# 2025 Urban Water Management Plan

**FINAL DRAFT** / April 2026

carollo in collaboration with CDM Smith and Maddaus Water Management Inc.

# 2025 Urban Water Management Plan

April 2026 / FINAL DRAFT

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# Abbreviations

| | |
|---|---|
| °C | degree Celsius |
| AB | Assembly Bill |
| ACS | US Census American Community Survey |
| ADU | accessory dwelling unit |
| AF | acre-foot |
| AFY | acre-feet per year |
| AMI | Advanced Metering Infrastructure |
| AVEK | Antelope Valley-East Kern |
| AWWA | American Water Works Association |
| BEA | Basin Equity Assessment |
| BiOps | Biