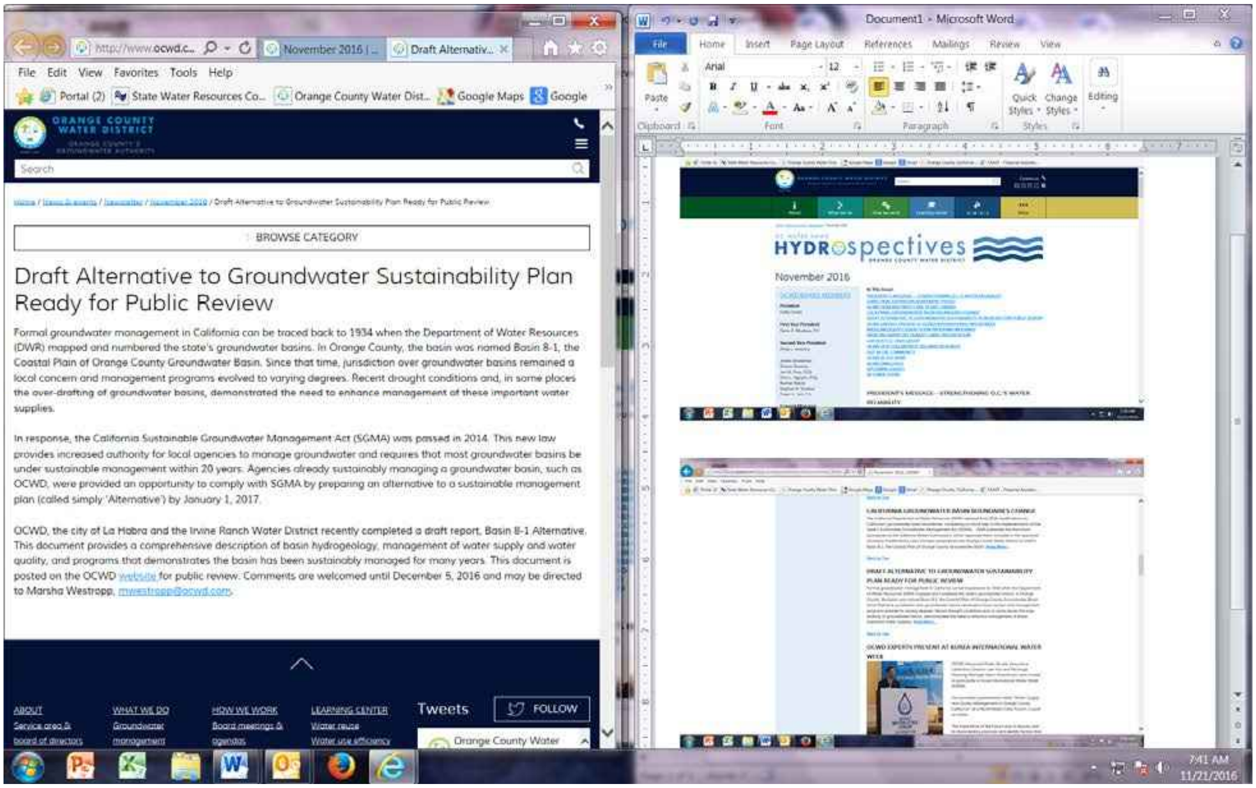
Back to Top

OCWD EXPERTS PRESENT AT KOREA INTERNATIONAL WATER WEEK

OCWD Advanced Water Quality Assurance Laboratory Director Lee Yoo and Recharge Planning Manager Adam Hutchinson were invited to participate in Korea International Water Week (KIWW).

Yoo provided a presentation titled "Water Supply and Quality Management in Orange County, California" at a World Water Cities Forum—a part of KIWW.

The importance of the Forum was to discuss and to share leading practices and identify factors that



Home / News & events / Newsletter / November 2016 / Draft Alternative to Groundwater Sustainability Plan Ready for Public Review

Draft Alternative to Groundwater Sustainability Plan Ready for Public Review

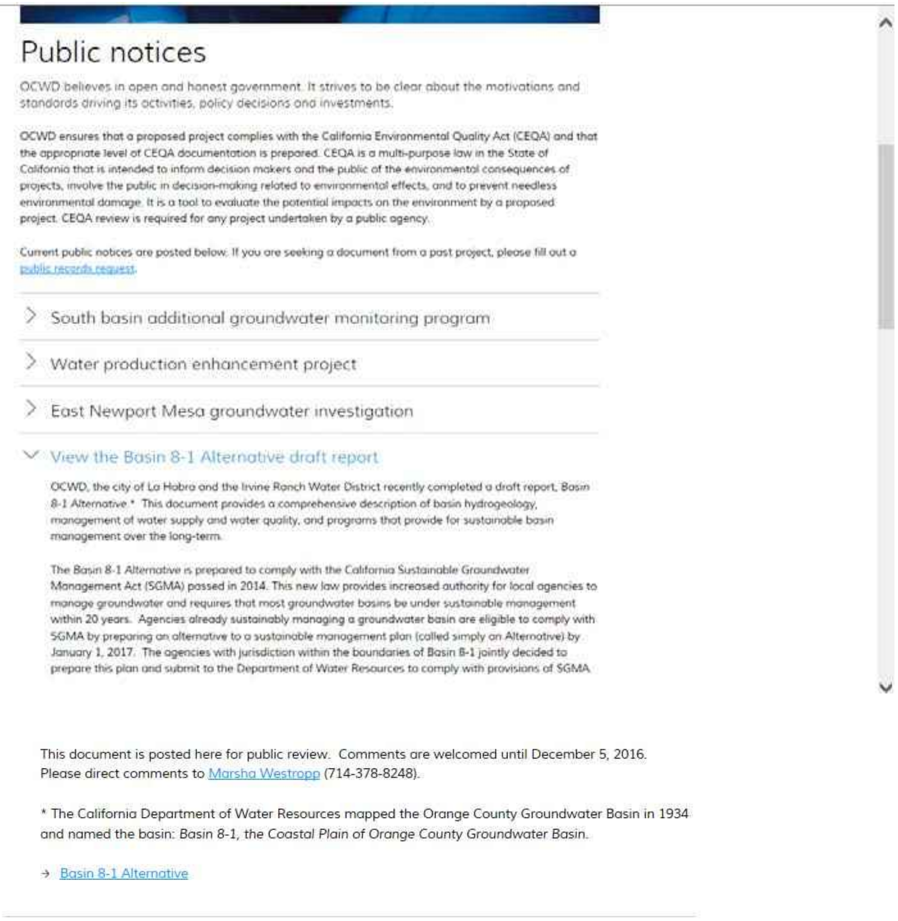
Formal groundwater management in California can be traced back to 1934 when the Department of Water Resources (DWR) mapped and numbered the state's groundwater basins. In Orange County, the basin was named Basin 8-1, the Coastal Plain of Orange County Groundwater Basin. Since that time, jurisdiction over groundwater basins remained a local concern and management programs evolved to varying degrees. Recent drought conditions and, in some places the over-drafting of groundwater basins, demonstrated the need to enhance management of these important water supplies.

In response, the California Sustainable Groundwater Management Act (SGMA) was passed in 2014. This new law provides increased authority for local agencies to manage groundwater and requires that most groundwater basins be under sustainable management within 20 years. Agencies already sustainably managing a groundwater basin, such as OCWD, were provided an opportunity to comply with SGMA by preparing an alternative to a sustainable management plan (called simply 'Alternative') by January 1, 2017.

OCWD, the city of La Habra and the Irvine Ranch Water District recently completed a draft report, Basin 8-1 Alternative. This document provides a comprehensive description of basin hydrogeology, management of water supply and water quality, and programs that demonstrates the basin has been sustainably managed for many years. This document is posted on the OCWD website for public review. Comments are welcomed until December 5, 2016 and may be directed to Marsha Westropp, mwestropp@ocwd.com.

Screen shot of OCWD Webpage

Posted 11/9/16



Public notices

OCWD believes in open and honest government. It strives to be clear about the motivations and standards driving its activities, policy decisions and investments.

OCWD ensures that a proposed project complies with the California Environmental Quality Act (CEQA) and that the appropriate level of CEQA documentation is prepared. CEQA is a multi-purpose law in the State of California that is intended to inform decision makers and the public of the environmental consequences of projects, involve the public in decision-making related to environmental effects, and to prevent needless environmental damage. It is a tool to evaluate the potential impacts on the environment by a proposed project. CEQA review is required for any project undertaken by a public agency.

Current public notices are posted below. If you are seeking a document from a past project, please fill out a public records request.

View the Basin 8-1 Alternative draft report

OCWD, the city of La Habra and the Irvine Ranch Water District recently completed a draft report, Basin 8-1 Alternative.* This document provides a comprehensive description of basin hydrogeology, management of water supply and water quality, and programs that provide for sustainable basin management over the long-term.

The Basin 8-1 Alternative is prepared to comply with the California Sustainable Groundwater Management Act (SGMA) passed in 2014. This new law provides increased authority for local agencies to manage groundwater and requires that most groundwater basins be under sustainable management within 20 years. Agencies already sustainably managing a groundwater basin are eligible to comply with SGMA by preparing an alternative to a sustainable management plan (called simply an Alternative) by January 1, 2017. The agencies with jurisdiction within the boundaries of Basin 8-1 jointly decided to prepare this plan and submit to the Department of Water Resources to comply with provisions of SGMA.

This document is posted here for public review. Comments are welcomed until December 5, 2016. Please direct comments to Marsha Westropp (714-378-8248).

* The California Department of Water Resources mapped the Orange County Groundwater Basin in 1934 and named the basin: *Basin 8-1, the Coastal Plain of Orange County Groundwater Basin.*

→ Basin 8-1 Alternative

From: Kennedy, John
Sent: Wednesday, November 09, 2016 11:16 AM
To: avalenzuela@tustinca.org; Bill Murray; Brian A. Ragland ; Carlo Nafarrete (La Palma) (carlon@cityoflapalma.org); 'Cel Pasillas'; Cook@irwd.com; David Spitz (dspitz@sealbeachca.gov); George Murdoch, NB; Hye Jin Lee - City of Fullerton (HyeJinL@ci.fullerton.ca.us); Jerry Vilander; Jose Diaz (jdiaz@cityoforange.org); Lisa Ohlund; Marc Marcantonio (mmarcantonio@ylwd.com); Mark Lewis (mark.lewis@fountainvalley.org); Michael Grisso (mgrisso@buenapark.com); Michael Moore (mrmoore@anaheim.net); Nabil Saba (Santa Ana); pauls@mesawater.org; Scott Miller - City of Westminster (scottm@CI.WESTMINSTER.CA.US); Steffen Catron (scatron@newportbeachca.gov); Vecchiarelli, Ken
Cc: Markus, Mike; Woodside, Greg; Hutchinson, Adam; Westropp, Marsha
Subject: November 10th Producers Meeting - Sustainable Groundwater Management Act - Alternative Plan

All

At tomorrow's Producers meeting we will discuss the Alternative plan that OCWD has prepared to comply with the Sustainable Groundwater Management Act. Below is a link to the plan if you want to review it ahead of the meeting.

http://www.ocwd.com/media/4792/basin-8-1-alternative-draft-november-4-2016.pdf

John Kennedy
Executive Director of Engineering and Water Resources
Orange County Water District
18700 Ward Street
Fountain Valley, CA 92708
tel: (714) 378-3304
email: jkennedy@ocwd.com

AGENDA ITEM SUBMITTAL

Meeting Date: November 16, 2016

To: Board of Directors

From: Mike Markus

Staff Contact: G. Woodside/A. Hutchinson
M. Westropp

Budgeted: N/A
Budgeted Amount: N/A
Cost Estimate: N/A
Funding Source: N/A
Program/Line Item No. N/A
General Counsel Approval: N/A
Engineers/Feasibility Report: N/A
CEQA Compliance: N/A

Subject: **DRAFT BASIN 8-1 ALTERNATIVE TO COMPLY WITH SUSTAINABLE GROUNDWATER MANAGEMENT ACT**

SUMMARY

To comply with the Sustainable Groundwater Management Act, a draft Alternative to a Groundwater Sustainability Plan has been prepared that covers the entirety of the Department of Water Resources Basin 8-1, Coastal Plain of Orange County Groundwater Basin. The draft Basin 8-1 Alternative was prepared by District staff and other stakeholders in Basin 8-1 that are outside of the District's boundary. The Alternative shows that the basin has been sustainably managed.

Attachment(s):
- Presentation
- Draft Basin 8-1 Alternative – (posted to www.ocwd.com)

RECOMMENDATION

Provide comments on draft Basin 8-1 Alternative as appropriate

BACKGROUND/ANALYSIS

On September 16, 2014 Governor Brown signed three bills (SB1168, AB1739, and SB1319), which comprise the Sustainable Groundwater Management Act (Act).

The Act requires that all high- and medium-priority basins designated by the Department of Water Resources (DWR) be sustainably managed. DWR designated the Coastal Plain of Orange County Groundwater Basin (Basin 8-1) as a medium-priority basin, primarily due to heavy reliance on the basin's groundwater as a source of water supply.

Compliance with the Act can be achieved by one of two options:

1) Forming a Groundwater Sustainability Agency (GSA) and submitting a Groundwater Sustainability Plan (GSP), or
2) Submitting an Alternative to a GSP

Basin 8-1, as defined by DWR, includes areas within and outside of OCWD's service area as shown in Figure 1. Approximately 78 percent of Basin 8-1 is within OCWD's jurisdiction. Areas outside of OCWD include a northern section within the cities of La

Habra and Brea, land along the Santa Ana River upstream of Imperial Highway, and land outside of the southern and southeastern OCWD boundary within the jurisdiction of Irvine Ranch Water District, El Toro Water District and the city of Orange. To be eligible to submit an Alternative to a GSP, the entirety of Basin 8-1 must be included in the Alternative and it must be demonstrated that Basin 8-1 has been sustainability managed.

The agencies within Basin 8-1 have agreed to prepare and submit an Alternative to a GSP, which is referred to as the Basin 8-1 Alternative. In accordance with §10733.6(b)(3), the Basin 8-1 Alternative presents an analysis of basin conditions that demonstrates that the basin has operated sustainably over a period of at least 10 years. In fact, Basin 8-1 has been operated sustainably for more than 10 years without experiencing the undesirable results, which are defined by the California Water Code as significant and unreasonable lowering of groundwater levels, reduction in storage, water quality degradation, seawater intrusion, or inelastic land subsidence. Since the basin has been sustainably managed, no new actions are required and the Basin 8-1 Alternative essentially describes the ongoing actions that will continue the sustainable management of the basin.

The Basin 8-1 draft Alternative was jointly prepared by the Orange County Water District (OCWD) and agencies with jurisdiction outside of OCWD's boundaries, including the City of La Habra and the Irvine Ranch Water District (IRWD). Table 1 shows the lead agencies responsible for preparing the sections covering the management areas.

Table 1: Lead Agencies for Preparation of Basin 8-1 Alternative

Agency	Management Area
City of La Habra	La Habra/Brea
OCWD	OCWD
OCWD	Santa Ana Canyon
Irvine Ranch Water District	South East

Other agencies within Basin 8-1 support submission of the Basin 8-1 Alternative and either have participated in preparing the Alternative and/or reviewed the Alternative. These agencies include the cities of Brea, Corona, Orange, and Chino Hills; the Counties of Orange, Riverside, and San Bernardino; Yorba Linda Water District, and El Toro Water District. Pursuant to §10733.2, the Basin 8-1 Alternative has been prepared by or under the direction of a professional geologist or professional engineer.

In the Basin 8-1 Alternative, four management areas were identified as shown in Figure 1. Accordingly, the Basin 8-1 Alternative is organized as follows:

- **Overview**: Provides a map and description of Basin 8-1 and a brief description of the basin management areas.
- **Hydrology of Basin 8-1**: Provides a description of the hydrogeology of Basin 8-1 including a description of the basin, the aquifer systems, fault zones, total basin volume, basin cross-sections, basin characteristics, and general groundwater quality.
- **La Habra-Brea Management Area**

- **OCWD Management Area**
- **South East Management Area**
- **Santa Ana Canyon Management Area**

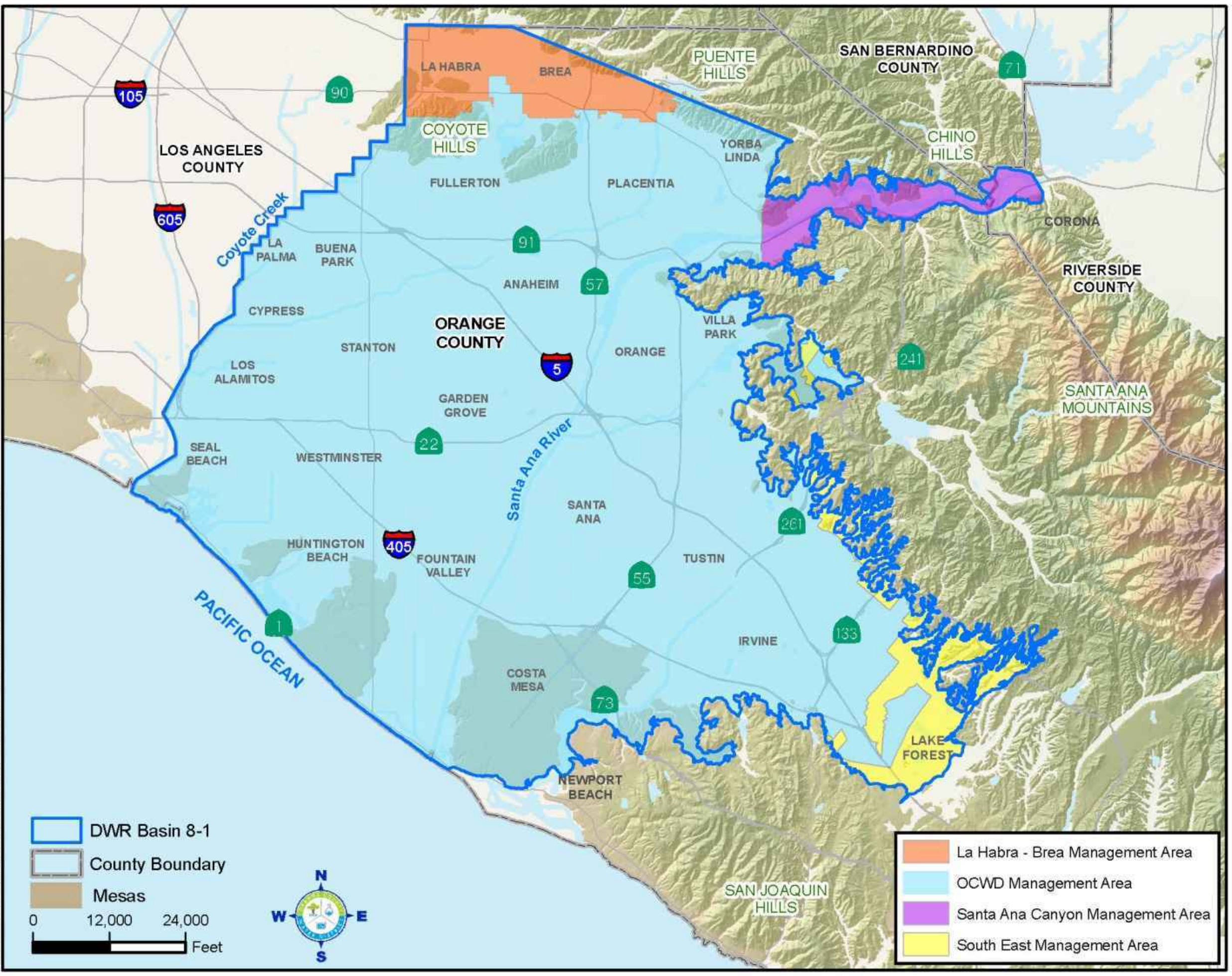
The OCWD Management Area description is based primarily on the information in the OCWD Groundwater Management Plan, which was adopted by the Board in June 2015. The OCWD Management area includes a small portion of the City of Fullerton and unincorporated Orange County that are outside OCWD's boundaries.

The Santa Ana Canyon Management area, which extends eastward into Riverside and San Bernardino Counties, includes the following agencies: OCWD, the cities of Anaheim, Yorba Linda, Chino Hills, Corona, and the counties of Riverside, San Bernardino and Orange.

The Basin 8-1 Alternative is posted on OCWD's website and will also be distributed by the other participating agencies for public review. District staff, La Habra, and IRWD will review the comments submitted on the draft Alternative and prepare the final Basin 8-1 Alternative, which must be submitted to the DWR by the statutory deadline of January 1, 2017.

After the Basin 8-1 Alternative is submitted to DWR, DWR will post on their website to allow for further public review. Once DWR approves the Basin 8-1 Alternative, the lead agencies within each management area will be required to update the Alternative every 5 years.

Figure 1
Management Areas in Basin 8-1 Alternative



PRIOR RELEVANT BOARD ACTION(S)

10-21-15	Informational Item, Sustainable Groundwater Management Act: Compliance Options
10-15-14, M14-160	Direct Staff to Identify Steps for Managing Groundwater Outside of District Boundaries (Sustainable Groundwater Management Act)
08-20-14, M14-119	Adopt Support if Amended Position on State Legislation - SB1168/ AB1739 (Groundwater Management Legislation)
07-16-14, R14-7-104	Adopt Groundwater Management Legislation Policy Principles

AGENDA ITEM SUBMITTAL

Meeting Date: December 14, 2016

To: Water Issues Committee
Board of Directors

From: Mike Markus

Staff Contact: G. Woodside/A. Hutchinson
/M. Westropp

Budgeted: N/A
Budgeted Amount: N/A
Cost Estimate: N/A
Funding Source: N/A
Program/Line Item No: N/A
General Counsel Approval: N/A
Engineers/Feasibility Report: N/A
CEQA Compliance: Notice of Exemption

Subject: **FINAL BASIN 8-1 ALTERNATIVE TO COMPLY WITH SUSTAINABLE GROUNDWATER MANAGEMENT ACT**

SUMMARY

To comply with the Sustainable Groundwater Management Act, an Alternative to a Groundwater Sustainability Plan has been prepared that covers the entirety of the Department of Water Resources Basin 8-1, Coastal Plain of Orange County Groundwater Basin. The Basin 8-1 Alternative was prepared by District staff and other stakeholders in Basin 8-1 that are outside of the District's boundary. The Alternative shows that the basin has been sustainably managed for more than 10 years.

Attachment(s):
- Resolution
- Presentation
- Final Basin 8-1 Alternative

RECOMMENDATION

Agendize for December 21 Board meeting: Adopt resolution to support submission of the Basin 8-1 Alternative to the California Department of Water Resources to comply with the Sustainable Groundwater Management Act which includes the following actions:
- Authorize the General Manager to submit the Alternative to DWR
- Authorize the General Manager to submit other required information and make minor modifications to the Alternative
- Authorize staff to file a notice of exemption with respect to the California Environmental Quality Act

BACKGROUND/ANALYSIS

On September 16, 2014 Governor Brown signed three bills (SB1168, AB1739, and SB1319), which comprise the Sustainable Groundwater Management Act (Act).

The Act requires that all high- and medium-priority basins designated by the Department of Water Resources (DWR) be sustainably managed. DWR designated the Coastal Plain of Orange County Groundwater Basin (Basin 8-1) as a medium-priority basin, primarily due to heavy reliance on the basin's groundwater as a source of water supply.

Compliance with the Act can be achieved by one of two options:

1) Forming a Groundwater Sustainability Agency (GSA) and submitting a Groundwater Sustainability Plan (GSP), or
2) Submitting an Alternative to a GSP

Basin 8-1, as defined by DWR, includes areas within and outside of OCWD's jurisdiction as shown in Figure 1. Approximately 89 percent of Basin 8-1 is within OCWD's jurisdiction. Areas outside of OCWD include a northern section within the cities of La Habra and Brea, land along the Santa Ana River upstream of Imperial Highway, and land outside of the southern and southeastern OCWD boundary within the jurisdiction of Irvine Ranch Water District, El Toro Water District and the city of Orange.

SGMA identified OCWD as the exclusive local agency to comply with the SGMA within its boundaries (§10723(c)(1)(K)); however, to be eligible to submit an Alternative to a GSP, the entirety of Basin 8-1 must be included in the Alternative and it must be demonstrated that Basin 8-1 has been sustainability managed.

The agencies within Basin 8-1 have agreed to prepare and submit an Alternative to a GSP, which is referred to as the Basin 8-1 Alternative. In accordance with §10733.6(b)(3), the Basin 8-1 Alternative presents an analysis that demonstrates the basin has operated sustainably over a period of at least 10 years. In fact, Basin 8-1 has been operated sustainably for more than 10 years without experiencing the undesirable results, which are defined by the California Water Code as significant and unreasonable lowering of groundwater levels, reduction in storage, water quality degradation, seawater intrusion, inelastic land subsidence, or depletions of interconnected surface water that impacts beneficial uses of surface water. Since the basin has been sustainably managed and no new actions are required, the Basin 8-1 Alternative essentially describes the ongoing actions that will continue sustainable management of the basin. The Alternative does not authorize or otherwise empower the other submitting agencies (La Habra and IRWD) to require OCWD to take any action or refrain from taking any action.

The Basin 8-1 Alternative was jointly prepared by the Orange County Water District (OCWD) and agencies with jurisdiction outside of OCWD's boundaries, including the City of La Habra and the Irvine Ranch Water District (IRWD). Table 1 shows the lead agencies responsible for preparing the sections covering the management areas.

Table 1: Lead Agencies for Preparation of Basin 8-1 Alternative

Agency	Management Area
City of La Habra	La Habra/Brea
OCWD	OCWD
OCWD	Santa Ana Canyon
Irvine Ranch Water District	South East

Other agencies within Basin 8-1 support submission of the Basin 8-1 Alternative and either have participated in preparing the Alternative and/or reviewed the Alternative. These agencies include the cities of Brea, Corona, Orange, and Chino Hills; the Counties of Orange, Riverside, and San Bernardino; Yorba Linda Water District, and the El Toro

Water District. Pursuant to §10733.2, the Basin 8-1 Alternative has been prepared by or under the direction of a professional geologist or professional engineer.

In the Basin 8-1 Alternative, four management areas were identified as shown in Figure 1. Accordingly, the Basin 8-1 Alternative is organized as follows:

- **Overview**: Provides a map and description of Basin 8-1 and a brief description of the basin management areas.
- **Hydrology of Basin 8-1**: Provides a description of the hydrogeology of Basin 8-1 including a description of the basin, the aquifer systems, fault zones, total basin volume, basin cross-sections, basin characteristics, and general groundwater quality.
- **La Habra-Brea Management Area**
- **OCWD Management Area**
- **South East Management Area**
- **Santa Ana Canyon Management Area**

A draft Basin 8-1 Alternative was posted on OCWD's website on November 8, 2016 and was distributed to the other participating agencies for public review. No public comments were received on the draft document. The final version of this report is complete and ready to submit to DWR.

The Basin 8-1 Alternative is exempt from CEQA because the Alternative is an informational document that does not bind, commit or predispose OCWD or other cooperating agencies to further consideration, approval or implementation of any potential project. Submission of the Basin 8-1 Alternative would not cause either a direct physical change to the environment or a reasonably foreseeable indirect physical change to the environment.

Submission to DWR

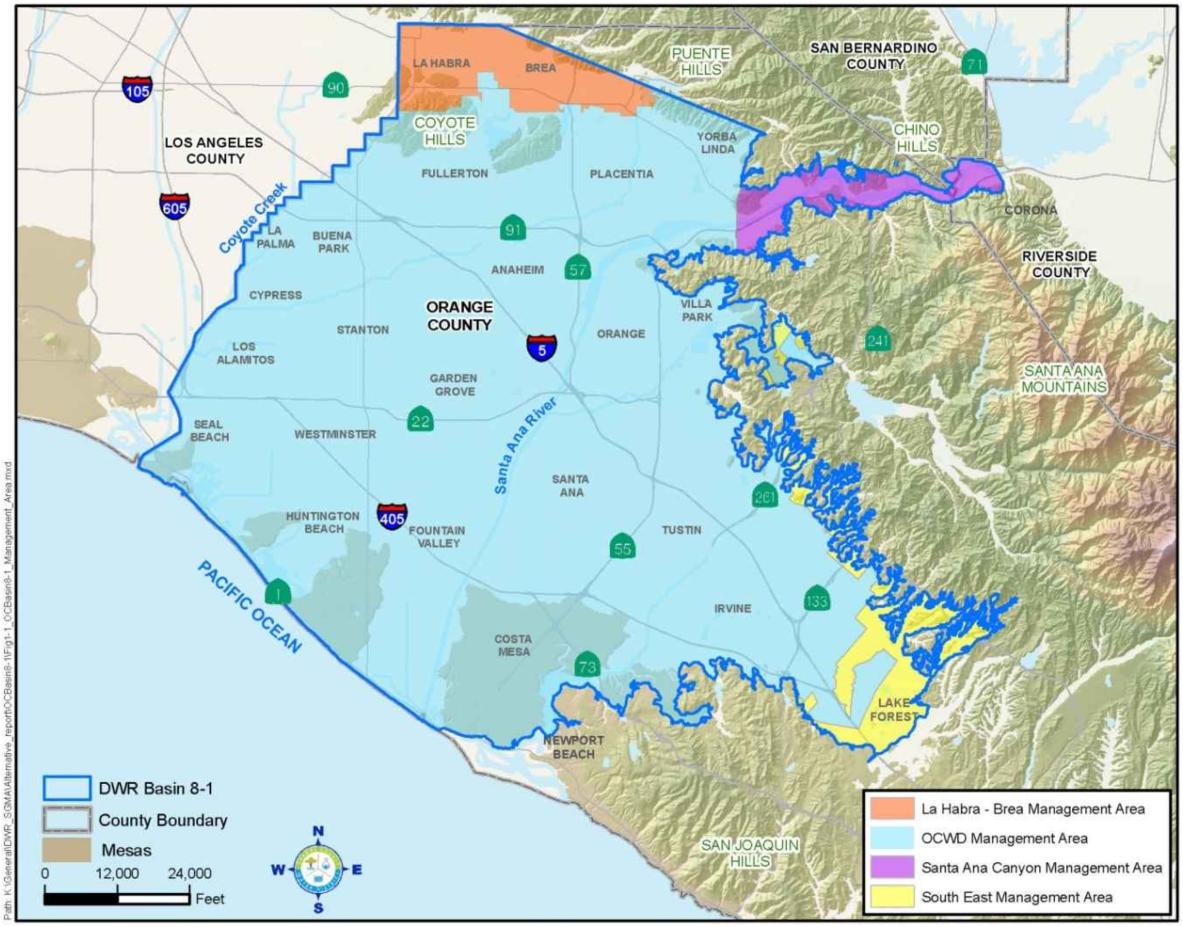
The Basin 8-1 Alternative must be submitted to the DWR by the statutory deadline of January 1, 2017. If the Alternative is not submitted by January 1, 2017, the District would need to become a GSA and submit a GSP. Development of a GSP is more arduous than an Alternative and it is advantageous for the District to comply with SGMA by submitting the Alternative. Additionally, if the District becomes a GSA for the OCWD boundaries, one or more separate GSAs would need to be formed for the areas outside OCWD's boundaries in the Irvine area and the Santa Ana Canyon area.

As part of the submittal to DWR, OCWD must include a resolution or other evidence of compliance that indicates that the Alternative satisfies the objectives of SGMA. The attached resolution satisfied this requirement and authorizes:

- The General Manager or designee to submit the Basin 8-1 Alternative to DWR
- The General Manager or designee to submit other required information and make minor modifications to the Alternative
- District staff to file a notice of CEQA exemption regarding submission of the Basin 8-1 Alternative.

After the Basin 8-1 Alternative is submitted to DWR, DWR will post on their website to allow for 60 days of public review. DWR has indicated that it may take up to one year to complete their review of Alternatives. Once DWR approves the Basin 8-1 Alternative, the lead agencies within each management area will be required to update the Alternative every 5 years.

Figure 1
Management Areas in Basin 8-1 Alternative



PRIOR RELEVANT BOARD ACTION(S)

07-16-14, R14-7-104	Adopt Groundwater Management Legislation Policy Principles
08-20-14, M14-119	Adopt Support if Amended Position on State Legislation - SB1168/ AB1739 (Groundwater Management Legislation)
10-15-14, M14-160	Direct staff to identify steps for managing Groundwater Outside of District Boundaries (Sustainable Groundwater Management Act)
10-21-15	Water Issues Committee – Informational Sustainable Groundwater Management Act: Compliance Options
11-9-16	Water Issues Committee - Provide comments as appropriate on Draft Basin 8-1 Alternative to Comply with the Sustainable Groundwater Management Act.

CERTIFICATION OF SECRETARY

I do hereby certify that at its meeting held December 21, 2016, the Orange County Water District Board of Directors approved and adopted the following resolution:

RESOLUTION OF THE
BOARD OF DIRECTORS OF THE ORANGE COUNTY WATER DISTRICT
TO SUPPORT SUBMISSION OF BASIN 8-1 ALTERNATIVE TO THE CALIFORNIA
DEPARTMENT OF WATER RESOURCES TO COMPLY WITH THE SUSTAINABLE
GROUNDWATER MANAGEMENT ACT.
(CCR, Title 23, Division 2, Chapter 1.5, Subchapter 1)

WHEREAS, California Governor Jerry Brown signed into law Senate Bills 1168 and 1319 and Assembly Bill 1739, collectively comprising the Sustainable Groundwater Management Act (SGMA), which took effect on January 1, 2015; and,

WHEREAS, the SGMA requires all high and medium priority groundwater basins as designated by the California Department of Water Resources (DWR) to develop a process that will lead to or ensure continuation of sustainable groundwater management; and,

WHEREAS, the SGMA has designated the Orange County Water District (OCWD) as the exclusive local agency within its statutory boundaries to comply with SGMA per Water Code Section 10723 (c)(1); and,

WHEREAS, the SGMA allows local agencies to submit an Alternative to a Groundwater Sustainability Plan (Alternative) by January 1, 2017 that shows an entire basin has been sustainably managed for 10 years or more and otherwise satisfies the objectives of SGMA (Water Code Section 10733.6 (b)(3)); and,

WHEREAS, OCWD has consulted with and has been working with other affected Counties, local agencies, public water systems, and stakeholders that are within or adjacent to the Coastal Plain of Orange County Groundwater Basin, a medium priority basin, designated in DWR Bulletin 118 as Basin 8-1 (Basin 8-1); and,

WHEREAS, to be approved by DWR an Alternative must demonstrate management of an entire Bulletin 118 basin; and

WHEREAS, OCWD's boundaries cover a majority of, but not all of the area within Basin 8-1; and,

WHEREAS, a number of local agencies overlie areas of Basin 8-1 that fall outside of OCWD's boundaries; and,

WHEREAS, OCWD, in collaboration with other agencies, principally the City of La Habra and Irvine Ranch Water District, has prepared and compiled an Alternative that will facilitate and ensure sustainable management in the entirety of the Basin 8-1; and,

WHEREAS, OCWD, the City of La Habra, and the Irvine Ranch Water District have agreed to jointly submit the Alternative to DWR and are referred to in the Alternative submission as 'submitting agencies'; and,

WHEREAS, the Alternative does not authorize (or otherwise empower) the other submitting agencies to require OCWD to take any action, or refrain from taking any action; and,

WHEREAS, the Alternative discusses Basin 8-1's physical features, the OCWD's facilities and monitoring and operating programs, and the management tools available to manage the basin for each of the submitting agencies, but does not bind, commit, or predispose OCWD to further consideration, approval or implementation of any potential project; and,

WHEREAS, Submission of the Alternative to DWR does not have the effect of approving any current or future project but instead describes a continuing process of groundwater management that OCWD has utilized in largely the same manner since prior to the enactment of the California Environmental Quality Act (CEQA) in 1970; and,

WHEREAS, If any individual future project discussed in the Alternative is carried forward by the District for approval, an Engineer's Report will be prepared for that potential project for consideration by the Board of Directors, as required by Section 20.7 of the District Act. The District will also concurrently conduct appropriate environmental analysis in accordance with CEQA with respect to each potential project that is carried forward for consideration and possible approval by the OCWD Board of Directors; and,

WHEREAS, submission of the Alternative will not cause either a direct physical change in the environment or a reasonably foreseeable indirect physical change in the environment, and is therefore not a "project" regulated by CEQA. To the extent it could be considered a "project" for purposes of CEQA, the Alternative is exempt from CEQA per State CEQA Guidelines Sections 15261 (Ongoing Project), 15262 (Feasibility and Planning Studies), and 15306 (Information Collection and Management); and,

WHEREAS, DWR has a statutory deadline of January 1, 2017 by which the Alternative for all of Basin 8-1, must be submitted to DWR; and,

WHEREAS, the submitting agencies are prepared to submit the Alternative covering all of Basin 8-1 to DWR.

NOW, THEREFORE, BE IT RESOLVED AND HEREBY ORDERED that the Orange County Water District Board of Directors approves the following:

1. The Orange County Water District authorizes the General Manager or his designee to submit the Basin 8-1 Alternative to DWR.
2. The General Manager or his designee is authorized to submit other required information associated with the Alternative to DWR and/or make minor modifications to the Alternative in response to comments on the Alternative.

3. District staff is authorized and directed to file a notice of exemption in accordance with CEQA regarding OCWD's submission of the Alternative.

IN WITNESS WHEREOF, I have executed this Certificate on December 21, 2016

Judy-Rae Karlsen, Assistant District Secretary

Orange County Water District
18700 Ward Street
Fountain Valley, CA 92708
(714) 378-3200

NOTICE OF EXEMPTION

From the Requirements of the California Environmental Quality Act (CEQA)

TO: County Clerk/County of Orange
P.O. Box 238
Santa Ana, CA 92702

State Clearinghouse
P.O. Box 3044
Sacramento, CA 95812-3044

FROM: Orange County Water District
Planning & Watershed Management
18700 Ward Street
Fountain Valley, CA 92708

PROJECT TITLE: Submission of Basin 8-1 Alternative to comply with Sustainable Groundwater Management Act

APPROVAL DATE: December 21, 2016

PROJECT LOCATION: CA Department of Water Resources Basin 8-1 (primarily in north & central Orange County) – see figure on next page
CITY: Various **COUNTY**: Orange, Riverside, San Bernardino

DESCRIPTION OF THE PROJECT: The submission of the Basin 8-1 Alternative to comply with the Sustainable Groundwater Management Act assists the Orange County Water District with documenting that Basin 8-1 identified by the CA Department of Water Resources (DWR) has been sustainably managed over a period of at least 10 years.

NAME & ADDRESS OF APPLICANT: Orange County Water District, 18700 Ward Street, Fountain Valley CA 92708

NAME OF PUBLIC AGENCY APPROVING PROJECT: Orange County Water District

EXEMPT STATUS:

☐ Ministerial (Sec. 15268)
☐ Declared Emergency (Sec. 15269 (a))
☐ Emergency Project (Sec. 15269(a)&(b))
☐ General Rule (Sec. 15061(b)(3))
X Statutory Exemption: Section 15261, Section 15262
X Categorical Exemption: Class 6 Section 15306

REASON(S) WHY PROJECT IS EXEMPT FROM CEQA:
Submission of the Basin 8-1 Alternative to DWR does not have the effect of approving any current or future project but instead describes a continuing process of groundwater management that OCWD has utilized in largely the same manner since prior to the enactment of the California Environmental Quality Act (CEQA) in 1970. Additionally, submission of the Alternative will not cause either a direct physical change in the environment or a reasonably foreseeable indirect physical change in the environment, and is therefore not a "project" regulated by CEQA. To the extent it could be considered a "project" for purposes of CEQA, the Alternative is exempt from CEQA per State CEQA Guidelines Sections 15261 (Ongoing Project), 15262 (Feasibility and Planning Studies), and 15306 (Information Collection and Management).

Orange County Water District
18700 Ward Street
Fountain Valley, CA 92708
(714) 378-3200

CONTACT PERSON: Adam Hutchinson

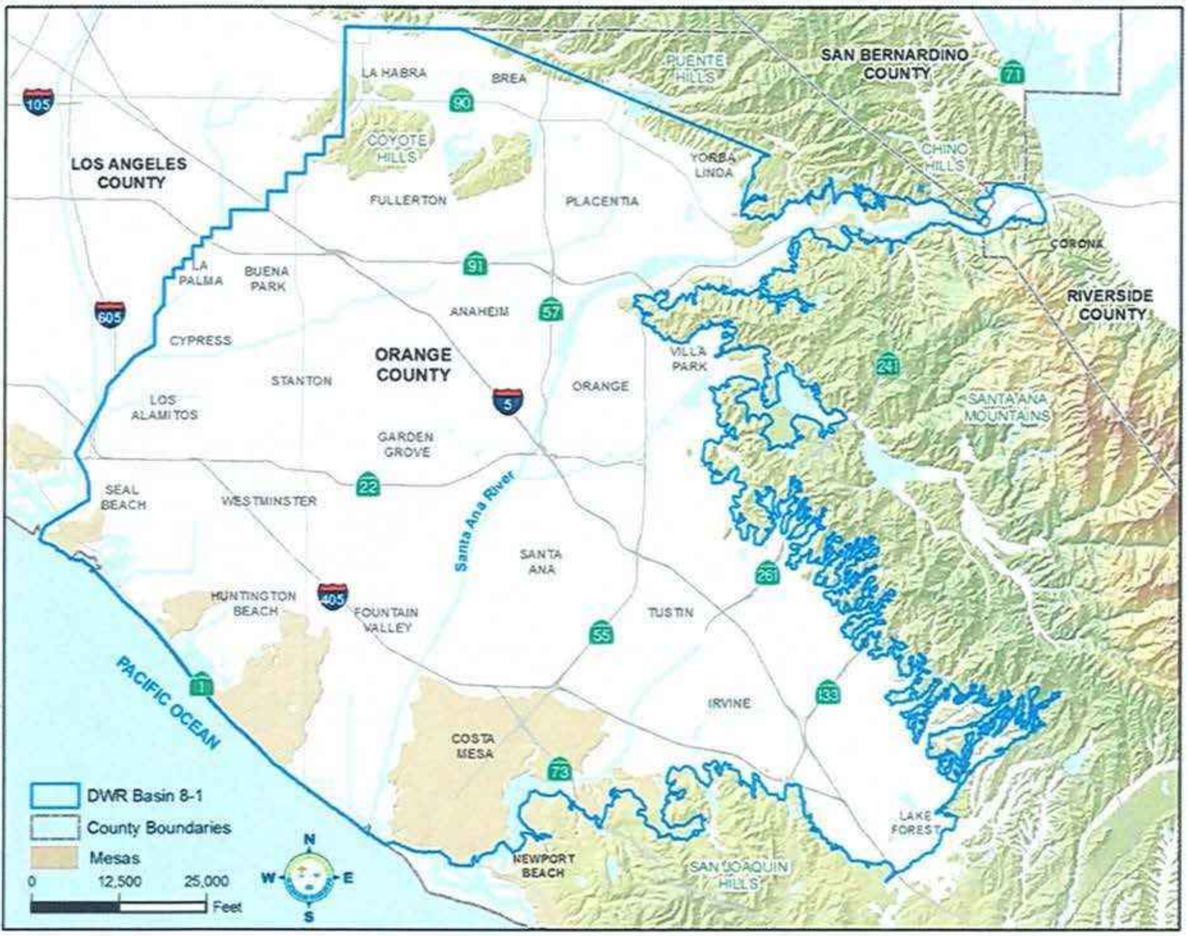
TELEPHONE No: 714 378-3214

SIGNATURE: ______________________

DATE: December 22, 2016

TITLE: Recharge Planning Manager

Figure showing Location of CA Department of Water Resources Basin 8-1



City of La Habra
ADMINISTRATION

"A Caring Community"

201 E. La Habra Boulevard
Post Office Box 337
La Habra, CA 90633-0785
Office: (562) 383-4010
Fax: (562) 383-4474

December 19, 2016

Michael R. Markus
General Manager
Orange County Water District
18700 Ward Street,
Fountain Valley, CA 92708

Re: City of La Habra Support for Orange County Water District Alternative Plan for Basin 8-1 Under the Sustainable Groundwater Management Act

Dear Mr. Markus:

The City of La Habra ("City") supports Orange County Water District's Alternative Plan under the Sustainable Groundwater Management Act. The City recognizes OCWD's dilemma in satisfying the Department of Water Resources' requirement that the OCWD Alternative Plan must cover portions of Basin 8-1 (DWR Bulletin 118) which are outside of OCWD's jurisdiction. So, when we met in June this year the City agreed to collaborate with OCWD in preparation of the OCWD Alternative Plan. Reciprocally, OCWD adopted a resolution in support the City's request to DWR to re-establish the La Habra Basin as separate from the balance of Basin 8-1.

The City staff, consultants and attorneys have collaborated with OCWD in the development of the OCWD Alternative Plan. The Plan accurately characterizes La Habra Basin as a management area separate and apart from the OCWD management area, even though both are depicted in Bulletin 118 as being within Basin 8-1. The OCWD Alternative plan also accurately describes the City as the recognized the GSA for groundwater resources underlying the cities of La Habra and Brea. The Plan also accurately describes the City's past and current sustainable groundwater management practices and City's intent to develop a Groundwater Sustainability Plan under SGMA for the La Habra management area. The City endorses the portions of the OCWD Alternative Plan which describe the La Habra management area and the past and intended future groundwater sustainability actions therein.

Separate and independent sustainable groundwater management programs for the Orange County Basin and the La Habra Basin have co-existed for many years. The City of La Habra fully intends that relationship to continue into the future. To that end, the City, as GSA for La Habra Basin, will continue to cooperate and collaborate with OCWD on mutual concerns related to SGMA and to sustainable groundwater management practices.

The City of La Habra endorses those portions of the OCWD Alternative Plan related to the La Habra management area and fully supports OCWD's efforts to comply with SGMA through the OCWD Alternative Plan. If OCWD desires, you may use this letter as part of the

OCWD Alternative Plan submittal to DWR.

Sincerely,

Jim Sadro
City Manager

CC: City Manager, City of Brea
City Manager, City of Fullerton

APPENDIX H

Water Shortage Contingency Plan

CITY OF SEAL BEACH
CALIFORNIA

ARCADIS

MADDAUS
WATER
MANAGEMENT INC.

June 2021

2020 Water Shortage Contingency Plan

Final Draft

2020 Water Shortage Contingency Plan

June 2021

Prepared By:
Arcadis U.S., Inc.
320 Commerce, Suite 200
Irvine
California 92602
Phone: 714 730 9052
https://www.arcadis.com

Prepared For:
City of Seal Beach
218 8th Street
Seal Beach
California 90740
Phone: 562 431 2527
https://www.sealbeachca.gov/

Maddaus Water Management, Inc.
Danville, California 94526
Sacramento, California 95816
www.maddauswater.com

Our Ref:
30055240

Lisa Maddaus, P.E.
Technical Lead

Sarina Sriboonlue, P.E.
Project Manager

Contents

Tables

Figures

Appendices

Acronyms and Abbreviations

%	Percent
AF	Acre-Feet
Annual Assessment	Annual Water Supply and Demand Assessment
BPP	Basin Production Percentage
City	City of Seal Beach
CRA	Colorado River Aqueduct
DDW	Division of Drinking Water
DRA	Drought Risk Assessment
DVL	Diamond Valley Lake
DWR	California Department of Water Resources
EAP	Emergency Operations Center Actions Plan
EOC	Emergency Operation Center
EOP	Emergency Operations Plan
FY	Fiscal Year
GSP	Groundwater Sustainability Plan
HMP	Hazard Mitigation Plan
IAWP	Interim Agricultural Water Program
IRP	Integrated Water Resource Plan
M&I	Municipal and Industrial
MCL	Maximum Contaminant Level
MET	Metropolitan Water District of Southern California
Metropolitan Act	Metropolitan Water District Act
MWDOC	Municipal Water District of Orange County
NIMS	National Incident Management System
OCWD	Orange County Water District
PFAS	Per- and Polyfluoroalkyl Substances
PFOA	Perfluorooctanoic Acid
PFOS	Perfluorooctane Sulfanate
Producer	Groundwater Producer
SEMS	California Standardized Emergency Management System
Supplier	Urban Water Supplier
SWP	State Water Project
SWRCB	California State Water Resources Control Board
UWMP	Urban Water Management Plan
Water Code	California Water Code
WEROC	Water Emergency Response Organization of Orange County
WSAP	Water Supply Allocation Plan
WSCP	Water Shortage Contingency Plan
WSDM	Water Surplus and Drought Management Plan

1 INTRODUCTION AND WSCP OVERVIEW

The Water Shortage Contingency Plan (WSCP) is a strategic planning document designed to prepare for and respond to water shortages. This WSCP complies with California Water Code (Water Code) Section 10632, which requires that every urban water supplier (Supplier) shall prepare and adopt a WSCP as part of its Urban Water Management Plan (UWMP). This level of detailed planning and preparation is intended to help maintain reliable supplies and reduce the impacts of supply interruptions.

The WSCP is the City of Seal Beach (City)'s operating manual that is used to prevent catastrophic service disruptions through proactive, rather than reactive, management. A water shortage, when water supply available is insufficient to meet the normally expected customer water use at a given point in time, may occur due to a number of reasons, such as drought, climate change, and catastrophic events. This plan provides a structured guide for the City to deal with water shortages, incorporating prescriptive information and standardized action levels, along with implementation actions in the event of a catastrophic supply interruption. This way, if and when shortage conditions arise, the City's governing body, its staff, and the public can easily identify and efficiently implement pre-determined steps to manage a water shortage. A well-structured WSCP allows real-time water supply availability assessment and structured steps designed to respond to actual conditions, to allow for efficient management of any shortage with predictability and accountability.

The WSCP also describes the City's procedures for conducting an Annual Water Supply and Demand Assessment (Annual Assessment) that is required by Water Code Section 10632.1 and is to be submitted to the California Department of Water Resources (DWR) on or before July 1 of each year, or within 14 days of receiving final allocations from the State Water Project (SWP), whichever is later. The City's 2020 WSCP is included as an appendix to its 2020 UWMP, which will be submitted to DWR by July 1, 2021. However, this WSCP is created separately from the City's 2020 UWMP and can be amended, as needed, without amending the UWMP. Furthermore, the Water Code does not prohibit a Supplier from taking actions not specified in its WSCP, if needed, without having to formally amend its UWMP or WSCP.

1.1 Water Shortage Contingency Plan Requirements and Organization

The WSCP provides the steps and water shortage response actions to be taken in times of water shortage conditions. The WSCP has prescriptive elements, such as an analysis of water supply reliability; the water shortage response actions for each of the six standard water shortage levels that correspond to water shortage percentages ranging from 10% to greater than 50%; an estimate of potential to close supply gap for each measure; protocols and procedures to communicate identified actions for any current or predicted water shortage conditions; procedures for an Annual Assessment; monitoring and reporting requirements to determine customer compliance; and reevaluation and improvement procedures for evaluating the WSCP.

This WSCP is organized into three main sections, with Section 3 aligned with Water Code Section 16032 requirements.

Section 1 Introduction and WSCP Overview gives an overview of the WSCP fundamentals.

Section 2 Background provides a background on the City's water service area.

Section 3 Water Shortage Contingency Preparedness and Response Planning

Section 3.1 Water Supply Reliability Analysis provides a summary of the water supply analysis and water reliability findings from the 2020 UWMP.

Section 3.2 Annual Water Supply and Demand Assessment Procedures provide a description of procedures to conduct and approve the Annual Assessment.

Section 3.3 Six Standard Water Shortage Stages explains the WSCP's six standard water shortage levels corresponding to progressive ranges of up to 10, 20, 30, 40, 50, and more than 50% shortages.

Section 3.4 Shortage Response Actions describes the WSCP's shortage response actions that align with the defined shortage levels.

Section 3.5 Communication Protocols addresses communication protocols and procedures to inform customers, the public, interested parties, and local, regional, and state governments, regarding any current or predicted shortages and any resulting shortage response actions.

Section 3.6 Compliance and Enforcement describes customer compliance, enforcement, appeal, and exemption procedures for triggered shortage response actions.

Section 3.7 Legal Authorities is a description of the legal authorities that enable the City to implement and enforce its shortage response actions.

Section 3.8 Financial Consequences of the WSCP provides a description of the financial consequences of and responses for drought conditions.

Section 3.9 Monitoring and Reporting describes monitoring and reporting requirements and procedures that ensure appropriate data is collected, tracked, and analyzed for purposes of monitoring customer compliance and to meet state reporting requirements**.**

Section 3.10 WSCP Refinement Procedures addresses reevaluation and improvement procedures for monitoring and evaluating the functionality of the WSCP.

Section 3.11 Special Water Feature Distinction is a required definition for inclusion in a WSCP per the Water Code.

Section 3.12 Plan Adoption, Submittal, and Implementation provides a record of the process the City followed to adopt and implement its WSCP.

1.2 Integration with Other Planning Efforts

As a retail water supplier in Orange County, the City considered other key entities in the development of this WSCP, including the Municipal Water District of Orange County ([MWDOC] (regional wholesale supplier)), the Metropolitan Water District of Southern California ([MET] (regional wholesaler for Southern California and the direct supplier of imported water to MWDOC)), and Orange County Water District ([OCWD] (Orange County Groundwater Basin manager and provider of recycled water in North Orange County). As a MWDOC member agency, the City also developed this WSCP with input from several coordination efforts led by MWDOC.

Some of the key planning and reporting documents that were used to develop this WSCP are:

- **MWDOC's 2020 UWMP** provides the basis for the projections of the imported supply availability over the next 25 years for the City's service area.
- **MWDOC's 2020 WSCP** provides a water supply availability assessment and structured steps designed to respond to actual conditions that will help maintain reliable supplies and reduce the impacts of supply interruptions.
- **2021 Orange County Water Demand Forecast for MWDOC and OCWD Technical Memorandum (Demand Forecast TM)** provides the basis for water demand projections for MWDOC's member agencies as well as Anaheim, Fullerton, and Santa Ana.
- **MET's 2020 Integrated Water Resources Plan (IRP)** is a long-term planning document to ensure water supply availability in Southern California and provides a basis for water supply reliability in Orange County.
- **MET's 2020 UWMP** was developed as a part of the 2020 IRP planning process and was used by MWDOC as another basis for the projections of supply capability of the imported water received from MET.
- **MET's 2020 WSCP** provides a water supply assessment and guide for MET's intended actions during water shortage conditions.
- **OCWD's 2019-20 Engineer's Report** provides information on the groundwater conditions and basin utilization of the Orange County Groundwater Basin (OC Basin).
- **OCWD's 2017 Basin 8-1 Alternative** is an alternative to the Groundwater Sustainability Plan (GSP) for the OC Basin and provides significant information related to sustainable management of the basin in the past and hydrogeology of the basin, including groundwater quality and basin characteristics.
- **2020 Local Hazard Mitigation Plan (HMP)** provides the basis for the seismic risk analysis of the water system facilities.
- **Orange County Local Agency Formation Commission's 2020 Municipal Service Review for MWDOC Report** provides a comprehensive service review of the municipal services provided by MWDOC.
- **Water Master Plan and Sewer Master Plan** of the City provide information on water infrastructure planning projects and plans to address any required water system improvements.
- **Groundwater Management Plans** provide the groundwater sustainability goals for the basins in the MWDOC's service area and the programs, actions, and strategies activities that support those goals.

2 BACKGROUND INFORMATION

The City is a predominantly residential community located along the California coastline in Orange County. It was incorporated in 1915 and became a charter city in 1964. The City is administered under a council-manager form of government and is governed by a five-member City council elected by district serving four-year alternating terms. Originally called Bay City, Seal Beach was developed in the early 1900's as a resort destination for residents of the Los Angeles area. Its early growth was accelerated by the construction of the Pacific Electric Railway Trolley, and in 1926, oil was discovered in the City, and the oil boom that followed resulted in the development of Seal Beach into the residential community it is today.

2.1 City Service Area

The City is bordered to the north by the City of Los Alamitos, and the unincorporated Rossmoor community; to the east by the Cities of Garden Grove, Westminster, and Huntington Beach; to the south by the Pacific Ocean and City of Huntington Beach; and to the west by the City of Long Beach.

Rossmoor Center, located in the City, is served by an investor-owned water utility, the Golden State Water Company, and thus, the WSCP is limited to those communities receiving water service from the City and covers an aerial extent of approximately 7,135 acres within the City's boundaries. The Leisure World Retirement Community, with 6,808 dwelling units, is served by the City through three master meters. The City maintains the water distribution facilities and the fire hydrants within Leisure World.

The service area is divided into several distinct communities as shown in Figure 2-1 and described below:

- **Old Town**, which is the area south of Pacific Coast Highway and Marina Drive, between First Street and Seal Beach Boulevard, was developed in the 1920's. It is the oldest area of the City. High density residential and commercial land uses are prevalent. Large single-family residential lots are found in the Gold Coast District. The City's mile long beach in Old Town is used for surfing and swimming. The Seal Beach Pier, located at the end of Main Street, provides fishing facilities.
- **Bridgeport** is the area west of Pacific Coast Highway north of Marina Drive and southeast of the San Gabriel River. It was primarily developed in the 1960's and consists of medium and high-density residential land uses. It includes the Seal Beach Trailer Park, and Oakwood Apartments. Old Town and Bridgeport cover 276 acres.
- **Marina Hill** was developed in the 1950's and consists mostly of single-family homes. This area covers 201 acres north of Pacific Coast Highway and west of Seal Beach Boulevard, adjacent to the south edge of the Hellman Ranch property. It is further divided into Marina Hill-North and Marina Hill South, with Bolsa Avenue forming the boundary.
- **Hellman Ranch** Covers 199 acres and is located west of Seal Beach Boulevard and north of Marina Hill. The development includes 100 acres of open space, freshwater wetlands and 70 single-family residential units.

- **The Boeing Facility, Police Facility and City Yard** are located on 107 acres between Hellman Ranch and Westminster Boulevard, west of Seal Beach Boulevard. This area is zoned for light industry. The Boeing Facility supports Boeing’s commercial aviation program. Engineering and design operations are also conducted from this facility. Development plans for the area include 31 acres of industrial, 19 acres of commercial, and a 120 room hotel on 2 acres.
- **Surfside**, a colony that was incorporated in the 1930’s, became a part of Seal Beach in 1969. The area consists of single-family dwelling units located on 10 acres of the south spit of Anaheim Bay. Although a gated community, pedestrian and bicycle access to the beach is available.
- **Leisure World**, completed in 1962, covers the portion of the City between Westminster Boulevard and the San Diego Freeway westerly of Seal Beach Boulevard. It is a gated community of 533 acres with 6,608 dwelling units, four club houses, and a nine-hole golf course. Leisure World is a retirement community for seniors 55 years and older. Medical, religious, commercial, and recreational facilities are all provided within the compound limits. The existing population is 8,400.
- **College Park East** is a single-family residential area developed in the late 1960’s. It is located on 292 acres between the San Diego Freeway and Lampson Avenue, west of Bolsa Chica Channel in the northeast section of the City.
- **Bixby Old Ranch and Old Ranch Golf Course** are located north of Lampson Avenue and east of Seal Beach Boulevard. Most of Bixby Old Ranch has recently been developed. This area covers 230 acres. The golf course is served through two meters. Irrigation water to the golf course is provided by a private on-site well.
- **College Park West** is a 62-acre small residential community located along San Gabriel River northeast of Leisure World. Water service to College Park West is provided through a metered supply connection from Leisure World.
- **The Seal Beach National Wildlife Refuge** was established in 1972 and preserves 911 acres of salt marsh and upland area in Anaheim Bay. The refuge is located within the boundaries of the U.S. Naval Weapons Station and there is no public access.
- **Sunset Aquatic Park** was acquired by the County in 1962 from the U.S. Navy. It encompasses 67 acres of Anaheim Bay and is the site of a public marina and park.
- **The U.S. Naval Weapons Station** was established in 1944. It covers approximately 5,000 acres of land located between Seal Beach Boulevard and Bolsa Chica Road from the San Diego Freeway to Pacific Coast Highway.

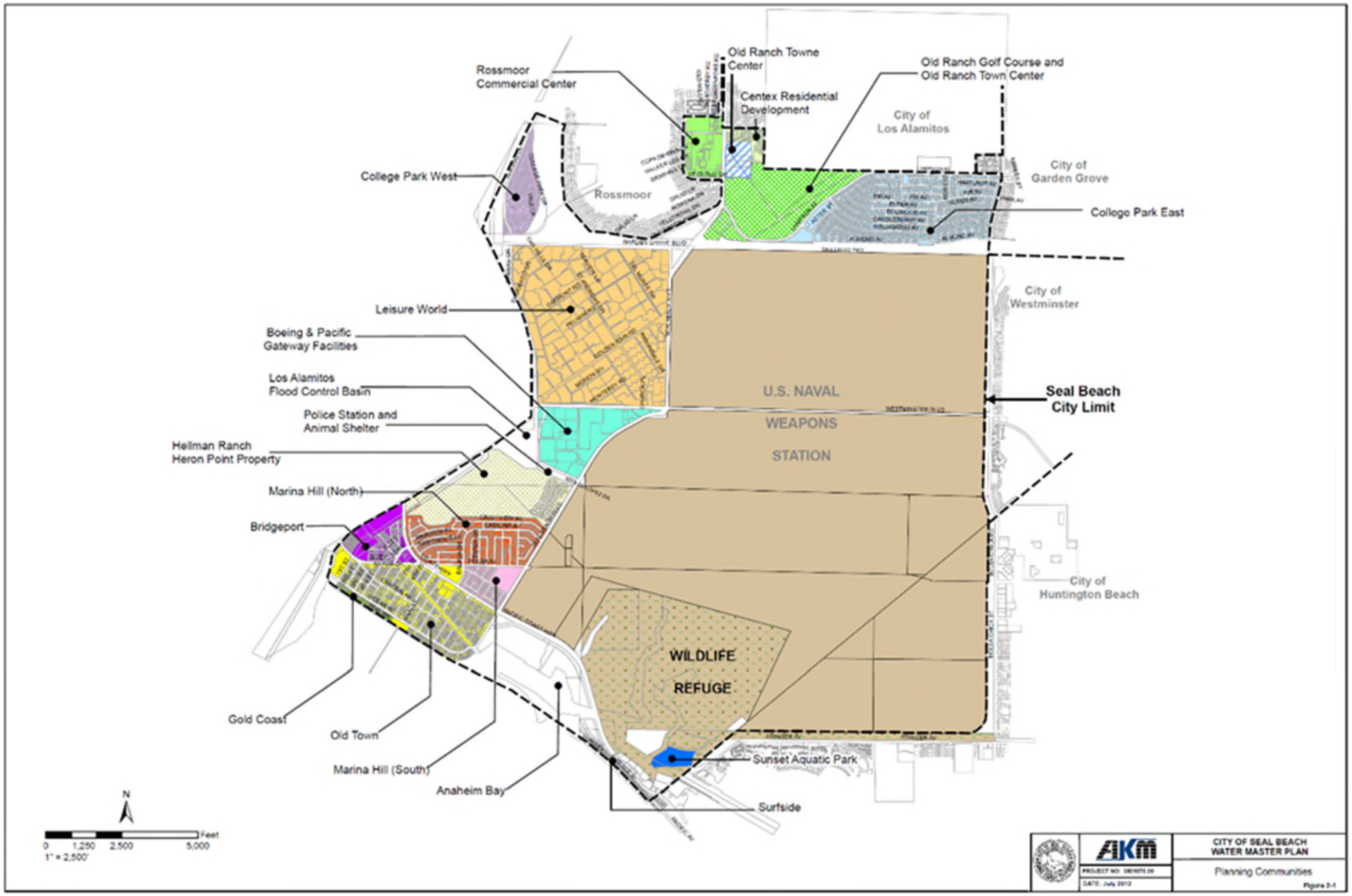


Figure 2-1: City Service Area

2.2 Relationship to Wholesalers

The Metropolitan Water District of Southern California: MET is the largest water wholesaler for domestic and municipal uses in California, serving approximately 19 million customers. MET wholesales imported water supplies to 26 member cities and water districts in six Southern California counties. Its service area covers the Southern California coastal plain, extending approximately 200 miles along the Pacific Ocean from the City of Oxnard in the north to the international boundary with Mexico in the south. This encompasses 5,200 square miles and includes portions of Los Angeles, Orange, Riverside, San Bernardino, San Diego, and Ventura counties. Approximately 85% of the population from the aforementioned counties reside within MET's boundaries.

MET is governed by a Board of Directors comprised of 38 appointed individuals with a minimum of one representative from each of MET’s 26 member agencies. The allocation of directors and voting rights are determined by each agency’s assessed valuation. Each member of the Board shall be entitled to cast one vote for each ten million dollars ($10,000,000) of assessed valuation of property taxable for district purposes, in accordance with Section 55 of the Metropolitan Water District Act (Metropolitan Act). Directors can be appointed through the chief executive officer of the member agency or by a majority vote of the governing board of the agency. Directors are not compensated by MET for their service.

MET is responsible for importing water into the region through its operation of the Colorado River Aqueduct (CRA) and its contract with the State of California for SWP supplies. Member agencies receive water from MET through various delivery points and pay for service through a rate structure made up of volumetric rates, capacity charges and readiness to serve charges. Member agencies provide estimates of imported water demand to MET annually in April regarding the amount of water they anticipate they will need to meet their demands for the next five years.

The Municipal Water District of Orange County: In Orange County, MWDOC and the cities of Anaheim, Fullerton, and Santa Ana are MET member agencies that purchase imported water directly from MET. Furthermore, MWDOC purchases both treated potable and untreated water from MET to supplement its retail agencies’ local supplies.

The City is one of MWDOC’s 28 member agencies receiving imported water from MWDOC. The City’s location within MWDOC’s service area is shown on Figure 2-2.

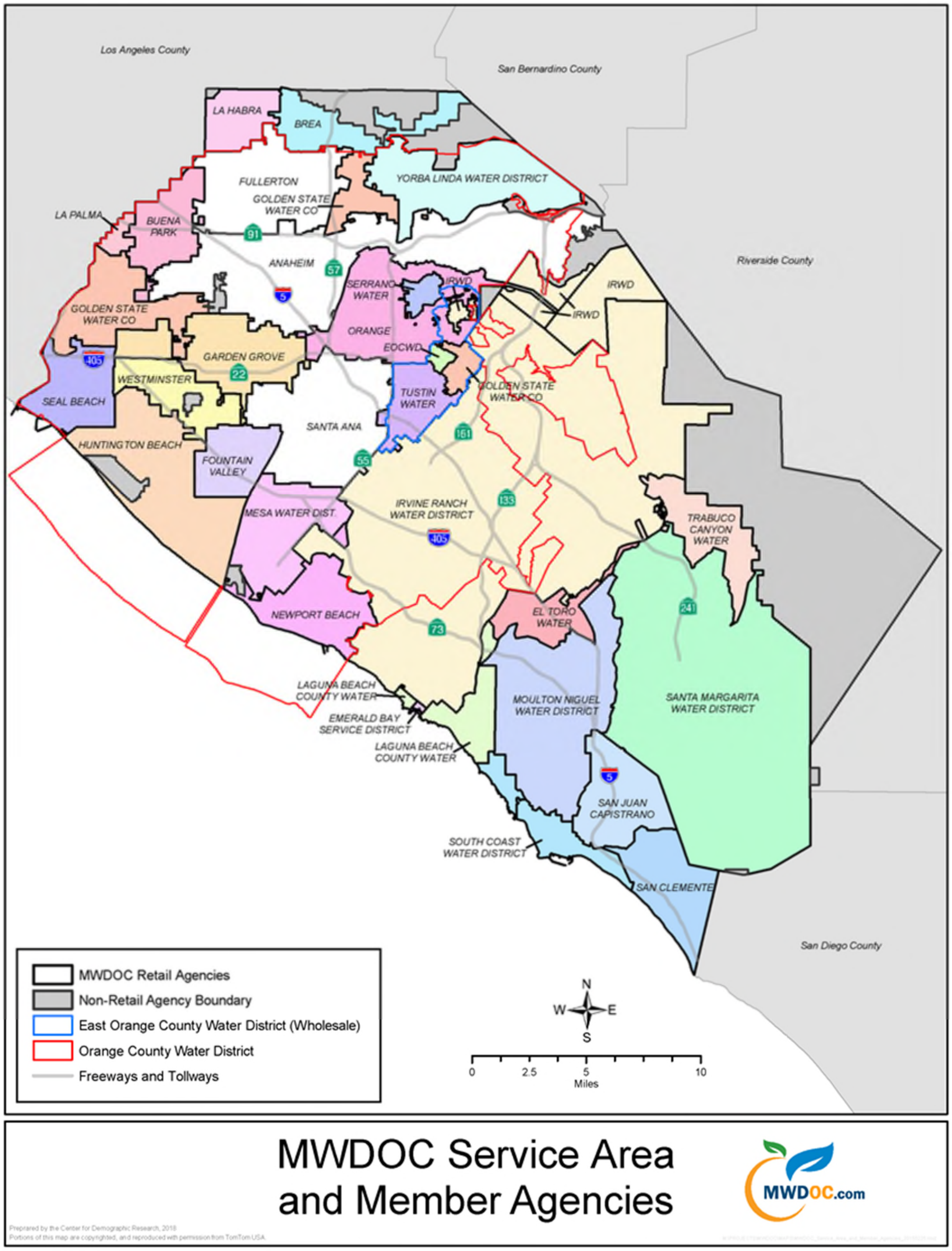


Figure 2-2: Regional Location of the City and Other MWDOC Member Agencies

2.3 Relationship with Wholesaler Water Shortage Planning

The WSCP is designed to be consistent with MET's Water Shortage and Demand Management (WSDM) Plan, MWDOC's Water Supply Allocation Plan (WSAP), and other emergency planning efforts as described below. MWDOC's WSAP is integral to the WSCP's shortage response strategy in the event that MET or MWDOC determines that supply augmentation (including storage) and lesser demand reduction measures would not be sufficient to meet a projected shortage levels needed to meet demands.

2.3.1 MET Water Surplus and Drought Management Plan

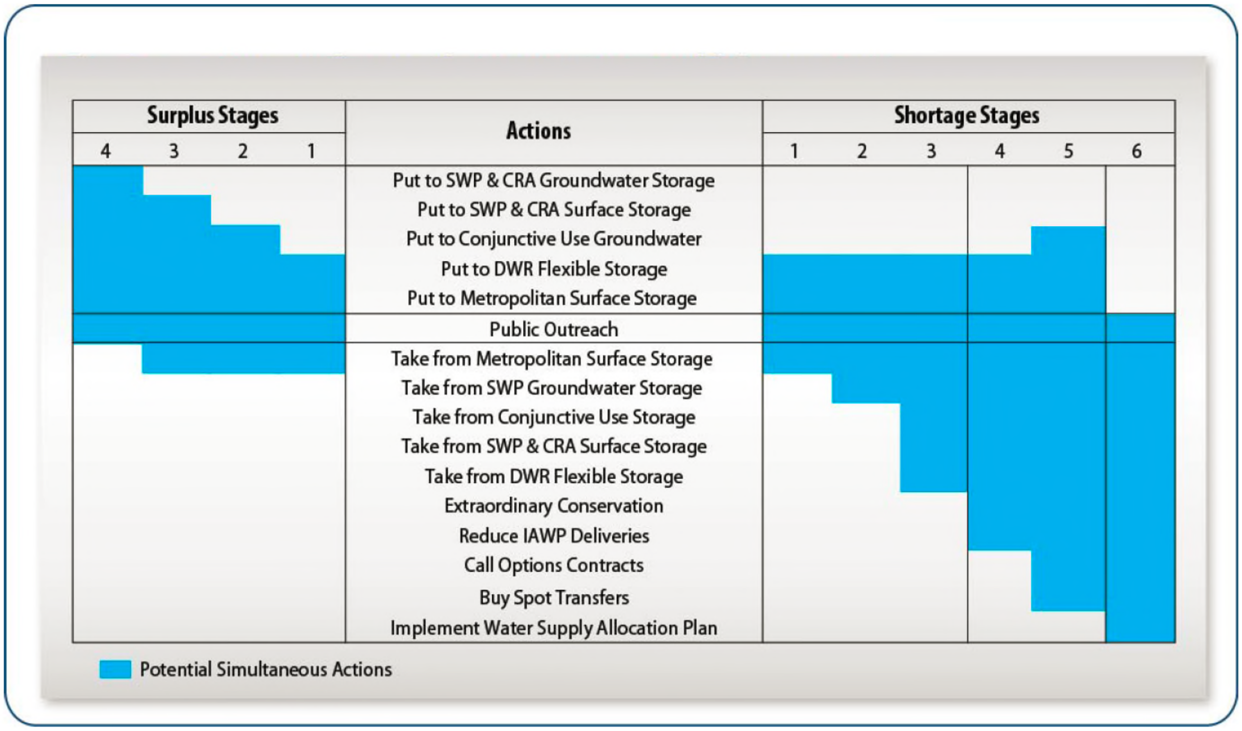
MET evaluates the level of supplies available and existing levels of water in storage to determine the appropriate management stage annually. Each stage is associated with specific resource management actions to avoid extreme shortages to the extent possible and minimize adverse impacts to retail customers should an extreme shortage occur. The sequencing outlined in the WSDM Plan reflects anticipated responses towards MET's existing and expected resource mix.

Surplus stages occur when net annual deliveries can be made to water storage programs. Under the WSDM Plan, there are four surplus management stages that provides a framework for actions to take for surplus supplies. Deliveries in Diamond Valley Lake (DVL) and in SWP terminal reservoirs continue through each surplus stage provided there is available storage capacity. Withdrawals from DVL for regulatory purposes or to meet seasonal demands may occur in any stage.

The WSDM Plan distinguishes between shortages, severe shortages, and extreme shortages. The differences between each term are listed below.

- **Shortage**: MET can meet full-service demands and partially meet or fully meet interruptible demands using stored water or water transfers as necessary (Stages 1-3).
- **Severe Shortage**: MET can meet full-service demands only by making withdrawals from storage, calling on its water transfers, and possibly calling for extraordinary conservation and reducing deliveries under the Interim Agricultural Water Program (IAWP) (Stages 4-5).
- **Extreme Shortage**: MET must allocate available imported supplies to full-service customers (Stage 6).

There are six shortage management stages to guide resource management activities. These stages are defined by shortfalls in imported supply and water balances in MET's storage programs. When MET must make net withdrawals from storage to meet demands, it is considered to be in a shortage condition. Figure 2-3 gives a summary of actions under each surplus and shortage stages when an allocation plan is necessary to enforce mandatory cutbacks. The goal of the WSDM plan is to avoid Stage 6, an extreme shortage (MET, 1999).



Surplus Stages				Actions	Shortage Stages					
4	3	2	1		1	2	3	4	5	6
🟦				Put to SWP & CRA Groundwater Storage						
🟦	🟦			Put to SWP & CRA Surface Storage						
🟦	🟦	🟦		Put to Conjunctive Use Groundwater					🟦	
🟦	🟦	🟦	🟦	Put to DWR Flexible Storage	🟦	🟦	🟦	🟦	🟦	
🟦	🟦	🟦	🟦	Put to Metropolitan Surface Storage	🟦	🟦	🟦	🟦	🟦	
🟦	🟦	🟦	🟦	Public Outreach	🟦	🟦	🟦	🟦	🟦	🟦
	🟦	🟦	🟦	Take from Metropolitan Surface Storage	🟦	🟦	🟦	🟦	🟦	🟦
				Take from SWP Groundwater Storage		🟦	🟦	🟦	🟦	🟦
				Take from Conjunctive Use Storage			🟦	🟦	🟦	🟦
				Take from SWP & CRA Surface Storage			🟦	🟦	🟦	🟦
				Take from DWR Flexible Storage			🟦	🟦	🟦	🟦
				Extraordinary Conservation				🟦	🟦	🟦
				Reduce IAWP Deliveries				🟦	🟦	🟦
				Call Options Contracts					🟦	🟦
				Buy Spot Transfers					🟦	🟦
				Implement Water Supply Allocation Plan						🟦

🟦 Potential Simultaneous Actions

Figure 2-3: Resource Stages, Anticipated Actions, and Supply Declarations
Source: MET, 1999.

MET's Board of Directors adopted a Water Supply Condition Framework in June 2008 in order to communicate the urgency of the region's water supply situation and the need for further water conservation practices. The framework has four conditions, each calling increasing levels of conservation. Descriptions for each of the four conditions are listed below:

- Baseline Water Use Efficiency: Ongoing conservation, outreach, and recycling programs to achieve permanent reductions in water use and build storage reserves.
- Condition 1 Water Supply Watch: Local agency voluntary dry-year conservation measures and use of regional storage reserves.
- Condition 2 Water Supply Alert: Regional call for cities, counties, member agencies, and retail water agencies to implement extraordinary conservation through drought ordinances and other measures to mitigate use of storage reserves.
- Condition 3 Water Supply Allocation: Implement MET's WSAP.

As noted in Condition 3, should supplies become limited to the point where imported water demands cannot be met, MET will allocate water through the WSAP (MET, 2021a).

2.3.2 MET Water Supply Allocation Plan

MET's imported supplies have been impacted by a number of water supply challenges, as noted earlier. In case of extreme water shortage within the MET service area is the implementation of its WSAP.

MET’s Board of Directors originally adopted the WSAP in February 2008 to fairly distribute a limited amount of water supply and applies it through a detailed methodology to reflect a range of local conditions and needs of the region’s retail water consumers (MET, 2021a).

The WSAP includes the specific formula for calculating member agency supply allocations and the key implementation elements needed for administering an allocation. MET’s WSAP is the foundation for the urban water shortage contingency analysis required under Water Code Section 10632 and is part of MET’s 2020 UWMP.

MET’s WSAP was developed in consideration of the principles and guidelines in MET’s 1999 WSDM Plan with the core objective of creating an equitable “needs-based allocation.” The WSAP’s formula seeks to balance the impacts of a shortage at the retail level while maintaining equity on the wholesale level for shortages of MET supplies of greater than 50% cutbacks. The formula takes into account a number of factors, such as the impact on retail customers, growth in population, changes in supply conditions, investments in local resources, demand hardening aspects of water conservation savings, recycled water, extraordinary storage and transfer actions, and groundwater imported water needs.

The formula is calculated in three steps: 1) based period calculations, 2) allocation year calculations, and 3) supply allocation calculations. The first two steps involve standard computations, while the third step contains specific methodology developed for the WSAP.

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

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

Step 3: Supply Allocation Calculations – The final step is calculating the water supply allocation for each member agency based on the allocation year water needs identified in Step 2.

In order to implement the WSAP, MET’s Board of Directors makes a determination on the level of the regional shortage, based on specific criteria, typically in April. The criteria used by MET includes current levels of storage, estimated water supplies conditions, and projected imported water demands. The allocations, if deemed necessary, go into effect in July of the same year and remain in effect for a 12-month period. The schedule is made at the discretion of the Board of Directors (MET, 2021b).

As demonstrated by the findings in MET’s 2020 UWMP, both the Water Reliability Assessment and the Drought Risk Assessment (DRA) demonstrate that MET is able to mitigate the challenges posed by hydrologic variability, potential climate change, and regulatory risk on its imported supply sources through the significant storage capabilities it has developed over the last two decades, both dry-year and emergency storage (MET, 2021a).

Although MET’s 2020 UWMP forecasts that MET will be able to meet projected imported demands throughout the projected period from 2025 to 2045, uncertainty in supply conditions can result in MET needing to implement its WSAP to preserve dry-year storage and curtail demands (MET, 2021b).

2.3.3 MWDOC Water Supply Allocation Plan

To prepare for the potential allocation of imported water supplies from MET, MWDOC worked collaboratively with its 28 retail agencies to develop its own WSAP that was adopted in January 2009 and amended in 2016. The MWDOC WSAP outlines how MWDOC will determine and implement each of its retail agency's allocation during a time of shortage.

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

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

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

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

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

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

The MWDOC WSAP includes additional measures for plan implementation, including the following (MWDOC, 2016):

- **Appeal Process –** An appeals process to provide retail agencies the opportunity to request a change to their allocation based on new or corrected information. MWDOC anticipates that under most circumstances, a retail agency's appeal will be the basis for an appeal to MET by MWDOC.
- **Melded Allocation Surcharge Structure –** At the end of the allocation year, MWDOC would only charge an allocation surcharge to each retail agency that exceeded their allocation if MWDOC exceeds its total allocation and is required to pay a surcharge to MET. MET enforces allocations to retail agencies through an allocation surcharge to a retail agency that exceeds its total annual allocation at the end of the 12-month allocation period. MWDOC's surcharge would be assessed

according to the retail agency's prorated share (acre-feet [AF] over usage) of MWDOC amount with MET. Surcharge funds collected by MET will be invested in its Water Management Fund, which is used to in part to fund expenditures in dry-year conservation and local resource development.

- **Tracking and Reporting Water Usage –** MWDOC will provide each retail agency with water use monthly reports that will compare each retail agency's current cumulative retail usage to their allocation baseline. MWDOC will also provide quarterly reports on its cumulative retail usage versus its allocation baseline.
- **Timeline and Option to Revisit the Plan –** The allocation period will cover 12 consecutive months and the Regional Shortage Level will be set for the entire allocation period. MWDOC only anticipates calling for allocation when MET declares a shortage; and no later than 30 days from MET's declaration will MWDOC announce allocation to its retail agencies.

3 WATER SHORTAGE CONTINGENCY PREPAREDNESS AND RESPONSE PLANNING

The City's WSCP is a detailed guide of how the City intends to act in the case of an actual water shortage condition. The WSCP anticipates a water supply shortage and provides pre-planned guidance for managing and mitigating a shortage. Regardless of the reason for the shortage, the WSCP is based on adequate details of demand reduction and supply augmentation measures that are structured to match varying degrees of shortage will ensure the relevant stakeholders understand what to expect during a water shortage situation.

3.1 Water Supply Reliability Analysis

Per Water Code Section 10632 (a)(1), the WSCP shall provide an analysis of water supply reliability conducted pursuant to Water Code Section 10635, and the key issues that may create a shortage condition when looking at the City's water asset portfolio.

Understanding water supply reliability, factors that could contribute to water supply constraints, availability of alternative supplies, and what effect these have on meeting customer demands provides the City with a solid basis on which to develop appropriate and feasible response actions in the event of a water shortage. In the 2020 UWMP, the City conducted a Water Reliability Assessment to compare the total water supply sources available to the water supplier with long-term projected water use over the next 20 years, in five-year increments, for a normal water year, a single dry water year, and a drought lasting five consecutive water years (Seal Beach, 2021).

The City also conducted a DRA to evaluate a drought period that lasts five consecutive water years starting from the year following when the assessment is conducted. An analysis of both assessments determined that the City is capable of meeting all customers' demands from 2021 through 2045 for a normal year, a single dry year, and a drought lasting five consecutive years with significant imported water supplemental drought supplies from MWDOC/MET and ongoing conservation program efforts. The City has also added reliability through receiving the majority of its water supply from groundwater from the OC Basin and supplemental supplies from MWDOC/MET. As a result, there is no projected shortage condition due to drought that will trigger customer demand reduction actions until MWDOC notifies the City of insufficient imported supplies. More information is available in the City's 2020 UWMP Sections 6 and 7 (Seal Beach, 2021).

3.2 Annual Water Supply and Demand Assessment Procedures

Per Water Code Section 10632.1, the City will conduct an Annual Assessment pursuant to subdivision (a) of Section 10632 and by July 1st of each year, beginning in 2022, submit an Annual Assessment with information for anticipated shortage, triggered shortage response actions, compliance and enforcement actions, and communication actions consistent with the Supplier's WSCP.

The City must include in its WSCP the procedures used for conducting an Annual Assessment. The Annual Assessment is a determination of the near-term outlook for supplies and demands and how a perceived shortage may relate to WSCP shortage stage response actions in the current calendar year. This determination is based on information available to the City at the time of the analysis. Starting in 2022, the Annual Assessment will be due by July 1 of every year.

This section documents the decision-making process required for formal approval of the City's Annual Assessment determination of water supply reliability each year and the key data inputs and the methodologies used to evaluate the water system reliability for the coming year, while considering that the year to follow would be considered dry.

3.2.1 Decision-Making Process

The following decision-making process describes the functional steps that the City will take to formally approve the Annual Assessment determination of water supply reliability each year.

3.2.1.1 City Steps to Approve the Annual Assessment Determination

The Annual Assessment will be predicated on the OCWD Basin Production Percentage (BPP) and on MWDOCs Annual Assessment outcomes.

The City receives groundwater from OCWD. The OC Basin is not adjudicated and as such, pumping from the OC Basin is managed through a process that uses financial incentives to encourage groundwater producers (Producers) to pump a sustainable amount of water. The framework for the financial incentives is based on establishing the BPP, the percentage of each Producer's total water supply that comes from groundwater pumped from the OC Basin. The BPP is set uniformly for all Producers by OCWD on an annual basis in by OCWD Board of Directors. Based on the projected water demand and water modeled water supply, over the long-term, OCWD anticipates sustainably supporting a BPP of 85%; however, volumes of groundwater and imported water may vary depending on OCWD's actual BPP projections. A supply reduction that may result from the annual BPP projection will be included in the Annual Assessment.

While the City's primary source of water is OCWD groundwater, any remaining source to meet retail demands comes from the purchase of imported water from MWDOC. MWDOC surveys its member agencies annually for anticipated water demands and supplies for the upcoming year. MWDOC utilizes this information to plan for the anticipated imported water supplies for the MWDOC service area. This information is then shared and coordinated with MET and is incorporated into their analysis of their service area's annual imported water needs. Based on the year's supply conditions and WSDM actions, MET will present a completed Annual Assessment for its member agencies' review from which they will then seek Board approval in April of each year. Additionally, MET expects that any triggers or specific shortage response actions that result from the Annual Assessment would be approved by their Board at that time. Based upon MET's Assessment and taking into consideration information provided to MWDOC through the annual survey, MWDOC will provide an anticipated estimate of imported supplies for City to incorporate into the Annual Assessment.

The City Manager and/or his or her designated representative shall review the Annual Assessments from MET, MWDOC, and OCWD and incorporate the finding into the City's assessment. The City Manager and/or his or her designee will authorize the City's Annual Assessment determining specific shortage response action necessary to prudently plan for water supply needs to its customers, and/or or comply with regulations and/or restrictions implemented by the State Water Resources Control Board, MET, MWDOC, or OCWD. The City will formally submit assessment findings to DWR prior to the July 1 deadline.

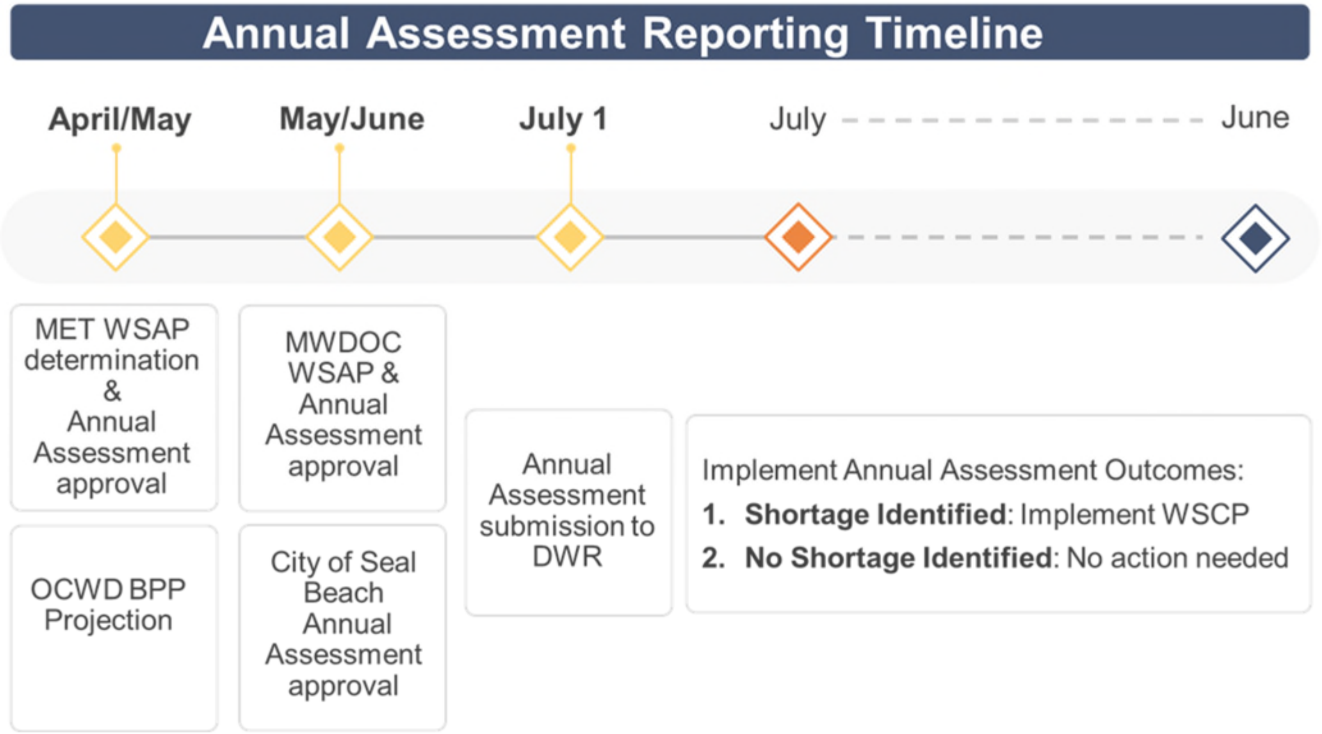


Figure 3-1: Annual Assessment Reporting Timeline

3.2.2 Data and Methodologies

The following paragraphs document the key data inputs and methodologies that are used to evaluate the water system reliability for the coming year, while considering that the year to follow would be considered dry.

3.2.2.1 Assessment Methodology

The City will evaluate water supply reliability for the current year and one dry year for the purpose of the Annual Assessment. The Annual Assessment determination will be based on considerations of unconstrained water demand, local water supplies, MET/MWDOC imported water supplies, planned water use, and infrastructure considerations. The balance between projected local supplies coupled with MET imported supplies and anticipated unconstrained demand will be used to determine what, if any, shortage stage is expected under the WSCP framework as presented in Figure 3-2. The WSCP's standard shortage stages are defined in terms of shortage percentages. Shortage percentages will be calculated by dividing the difference between water supplies and unconstrained demand by total unconstrained demand. This calculation will be performed separately for anticipated current year conditions and for assumed dry year conditions.

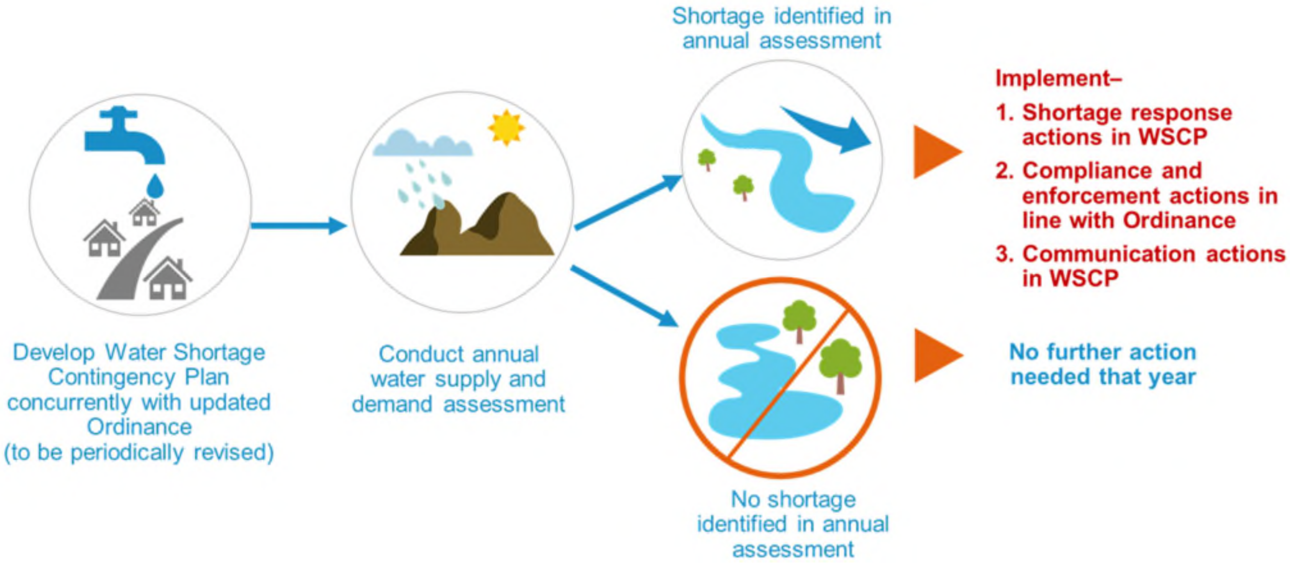


Figure 3-2: Water Shortage Contingency Plan Annual Assessment Framework

3.2.2.2 Locally Applicable Evaluation Criteria

Within Orange County, there are no significant local applicable criteria that directly affect reliability. Through the years, the water agencies in Orange County have made tremendous efforts to integrate their systems to provide flexibility to interchange with different sources of supplies. There are emergency agreements in place to ensure all parts of the County have an adequate supply of water. In the northern part of the County, agencies have the ability to meet a majority of their demands through groundwater with very little limitation, except for the OCWD BPP.

The City will also continue to monitor emerging supply and demand conditions related to supplemental imported water from MWDOC/MET and take appropriate actions consistent with the flexibility and adaptiveness inherent to the WSCP. The City's Annual Assessment was based on the City's service area, water sources, water supply reliability, and water use as described in Water Code Section 10631, including available data from state, regional, or local agency population, land use development, and climate change projections within the service area of the City. Some conditions that affect MWDOC's wholesale supply and demand, such as groundwater replenishment, surface water and local supply production, can differ significantly from earlier projections throughout the year.

If a major earthquake on the San Andreas Fault occurs, it has the potential to damage all three key regional water aqueducts and disrupt imported supplies for up to six months. The region would likely impose a water use reduction ranging from 10-25% until the system is repaired. However, MET has taken proactive steps to handle such disruption, such as constructing DVL, which mitigates potential impacts. DVL, along with other local reservoirs, can store a six to twelve-month supply of emergency water (MET, 2021b).

3.2.2.3 Water Supply

As detailed in the City's 2020 UWMP, the City meets all of its customers' demands with a combination of local groundwater from the OC Basin and imported water from MWDOC/MET. The City's main source of water supply is groundwater, with imported water making up the rest of the City's water supply portfolio. In fiscal year (FY) 2019-20, the City relied on 65% groundwater and 35% imported water. It is projected that by 2045, the water supply portfolio will change to approximately 85% groundwater and 15% imported water, reflecting the increase in OCWD's BPP to 85% (Seal Beach, 2021).

3.2.2.4 Unconstrained Customer Demand

The WSCP and Annual Assessment define unconstrained demand as expected water use prior to any projected shortage response actions that may be taken under the WSCP. Unconstrained demand is distinguished from observed demand, which may be constrained by preceding, ongoing, or future actions, such as emergency supply allocations during a multi-year drought. WSCP shortage response actions to constrain demand are inherently extraordinary; routine activities such as ongoing conservation programs and regular operational adjustments are not considered as constraints on demands.

The City's DRA reveals that its supply capabilities are expected to balance anticipated total water use and supply, assuming a five-year consecutive drought from FY 2020-21 through FY 2024-25 (Seal Beach, 2021). Water demands in a five-year consecutive drought are calculated as a 6% increase in water demand above a normal year for each year of the drought (CDM Smith, 2021).

3.2.2.5 Planned Water Use for Current Year Considering Dry Subsequent Year

Water Code Section 10632(a)(2)(B)(ii) requires the Annual Assessment to determine “current year available supply, considering hydrological and regulatory conditions in the current year and one dry year.”

The Annual Assessment will include two separate estimates of City's annual water supply and unconstrained demand using: 1) current year conditions, and 2) assumed dry year conditions. Accordingly, the Annual Assessment's shortage analysis will present separate sets of findings for the current year and dry year scenarios. The Water Code does not specify the characteristics of a dry year, allowing discretion to the Supplier. The City will use its discretion to refine and update its assumptions for a dry year scenarios in each Annual Assessment as information becomes available and in accordance with best management practices.

Supply and demand analyses for the single-dry year case was based on conditions affecting the SWP as this supply availability fluctuates the most among MET's, and therefore MWDOC and the City's, sources of supply. FY 2013-14 was the single driest year for SWP supplies with an allocation of 5% to Municipal and Industrial (M&I) uses. Unique to this year, the 5% SWP allocation was later reduced to 0%, before ending up at its final allocation of 5%, highlight the stressed water supplies for the year. Furthermore, on January 17, 2014 Governor Brown declared the drought State of Emergency citing 2014 as the driest year in California history. Additionally, within MWDOC's service area, precipitation for FY 2013-14 was the second lowest on record, with 4.37 inches of rain, significantly impacting water demands.

The water demand forecasting model developed for the Demand Forecast TM isolated the impacts that weather and future climate can have on water demand through the use of a statistical model. The impacts of hot/dry weather conditions are reflected as a percentage increase in water demands from the normal year condition (average of FY 2017-18 and FY 2018-19). For a single dry year condition (FY 2013-14), the model projects a 6% increase in demand for the OC Basin area where the City's service area is located (CDM Smith, 2021). Detailed information of the model is included in the City's 2020 UWMP.

The City has documented that it is 100% reliable for single dry year demands from 2025 through 2045 with a demand increase of 6% from normal demand with significant reserves held by MET, local groundwater supplies, and conservation (Seal Beach, 2021).

3.2.2.6 Infrastructure Considerations

The Annual Assessment will include consideration of any infrastructure issues that may pertain to near-term water supply reliability, including repairs, construction, and environmental mitigation measures that may temporarily constrain capabilities, as well as any new projects that may add to system capacity. MWDOC closely coordinates with MET and its member agencies, including the City, on any planned infrastructure work that may impact water supply availability. Throughout each year, MET regularly carries out preventive and corrective maintenance of its facilities within the MWDOC service area that may require shutdowns to inspect and repair pipelines and facilities and support capital improvement projects. These shutdowns involve a high level of planning and coordination between MWDOC, MWDOC's member agencies, and MET to ensure that major portions of the distribution system are not out of service at the same time. Operational flexibility within MET's system and the cooperation of member agencies allow shutdowns to be successfully completed while continuing to meet all system demands.

Specifically for the City, infrastructure considerations that could impact water supply reliability include:

- Power outages and surges.
- Wells or pumps temporarily out of service during rehabilitation projects, improvements, or maintenance.
- Capital projects including the Lampson Well connection improvement, Hellman Ranch 18-inch line rehabilitation, 405 Freeway widening water line reconfiguration, Lampson Ave 12-inch water main replacement, and other water main replacements in various parts of the system.
- Other considerations such as the age of lines and the single feed water line to Surfside and Sunset Aquatic Park.

3.2.2.7 Other Factors

For the Annual Assessment, any known issues related to water quality would be considered for their potential effects on water supply reliability. Specifically for the City, Lampson Well has an odor issue.

Per- and polyfluoroalkyl substances (PFAS) are a group of thousands of manmade chemicals that includes perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS). PFAS compounds were once commonly used in many products including, among many others, stain- and water-repellent fabrics, nonstick products (e.g., Teflon), polishes, waxes, paints, cleaning products, and fire-fighting foams. Beginning in the summer of 2019, the California State Division of Drinking Water (DDW) began requiring testing for PFAS compounds in some groundwater production wells in the OCWD area. The City has 4 wells none of which is impacted by PFAS.

PFAS are of particular concern for groundwater quality, and since the summer of 2019, DDW requires testing for PFAS compounds in some groundwater production wells in the OCWD area. In February 2020, the DDW lowered its Response Levels (RL) for PFOA and PFOS to 10 and 40 parts per trillion (ppt), respectively. The DDW recommends Producers not serve any water exceeding the RL – effectively making the RL an interim Maximum Contaminant Level (MCL) while DDW undertakes administrative action to set a MCL. In response to DDW's issuance of the revised RL, as of December 2020, approximately 45 wells in the OCWD service area have been temporarily turned off until treatment systems can be constructed. As additional wells are tested, OCWD expects this figure may increase to at least 70 to 80 wells. The state has begun the process of establishing MCLs for PFOA and PFOS and anticipates these MCLs to be in effect by the Fall of 2023. OCWD anticipates the MCLs will be set at or below the RLs.

In April 2020, OCWD as the groundwater basin manager, executed an agreement with the impacted Producers to fund and construct the necessary treatment systems for production wells impacted by PFAS compounds. The

PFAS treatment projects includes the design, permitting, construction, and operation of PFAS removal systems for impacted Producer production wells. Each well treatment system will be evaluated for use with either granular activated carbon or ion exchange for the removal of PFAS compounds. These treatment systems utilize vessels in a lead-lag configuration to remove PFOA and PFOS to less than 2 ppt (the current non-detect limit). Use of these PFAS treatment systems are designed to ensure the groundwater supplied by Producer wells can be served in compliance with current and future PFAS regulations. With financial assistance from OCWD, the Producers will operate and maintain the new treatment systems once they are constructed.

To minimize expenses and provide maximum protection to the public water supply, OCWD initiated design, permitting, and construction of the PFAS treatment projects on a schedule that allows rapid deployment of treatment systems. Construction contracts were awarded for treatment systems for production wells in the City of Fullerton and Serrano Water District in Year 2020. Additional construction contracts will likely be awarded in the first and second quarters of 2021. OCWD expects the treatment systems to be constructed for most of the initial 45 wells above the RL within the next 2 to 3 years.

As additional data are collected and new wells experience PFAS detections at or near the current RL, and/or above a future MCL, and are turned off, OCWD will continue to partner with the affected Producers and take action to design and construct necessary treatment systems to bring the impacted wells back online as quickly as possible.

Groundwater production in FY 2019-20 was expected to be approximately 325,000 acre-feet (AF) but declined to 286,550 AF primarily due to PFAS impacted wells being turned off around February 2020. OCWD expects groundwater production to be in the area of 245,000 AF in FY 2020-21 due to the currently idled wells and additional wells being impacted by PFAS and turned off. As PFAS treatment systems are constructed, OCWD expects total annual groundwater production to slowly increase back to normal levels (310,000 to 330,000 AF) (OCWD, 2020).

3.3 Six Standard Water Shortage Levels

Per Water Code Section 10632 (a)(3)(A), the City must define the water shortage levels that represent shortages from the normal reliability as determined in the Annual Assessment. The Water Code provides an option for suppliers to align with six standard water shortage levels; however, the City has selected to retain its existing water shortage levels as defined in Municipal Code Section 9.35 (Appendix B and Table 3-1). Table 3-2 shows the City’s water shortage levels in relationship to the six standard water shortage levels prescribed by statute. This crosswalk is intended to clearly translate the City’s water shortage levels to those mandated by statute.

Table 3-1: Water Shortage Contingency Plan Levels

Submittal Table 8-1 Water Shortage Contingency Plan Levels		
Shortage Level	**Percent Shortage Range**	**Shortage Response Actions**
1	Up to 20%	A Phase 1 water supply shortage exists when the city council determines, in its sole discretion, that due to drought or other water supply conditions, a water supply shortage or threatened shortage exists and a 20% consumer demand of reduction is necessary to make more efficient use of water and appropriately respond to existing water conditions. Upon the declaration by the city council of a Phase 1 water supply shortage condition, the city council will implement the mandatory Phase 1 conservation measures identified in this section.
2	Up to 40%	A Phase 2 water supply shortage exists when the city council determines, in its sole discretion, that due to drought or other water supply conditions, a severe water supply shortage or threatened shortage exists and a 40% consumer demand reduction is necessary to make more efficient use of water and appropriately respond to existing water conditions. Upon the declaration by the city council of a Phase 2 water supply shortage condition, the city council will implement the mandatory Phase 2 conservation measures identified in this section.
3	Greater than 40%	A Phase 3 water supply shortage condition is also referred to as an “emergency” condition. A Phase 3 condition exists when the city council declares a water shortage emergency and notifies its residents and businesses that a significant reduction of greater than 40% in consumer demand is necessary to maintain sufficient water supplies for public health and safety. Upon the declaration of a Phase 3 water supply shortage condition, the city council will implement the mandatory Phase 3 conservation measures identified in this section.
NOTES: Source: Seal Beach Municipal Code Section 9.35 (Appendix B).		

Table 3-2: Relationship Between the City's Water Shortage Levels and Mandated Shortage Levels

Relationship Between City of Seal Beach Water Shortage Levels and Mandated Shortage Levels (DWR Table 8-1)			
City of Seal Beach Water Shortage Levels		**Mandated Shortage Levels**	
Shortage Level	**Percent Shortage Range**	**Shortage Level**	**Percent Shortage Range**
Permanent Water Conservation Requirements	0%	**N/A**	0%
1	Up to 20%	**1**	Up to 10%
		2	10-20%
2	20-40%	**3**	20 – 30%
		4	30 - 40%
3	>40%	**5**	40 - 50%
		6	>50%

3.4 Shortage Response Actions

Water Code Section 10632 (a)(4) requires the WSCP to specify shortage response actions that align with the defined shortage levels. The City has defined specific shortage response actions that align with the defined shortage levels in DWR Tables 8-2 and 8-3 (Appendix A). These shortage response actions were developed with consideration to the system infrastructure and operations changes, supply augmentation responses, customer-class or water use-specific demand reduction initiatives, and increasingly stringent water use prohibitions.

3.4.1 Demand Reduction

The demand reduction measures that would be implemented to address shortage levels are described in DWR Table 8-2 (Appendix A). This table indicates which actions align with specific defined shortage levels and estimates the extent to which the actions will reduce the gap between supplies and demands to deliver the outcomes necessary to meet the requirements of a given shortage level. This table also identifies the enforcement action, if any, associated with each demand reduction measure.

3.4.2 Supply Augmentation

The supply augmentation actions are described in DWR Table 8-3 (Appendix A). These augmentations represent short-term management objectives triggered by the MET's WSDM Plan and do not overlap with the long-term new water supply development or supply reliability enhancement projects. Supply Augmentation is made available to the City through MWDOC and MET. The City relies on MET's reliability portfolio of water supply programs including existing water transfers, storage and exchange agreements to supplement gaps in the City's supply/demand balance. MET has developed significant storage capacity (over 5 million AF) in reservoirs and groundwater banking programs both within and outside of the Southern California region. Additionally, MET can pursue additional water transfer and exchange programs with other water agencies to help mitigate supply/demand imbalances and provide additional dry-year supply sources.

MWDOC, and in turn its retail agencies, including the City, has access to supply augmentation actions through MET. MET may exercise these actions based on regional need, and in accordance with their WSCP, and may include the use of supplies and storage programs within the Colorado River, SWP, and in-region storage. The City has the ability to augment its supply to reduce the shortage gap by up to 100% by purchasing additional imported water through MWDOC or pumping additional groundwater in the OC Basin; however, both are subject to rate penalties from MWDOC and OCWD, respectively.

3.4.3 Operational Changes

During shortage conditions, operations may be affected by supply augmentation or demand reduction responses. The City will consider their operational procedures when it completes its Annual Assessment or as needed to identify changes that can be implemented to address water shortage on a short-term basis. The City considered their operational procedures to identify changes that can be implemented to address water shortage on a short-term basis, including:

- Fill and maintain storage reservoirs at their maximum capacity.
- Postpone unessential system repairs (i.e., certain types of valve replacements) that would result in substantial water loss.
- Limit system flushing.
- Minimize or cease City irrigation and other nonessential water use.

3.4.4 Additional Mandatory Restrictions

Water Code Section 10632(a)(4)(D) calls for "additional, mandatory prohibitions against specific water use practices that are in addition to state-mandated prohibitions and appropriate to the local conditions" to be included among the WSCP's shortage response actions. The City will identify additional mandatory restrictions as needed based on the existing Seal Beach Municipal Code Chapter 9.35 Water and Water Conservation (Appendix B). The City intends to update any mandatory restrictions in a subsequently adopted ordinance which will supersede the existing ordinance.

3.4.5 Emergency Response Plan (Hazard Mitigation Plan)

A catastrophic water shortage would be addressed according to the appropriate water shortage level and response actions. It is likely that a catastrophic shortage would immediately trigger Shortage Level 3 and response actions have been put in place to mitigate a catastrophic shortage. In addition, there are several Plans that address catastrophic failures and align with the WSCP, including MET's WSDM and WSAP, the City's HMP, and the Water Emergency Response Organization of Orange County (WEROC)'s Emergency Operations Plan (EOP).

3.4.5.1 MET's WSDM and WSAP

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

3.4.5.2 Water Emergency Response Organization of Orange County Emergency Operations Plan

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

As a member of WEROC, the City will follow WEROC's EOP in the event of an emergency and coordinate with WEROC to assess damage, initiate repairs, and request and coordinate mutual aid resources in the event that the City is unable to provide the level of emergency response support required by the situation.

The EOP defines the actions to be taken by WEROC Emergency Operations Center (EOC) staff to reduce the loss of water and wastewater infrastructure; to respond effectively to a disaster; and to coordinate recovery operations in the aftermath of any emergency involving extensive damage to Orange County water and wastewater utilities. The EOP includes activation notification protocol that will be used to contact partner agencies to inform them of the situation, activation status of the EOC, known damage or impacts, or resource needs. The EOP is a standalone document that is reviewed annually and approved by the Board every three years.

WEROC is organized on the basis that each member agency is responsible for developing its own EOP in accordance with the California Standardized Emergency Management System (SEMS), National Incident Management System (NIMS), and Public Health Security and Bioterrorism Preparedness and Response Act of 2002 to meet specific emergency needs within its service area.

The WEROC EOC is responsible for assessing the overall condition and status of the Orange County regional water distribution and wastewater collection systems including MET facilities that serve Orange County.
The EOC can be activated during an emergency situation that can result from both natural and man-made causes, and can be activated through automatic, manual, or standby for activation.

WEROC recognized four primary phases of emergency management, which include:

- **Preparedness:** Planning, training, and exercises that are conducted prior to an emergency to support and enhance response to an emergency or disaster.

- **Response:** Activities and programs designed to address the immediate and short-term effects of the onset of an emergency or disaster that helps to reduce effects to water infrastructure and speed recovery. This includes alert and notification, EOC activation, direction and control, and mutual aid.
- **Recovery:** This phase involved restoring systems to normal, in which short-term recovery actions are taken to assess the damage and return vital life-support systems to minimum operating standards, while long-term recovery actions have the potential to continue for many years.
- **Mitigation/Prevention:** These actions prevent the occurrence of an emergency or reduce the area's vulnerability in ways that minimize the adverse impacts of a disaster or emergency. MWDOC's HMP outlines threats and identifies mitigation projects.

The EOC Action Plans (EAP) provide frameworks for EOC staff to respond to different situations with the objectives and steps required to complete them, which will in turn serve the WEROC member agencies. In the event of an emergency which results in a catastrophic water shortage, the City will declare a water shortage condition of up to Level 3 for the impacted area depending on the severity of the event, and coordination with WEROC is anticipated to begin at Level 4 or greater (WEROC, 2018).

3.4.5.3 City of Seal Beach's Emergency Response Plan

The City will also refer to its current American Water Infrastructure Act Risk and Resilience Assessment and Emergency Response Plan in the event of a catastrophic supply interruption.

3.4.6 Seismic Risk Assessment and Mitigation Plan

Per the Water Code Section 10632.5, Suppliers are required to assess seismic risk to water supplies as part of their WSCP. The plan also must include the mitigation plan for the seismic risk(s). Given the great distances that imported supplies travel to reach Orange County, the region is vulnerable to interruptions along hundreds of miles of aqueducts, pipelines and other facilities associated with delivering the supplies to the region. Additionally, the infrastructure in place to deliver supplies are susceptible to damage from earthquakes and other disasters.

In lieu of conducting a seismic risk assessment specific to the City's 2020 UWMP, the City has included the previously prepared regional HMP by MWDOC as the regional imported water wholesaler that is required under the federal Disaster Mitigation Act of 2000 (Public Law 106-390).

MWDOC's HMP identified that the overarching goals of the HMP were the same for all of its member agencies, which include:

- Goal 1: Minimize vulnerabilities of critical infrastructure to minimize damages and loss of life and injury to human life caused by hazards.
- Goal 2: Minimize security risks to water and wastewater infrastructure.
- Goal 3: Minimize interruption to water and wastewater utilities.
- Goal 4: Improve public outreach, awareness, education, and preparedness for hazards in order to increase community resilience.
- Goal 5: Eliminate or minimize wastewater spills and overflows.
- Goal 6: Protect water quality and supply, critical aquatic resources, and habitat to ensure a safe water supply.
- Goal 7: Strengthen Emergency Response Services to ensure preparedness, response, and recovery during any major or multi-hazard event.

MWDOC's HMP evaluates hazards applicable to all jurisdictions in its entire planning area, prioritized based on probability, location, maximum probable extent, and secondary impacts. The identification of hazards is highly dependent on the location of facilities within the City's jurisdiction and takes into consideration the history of the hazard and associated damage, information provided by agencies specializing in a specific hazard, and relies upon the City's expertise and knowledge.

Earthquake fault rupture and seismic hazards, including ground shaking and liquefaction, are among the highest ranked hazards to the region as a whole because of its long history of earthquakes, with some resulting in considerable damage. A significant earthquake along one of the major faults could cause substantial casualties, extensive damage to infrastructure, fires, damages and outages of water and wastewater facilities, and other threats to life and property.

Nearly all of Orange County is at risk of moderate to extreme ground shaking, with liquefaction possible throughout much of Orange County but the most extensive liquefaction zones occur in coastal areas. Based on the amount of seismic activity that occurs within the region, there is no doubt that communities within Orange County will continue to experience future earthquake events, and it is a reasonable assumption that a major event will occur within a 30-year timeframe.

The mitigation actions identify the hazard, proposed mitigation action, location/facility, local planning mechanism, risk, cost, timeframe, possible funding sources, status, and status rationale, as applicable. Mitigation actions for the City for seismic risks may include (Seal Beach, 2019):

- In coordination with Caltrans, conduct a facilities condition assessment for bridges along evacuation routes to identify bridges that need retrofitting, including considering highest standard improvement options for bridges with seismic deficiencies.
- Encourage the installation of seismically appropriate piping for new or replacement pipelines, in close coordination with local water, natural gas, and other providers.
- Pursue ground improvement projects, such as constructing a high strength capping layer, soil mixing, stone columns, soil wicks, chemical and pressure grouting, and other soil improvement techniques that reduce liquefaction susceptibility.

3.4.7 Shortage Response Action Effectiveness

For each specific Shortage Response Action identified in the plan, the WSCP also estimates the extent to which that action will reduce the gap between supplies and demands identified in DWR Table 8-2 (Appendix A). To the extent feasible, the City has estimated percentage savings for the chosen suite of shortage response actions, which can be anticipated to deliver the expected outcomes necessary to meet the requirements of a given shortage level.

3.5 Communication Protocols

Timely and effective communication is a key element of the WSCP implementation. In the context of water shortage response, the purpose may be an emergency water shortage situation, such as may result from an earthquake, or a longer-term, non-emergency, shortage condition, such as may result from a drought. In an emergency, the City will activate the communication protocol detailed in the Emergency Response Plan. In a non-emergency water shortage situation, the City will implement the communication protocols described below.

Per the Water Code Section 10632 (a)(5), the City has established communication protocols and procedures to inform customers, the public, interested parties, and local, regional, and state governments regarding any current or predicted shortages as determined by the Annual Assessment described pursuant to Section 10632.1; any shortage response actions triggered or anticipated to be triggered by the annual water supply and demand assessment described pursuant to Section 10632.1; and any other relevant communications.

Non-emergency water shortage communication protocols are focused on communicating the water shortage contingency planning actions that can be derived from the results of the Annual Assessment, and it would likely trigger based upon the decision-making process in Section 3.2. Prior to water shortage level declaration, the City will pursue outreach to inform customers of water shortage levels and definitions, targeted water savings for each drought stage, guidelines that customers are to follow during each stage, and sources of current information on the City's supply and demand response status.

The type and degree of communication will vary with each shortage level in order to inform stakeholders of the current water shortage level status and associated shortage response actions, as defined in Section 3.4.1. Predefined communication objectives and tools will ensure the City's ability to message necessary events and information to ensure compliance with shortage response actions. These communication objectives and tools are summarized in Table 3-3.

The City's Public Relations department will lead public information and outreach efforts in close coordination with other MWDOC and MET. The City will share information and provide guidance to its customers as well as monitor the customer response and attitude toward both voluntary and mandatory customer response guidelines. The City's customer outreach is required to successfully achieve targeted water savings during each shortage level.

Table 3-3: Communication Procedures

Shortage level	Communication Objectives	Communication Tools
1	Compliance with shortage response actions, 20% reduction in water use	Social Media, City Media Channel, Educational Material (e.g. Door Hanger, Brochure) Educational Site Visits (Commercial and Residential)
2	Compliance with storage response actions, 40% reduction in water use	Social Media, City Media Channel, Educational Material (e.g. Door Hanger, Brochure) Educational Site Visits (Commercial and Residential) PSA by City of Seal Beach City Manager (or City Council)
3	Compliance with shortage response actions, >40% reduction in water use	Social Media, City Media Channel, Educational Material (e.g. Door Hanger, Brochure) Educational Site Visits (Commercial and Residential) PSA by City of Seal Beach City Manager (or City Council)

3.6 Compliance and Enforcement

Per the Water Code Section 10632 (a)(6), the City has defined customer compliance, enforcement, appeal, and exemption procedures for triggered shortage response actions in the existing Seal Beach Municipal Code Chapter 9.35 Water and Water Conservation (Appendix B). Communication procedures to ensure customer compliance are described in Section 3.5 and Table 3-4Table 3-4 summarizes the means the City will use to ensure compliance and enforcement of Shortage Response Actions.

Table 3-4: Shortage Response Compliance and Enforcement Actions

Shortage Response Actions	Compliance	Enforcement
Customer service, education, and communication programs	Reduce water usage	Educational Letter
Water-waste patrols	Eliminate/Cease water wasting activity	Educational Letter/Verbal Warning/Violation Notice/Administrative Civil Penalties
Warning and citation protocols	Correct malfunction (e.g. broken sprinkler), Reduce water usage/ Cease water wasting activity	Violation Notice/Administrative Civil Penalties
Fines and surcharges	Correct malfunction (e.g. broken sprinkler), Reduce water usage/ Cease water wasting activity	Violation Notice/Administrative Civil Penalties

3.7 Legal Authorities

Per Water Code Section 10632 (a)(7)(A), the City has provided a description of the legal authorities that empower the City to implement and enforce its shortage response in the Seal Beach Municipal Code Chapter 9.35 Water and Water Conservation (Appendix B). The City intends to update any legal authorities in a subsequently adopted ordinance which will supersede the existing ordinance.

Per Water Code Section 10632 (a)(7) (B), the City shall declare a water shortage emergency condition to prevail within the area served by such wholesaler whenever it finds and determines that the ordinary demands and requirements of water consumers cannot be satisfied without depleting the water supply of the distributor to the extent that there would be insufficient water for human consumption, sanitation, and fire protection.

Per Water Code Section 10632 (a)(7)(C), the City shall coordinate with any agency or county within which it provides water supply services for the possible proclamation of a local emergency under California Government Code, California Emergency Services Act (Article 2, Section 8558). Table 3-5 identifies the contacts for all cities or counties for which the Supplier provides service in the WSCP, along with developed coordination protocols, can facilitate compliance with this section of the Water Code in the event of a local emergency as defined in subpart (c) of Government Code Section 8558.

Table 3-5: Agency Contacts and Coordination Protocols

Contact	Agency	Coordination Protocols
Jay Cobnes (562) 493-4045 x101	Golden State Water	Directly contact Mr. Cobnes via telephone.
Public Works Director	County of Orange	Phone/email
City Council/City Manager	City of Seal Beach	Meeting/Memo

3.8 Financial Consequences of WSCP

Per Water Code Section 10632(a)(8), Suppliers must include a description of the overall anticipated financial consequences to the Supplier of implementing the WSCP. This description must include potential reductions in revenue and increased expenses associated with implementation of the shortage response actions. This should be coupled with an identification of the anticipated mitigation actions needed to address these financial impacts.

During a catastrophic interruption of water supplies, prolonged drought, or water shortage of any kind, the City will experience a reduction in revenue due to reduced water sales. Throughout this period of time, expenditures may increase or decrease with varying circumstances. Expenditures may increase in the event of significant damage to the water system, resulting in emergency repairs. Expenditures may also decrease as less water is pumped through the system, resulting in lower power costs. Water shortage mitigation actions will also impact revenues and require additional costs for drought response activities such as increased staff costs for tracking, reporting, and communications.

The City receives water revenue from a service charge and a commodity charge based on consumption. The service charge recovers costs associated with providing water to the serviced property. The service charge does not vary with consumption and the commodity charge is based on water usage. Rates have been designed to recover the full cost of water service in the charges. Therefore, the total cost of purchasing water would decrease as the usage or sale of water decreases. In the event of a drought emergency, the City will impose excessive water use penalties on its customers, which may include additional costs associated with reduced water revenue, staff time taken for penalty enforcement, and advertising the excessive use penalties. The excessive water use penalties are further described in the City’s Municipal Code Chapter 9.35 Water and Water Conservation (Appendix B).

However, there are significant fixed costs associated with maintaining a minimal level of service. The City will monitor projected revenues and expenditures should an extreme shortage and a large reduction in water sales occur for an extended period of time. To overcome these potential revenue losses and/or expenditure impacts, the City may use reserves. If necessary, the City may reduce expenditures by delaying implementation of its Capital Improvement Program and equipment purchases to reallocate funds to cover the cost of operations and critical maintenance, adjust the work force, implement a drought surcharge, and/or make adjustments to its water rate structure.

Based on current water rates, a volumetric cutback of 50% and above of water sales may lead to a range of reduction in revenues. The impacts to revenues will depend on a proportionate reduction in variable costs related to supply, pumping, and treatment for the specific shortage event. The City has set aside reserve funding to mitigate short-term water shortage situation.

3.9 Monitoring and Reporting

Per Water Code Section 10632(a)(9), the City is required to provide a description of the monitoring and reporting requirements and procedures that have been implemented to ensure appropriate data is collected, tracked, and analyzed for purposes of monitoring customer compliance and to meet state reporting requirements.

Monitoring and reporting key water use metrics is fundamental to water supply planning and management. Monitoring is also essential in times of water shortage to ensure that the response actions are achieving their intended water use reduction purposes, or if improvements or new actions need to be considered (see Section 3.10). Monitoring for customer compliance tracking is also useful in enforcement actions.

Under normal water supply conditions, potable water production figures are recorded daily. Weekly and monthly reports are prepared and monitored. The data from these reports will be used to measure the effectiveness of any water shortage contingency level that may be implemented. As levels of water shortage are declared by MET and MWDOC, the City will follow implementation of those levels as appropriate based on the City's risk profile provided in UWMP Chapter 6 and continue to monitor water demand levels. When MET calls for extraordinary conservation, MET's Drought Program Officer will coordinate public information activities with MWDOC and monitor the effectiveness of ongoing conservation programs.

The City will participate in monthly member agency manager meetings with both MWDOC and OCWD to monitor and discuss monthly water allocation charts. This will enable the City to be aware of import and groundwater use on a timely basis as a result of specific actions taken responding to the City's WSCP.

3.10 WSCP Refinement Procedures

Per Water Code Section 10632 (a)(10), the City must provide reevaluation and improvement procedures for systematically monitoring and evaluating the functionality of the water shortage contingency plan in order to ensure shortage risk tolerance is adequate and appropriate water shortage mitigation strategies are implemented as needed.

The City's WSCP is prepared and implemented as an adaptive management plan. The City will use the monitoring and reporting process defined in Section 3.9 to refine the WSCP. In addition, if certain procedural refinements or new actions are identified by City staff, or suggested by customers or other interested parties, the City will evaluate their effectiveness, incorporate them into the WSCP, and implement them quickly at the appropriate water shortage level.

It is envisioned that the WSCP will be periodically re-evaluated to ensure that its shortage risk tolerance is adequate and the shortage response actions are effective and up to date based on lessons learned from implementing the WSCP. The WSCP will be revised and updated during the UWMP update cycle to incorporate updated and new information. For example, new supply augmentation actions will be added, and actions that are no longer applicable for reasons such as program expiration will be removed. However, if revisions to the WSCP are warranted before the UWMP is updated, the WSCP will be updated outside of the UWMP update cycle. In the course of preparing the Annual Assessment each year, City staff will routinely consider the functionality the overall WSCP and will prepare recommendations for City Council if changes are found to be needed.

3.11 Special Water Feature Distinction

Per Water Code Section 10632 (b), the City has defined water features in 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, in the City's Municipal Code Chapter 9.35 Water and Water Conservation (Appendix B).

3.12 Plan Adoption, Submittal, and Availability

Per Water Code Section 10632 (a)(c), the City provided notice of the availability of the draft 2020 UWMP and draft 2020 WSCP and notice of the public hearing to consider adoption of the WSCP. The public review drafts of the 2020 UWMP and the 2020 WSCP were posted prominently on the City's website in advance of the public hearing on June 14, 2021. Copies of the draft WSCP were also made available for public inspection at the City Clerk's and Utilities Department offices and public hearing notifications were published in local newspapers. A copy of the published Notice of Public Hearing is included in Appendix C.

The City held the public hearing for the draft 2020 UWMP and draft WSCP on June 14, 2021, at the City Council meeting. The City Council reviewed and approved the 2020 UWMP and the WSCP at its June 14, 2021 meeting after the public hearing. See Appendix D for the resolution approving the WSCP.

By July 1, 2021, the City's adopted 2020 UWMP and WSCP was filed with DWR, California State Library, and the County of Orange. The City will make the WSCP available for public review on its website no later than 30 days after filing with DWR.

Based on DWR's review of the WSCP, the City will make any amendments in its adopted WSCP, as required and directed by DWR.

If the City revises its WSCP after UWMP is approved by DWR, then an electronic copy of the revised WSCP will be submitted to DWR within 30 days of its adoption.

4 REFERENCES

CDM Smith. (2021, March 30). *Orange County Water Demand Forecast for MWDOC and OCWD Technical Memorandum.*

City of Seal Beach. (2021, July). *2020 Urban Water Management Plan*.

City of Seal Beach. (2019, May). *Local Hazard Mitigation Plan*. https://www.sealbeachca.gov/Portals/0/Seal%20Beach%20HMP-20190531_Final%20Draft.pdf?ver=2019-06-13-094613-707

Metropolitan Water District of Southern California (MET). (2021a, April. *Water Shortage Contingency Plan*. http://www.mwdh2o.com/PDF_About_Your_Water/Draft%20Metropolitan%20Water%20Shortage%20Contingency%20Plan%20April%202021.pdf

Metropolitan Water District of Southern California (MET). (2021b, June). *2020 Urban Water Management Plan.*

Metropolitan Water District of Southern California (MET). (1999, August). *Water Surplus and Drought Management Plan*. http://www.mwdh2o.com/PDF_About_Your_Water/2.4_Water_Supply_Drought_Management_Plan.pdf

Municipal Water District of Orange County (MWDOC). (2016). *Water Supply Allocation Plan*.

Municipal Water District of Orange County (MWDOC). (2019, August). *Orange County Regional Water and Wastewater Hazard Mitigation Plan*.

Water Emergency Response Organization of Orange County (WEROC). (2018, March). *WEROC Emergency Operations Plan (EOP).*

Appendix A

DWR Submittal Tables

Submittal Table 8-1
Water Shortage Contingency Plan Levels

Shortage Level	Percent Shortage Range	Shortage Response Actions (*Narrative description)*
1	Up to 20%	A Phase 1 water supply shortage exists when the city council determines, in its sole discretion, that due to drought or other water supply conditions, a water supply shortage or threatened shortage exists and a 20% consumer demand of reduction is necessary to make more efficient use of water and appropriately respond to existing water conditions. Upon the declaration by the city council of a Phase 1 water supply shortage condition, the city council will implement the mandatory Phase 1 conservation measures identified in this section.
2	Up to 40%	A Phase 2 water supply shortage exists when the city council determines, in its sole discretion, that due to drought or other water supply conditions, a severe water supply shortage or threatened shortage exists and a 40% consumer demand reduction is necessary to make more efficient use of water and appropriately respond to existing water conditions. Upon the declaration by the city council of a Phase 2 water supply shortage condition, the city council will implement the mandatory Phase 2 conservation measures identified in this section.
3	Greater than 40%	A Phase 3 water supply shortage condition is also referred to as an “emergency” condition. A Phase 3 condition exists when the city council declares a water shortage emergency and notifies its residents and businesses that a significant reduction of greater than 40% in consumer demand is necessary to maintain sufficient water supplies for public health and safety. Upon the declaration of a Phase 3 water supply shortage condition, the city council will implement the mandatory Phase 3 conservation measures identified in this section.

NOTES:

Submittal Table 8-2: Demand Reduction Actions

Shortage Level	Demand Reduction Actions ***Drop down list*** *These are the only categories that will be accepted by the WUEdata online submittal tool. Select those that apply.*	How much is this going to reduce the shortage gap? *Include units used (volume type or percentage)*	Additional Explanation or Reference *(optional)*	Penalty, Charge, or Other Enforcement? ***For Retail Suppliers Only*** *Drop Down List*
Permanent Year-Round	Landscape - Limit landscape irrigation to specific times	On-going Long Term-Conservation Savings Measure. Not applicable to Water Shortage Contingency Plan quantifiable savings.	Watering or irrigating of lawns, landscaping, and other vegetated areas with potable water between 9:00 a.m. and 5:00 p.m. on any day, except by use of a hand-water shut-off nozzle or device, or for a very short period of time for the limited purpose of adjusting or repairing an irrigaiton system.	
Permanent Year-Round	Landscape - Limit landscape irrigation to specific times	On-going Long Term-Conservation Savings Measure. Not applicable to Water Shortage Contingency Plan quantifiable savings.	No water user shall cuase or allow watering or irrigaiton of lawn, landscape or other vegetated area with potable water using a landscape irrigation system ora watering device that is not continuosly attended for longer than 15 mintues watering per day per station. This section does not apply to landscape irrigation systems that exclusively use very low-flow drip type irrigation systems wien no emitter produces more tha 2 gallons of water per hour and weather based controllers or stream rotor sprinklers that meet a 70% efficiency standard.	
Permanent Year-Round	Other - Require automatic shut of hoses	On-going Long Term-Conservation Savings Measure. Not applicable to Water Shortage Contingency Plan quantifiable savings.	No person shall wash a motor vehicle, trailer, boat or other type of mobile equipment other than by a hand-held bucket or by a hose equipped with a positive shut-off nozzle. This prohibition shall not apply to washing performed at a commercial car wash.	
Permanent Year-Round	Water Features - Restrict water use for decorative water features, such as fountains	On-going Long Term-Conservation Savings Measure. Not applicable to Water Shortage Contingency Plan quantifiable savings.	No person shall operate a water fountatin or other decorative water feature that does not use re-circulated water.	
Permanent Year-Round	Landscape - Restrict or prohibit runoff from landscape irrigation	On-going Long Term-Conservation Savings Measure. Not applicable to Water Shortage Contingency Plan quantifiable savings.	No water user shall cause or allow water to run off landscape areas into adjoining streets, sidewalks, driveways, alleys, gutters, ditches or any paved surfaces due to incorrectly maintained sprinklers, excessive watering or use.	

Submittal Table 8-2: Demand Reduction Actions

Shortage Level	Demand Reduction Actions *Drop down list* *These are the only categories that will be accepted by the WUEdata online submittal tool. Select those that apply.*	How much is this going to reduce the shortage gap? *Include units used (volume type or percentage)*	Additional Explanation or Reference *(optional)*	Penalty, Charge, or Other Enforcement? ***For Retail Suppliers Only*** *Drop Down List*
Permanent Year-Round	Other - Customers must repair leaks, breaks, and malfunctions in a timely manner	On-going Long Term-Conservation Savings Measure. Not applicable to Water Shortage Contingency Plan quantifiable savings.	Each water user shall repair all leaks from indoor and outdoor plumbing fixture at the user's premises. Such water user shall eliminate any loss or escape of water through breaks, leaks or other malfunctions in the water user's plumbing or distribution system promptly after discovering the leak and in no event in less than 7 days.	
Permanent Year-Round	CII - Restaurants may only serve water upon request	On-going Long Term-Conservation Savings Measure. Not applicable to Water Shortage Contingency Plan quantifiable savings.	Restaurants shall not offer water servce and shall servie water only to a customer that specifically requests water.	
Permanent Year-Round	Other - Prohibit vehicle washing except at facilities using recycled or recirculating water	On-going Long Term-Conservation Savings Measure. Not applicable to Water Shortage Contingency Plan quantifiable savings.	No person shall install non-recirculating water systems in connection with commercial conveyor car wash and commercial laundry systems. Effective on January 1, 2010, the owner or operator of any commercial conveyor car wash system shall install operational re-circulating water systems, or secure a waiver of this requirement from the director.	
Permanent Year-Round	CII - Other CII restriction or prohibition	On-going Long Term-Conservation Savings Measure. Not applicable to Water Shortage Contingency Plan quantifiable savings.	No person shall install single pass cooling systems in connection with new water service.	
1	Expand Public Information Campaign	5%	Community Outreach and Messaging (Expand Public Information Campaign to reflect Level 1 Shortage Response Actions)	No
1	Landscape - Limit landscape irrigation to specific times	2%	Irrigation shall not be performed except on designated irrigation days and between the hours of 6:00 p.m. and 6:00 a.m. Irrigation may be performed at any time if done by means of a hand-held hose equipped with a positive shut-off nozzle, a hand-held faucet filled bucket of 5 gallons or less, or a drip irrigation system.	Yes

Submittal Table 8-2: Demand Reduction Actions

Shortage Level	Demand Reduction Actions **Drop down list** *These are the only categories that will be accepted by the WUEdata online submittal tool. Select those that apply.*	How much is this going to reduce the shortage gap? *Include units used (volume type or percentage)*	Additional Explanation or Reference *(optional)*	Penalty, Charge, or Other Enforcement? ***For Retail Suppliers Only*** *Drop Down List*
1	Other	2%	Agricultural users and commercial nurseries shall curtail all non-essential water use, but are otherwise exempt from Phase 1 measures. Watering of livestock and irrigation of propagation beds are permitted at any time.	Yes
1	Other	1%	Washing of motor vehicles, boats, airplanes and other mobile equipment shall be performed only on designated irrigation days and between the hours of 6:00 p.m. and 6:00 a.m. This prohibition shall not apply to the washing of garbage trucks, vehicles used to transport food and perishables and other mobile equipment for which frequent cleaning is essential for the protection of the public health, safety and welfare.	Yes
1	Other water feature or swimming pool restriction	1%	Filling or refilling of swimming pools, spas, ponds and artificial lakes shall be performed only on designated irrigation days and between the hours of 6:00 p.m. and 6:00 a.m.	Yes
1	Landscape - Limit landscape irrigation to specific times	1%	Watering golf courses, parks, school grounds and recreational fields shall be performed only between the hours of 6:00 p.m. and 6:00 a.m. This prohibition does not apply to golf course greens.	Yes
1	Other - Prohibit use of potable water for washing hard surfaces	1%	Water shall not be used to wash down sidewalks, hard or paved surfaces, including but not limited to sidewalks, walkways, driveways, parking areas, tennis courts, patios or alleys. Notwithstanding this prohibition, a water user may wash down such surfaces when necessary to alleviate safety or sanitary hazards, and then only by use of a hand-held bucket or similar container, a hand-held hose equipped with a positive self-closing water shut-off device, a low-volume, high-pressure cleaning machine equipped to recycle any water used, or a low-volume high-pressure water broom.	Yes

Submittal Table 8-2: Demand Reduction Actions				
Shortage Level	Demand Reduction Actions **_Drop down list_** *These are the only categories that will be accepted by the WUEdata online submittal tool. Select those that apply.*	How much is this going to reduce the shortage gap? *Include units used (volume type or percentage)*	Additional Explanation or Reference *(optional)*	Penalty, Charge, or Other Enforcement? **_For Retail Suppliers Only_** *Drop Down List*
1	Other - Customers must repair leaks, breaks, and malfunctions in a timely manner	2%	Each water user shall repair all leaks from indoor and outdoor plumbing fixture at the user's premises. Such water user shall eliminate any loss or escape of water through breaks, leaks or other malfunctions in the water user's plumbing or distribution system promptly after discovering the leak and in no event in less than 5 days.	
1	Landscape - Limit landscape irrigation to specific days	15%	Watering or irrigating of lawn, landscape, or other vegetated area with potable water is limited to three (3) days per week.	Yes
1	Other water feature or swimming pool restriction	3%	Ornamental fountains and similar structures shall not be operated.	Yes
2	Expand Public Information Campaign	5%	Community Outreach and Messaging (Expand Public Information Campaign to reflect Level 2 Shortage Response Actions)	No
2	Other - Customers must repair leaks, breaks, and malfunctions in a timely manner	2%	Each water user shall repair all leaks from indoor and outdoor plumbing fixture at the user's premises. Such water user shall eliminate any loss or escape of water through breaks, leaks or other malfunctions in the water user's plumbing or distribution system promptly after discovering the leak and in no event in less than 3 days.	
2	Landscape - Limit landscape irrigation to specific days	15%	Watering or irrigating of lawn, landscape, or other vegetated area with potable water is limited to one (1) days per week.	Yes
2	Landscape - Limit landscape irrigation to specific times	1%	Irrigation shall not be performed except on designated irrigation days and between the hours of 10:00 p.m. and 6:00 a.m.	Yes
2	Landscape - Limit landscape irrigation to specific times	1%	Agricultural users and commercial nurseries shall use water only between the hours of 6:00 p.m. and 6:00 a.m. Watering of livestock and irrigation of propagation beds are permitted at any time.	Yes

Submittal Table 8-2: Demand Reduction Actions

Shortage Level	Demand Reduction Actions **_Drop down list_** *These are the only categories that will be accepted by the WUEdata online submittal tool. Select those that apply.*	How much is this going to reduce the shortage gap? *Include units used (volume type or percentage)*	Additional Explanation or Reference *(optional)*	Penalty, Charge, or Other Enforcement? **_For Retail Suppliers Only_** *Drop Down List*
2	Other - Prohibit vehicle washing except at facilities using recycled or recirculating water	2%	Washing of motor vehicles, boats, airplanes and other mobile equipment is prohibited except when performed at a commercial car wash. This prohibition shall not apply to the washing of garbage trucks, vehicles used to transport food and perishables and other mobile equipment for which frequent cleaning is essential for the protection of the public health, safety and welfare.	Yes
2	Other water feature or swimming pool restriction	1%	Filling or refilling of swimming pools, spas, ponds and artificial lakes shall be performed only on designated irrigation days and between the hours of 10:00 p.m. and 6:00 a.m.	Yes
2	Landscape - Limit landscape irrigation to specific times	2%	Watering golf courses, parks, school grounds and recreational fields shall be performed only between the hours of 10:00 p.m. and 6:00 a.m. This prohibition does not apply to golf course greens.	Yes
2	Moratorium or Net Zero Demand Increase on New Connections	3%	New construction meters and permits for unmetered service shall not be issued. Construction water shall not be used for earth work or road construction purposes.	Yes
2	Other	1%	The use of non-reclaimed and non-recycled water by commercial car washes shall be reduced in volume by 20%.	Yes
3	Expand Public Information Campaign	5%	Community Outreach and Messaging (Expand Public Information Campaign to reflect Level 3 Shortage Response Actions)	No
3	Other - Customers must repair leaks, breaks, and malfunctions in a timely manner	2%	Each water user shall repair all leaks from indoor and outdoor plumbing fixture at the user’s premises. Such water user shall eliminate any loss or escape of water through breaks, leaks or other malfunctions in the water user’s plumbing or distribution system promptly after discovering the leak and in no event in less than 1 day.	Yes

Submittal Table 8-2: Demand Reduction Actions				
Shortage Level	Demand Reduction Actions ***Drop down list*** *These are the only categories that will be accepted by the WUEdata online submittal tool. Select those that apply.*	How much is this going to reduce the shortage gap? *Include units used (volume type or percentage)*	Additional Explanation or Reference *(optional)*	Penalty, Charge, or Other Enforcement? ***For Retail Suppliers Only*** *Drop Down List*
3	Landscape - Prohibit all landscape irrigation	15%	Outdoor irrigation is prohibited.	Yes
3	CII - Other CII restriction or prohibition	2%	Use of water for agricultural or commercial nursery purposes is prohibited. This prohibition shall not apply to watering of livestock.	Yes
3	Other - Prohibit vehicle washing except at facilities using recycled or recirculating water	1%	Washing of motor vehicles, boats, airplanes and other mobile equipment is prohibited except when performed at a commercial car wash. This prohibition shall not apply to the washing of garbage trucks, vehicles used to transport food and perishables and other mobile equipment for which frequent cleaning is essential for the protection of the public health, safety and welfare.	Yes
3	Other water feature or swimming pool restriction	2%	Filling or refilling of swimming pools, spas, ponds and artificial lakes is prohibited.	Yes
3	Landscape - Other landscape restriction or prohibition	5%	Watering golf course areas, other than greens, is prohibited. Watering of parks, school grounds and recreational fields is prohibited except for plant materials classified as rare, exceptionally valuable or essential to the well being of rare animals.	Yes
3	Moratorium or Net Zero Demand Increase on New Connections	2%	New construction meters and permits for unmetered service shall not be issued. Construction water shall not be used for earth work or road construction purposes.	Yes
3	Other	2%	The use of non-reclaimed and non-recycled water by commercial car washes shall be reduced in volume by 50%.	Yes
3	CII - Other CII restriction or prohibition	2%	The use of water for commercial manufacturing or processing purposes shall be reduced in volume by 50%.	Yes

Submittal Table 8-2: Demand Reduction Actions

Shortage Level	Demand Reduction Actions **_Drop down list_** *These are the only categories that will be accepted by the WUEdata online submittal tool. Select those that apply.*	How much is this going to reduce the shortage gap? *Include units used (volume type or percentage)*	Additional Explanation or Reference *(optional)*	Penalty, Charge, or Other Enforcement? **_For Retail Suppliers Only_** *Drop Down List*
3	Other	2%	Water shall not be used for air conditioning purposes.	Yes
3	Other	50%	Water use for public health and safety purposes only.	Yes

NOTES:

Submittal Table 8-3: Supply Augmentation and Other Actions

Shortage Level	Supply Augmentation Methods and Other Actions by Water Supplier ***Drop down list*** *These are the only categories that will be accepted by the WUEdata online submittal tool*	How much is this going to reduce the shortage gap? *Include units used (volume type or percentage)*	Additional Explanation or Reference *(optional)*
1 through 3	Other Purchases	0 - 100%	Additional imported water purchase through MWDOC

NOTES:
Additional Imported Water Purchases to meet the supply gap may have financial ramifications per the MWDOC Water Supply Allocation Plan.

Appendix B

Seal Beach Municipal Code Chapter 9.35 Water and Water Conservation

Below is the weblink to the current ordinance (last accessed on May 17, 2021)
http://www.qcode.us/codes/sealbeach/

Appendix C

Notice of Public Hearing (Pending)

City of Seal Beach

CITY HALL 211 EIGHTH STREET
SEAL BEACH, CALIFORNIA 90740
(562) 431-2527 • www.sealbeachca.gov

POSTED
MAR 05 2021
ORANGE COUNTY CLERK-RECORDER DEPARTMENT
BY: DEPUTY

March 4, 2021
County of Orange
Attn: Mr. Hugh Nguyen, Clerk Recorder
12 Civic Center Plaza, Room 101
Santa Ana, California 92701

Subject: City of Seal Beach 2020 Urban Water Management Plan Update

The City of Seal Beach (City) is in the process of preparing and updating its 2020 Urban Water Management Plan (UWMP) in compliance with the Urban Water Management Planning Act and the Water Conservation Act of 2009, commonly referred to as SBX7-7. An update of the City's UWMP is required every five (5) years.

Water Code section 10621(b) requires an urban water supplier updating its UWMP to notify cities and counties within its service area of the update at least sixty (60) days prior to holding a public hearing. This letter serves as City's notice that it is preparing and updating its 2020 UWMP, to be adopted and submitted to the California Department of Water Resources before the July 1, 2021 deadline. City will be adopting its Water Shortage Contingency Plan as part of the 2020 UWMP.

City is also considering an Addendum to the 2015 UWMP to demonstrate consistency with the Delta Plan Policy to Reduce Reliance on the Delta Through Improved Regional Water Self-Reliance (California Code Reg., tit. 23, § 5003). The 2015 UWMP Addendum and a copy of City's draft 2020 UWMP will be available for review on the City website (www.sealbeachca.gov) in spring of 2021, and City will subsequently hold noticed public hearings on the 2020 UWMP, Water Shortage Contingency Plan, and 2015 UWMP Addendum in advance of their proposed adoption.

City invites you to submit comments and consult with City regarding its 2020 UWMP update and 2015 UWMP Addendum. City anticipates holding a public comment period in spring 2021, with a public hearing planned during that time.

If you have any input for the matters contained in this notice letter, require additional information, or would like to set up a meeting to discuss City's 2020 UWMP update, please contact me at (562) 431-2527 ext. 1321, or by email at smyrter@sealbeachca.gov.

Sincerely,

Steve Myrter, P.E.
Public Works Director

HUGH NGUYEN
CLERK-RECORDER

BIRTH AND DEATH RECORDS
FICTITIOUS BUSINESS NAMES
MARRIAGE LICENSES/RECORDS
NOTARY REGISTRATION
ORANGE COUNTY ARCHIVES
PASSPORTS
PROPERTY RECORDS

RECEIVED

MAY 06 2021

CITY CLERK
CITY OF SEAL BEACH

CITY OF SEAL BEACH
211 EIGHTH ST
SEAL BEACH, CA 90740

Office of the Orange County Clerk-Recorder
Memorandum

SUBJECT: PUBLIC NOTICE

The attached notice was received, filed and a copy was posted on 03/09/2021

It remained posted for 30 (thirty) days.

Hugh Nguyen
Clerk - Recorder
In and for the County of Orange

By: Sandra Lopez Deputy

Public Resource Code 21092.3

The notice required pursuant to Sections 21080.4 and 21092 for an environmental impact report shall be posted in the office of the County Clerk of each county *** in which the project will be located and shall remain posted for a period of 30 days. The notice required pursuant to Section 21092 for a negative declaration shall be so posted for a period of 20 days, unless otherwise required by law to be posted for 30 days. The County Clerk shall post notices within 24 hours of receipt.

Public Resource Code 21152

All notices filed pursuant to this section shall be available for public inspection, and shall be posted ***** within 24 hours of receipt** in the office of the County Clerk. Each notice shall remain posted for a period of 30 days. *** Thereafter, the clerk shall return the notice to the local **lead** agency *** within a notation of the period it was posted. The local **lead** agency shall retain the notice for not less than nine months.

Additions or changes by underline; deletions by ***

Appendix D

Adopted WSCP Resolution (Pending)

APPENDIX I

Water Use Efficiency Implementation Report

Orange County
Water Use Efficiency Programs Savings
and
Implementation Report

Retrofits and Acre-Feet Water Savings for Program Activity

Program			Month Indicated		Current Fiscal Year		Overall Program		
	Program Start Date	Retrofits Installed in	Interventions	Water Savings	Interventions	Water Savings	Interventions	Annual Water Savings[4]	Cumulative Water Savings[4]
High Efficiency Clothes Washer Program	2001	June-20	91	0.26	0	0.00	121,432	4,189	33,965
Smart Timer Program - Irrigation Timers	2004	June-20	228	3.40	0	0.00	27,423	8,885	64,167
Rotating Nozzles Rebate Program	2007	June-20	0	0.00	0	0.00	570,818	2,789	23,762
Commercial Plumbing Fixture Rebate Program	2002	June-20	584	2.69	0	117.64	110,302	5,295	60,670
Industrial Process/Water Savings Incentive Program (WSIP)	2006	July-20	0	0.00	3	0.00	0	1,257	5,149
Turf Removal Program[3]	2010	July-20	87,920	1.03	87,920	8.20	23,023,586	3,224	16,549
High Efficiency Toilet (HET) Program	2005	June-20	8	0.03	0	0.00	60,567	2,239	21,870
Water Smart Landscape Program [1]	1997						12,677	10,621	72,668
Home Water Certification Program	2013						312	7.339	15.266
Synthetic Turf Rebate Program	2007						685,438	96	469
Ultra-Low-Flush-Toilet Programs [2]	1992						363,926	13,452	162,561
Home Water Surveys [2]	1995						11,867	160	1,708
Showerhead Replacements [2]	1991						270,604	1,667	19,083

Total Water Savings All Programs				**7**	**87,923**	**126**	**25,258,952**	**53,882**	**482,636**

(1) Water Smart Landscape Program participation is based on the number of water meters receiving monthly Irrigation Performance Reports.

(2) Cumulative Water Savings Program To Date totals are from a previous Water Use Efficiency Program Effort.

(3) Turf Removal Interventions are listed as square feet.

[4] Cumulative & annual water savings represents both active program savings and passive savings that continues to be realized due to plumbing code changes over time.

HIGH EFFICIENCY CLOTHES WASHERS INSTALLED BY AGENCY

through MWDOC and Local Agency Conservation Programs

Agency	FY 12/13	FY13/14	FY14/15	FY15/16	FY16/17	FY17/18	FY18/19	FY19/20	FY20/21	Total	Current FY Water Savings Ac/Ft (Cumulative)	Cumulative Water Savings across all Fiscal Years	15 yr. Lifecycle Savings Ac/Ft
Brea	93	115	114	76	57	55	53	36	-	2,011	0.00	562.09	1,041
Buena Park	105	106	91	76	54	50	46	28	-	1,642	0.00	447.38	850
East Orange CWD RZ	10	8	8	8	3	1	6	2	-	201	0.00	59.47	104
El Toro WD	134	121	111	65	47	50	40	29	-	1,640	0.00	448.04	849
Fountain Valley	115	102	110	76	65	48	39	34	-	2,521	0.00	736.15	1,304
Garden Grove	190	162	165	251	127	87	70	63	-	3,783	0.00	1,058.84	1,957
Golden State WC	265	283	359	260	138	156	92	95	-	5,358	0.00	1,503.23	2,772
Huntington Beach	334	295	319	225	180	139	93	115	-	8,593	0.00	2,548.98	4,446
Irvine Ranch WD	1,763	1,664	1,882	1,521	1,369	1,194	883	490	-	27,229	0.00	7,265.10	14,089
La Habra	82	114	87	66	53	48	48	46	-	1,469	0.00	394.49	760
La Palma	34	25	34	29	10	14	7	12	-	491	0.00	135.74	254
Laguna Beach CWD	38	37	39	32	19	20	18	16	-	986	0.00	280.60	510
Mesa Water	114	86	89	113	79	53	42	41	-	2,653	0.00	783.81	1,373
Moulton Niguel WD	442	421	790	688	574	524	357	298	-	11,099	0.00	2,893.60	5,743
Newport Beach	116	92	95	66	61	51	41	28	-	2,744	0.00	824.95	1,420
Orange	218	163	160	124	80	73	56	59	-	4,086	0.00	1,216.88	2,114
San Juan Capistrano	76	73	92	63	33	32	23	26	-	1,540	0.00	436.50	797
San Clemente	140	94	141	75	70	83	64	61	-	2,828	0.00	792.41	1,463
Santa Margarita WD	553	662	792	466	367	271	213	251	-	10,251	0.00	2,785.14	5,304
Seal Beach	31	29	38	23	9	17	8	21	-	648	0.00	182.31	335
Serrano WD	13	10	26	8	11	8	2	7	-	374	0.00	110.35	194
South Coast WD	89	79	68	43	44	36	28	30	-	1,678	0.00	470.72	868
Trabuco Canyon WD	30	45	47	34	28	22	13	12	-	845	0.00	235.90	437
Tustin	78	59	80	66	44	48	34	29	-	1,723	0.00	497.50	892
Westminster	121	82	109	149	84	65	46	36	-	2,733	0.00	773.73	1,414
Yorba Linda	181	167	156	123	55	66	43	62	-	3,922	0.00	1,166.59	2,029
MWDOC Totals	5,365	5,094	6,002	4,726	3,661	3,211	2,365	1,927	-	103,060	0.00	28,614.91	19,911
Anaheim	331	285	295	266	213	173	135	119	-	11,109	0.00	3,328.69	5,748
Fullerton	200	186	211	165	107	99	113	84	-	3,991	0.00	1,114.54	2,065
Santa Ana	163	131	132	259	141	124	128	49	-	3,272	0.00	906.40	1,693
Non-MWDOC Totals	694	602	638	690	461	396	376	252	-	18,372	0.00	5,349.63	3,549
Orange County Totals	6,059	5,696	6,640	5,416	4,122	3,607	2,741	2,179	-	121,432	0.00	33,964.54	23,460

SMART TIMERS INSTALLED BY AGENCY

through MWDOC and Local Agency Conservation Programs

	FY 12/13		FY 13/14		FY 14/15		FY 15/16		FY16/17		FY17/18		FY18/19		FY19/20		FY20/21		Total Program		Cumulative Water Savings across all Fiscal Years
Agency	**Res**	**Comm**	**Res**	**Comm**	**Res**	**Comm**	**Res**	**Comm**	**Res**	**Comm**	**Res**	**Comm**	**Res**	**Comm**	**Res**	**Comm**	**Res**	**Comm**	**Res**	**Comm.**	
Brea	9	8	4	0	43	6	20	4	31	4	32	0	33	0	31	0	0	0	227	80	650.09
Buena Park	3	0	0	0	4	10	7	4	10	7	15	3	17	7	22	1	0	0	85	52	225.69
East Orange CWD RZ	2	0	0	0	2	0	1	0	11	1	6	0	1	0	1	0	0	0	33	1	34.78
El Toro WD	7	2	11	0	8	9	9	17	33	8	29	4	34	0	21	3	0	0	199	362	2,982.96
Fountain Valley	3	2	4	0	7	10	13	1	33	12	28	12	36	4	41	(2)	0	0	196	54	278.03
Garden Grove	5	2	9	0	10	14	13	11	28	0	27	2	36	3	31	0	0	0	195	43	249.83
Golden State WC	9	49	9	25	39	12	35	16	56	37	88	6	85	15	89	0	0	0	487	213	1,147.32
Huntington Beach	18	33	20	35	19	2	42	12	88	94	70	30	105	65	71	21	0	0	518	384	1,631.53
Irvine Ranch WD	414	135	71	59	67	310	239	207	344	420	416	78	379	105	292	146	0	0	2,856	2,615	15,058.23
La Habra	4	7	2	0	4	7	3	1	12	7	8	0	19	3	22	(2)	0	0	85	45	272.16
La Palma	1	0	2	0	2	0	3	2	1	0	5	0	7	0	6	0	0	0	28	2	11.21
Laguna Beach CWD	76	2	71	0	86	0	86	1	27	0	11	0	8	0	15	0	0	0	531	20	310.69
Mesa Water	10	2	15	2	17	28	36	12	149	41	49	0	34	55	31	3	0	0	432	212	1,056.92
Moulton Niguel WD	51	74	40	45	46	95	163	100	236	129	284	33	316	64	279	45	0	0	1,793	943	5,001.61
Newport Beach	242	26	168	75	11	9	28	43	30	12	24	0	21	0	11	32	0	0	1,094	441	3,288.87
Orange	20	24	13	9	18	31	51	13	69	10	61	13	93	26	99	15	0	0	538	219	1,268.69
San Juan Capistrano	14	18	6	11	6	19	20	8	22	8	23	5	20	1	24	9	0	0	289	140	854.67
San Clemente	26	7	28	2	28	24	26	3	37	13	38	41	36	0	35	16	0	0	1,160	431	3,359.54
Santa Margarita WD	53	171	64	93	53	321	189	136	326	221	273	220	222	37	223	31	0	0	1,872	1,660	8,154.35
Seal Beach	1	0	1	36	1	12	2	2,446	2	4	5	0	6	31	10	0	0	0	28	2,533	8,531.75
Serrano WD	1	0	0	0	4	0	11	2	4	0	8	0	10	0	9	0	0	0	65	2	22.60
South Coast WD	13	16	8	4	104	73	9	11	7	0	15	2	7	7	14	0	0	0	314	221	1,475.46
Trabuco Canyon WD	6	0	2	0	6	1	16	50	13	3	20	0	33	0	35	0	0	0	191	157	1,178.53
Tustin	8	4	9	1	18	14	33	8	33	23	27	1	37	0	40	0	0	0	247	81	470.96
Westminster	1	1	2	0	13	17	7	1	17	12	22	0	24	0	20	0	0	0	131	44	268.38
Yorba Linda	20	0	12	5	32	2	61	27	72	71	68	10	74	4	111	5	0	0	591	202	1,154.22
MWDOC Totals	1,017	583	571	402	648	1,026	1,123	3,136	1,691	1,137	1,652	460	1,693	427	1,583	323	0	0	14,185	11,157	58,939.06
Anaheim	19	10	9	26	7	52	30	34	87	10	66	0	142	73	111	9	0	0	563	539	3,375.50
Fullerton	9	29	8	0	40	26	32	12	53	7	45	0	77	0	61	8	0	0	382	207	1,241.33
Santa Ana	8	19	7	8	9	27	22	26	15	3	16	0	24	20	19	129	0	0	141	249	611.32
Non-MWDOC Totals	36	58	24	34	56	105	84	72	155	20	127	0	243	93	191	146	0	0	1086	995	5,228.15
Orange County Totals	1,053	641	595	436	704	1,131	1,207	3,208	1,846	1,157	1,779	460	1,936	520	1,774	469	-	-	15,271	12,152	64,167

ROTATING NOZZLES INSTALLED BY AGENCY
through MWDOC and Local Agency Conservation Programs

	FY 13/14			FY 14/15			FY 15/16			FY 16/17			FY 17/18			FY 18/19			FY 19/20			FY 20/21			Total Program			Cumulative Water Savings across all Fiscal Years
	Small		Large	Small		Large	Small		Large	Small		Large	Small		Large	Small		Large	Small		Large	Small		Large	Small		Large	
Agency	Res	Comm.	Comm.	Res	Comm.	Comm.	Res	Comm.	Comm	Res	Comm.	Comm.	Res	Comm.	Comm.	Res	Comm.	Comm.	Res	Comm.	Comm.	Res	Comm.	Comm.	Res	Comm.	Comm.	
Brea	84	0	0	157	45	0	74	2,484	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	572	2,749	0	86.96
Buena Park	53	0	0	248	0	0	45	98	0	0	0	0	0	0	0	0	0	0	49	0	0	0	0	0	558	173	2,535	909.02
East Orange	30	0	0	221	0	0	0	0	0	0	0	0	30	0	0	0	0	0	0	0	0	0	0	0	781	0	0	25.10
El Toro	56	3,288	0	1,741	28,714	0	730	4,457	0	55	242	0	36	0	0	0	0	0	0	0	0	0	0	0	3,405	46,222	890	1,786.08
Fountain Valley	0	0	0	107	0	0	222	0	0	0	0	0	85	0	0	0	283	0	0	0	0	0	0	0	795	283	0	27.71
Garden Grove	80	0	0	88	50	0	110	0	0	55	98	0	52	0	0	0	0	0	72	0	0	0	0	0	1,057	299	0	43.46
Golden State	192	0	0	583	1,741	0	1,088	0	0	207	6,008	0	161	-495	0	35	259	0	63	1,652	0	0	0	0	3,707	12,732	0	414.03
Huntington Beach	120	0	0	798	1,419	0	1,345	2,836	0	149	3,362	0	-37	0	0	0	0	0	65	0	0	0	0	0	3,825	12,526	2,681	1,552.33
Irvine Ranch	11,010	4,257	0	1,421	632	0	1,989	5,047	0	335	9,511	0	356	-215	0	72	0	0	157	0	0	0	0	0	47,722	94,346	2,004	5,867.21
La Habra	15	0	0	109	338	0	300	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	481	1,236	900	410.43
La Palma	0	0	0	0	0	0	46	505	0	0	2,385	0	33	0	0	0	0	0	0	0	0	0	0	0	89	2,890	0	61.87
Laguna Beach	2,948	878	0	2,879	1,971	0	1,390	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12,139	2,896	0	470.55
Mesa Water	361	0	0	229	0	0	166	0	0	113	0	0	36	0	0	0	0	0	50	0	0	0	0	0	2,116	385	343	226.89
Moulton Niguel	361	227	0	1,596	4,587	0	5,492	1,441	0	153	5,872	0	893	0	0	713	38	0	687	0	0	0	0	0	14,167	20,553	2,945	2,122.70
Newport Beach	19,349	6,835	0	460	3,857	0	348	670	0	0	0	0	45	0	0	0	0	0	0	0	0	0	0	0	46,723	21,413	0	2,312.34
Orange	245	120	0	304	668	0	631	91	0	0	0	0	0	0	0	30	0	0	67	0	0	0	0	0	3,267	1,072	0	145.68
San Juan Capistrano	370	0	0	495	737	0	310	593	0	75	123	0	59	0	0	40	1,400	0	58	0	0	0	0	0	5,652	10,252	0	548.86
San Clemente	415	5,074	0	326	0	0	426	0	0	0	0	0	146	0	0	0	0	0	35	0	0	0	0	0	10,170	7,538	1,343	975.61
Santa Margarita	389	0	0	1,207	1,513	0	1,820	837	0	15	0	0	224	0	0	30	0	0	229	0	0	0	0	0	16,648	6,921	611	997.51
Seal Beach	0	0	0	40	5,261	0	0	2,300	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	155	7,852	0	220.24
Serrano	105	0	0	377	0	0	695	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3,405	0	0	117.83
South Coast	70	0	0	4,993	13,717	0	1,421	2,889	0	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8,130	18,870	0	768.96
Trabuco Canyon	0	0	0	56	0	0	130	0	0	0	4,339	0	0	0	0	0	0	0	0	0	0	0	0	0	2,086	5,130	0	196.90
Tustin	329	0	0	408	0	0	317	386	0	65	-341	0	30	0	0	47	0	0	55	0	0	0	0	0	3,503	1,058	0	152.23
Westminster	0	0	0	54	0	0	73	0	0	105	0	0	50	0	0	42	0	0	0	0	0	0	0	0	556	0	0	16.12
Yorba Linda	40	990	0	921	0	0	1,715	0	0	213	0	0	0	0	0	34	0	0	0	0	0	0	0	0	6,115	4,359	500	556.57
MWDOC Totals	36,622	21,669	0	19,818	65,250	0	20,883	24,634	0	1,556	31,599	0	2,199	-710	0	1,043	1,980	0	###	1,652	0	0	0	0	197,824	281,755	14,752	21,013.19
Anaheim	338	0	0	498	712	0	794	5,221	0	147	3,953	0	0	0	0	0	0	0	0	0	0	0	0	0	4,020	49,799	105	1,672.74
Fullerton	107	0	0	684	1,196	0	521	7,015	0	65	3,034	0	0	0	0	140	0	0	75	0	0	0	0	0	3,125	11,309	1,484	881.09
Santa Ana	86	2,533	0	310	0	0	0	1,420	0	0	1,106	0	0	0	0	0	0	0	34	0	0	0	0	0	893	5,752	0	195.31
Non-MWDOC Totals	531	2,533	0	1,492	1,908	0	1,315	13,656	0	212	8,093	0	0	0	0	140	0	0	109	0	0	0	0	0	8,038	66,860	1,589	2,749.14
Orange County Totals	37,153	24,202	0	21,310	67,158	0	22,198	38,290	0	1,768	39,692	0	2,199	-710	0	1,183	1,980	0	###	1,652	0	0	0	0	205,862	348,615	16,341	23,762.33

COMMERCIAL PLUMBING FIXTURES INSTALLED BY AGENCY[1]

through MWDOC and Local Agency Conservation Programs

Agency	FY 12/13	FY 13/14	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20	FY 20/21	Totals	Cumulative Water Savings across all Fiscal Years
Brea	234	0	10	91	734	242	0	74	0	**1,681**	**756**
Buena Park	5	23	56	591	133	49	0	94	0	**2,632**	**1,656**
East Orange CWD RZ	0	0	0	0	0	0	0	0	0	**0**	**0**
El Toro WD	0	212	6	268	35	737	717	0	0	**2,516**	**929**
Fountain Valley	0	0	1	249	0	895	0	398	0	**2,165**	**946**
Garden Grove	4	1	167	676	410	0	354	388	0	**3,193**	**2,175**
Golden State WC	0	1	0	1,008	53	93	86	80	0	**3,124**	**2,676**
Huntington Beach	104	144	7	783	641	10	208	270	0	**3,442**	**2,352**
Irvine Ranch WD	1,090	451	725	11,100	5,958	1,599	1,000	15	0	**30,480**	**12,331**
La Habra	0	0	0	340	42	0	0	59	0	**984**	**786**
La Palma	0	0	0	0	509	0	0	0	0	**675**	**215**
Laguna Beach CWD	0	27	0	0	0	0	0	0	0	**446**	**435**
Mesa Water	6	0	79	661	782	0	110	19	0	**4,383**	**3,035**
Moulton Niguel WD	0	0	3	413	281	506	4,392	764	0	**6,939**	**1,808**
Newport Beach	0	0	566	0	0	0	1,596	16	0	**3,446**	**1,998**
Orange	1	271	81	275	2,851	458	532	395	0	**6,415**	**2,805**
San Juan Capistrano	0	14	0	0	0	0	0	0	0	**260**	**518**
San Clemente	0	0	1	0	0	0	0	321	0	**753**	**530**
Santa Margarita WD	0	0	2	90	743	598	699	0	0	**2,247**	**528**
Seal Beach	0	0	0	0	184	278	0	0	0	**816**	**611**
Serrano WD	0	0	0	0	0	0	0	0	0	**0**	**0**
South Coast WD	148	0	382	0	0	0	0	0	0	**1,320**	**782**
Trabuco Canyon WD	0	0	0	0	0	0	0	0	0	**11**	**20**
Tustin	0	0	75	358	212	2	408	254	0	**2,066**	**1,251**
Westminster	1	28	0	146	177	25	0	252	0	**1,415**	**1,401**
Yorba Linda	1	0	0	226	84	338	0	83	0	**1,016**	**815**
MWDOC Totals	**1,594**	**1,172**	**2,161**	**17,275**	**13,829**	**5,830**	**10,102**	**3,482**	**0**	**82,425**	**41,363**
Anaheim	165	342	463	3,072	309	1,808	686	592	0	**16,839**	**10,159**
Fullerton	94	0	178	476	621	274	384	356	0	**3,792**	**2,474**
Santa Ana	16	17	5	1,293	238	582	7	920	0	**7,246**	**6,675**
Non-MWDOC Totals	**275**	**359**	**646**	**4,841**	**1,168**	**2,664**	**1,077**	**1,868**	**0**	**27,877**	**19,308**
Orange County Totals	**1,869**	**1,531**	**2,807**	**22,116**	**14,997**	**8,494**	**11,179**	**5,350**	**0**	**110,302**	**60,670**

[1] Retrofit devices include ULF Toilets and Urinals, High Efficiency Toilets and Urinals, Multi-Family and Multi-Family 4-Liter HETs, Zero Water Urinals, High Efficiency Clothes Washers, Cooling Tower Conductivity Controllers, Ph Cooling Tower Conductivity Controllers, Flush Valve Retrofit Kits, Pre-rinse Spray heads, Hospital X-Ray Processor Recirculating Systems, Steam Sterilizers, Food Steamers, Water Pressurized Brooms, Laminar Flow Restrictors, and Ice Making Machines.

INDUSTRIAL PROCESS/WATER SAVINGS INCENTIVE PROGRAM

Number of Projects by Agency

Agency	FY 11/12	FY 12/13	FY 13/14	FY 14/15	FY 15/16	FY 16/17	FY 17/18	FY 18/19	FY 19/20	FY 20/21	Overall Program Interventions	Annual Water Savings[1]	Cumulative Water Savings across all Fiscal Years[1]
Brea	0	0	0	0	0	0	0	0	0	0	0	0	0
Buena Park	0	0	0	0	1	0	0	0	0	0	2	54	627
East Orange	0	0	0	0	0	0	0	0	0	0	0	0	0
El Toro	0	0	0	0	0	0	0	1	0	0	1	9	17
Fountain Valley	0	0	0	0	0	1	0	0	0	0	1	23	79
Garden Grove	0	0	0	0	1	0	0	0	1	0	2	7	6
Golden State	0	0	0	0	0	0	0	0	1	0	2	58	78
Huntington Beach	0	2	0	1	2	0	1	0	0	0	6	180	987
Irvine Ranch	1	1	1	0	2	1	1	0	0	0	10	119	910
La Habra	0	0	0	0	1	0	0	0	0	0	1	0	1
La Palma	0	0	0	0	0	0	0	0	0	0	0	0	0
Laguna Beach	0	0	0	0	0	0	0	0	0	0	0	0	0
Mesa Water	0	0	0	0	0	0	0	0	0	0	0	0	0
Moulton Niguel	0	0	0	0	0	0	0	0	0	0	0	0	0
Newport Beach	0	0	0	1	0	0	0	0	0	0	1	21	120
Orange	0	0	0	0	1	2	1	0	0	0	5	97	723
San Juan Capistrano	0	0	0	0	0	0	0	0	0	0	0	0	0
San Clemente	0	0	0	0	0	0	0	0	0	0	0	0	0
Santa Margarita	0	0	0	0	0	0	0	0	0	0	0	0	0
Seal Beach	0	0	0	0	0	0	0	0	0	0	0	0	0
Serrano	0	0	0	0	0	0	0	0	0	0	0	0	0
South Coast	0	0	0	0	1	1	0	0	0	0	2	134	459
Trabuco Canyon	0	0	0	0	0	0	0	0	0	0	0	0	0
Tustin	0	0	0	0	0	0	0	0	0	0	0	0	0
Westminster	0	0	0	0	0	0	0	1	0	0	1	117	146
Yorba Linda	0	0	0	0	0	0	0	1	0	0	1	20	38
MWDOC Totals	1	3	1	2	9	5	3	3	2	0	35	840	4192
Anaheim	0	0	0	0	0	0	0	0	0	0	0	0	0
Fullerton	0	0	0	0	0	0	0	0	1	0	1	282	282
Santa Ana	0	0	0	0	1	0	0	0	0	0	1	135	675
OC Totals	1	3	1	2	10	5	3	3	3	0	37	1257	5149

[1] Acre feet of savings determined during a one year monitoring period.

If monitoring data is not available, the savings estimated in agreement is used.

TURF REMOVAL BY AGENCY[1]

through MWDOC and Local Agency Conservation Programs

Agency	FY 13/14		FY 14/15		FY 15/16		FY 16/17		FY 17/18		FY 18/19		FY 19/20		FY 20/21		Total Program		Cumulative Water Savings across all Fiscal Years
	Res	Comm.	Res	Comm.	Res	Comm.	Res	Comm.	Res	Comm.	Res	Comm.	Res	Comm.	Res	Comm.	Res	Comm.	
Brea	5,697	0	71,981	30,617	118,930	404,411	8,354	479	9,853	27,234	3,180	44,733	8,244	0	0	0	237,241	516,940	**513.87**
Buena Park	0	0	11,670	1,626	77,127	16,490	3,741	0	4,586	0	1,230	0	7,222	0	0	0	105,576	18,116	**82.44**
East Orange	1,964	0	18,312	0	27,844	0	0	0	0	0	0	0	0	0	0	0	48,120	0	**36.80**
El Toro	4,582	0	27,046	221,612	63,546	162,548	13,139	48,019	7,273	42,510	12,856	9,895	5,203	21,290	3,018	0	146,066	578,592	**526.23**
Fountain Valley	4,252	0	45,583	5,279	65,232	0	3,679	0	8,631	0	5,764	28,700	734	0	0	0	135,857	41,503	**117.71**
Garden Grove	8,274	0	67,701	22,000	177,408	49,226	11,504	0	4,487	0	0	0	0	0	0	0	287,921	117,403	**337.17**
Golden State	32,725	8,424	164,507	190,738	310,264	112,937	0	0	0	0	0	48,595	0	0	0	0	581,902	394,867	**780.47**
Huntington Beach	20,642	0	165,600	58,942	305,420	270,303	9,560	21,534	14,236	6,032	9,539	40,135	10,225	13,193	3,235	0	576,107	475,065	**782.22**
Irvine Ranch	36,584	76,400	234,905	317,999	782,844	2,675,629	231,483	46,725	86,893	61,037	55,346	203,014	23,465	30,267	1,992	3,164	1,498,269	3,461,079	**3,389.45**
La Habra	0	0	14,014	1,818	49,691	72,164	0	0	3,003	0	1,504	0	6,102	0	1,793	0	76,107	90,019	**122.86**
La Palma	0	0	4,884	0	10,257	59,760	0	0	0	0	0	0	0	0	0	0	15,141	59,760	**53.11**
Laguna Beach	4,586	226	13,647	46,850	47,614	0	3,059	0	589	0	0	0	1,217	0	0	0	76,887	48,788	**100.54**
Mesa Water	22,246	0	131,675	33,620	220,815	106,896	4,173	77,033	17,373	77,785	3,023	0	16,189	47,075	0	0	432,938	342,409	**492.34**
Moulton Niguel	14,739	40,741	314,250	1,612,845	889,748	1,059,279	220,749	0	98,271	0	106,574	0	81,778	18,951	3,052	61,129	1,746,138	2,920,134	**3,403.10**
Newport Beach	894	0	33,995	65,277	76,675	375,404	2,924	0	5,938	6,499	0	90,403	1,294	0	455	0	129,177	539,929	**442.28**
Orange	11,244	0	120,093	281,402	289,990	106,487	12,847	2,366	11,956	0	13,645	1,798	2,190	0	0	0	490,887	400,776	**686.27**
San Clemente	18,471	13,908	90,349	1,137	215,249	438,963	4,267	0	33,083	7,098	6,500	0	6,420	13,719	5,213	0	417,116	487,990	**644.62**
San Juan Capistrano	12,106	0	101,195	32,366	197,290	143,315	2,624	40,748	0	0	0	0	0	0	0	0	365,415	347,277	**609.46**
Santa Margarita	17,778	48,180	211,198	514,198	534,048	550,420	17,010	28,094	62,706	25,000	24,616	23,198	11,357	51,999	2,542	0	897,853	1,269,650	**1,560.40**
Seal Beach	0	0	15,178	504	17,349	15,911	1,234	0	752	0	0	0	996	0	0	0	39,120	16,415	**41.54**
Serrano	2,971	0	41,247	0	127,877	4,403	5,450	0	555	0	4,000	0	840	0	0	0	182,940	4,403	**134.60**
South Coast	15,162	116,719	84,282	191,853	181,102	128,290	14,967	0	13,319	7,806	7,574	0	25,465	50,879	0	0	358,106	516,266	**651.77**
Trabuco Canyon	2,651	0	14,771	0	42,510	88,272	1,465	0	4,788	0	1,536	0	4,752	49,533	0	0	74,287	160,245	**143.94**
Tustin	1,410	0	71,285	14,137	232,697	33,362	11,173	0	16,926	0	13,189	6,894	15,343	6,936	1,613	0	373,616	61,329	**290.29**
Westminster	0	0	14,040	34,631	71,833	23,902	11,112	0	10,033	0	5,924	0	1,962	0	0	0	114,904	58,533	**118.86**
Yorba Linda	0	0	112,136	12,702	360,279	116,985	19,420	0	9,529	3,696	12,590	12,020	7,773	0	714	0	533,790	145,403	**477.38**
MWDOC Totals	**238,978**	**304,598**	**2,195,544**	**3,692,153**	**5,493,639**	**7,015,357**	**613,934**	**264,998**	**424,780**	**264,697**	**288,590**	**509,385**	**238,771**	**303,842**	**23,627**	**64,293**	**9,941,481**	**13,072,891**	**16,539.75**

Anaheim	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**-**
Fullerton	0	9,214	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9,214	**9.03**
Santa Ana	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**-**
Non-MWDOC Totals	**0**	**9,214**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**9,214**	**9.03**

Orange County Totals	**238,978**	**313,812**	**2,195,544**	**3,692,153**	**5,493,639**	**7,015,357**	**613,934**	**264,998**	**424,780**	**264,697**	**288,590**	**509,385**	**238,771**	**303,842**	**23,627**	**64,293**	**9,941,481**	**13,082,105**	**16,549**

[1]Installed device numbers are listed as square feet

HIGH EFFICIENCY TOILETS (HETs) INSTALLED BY AGENCY

through MWDOC and Local Agency Conservation Programs

Agency	FY 12-13	FY 13-14	FY 14-15	FY 15-16	FY 16-17	FY 17-18	FY 18-19	FY 19-20	FY 20-21	Total	Cumulative Water Savings across all Fiscal Years
Brea	0	38	146	154	4	6	1	0	0	**457**	**135.98**
Buena Park	0	96	153	112	13	3	0	2	0	**689**	**244.67**
East Orange CWD RZ	0	13	26	24	0	0	0	2	0	**88**	**27.92**
El Toro WD	133	218	869	264	12	6	10	5	0	**2,058**	**699.67**
Fountain Valley	0	41	132	220	7	8	1	3	0	**835**	**314.34**
Garden Grove	0	63	350	363	7	4	5	3	0	**1,496**	**538.88**
Golden State WC	2	142	794	512	9	11	5	7	0	**2,813**	**997.71**
Huntington Beach	0	163	1,190	628	4	3	4	2	0	**2,910**	**946.09**
Irvine Ranch WD	1,449	810	1,777	2,798	638	239	162	66	0	**17,376**	**6,772.94**
Laguna Beach CWD	0	45	112	81	1	4	0	2	0	**394**	**134.95**
La Habra	0	37	94	83	5	1	0	0	0	**591**	**241.01**
La Palma	0	21	59	52	4	2	4	3	0	**231**	**76.14**
Mesa Water	0	147	162	162	7	3	3	15	0	**1,639**	**720.61**
Moulton Niguel WD	0	400	2,497	1,939	49	38	21	17	0	**5,766**	**1,591.16**
Newport Beach	0	49	168	243	11	6	0	0	0	**731**	**239.39**
Orange	1	142	978	416	17	10	5	4	0	**2,198**	**702.74**
San Juan Capistrano	0	35	140	202	3	9	4	0	0	**536**	**162.75**
San Clemente	0	72	225	246	11	6	10	1	0	**889**	**294.17**
Santa Margarita WD	0	528	997	1,152	114	33	11	18	0	**3,371**	**938.51**
Seal Beach	2	17	50	69	-1	0	0	0	0	**857**	**458.19**
Serrano WD	0	2	40	55	3	0	3	0	0	**124**	**34.09**
South Coast WD	64	102	398	235	11	7	0	0	0	**1,028**	**310.30**
Trabuco Canyon WD	0	10	108	169	2	3	2	0	0	**344**	**92.74**
Tustin	0	64	132	201	12	10	4	7	0	**1,527**	**654.64**
Westminster	0	35	161	359	3	4	0	0	0	**1,335**	**517.43**
Yorba Linda WD	0	40	280	379	12	8	2	6	0	**1,267**	**442.95**
MWDOC Totals	1,651	3,330	12,038	11,118	958	424	257	163	0	**51,550**	**18,289.97**

Anaheim	0	156	1,188	614	70	19	5	11	0	**5,900**	**2,444.76**
Fullerton	0	61	293	286	14	9	8	7	0	**1,079**	**360.48**
Santa Ana	0	33	602	293	20	0	4	8	0	**2,033**	**774.58**
Non-MWDOC Totals	0	250	2,083	1,193	104	28	17	26	0	**9,012**	**3,579.81**

Orange County Totals	**1,651**	**3,580**	**14,121**	**12,311**	**1,062**	**452**	**274**	**189**	**0**	**60,562**	**21,869.79**

APPENDIX J

Demand Management Measures

1 WHOLESALE SUPPLIER ASSISTANCE PROGRAMS

As described in the 2020 UWMP Section 9, MWDOC provides financial incentives, conservation-related technical support, and regional implementation of a variety of demand management programs. In addition, MWDOC is providing assistance with compliance of the Conservation Framework and conducts research projects to evaluate implementation of both existing programs and new pilot programs. On behalf of its member agencies, MWDOC also organizes and provides the following:

- Monthly coordinator meetings
- Marketing materials
- Public speaking
- Community events
- Legislation compliance assistance

The many programs that MWDOC offers to Orange County on behalf of retail water agencies is described in detail in the following sections.

1.1 Landscape Ordinance

The Water Conservation in Landscaping Act (Assembly Bill 1881, Laird) was passed in 2006 to increase outdoor water use efficiency. Governor Brown's Drought Executive Order of April 1, 2015 (EO B-29-15) directed DWR to update the State's Model Water Efficient Landscape Ordinance (Ordinance) through expedited regulation. The California Water Commission approved the revised Ordinance on July 15, 2015.

This legislation required cities and counties to adopt a Water Efficient Landscape Ordinance by December 1, or adopt their own ordinance, which must be at least as effective in conserving water as the State's Ordinance. Local agencies working together to develop a regional ordinance had until February 1, 2016. MWDOC worked in partnership with the Orange County Division of the League of Cities, the County of Orange, Orange County cities, retail water providers, building industry, landscape architects, and irrigation consultants to develop an Orange County Model Water Efficient Landscape Ordinance specific to the needs of Orange County. The foundation of the Orange County Model Ordinance was based on the State Model Ordinance.

This collaborative, regional approach has ensured that local ordinances are consistent from city to city, and has limited the cost and complexity of implementing the mandate. Based on the Orange County model ordinance, cities and unincorporated areas have adopted local ordinances that set guidelines for designing and approving landscape projects. The new ordinance imposes a lower Maximum Applied Water Allowance (MAWA) that new and rehabilitated landscapes must be designed to meet.

Through this effort, cities throughout Orange County have adopted and are implementing landscape ordinances that are consistent with the requirements of the updated Water Conservation in the Landscape Act.

Today, MWDOC continues to provide the County and city planning departments with training on administering the Landscape Ordinance. This is done in partnership with the California Department of Water Resources, Metropolitan Water District of Southern California and California Landscape Contractors Association (Orange County Chapter). Additionally, MWDOC acts as a communication channel to disseminate reporting requirements and workshop notices from DWR to local ordinance administrators.

1.2 Metering

Metering with commodity rates by wholesale and retail agencies has been an industry standard throughout Orange County for many years. All customers are metered and billed based on commodity rates either monthly or bi-monthly.

With the sale of the Allen-McColloch Pipeline to Metropolitan in 1995, MWDOC no longer owns or operates a distribution system. Water purchased and sold by MWDOC is distributed through Metropolitan's system to the MWDOC retail agencies.

1.3 Conservation Pricing

MWDOC promotes conservation pricing and has helped water retailers shift away from uniform rates in Orange County. In 2008, MWDOC was awarded an Urban Drought Assistance grant from Department of Water Resources to assist Orange County retailers examine and implement budget-based tiered rates. This included assistance with irrigable area mapping, rate stud development, billing system modifications, and more. Progress and results from this project have been monitored up to the present. Table 1-1 shows the progression of agencies shift away from uniform rates towards conservation-based pricing, such as budget-based tiered rates.

Table 1-1: Summary of Rate Structure Types Used in Orange County

Types of Rate Structure	Number of Agencies Utilizing Different Rate Structure Types						
	1990	1995	2000	2005	2010	2015	2020
Declining Block	0	0	0	0	0	0	0
Uniform or Flat	22	23	19	16	8	9	10
Inclined Block	13	9	10	12	14	-	12
Seasonal Inclined Block	1	2	3	3	6	-	1
Seasonal Flat	-	-	-	-	-	-	1
Budget Based Tiered Rate	0	1	1	1	2	-	5

1.4 Public Information, Education, and Outreach

Municipal Water District of Orange County (MWDOC or District) develops, coordinates, and delivers a substantial number of public information, education, and outreach programs aimed at elevating water agency and consumer awareness and understanding of current water issues as well as efficient water use and water-saving practices, sound policy, and water reliability investments that are in the best interest of the region. As water is a necessary resource to all life, these efforts encourage good water stewardship that benefit all Orange County residents, businesses, and industries across all demographics.

MWDOC is steadfast in its mission to keep Orange County involved and up to date on current water news, water-saving opportunities, and pending policy matters through its award-winning public information programs and activities. A few examples are described below.

Print and Electronic Materials
MWDOC offers a variety of print and electronic materials that are designed to assist Orange County water users of all ages in discovering where their water comes from, what the District and other water industry professionals are doing to address water challenges, how to use water most efficiently, and more. Through the District's robust social media presence, award-winning website, eCurrents newsletter, media tool kits, public service announcements, flyers, brochures, and other outreach materials, MWDOC ensures that stakeholders are equipped with sufficient information and subject knowledge to assist them in making good behavioral and civic choices that ultimately affect the quality and quantity of the region's water supply.

Figure 1-1: Samples of Print and Electronic Outreach Materials

Public Events
Each year, MWDOC hosts an array of public events intended to engage a diverse range of water users in targeted discussions and actions that homes in on their specific interests or needs. Some of these public events include:

MWDOC Water Policy Forums and Orange County Water Summit are innovative and interactive symposiums that bring together hundreds of business professionals, elected officials, water industry stakeholders, and community leaders from throughout the state for a discussion on new and ongoing water supply challenges, water policy issues, and other important topics that impact our water supply, economy, and public health.

Inspection Trips of the state's water supply systems are sponsored each year by MWDOC and Metropolitan Water District of Southern California. Orange County elected officials, residents, business owners, and community leaders are invited to tour key water facilities throughout the state and learn more about the critical planning, procurement, and management of southern California's water supply, as well as the issues surrounding delivery and management of our most precious natural resource – water.

Community Events and Events Featuring MWDOC Mascot Ricky the Rambunctious Raindrop provide opportunities to interact with Orange County water users in a fun and friendly way, offer useful water-related information or education, and engage them in important discussions about the value of water and how their decisions at home, at work, and as tax- or ratepayers may impact Orange County's quality and quantity of water for generations to come.

Figure 1-2: Left to Right - MWDOC Water Policy Forum | Inspection Trip of Hoover Dam | Ricky the Rambunctious Raindrop at a Water Smart Community Event

Education Programs and Initiatives

Over the past several years, MWDOC has amplified its efforts in water education programs and activities for Orange County's youngest water users. This is accomplished by continuing to grow professional networks and partnerships that consist of leading education groups, advisors, and teachers, and by leading the way for the District and its 28 member agencies to be key contributors of both southern California and Orange County water-centric learning. Several key water education programs and initiatives include:

Environmental Literacy is an individual's awareness of the interconnectedness and interdependency between people and natural systems, being able to identify patterns and systems within their communities, while also gathering evidence to argue points and solve problems. By using the environment as the context for learning, K-12 students gain real-world knowledge by asking questions and solving problems that directly affect them, their families, and their communities. This approach to K-12 education builds critical thinking skills and promotes inquiry, and is the foundation for all MWDOC education programs, initiatives, and activities.

MWDOC Choice School Programs have provided Orange County K-12 students water-focused learning experiences for nearly five (5) decades. Interactive, grade-specific lessons invite students to connect with, and learn from, their local ecosystems, guiding them to identify and solve local water-related environmental challenges affecting their communities. Choice School Programs are aligned with state standards, and participation includes a dynamic in-class or virtual presentation, and pre- and post-activities that encourage and support Science

Technology Engineering Arts and Mathematics (STEAM)-based learning and good water stewardship.

Water Energy Education Alliance (WEEA) is a coalition of education and water and energy industry professionals led by MWDOC that works together to build and bolster Career Technical Education programs (CTE) for southern California high school students. These CTEs focus on workforce pathways in the Energy, Environment, and Utility Sectors, and connections established through this powerful southern California alliance assist stakeholders as they thoughtfully step up their investment in the education and career success of California's future workforce.

MWDOC Water Awareness Poster Contest is an annual activity developed to encourage Orange County's K-12 students to investigate and explore their relationship to water, connect the importance of good water stewardship to their daily lives, and express their conclusions creatively through art. Each year, MWDOC receives hundreds of entries, and 40 winners from across Orange County are invited to attend a special awards ceremony with their parents and teachers, and Ricky the Rambunctious Raindrop.

Boy Scouts Soil and Water Conservation Merit Badge and Girl Scouts Water Resources and Conservation Patch Programs guide Orange County Scouts on a learning adventure of where their water comes from, the importance of Orange County water resources, and how to be water efficient. These STEAM-based clinics are hosted by MWDOC and include interactive learning stations, hands-on activities, and a guided tour of an Orange County water source, water treatment facility, or ecological reserve

Figure 1-3: Left to Right - MWDOC Choice School Program Assembly | Girl Scouts Water Resources and Conservation Patch Clinic - Soil and Water Testing | Boy Scouts Soil and Water Conservation Merit Badge Clinic - Tour of a Water Treatment Plant

Partnerships are an integral part of achieving water-related goals that impact all Orange County water users. MWDOC's partner list is extensive, and acts as a collective catalyst for all those involved to grow and prosper. Some of the District's most recognized partners include local, regional, state, and federal legislators, educators, water and energy industry leaders, environmental groups, media, and business associations all focused on the common goals of water education, water use efficiency, and advocacy on behalf of the region.

Figure 1-4: Left to Right - MWDOC/Wyland Public Service Announcement | California Next Generation Science Standards State Rollout – Panel Participation with Local and State Education Partners | Orange County Department of Education and Bioneers STEM Symposium – Co-Presentation with Metropolitan Water District of Southern California

1.5 Programs to Assess and Manage Distribution System Real Loss

With the sale of the Allen-McColloch Pipeline to Metropolitan in 1995, MWDOC no longer owns or operates a distribution system. Water purchased and sold by MWDOC is distributed directly from Metropolitan's system into the MWDOC retail agency systems. However, MWDOC does help member agencies evaluate and reduce their distribution systems' real and apparent losses through comprehensive Water Loss Control Programs.

In October 2015, the MWDOC Board of Directors authorized staff to begin implementing a Water Loss Control Technical Assistance Program (TAP) to support member agency compliance with Senate Bills 1420 and 555, both of which address distribution system Water Loss. The TAP program established a menu of technical assistance that water retailers can elect to participate in. These programs connect water retailers with industry experts who provide one on one technical assistance through data analysis, agency specific advising and assessment. The TAP services include:

- Water Balance Compilation
- Component Analysis of Real and Apparent Losses
- Source/Production Meter Accuracy Testing
- Billing Data Chain Assessment
- Internal Water Loss Committee Planning

MWDOC's Water Loss Control TAP has a very positive impact on building knowledge of water loss recovery strategies by all retail water agencies in the County and implementation of those strategies. To date MWDOC has hosted 30 Water Loss Work Group Meetings with approximately 35 agency representatives' attending each meeting. A total of 137 Annual Water Balances have been compiled and validated over the last five years, vastly improving water agency understanding of volumes of real and apparent losses, strategies to recovery losses and value of losses.

Because the OC area retailers were so receptive to the TAP, MWDOC began to consider other services that would assist in controlling water loss. MWDOC sent out a survey to OC retailers in 2018 to collect information on what services were most needed and would be the most beneficial. In 2019, the MWDOC Board authorized the implementation of a Water Loss Control Shared Services Business Plan (Business Plan) based on the needs outlined in the survey and the direction of the Water Loss Control Performance Standards currently in development.

The following are guiding tenets of MWDOC's Water Loss Control Shared Services:

- Offer shared services at a competitive or lower cost than the same services provided by the private sector
- Provide quality shared services on par with or better than the same services provided by the private sector
- Realize economies of scale for these services by providing services at a regional level that cannot be justified at many local levels
- Continue collaboration and shared learning among all agencies throughout this process
- Phase implementation of new shared services over time, starting with the services that have the highest level of interest or demand by water agencies
- Integrate program administration and data management to share results and customize program offerings to the unique conditions of each member agency

The Business plan included hiring specialized MWDOC staff to provide services directly to retail water suppliers in OC. These services include:

- Water Balance Validation
- Customer Meter Accuracy Testing
- Distribution System Pressure Surveys
- Distribution System Leak Detection
- Suspected Leak Investigations
- No Discharge Distribution System Flushing

Since the start of the shared services program in August 2019, more than 780 miles of distribution system leak detection has been completed which resulted in discovery of 373 hidden leaks that have been repaired or are in the process of being repaired. These leak repairs result in recovering more than 84.5 million gallons of water valued at more than $300,000 per year. A total of 1,439 water meter accuracy tests have been completed by 6 agencies improving agency knowledge of meter performance and accuracy of water balance results. A total of thirty-two sites have been monitored during pressure surveys for three agencies that were used to calculate average system pressure, calibrate hydraulic models and investigate pressure anomalies. And lastly, 12 miles of distribution system mains have been flushed resulting in improved water quality for consumers and recovery of 176,200 gallons of water that was filtered and returned to the distribution system for beneficial use.

1.6 Water Conservation Program Coordination and Staffing Support

MWDOC's Water Use Efficiency Department is comprised of five (5) full time equivalent (FTE) positions and three (3) student intern positions. Heading the department is the Water Use Efficiency (WUE) Director. Beneath him on the department organizational chart are Water Use Efficiency Supervisor, Senior Water Use Efficiency Analyst, Water Use Efficiency Analyst II, and Water Use Efficiency Analyst I. The department also employs three part-time student interns who function in a support role to the full time staff. The department works together in a collaborative nature, assisting one another in the implementation of the many Water Use Efficiency Programs.

MWDOC's WUE Department has a rich history of writing successful grant proposal from both State and Federal sources. State granting agencies include the SWRCB, DWR, and Natural Resource Conservation

Service (NRCS); most state funding is procured through IRWM processes. Federal granting agencies include the United States Bureau of Reclamation (USBR). Local Funding is also a core component of MWDOC's WUE programs. This funding comes from two sources: Metropolitan Water District of Southern California and MWDOC's retail water agencies. MWDOC, as a regional wholesaler of imported water, is one of Metropolitans member agencies, and through water rates paid to Metropolitan, MWDOC recoups funding for water efficiency programs through Metropolitan's Conservation Credits program. Metropolitan establishes a bi-yearly funding budget for both WUE programs and devices, and MWDOC, in turn, establishes its own WUE programs using Conservation Credit funds. MWDOC assists Orange County retail agencies by implementing an array of regional and local water use efficiency programs and projects. All retail agencies elect to participate in the MWDOC programs and several provide funding of their own for select devices or services.

MWDOC's WUE department has a long standing practice of conducting regular investigations of program effectiveness via statistical program process and impact evaluations. The process evaluations are utilized to ensure administrative quality control and ease of access to consumers. An adaptive management approach is taken to implement efficiency practices or to correct for identified process deficiencies. The impact evaluations utilize robust statistical methodologies to measure the actual water saving achieved in comparison to the expected industry water savings estimates. Results from impact evaluations have provided insight relating to those devices and programs that yield the best water savings in relationship to program administrative effort, cost effectiveness, and appropriate rebate levels.

1.6.1 Residential Conservation Implementation (non-landscape)

MWDOC assists its retail water agencies to implement residential DMMs by making available the following programs aimed at increasing landscape and indoor water use efficiency for residential customers. MWDOC has implemented successful water use efficiency programs for residential customers for over 30 years. This began with our highly successful Ultra-Low-Flush Toilet Rebate Program, continued on through the High Efficiency Washer Program, and now continues with the High Efficiency Toilet Programs and more.

High Efficiency Clothes Washer Rebate Program

The High Efficiency Clothes Washer (HECW) Rebate Program provides residential customers with rebates for purchasing and installing HECWs that. Approximately 15% of home water use goes towards laundry, and HECWs use 35-50 percent less water than standard washer models, with savings of approximately 10,500 gallons per year, per device. Devices must meet or exceed the Consortium for Energy Efficiency (CEE) Tier 1 Standard, and a listing of qualified products can be found at ocwatersmart.com. There is a maximum of one rebate per home. Since 2011, MWDOC has facilitated the installation of over 122,000 high efficiency clothes washers saving over 4,220 AFY. Funding for this rebate comes from Metropolitan and Orange County retailers.

 High Efficiency Clothes Washers	Standard Incentive: $85 per washer Enhanced Incentive: up to $285 Per Unit Savings: 29 gallons per day (GPD) 14 year useful life .46 AF lifetime savings Cost per AF: **$185 with base rebate; $621with enhanced rebate**

Premium High Efficiency Toilet Rebate Program

The largest amount of water used inside a home, 30 percent, goes toward flushing the toilet. The Premium High Efficiency Toilet (HET) Rebate Program offers incentives to residential customers for replacing their toilets using 1.6 gallons per flush or more. Premium HETs use just 1.1 gallons of water or less per flush, which is 20 percent less water than WaterSense standard toilets. In addition, Premium HETS save an average of 9 gallons of water per day while maintaining high performance standards. Since 2005, MWDOC has facilitated the installation of over 60,000 high efficiency toilets saving more than 2,240 AFY. Funding for this rebate comes from Metropolitan and Orange County retailers.

 Premium High Efficiency Toilets	Standard Incentive: $40 per toilet Enhanced Incentive: up to $100 per toilet Per Unit Savings: 9 GPD 20 year useful life .21 AF lifetime savings Cost per AF: **$190** per AF

Pressure Regulating Valve Pilot Program

The Pressure Regulating Valve (PRV) Pilot Program seeks to test and replace broken residential PRVs. A PRV is a plumbing device typically installed on the intake pipe between the street and the front hose bib in homes in high pressure zones and is used to moderate high water pressure coming into the home. A failed PRV allows water to enter a home at a higher rate may increase the rate of leaks and cause appliances and fixtures to use more water when operated. This pilot will be used to determine the potential water savings associated with replacing failed PRVs. To date 135 PRVs have been assessed. Funding for this pilot comes from Metropolitan and DWR.

	Pressure Regulation Valve Pilot Program	Standard Incentive: Test & Replacement free to public Enhanced Incentive: none Per Unit Savings: To be determined by Pilot Study 20 year useful life .21 AF lifetime savings Cost per AF: **$190** per AF

1.6.2 Conservation Programs for Commercial, Industrial and Institutional Accounts (non-landscape)

MWDOC provides a variety of financial incentives to help Orange County businesses, restaurants, institutions, hotels, hospitals, industrial facilities, and public sector sites achieve their efficiency goals. Water users in these sectors have options to choose from a standardized list of water efficient equipment/devices or may complete customized projects through a pay-for-performance where the incentive is proportional to the amount of water saved. Such projects include high efficiency commercial equipment installation and manufacturing process improvements.

Water Savings Incentive Program

The Water Savings Incentive Program (WSIP is designed for non-residential customers to improve their water efficiency through upgraded equipment or services that do not qualify for standard rebates. WSIP is unique because it provides an incentive based on the amount of water customers actually save. This “pay-for-performance” design lets customers implement custom projects for their sites.

Projects must save at least 10 million gallons of water to qualify for the Program and are offered from $195 to $390 per acre foot of water saved. Examples of successfully projects include but are not limited to changing industrial process system water, capturing condensation and using it to supplement cooling tower supply, and replacing water-using equipment with more efficient products. Thirty-eight customized water efficiency improvements have been completed since 2008 saving more than 1,280 AFY. This Program is funded by Metropolitan and supplemental funding is provided by DWR, Orange County retailers and US Bureau of Reclamation.

On-site Retrofit Program

The On-site Retrofit Program provides another pay-for-performance financial incentive to commercial, industrial and institutional property owners, including Homeowner Associations, who convert potable water irrigation or industrial water systems to recycled water use.

Projects commonly include the conversion of mixed or dedicated irrigation meters using potable water to irrigate with reclaimed water, or convert industrial processes use to recycled water, such as a cooling towers. Financial incentives of up to $1,300 per AF of potable water saved are available for customer-side on the meter retrofits. Funding is provided by Metropolitan, USBR, and DWR. Since 2015, 166 projects have been completed saving 3,489 AFY.

Multi-Family Premium High Efficiency Toilet Incentive Program

MWDOC makes an effort to reach all water-users in Orange County. For the Multi-Family Premium High Efficiency Toilet Rebate Program, MWDOC targets multi-family buildings in both disadvantaged communities (DAC) and non-DAC communities, in addition to targeting all commercial buildings, and single-family residential homes through Premium HET device rebates.

MWDOC offers the DAC Multi-Family HET Program, a special version of the High Efficiency Toilet Program, to ensure regardless of economic status all water-users in Orange County can benefit from the rebate. This Program targets 3.5 gallon per flush (gpf) or greater toilets to replace them with WaterSense Labeled 1.1 gpf or less. For this purpose, DAC are referenced as communities facing economic hardship. This is defined using criteria established by DWR and the County of Orange, which includes communities where the median household income (MHI) is less than 85% of the Orange County MHI.

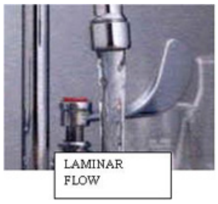
The DAC Multi-Family Program is contractor-driven, where a contractor works with building owners to replace all of the toilets in the building(s). To avoid any cost to tenants, the rebate is $200 per toilet paid to the contractor, essentially covering the contractor’s cost; therefore, there is little to no charge to the building owners that may be passed through to tenants. This process was formed after consulting contractors and multi-family building owners in Orange County. To serve those in multi-family buildings outside of designated DAC locations, MWDOC offers $75 per toilet through the same contractor-driven format. An additional option is available through SoCalWater$mart, which offers up to $250 per toilet to multi-family buildings that were built before 1994, therefore targeting buildings built before legislation required low-flow plumbing fixtures in new construction.

Device Retrofits

MWDOC offers additional financial incentives under the Socal Water$mart Rebate Program which offers rebates for various water efficient devices to CII customers. Core funding is provided by Metropolitan and supplemental funding is sourced from MWDOC via grant funds and/or retail water agencies.

 Ultra Low Water / Zero Water Urinals	Standard Incentive: $200 Enhanced Incentive: up to $310 Per Unit Savings: 110 GPD 20 year useful life 2.45 AF lifetime savings Cost per AF: Standard Incentive: $81–$127 per AF

 High Efficiency Toilet *(HETs)*	Standard Incentive: $40 Enhanced Incentive: up to $150 Per Unit Savings: 9 GD 20 year useful life 0.21 lifetime savings Cost per AF: $190–$750 per AF
 Connectionless Food Steamers (aka Boiler-less)	Standard Incentive: $485 per compartment Enhanced Incentive: up to $985 Per Unit Savings: 223 GPD 10 year useful life 2.5 AF lifetime savings Cost per AF: $194–$394 per AF
 Air-Cooled Ice Machines	Standard Incentive: $300 per machine Enhanced Incentive: Up to $1,050 Per Unit Savings: 137 GPD 10 year useful life 1.54 AF lifetime savings Cost per AF: $195–$682 per AF
 Standard Cooling Tower Conductivity Controller	Standard Incentive: $625 per controller Enhanced Incentive: up to $1,325 Per Unit Savings: 575 GPD 5 year useful life 3.22 AF lifetime savings Cost per AF: $195–$411 per AF
 pH-Cooling Tower Controller	Standard Incentive: $1,750 per controller Enhanced Incentive: up to $2,750 Per Unit Savings: 1,735 GPD 5 year useful life 9.72 AF lifetime savings Cost per AF: $180–$283 per AF

 Laminar Flow Restrictors	Incentive: $10 per restrictor Per Unit Savings: 21 GPD 5 year useful life 0.115 AF lifetime savings Cost per AF: $86 per AF
 Dry Vacuum Pumps	Incentive: $125 per 0.5 Horse Power Per Unit Savings: 82 GPD 7 year useful life 0.64 AF lifetime savings Cost per AF: $195 per AF

1.6.3 Residential and CII Landscape Conservation Programs and Incentives

One of the most active and exciting water use efficiency sectors MWDOC provides services for are those programs that target the reduction of outdoor water use. With close to 60 percent of water consumed outdoors, this sector has been and will continue to be a focus for MWDOC. MWDOC has pioneered numerous landscape water use efficiency programs aimed at both residential, commercial, and public agency water users that takes a holistic, sustainable approach to saving water that produces additional benefits to the watershed. Such benefits include reductions in dry and wet weather runoff and associated non-point source pollution, energy savings, green-waste reductions, and increases in biomass and carbon sequestration.

Water Efficiency Programs

Turf Removal Program

The Orange County Turf Removal Program offers incentives to remove turf grass from residential, commercial, and public properties throughout the County. This program is a partnership between MWDOC, Metropolitan, and local retail water agencies. The goals of this program are to increase water use efficiency through sustainable landscaping practices that result in multi-benefit projects across Orange County. Participants replace their turf grass with drought-tolerant, CA Friendly, or CA Native landscaping, and retrofit their irrigation systems to high efficiency equipment, such as drip, or remove it entirely, and are encouraged to utilize smart irrigation timers. Furthermore, projects are required to include a stormwater capture feature, such as a rain garden or dry stream bed, and have a minimum of three plants per 100 square feet to increase plant density and promote healthy soils. These projects save water and also reduce dry and wet weather runoff, increase urban biomass, and sequester more carbon than turf landscapes. Examples of projects are listed in Figure 1-5 below. Through December 2020, Orange County residents and commercial properties removed 23.2 million square feet of turf, resulting in approximately 3,245 AFY of water savings. This Program is funded by Metropolitan, DWR, USBR, and retail water agencies.

Figure 1-5: Examples of completed Turf Removal Projects as a residential home (left) and a City center median strip (right).

 Turf Removal Program	Standard **Residential & Commercial** Incentive: $2 per ft^2 Enhanced **Residential & Commercial** Incentive: up to $4 per ft^2 Per Unit **Residential & Commercial** Savings: 0.121 GPD per square foot 10 year useful life 0.001 AF lifetime savings per square foot Cost per AF: Residential $1,538–$3,077per AF

Landscape Design and Maintenance Plan Assistance Programs

To maximize the water efficiency and quality of Orange County's Turf Removal Program Projects, MWDOC offers free landscape designs and free landscape maintenance plans to participating residential customers. The Landscape Design Assistance Program is offered at the beginning stages of their turf removal project so that customers may receive a customized, professionally designed landscape to replace their turf. Landscape designs include plant selection, layout, irrigation plans, and a stormwater capture feature. These designs help ensure climate appropriate plants are chosen and planted by hydrozone, that appropriate high efficiency irrigation is properly utilized, that water savings are maximized as a result of the transformation. An example design is shown in Figure 1-6. Additionally, generic designs are available for free on MWDOC's website as an additional landscape resources. The Landscape Maintenance Assistance Plan provides a post-installation care plan to help ensure that the new landscape is properly cared for and is not overwatered. Approximately 375 participants have received customized Design templates and 87 participants have received customized maintenance plans.

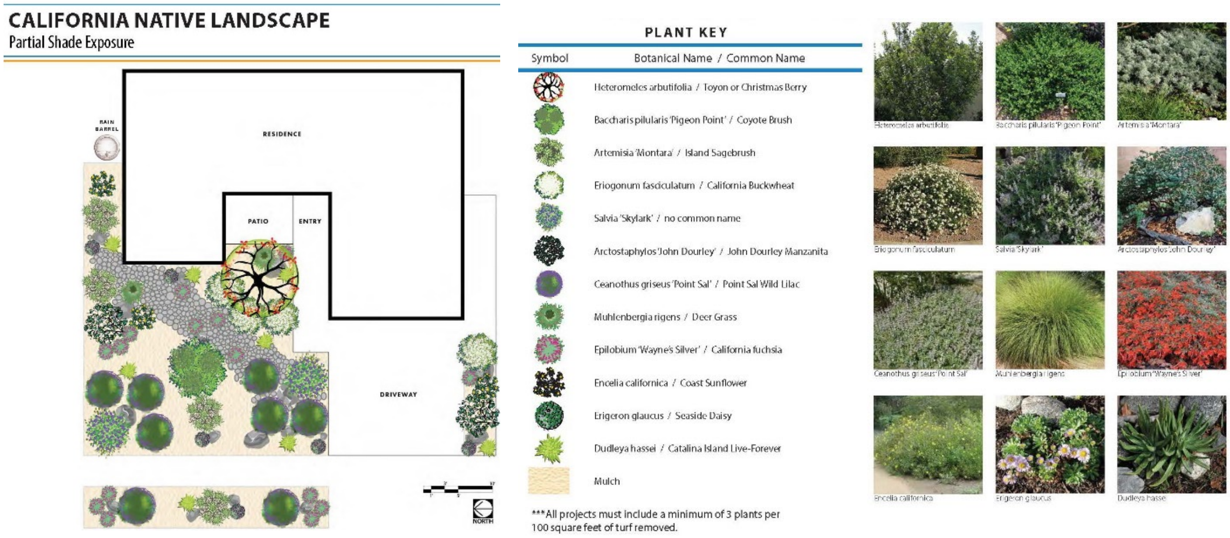


Figure 1-6: Examples of completed Turf Removal Projects as a residential home (left) and a City center median strip (right).

Spray-to-Drip Rebate Program

The Spray to Drip Rebate Program offers residential, commercial, and public agency customers rebates for converting areas irrigated by traditional high-precipitation rate spray heads to low-precipitation rate drip irrigation. Drip irrigation systems are extremely water-efficient. Rather than spraying wide areas subject to wind drift, overspray and runoff, drip systems use point emitters to deliver water to specific locations at or near plant root zones. Water drips slowly from the emitters either onto the soil surface or below ground. As a result, less water is lost to wind, evaporation, and overspray, saving water and reducing irrigation runoff and non-point source pollution.

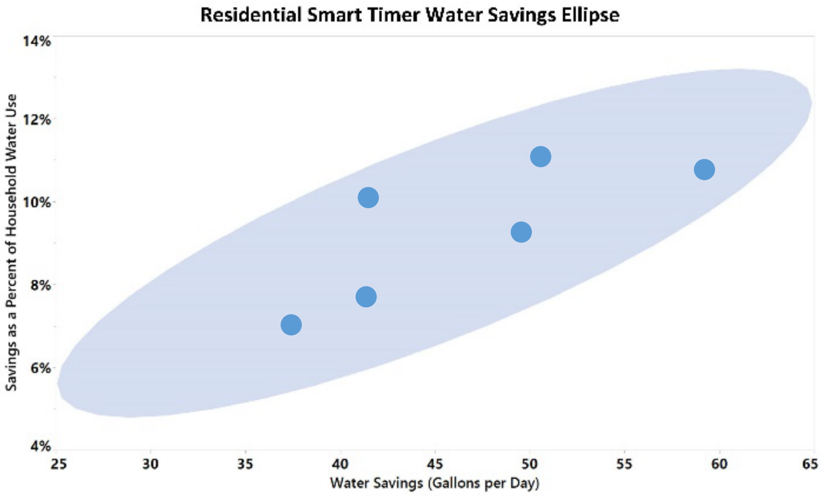
MWDOC pioneered drip conversion programs with the start of the Spray to Drip Pilot Program in 2012. In 2017, MWDOC evaluated its Spray-to-Drip Pilot Program through a processes and impact evaluation. Over 70% of survey participants reported observed water savings and positive impacts to their landscape since completing their project. The statistical impact analysis found that the average residential project saved over 31,000 gallons saved per site annually and 44 gallons per year to square foot of irrigated area converted. Commercial projects, on average, saved more than 4 million gallons per site annually and 35 gallons per year per square foot. Based on the positive pilot program results, MWDOC has continued to offer the successful Spray-to-Drip Program to Orange County and through December 2020 has converted 1.1 million square feet of inefficiently irrigated landscapes to drip irrigation saving approximately 132 AFY. Based on MWDOC's positive results, drip conversion programs are now becoming an industry standard landscape rebate with quantifiable and reliable water savings. See Figure 1-7 for projects installing dripline before being covered with mulch. Funding for this Program is provided by Metropolitan, DWR, USBR, and Orange County Retailers.

Figure 1-7: Examples of completed drip line installed through the Spray-to-Drip Program.

 Spray-to-Drip Irrigation	Standard **Residential** Incentive: \$0.25 per ft^2 Standard **Commercial** Incentive: \$0.20 per ft^2 Enhanced **Residential & Commercial** Incentive: up to \$0.70 per ft^2 Per Unit **Residential** Savings: 0.121 GPD per square foot 10 year useful life 0.001 AF lifetime savings per square foot Per Unit **Commercial** Savings: 0.095 GPD per square foot 10 year useful life 0.001 AF lifetime savings per station Cost per AF: Residential \$188–\$368 per AF Commercial \$195–\$470 per AF

Smart Timer Rebate Program

Smart Timers are irrigation clocks that are either weather-based irrigation controllers (WBIC) or soil moisture sensor systems. WBICs adjust the irrigation schedule automatically (usually daily) to reflect changes in local weather and site-specific landscape needs, such as sun exposure, soil type, slopes, and plant material, prompting turf and plants to receive the proper amount of water throughout the year. During the fall months, when property owners and landscape professionals often overwater, Smart Timers can save significant amounts of water. Soil moisture sensors determine the amount of water in the soil by way of sensors placed in the actual root zone of a given landscape area. This measurement of water is then relayed back to the controller and through the controller's programming, and the correct amount of water is then applied. MWDOC has been a pioneer of smart irrigation technology, which is not an industry standard landscape program that is associated with quantifiable and reliable water savings. MWDOC has conducted and disseminated several water savings research studies of Smart Timer Programs over the last sixteen years. Water savings predicative ellipses based on MWDOC's numerous research studies are shown in Figure 1-8. This representation is useful to visualize the correlation between water savings in gallons per day and savings as a percent of the site's overall water use, and also the mean of residential and commercial studies. Since 2004, MWDOC has facilitated the installation of close to 30,000 timers saving over 9,000 AFY.



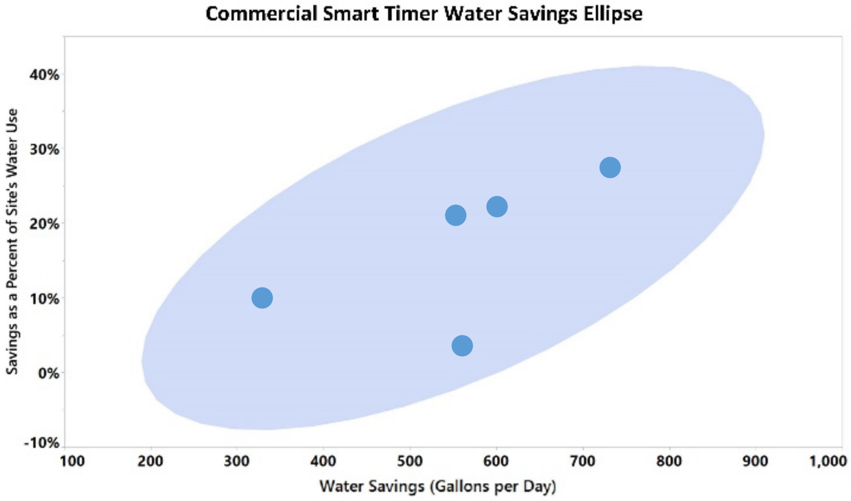


Figure 1-8: Water savings predictive ellipses based on MWDOC's smart irrigation timer research. Dark blue points represent results from MWDOC studies, the light blue ellipses represent the predicted location of a new observation, at 95% confidence.

 Smart Controllers (Weather-Based Irrigation Controllers and Soil Moisture Sensor Systems)	Standard **Residential** Incentive: $80 per controller Enhanced **Residential** Incentive: Up to $330 per controller Standard **Commercial** Incentive: $35 per station Enhanced **Commercial** Incentive: $75 per station Per Unit **Residential** Savings: 37 GPD 10 year useful life 0.41 Per Unit **Commercial** Savings: 16 GPD per station 10 year useful life 0.179 AF lifetime savings per station Cost per AF: Residential $193–$1,844 per AF Commercial $195–$419 per AF

Rotating Nozzles Rebate Program

The Rotating Nozzle Rebate Program provides incentives to residential and commercial properties for the replacement of high-precipitation rate spray nozzles with low-precipitation rate multi-stream, multi-trajectory rotating nozzles. The rebate offered through this Program aims to offset the cost of the device and installation. MWDOC has pioneered high efficiency rotating nozzle programs, which are now an industry standard landscape program associated with quantifiable and reliable water savings. Since 2007, MWDOC has facilitated the installation of over 570,000 high efficiency rotating nozzles, savings approximately 2,790 AFY. This Program is funded by Metropolitan and Orange County retailers.

 High Efficiency Rotating Nozzles	Incentive: $2 per nozzle for residential, commercial Enhanced Incentive: up to $6 per nozzle for residential, commercial Per Unit Savings: 2.36 GPD per nozzle 5 year useful life 0.013 AF lifetime savings Cost per AF: **$152** per AF

Additional Device Retrofits

MWDOC also offers additional financial incentives under the SoCal Water$mart Rebate Program for a variety of other water efficient landscape devices.

 Central Computer Irrigation Controllers	Standard Incentive: $35 per station Per Unit Savings: Same as standalone smart controllers 16 GPD per station 10 year useful life 0.179 AF lifetime savings per station Cost per AF: $196 per AF
 Large Rotary Nozzles	Standard Incentive: $13 per set of two nozzles Per Unit Savings: 16 GPD per set of two nozzles 10 year useful life 0.18 AF lifetime savings per set of two nozzles Cost per AF: $72 per AF.
 In-Stem Flow Regulators	Standard Incentive: $1 per flow regulator Per Unit Savings: 2.7 GPD per device 5 year useful life 0.015 AF lifetime savings per station Cost per AF: $67 per AF.
 Rain Barrels (50-99 gall.) Cisterns Small (200-500 gal.) Cistern Medium (501-999 gal.) Cistern Large (1,000+ gal.)	Standard Incentive: Rain Barrel: $35 per barrel Cistern Small: $250 per cistern Cistern Medium: $300 per cistern Cistern Large: $350 per cistern Enhanced Incentive: Rain Barrel: $75 per barrel Per Unit Rain Barrel Savings: 1.7 GPD per barrel 10 year useful life 0.010 AF Saved

	Per Unit Cistern Small Savings: 6.8 GPD per cistern 10 year useful life 0.076 AF Saved Per Unit Cistern Medium Savings: 8.4 GPD per cistern 10 year useful life 0.094 AF saved Per Unit Cistern Large Savings: 9.6 GPD per cistern 10 year useful life 0.108 AF Saved Cost Per AF: Rain Barrel: $1,837-$3,947 Cistern Small: $3,289 Cistern Medium: $3,191 Cistern Large: $3,241

Water Efficiency Landscape Classes, Certifications, and Resources

Landscape Training Classes

The California Friendly and Native Landscape Training and the Turf Removal and Garden Transformation Workshop provide education to residential homeowners, property managers, and professional landscape contractors on a variety of landscape water efficiency practices that they can employ and use to help design a beautiful garden using California Friendly and native plant landscaping principles. The California Friendly and Native Landscape Class demonstrates how to: implement storm water capture features in the landscape; create a living soil sponge that holds water; treat rainwater by a resource; select and arrange plants to maximize biodiversity and minimize water use; and control irrigation to minimize water waste, runoff and non-point source pollution.

The Turf Removal and Garden Transformation Workshop teaches participants how to transform thirsty turfgrass into a beautiful, climate-appropriate water efficient garden. This class teaches how to: evaluate the landscape's potential; plan for garden transformation; identify the type of turfgrass in the yard; remove grass without chemicals; build healthy, living soils; select climate-appropriate plants that minimize water use and maximize beauty and biodiversity; and implement a maintenance schedule to maintain the garden.

Qualified Water Efficient Landscape Certification (Commercial)

Since 2018, the Municipal Water District of Orange County (MWDOC), along with participating MWDOC member agencies, has offered free Qualified Water Efficient Landscaper (QWEL) certification classes designed for landscape professionals. Classes are open to any city staff, professional landscaper, water district employee, or maintenance personnel that would like to become a Qualified Water Efficient Landscaper. The QWEL certification program provides 20 hours of instruction on water efficient areas of expertise such as local water supply, sustainable landscaping, soil types, irrigation systems and maintenance, as well as irrigation controller scheduling and programing. QWEL has received recognition from EPA WaterSense for continued promotion of water use efficiency. To earn the QWEL certification, class participants must demonstrate their ability to perform an irrigation audit as well as pass the QWEL exam. Successful graduates will be listed as a Certified Professional on the WaterSense website as well as on MWDOC's landscape resources page, to encourage Turf Removal participants or those making any landscape improvements to hire a QWEL certified professional.

Started in December 2020, a hybrid version of QWEL is available in conjunction with the California Landscape Contractors Association's Water Management Certification Program. This joint effort allows landscape industry an opportunity to obtain two nationally recognized EPA WaterSense Professional Certifications with one course and one written test. This option is offered through Metropolitan Water District of Southern California.

OC Water Smart Gardens Resource Page

MWDOC's OC Water Smart Gardens webpage provides a surplus of helpful guides and fact sheets, as well as an interactive photo gallery of water-saving landscape ideas. The purpose of this resource is to help Orange County residents find a broad variety of solutions for their water efficient landscaping needs. This includes a detailed plant database with advanced to search features; photo and/or video-based garden tours; garden gallery with images organized into helpful landscape categories such as back yards, hillsides, full sun, and/or shade with detailed plant information; and the ability to select and store plants in a list that the user can print for use when shopping.

Additional technical resources are available such as a watering calculator calibrated for local evapotranspiration rates, and a garden resources section with fact sheets on sustainable landscape fundamentals, water and soil management, composting, solving run-off, and other appropriate topics. Web page is accessible through mwdoc.com and directly at www.ocwatersmartgardens.com.

APPENDIX K

Notice of Public Hearing (Pending)

City of Seal Beach

CITY HALL 211 EIGHTH STREET
SEAL BEACH, CALIFORNIA 90740
(562) 431-2527 • www.sealbeachca.gov

POSTED

MAR 05 2021

ORANGE COUNTY CLERK-RECORDER DEPARTMENT
BY: ________________ DEPUTY

March 4, 2021
County of Orange
Attn: Mr. Hugh Nguyen, Clerk Recorder
12 Civic Center Plaza, Room 101
Santa Ana, California 92701

Subject: City of Seal Beach 2020 Urban Water Management Plan Update

The City of Seal Beach (City) is in the process of preparing and updating its 2020 Urban Water Management Plan (UWMP) in compliance with the Urban Water Management Planning Act and the Water Conservation Act of 2009, commonly referred to as SBX7-7. An update of the City's UWMP is required every five (5) years.

Water Code section 10621(b) requires an urban water supplier updating its UWMP to notify cities and counties within its service area of the update at least sixty (60) days prior to holding a public hearing. This letter serves as City's notice that it is preparing and updating its 2020 UWMP, to be adopted and submitted to the California Department of Water Resources before the July 1, 2021 deadline. City will be adopting its Water Shortage Contingency Plan as part of the 2020 UWMP.

City is also considering an Addendum to the 2015 UWMP to demonstrate consistency with the Delta Plan Policy to Reduce Reliance on the Delta Through Improved Regional Water Self-Reliance (California Code Reg., tit. 23, § 5003). The 2015 UWMP Addendum and a copy of City's draft 2020 UWMP will be available for review on the City website (www.sealbeachca.gov) in spring of 2021, and City will subsequently hold noticed public hearings on the 2020 UWMP, Water Shortage Contingency Plan, and 2015 UWMP Addendum in advance of their proposed adoption.

City invites you to submit comments and consult with City regarding its 2020 UWMP update and 2015 UWMP Addendum. City anticipates holding a public comment period in spring 2021, with a public hearing planned during that time.

If you have any input for the matters contained in this notice letter, require additional information, or would like to set up a meeting to discuss City's 2020 UWMP update, please contact me at (562) 431-2527 ext. 1321, or by email at smyrter@sealbeachca.gov.

Sincerely,

Steve Myrter, P.E.
Public Works Director

HUGH NGUYEN
CLERK-RECORDER

BIRTH AND DEATH RECORDS
FICTITIOUS BUSINESS NAMES
MARRIAGE LICENSES/RECORDS
NOTARY REGISTRATION
ORANGE COUNTY ARCHIVES
PASSPORTS
PROPERTY RECORDS

RECEIVED

MAY 06 2021

CITY CLERK
CITY OF SEAL BEACH

CITY OF SEAL BEACH
211 EIGHTH ST
SEAL BEACH, CA 90740

Office of the Orange County Clerk-Recorder
Memorandum

SUBJECT: PUBLIC NOTICE

The attached notice was received, filed and a copy was posted on 03/09/2021

It remained posted for 30 (thirty) days.

Hugh Nguyen
Clerk - Recorder
In and for the County of Orange

By: Sandra Lopez Deputy

Public Resource Code 21092.3

The notice required pursuant to Sections 21080.4 and 21092 for an environmental impact report shall be posted in the office of the County Clerk of each county *** in which the project will be located and shall remain posted for a period of 30 days. The notice required pursuant to Section 21092 for a negative declaration shall be so posted for a period of 20 days, unless otherwise required by law to be posted for 30 days. The County Clerk shall post notices within 24 hours of receipt.

Public Resource Code 21152

All notices filed pursuant to this section shall be available for public inspection, and shall be posted ***** within 24 hours of receipt** in the office of the County Clerk. Each notice shall remain posted for a period of 30 days. *** Thereafter, the clerk shall return the notice to the local **lead** agency *** within a notation of the period it was posted. The local **lead** agency shall retain the notice for not less than nine months.

Additions or changes by underline; deletions by ***

APPENDIX L

Adopted UWMP Resolution (Pending)

Arcadis U.S., Inc.
320 Commerce, Suite 200
Irvine
California 92602
Phone: 714 730 9052

www.arcadis.com

Maddaus Water Management, Inc.

Danville, California 94526

Sacramento, California 95816

www.maddauswater.com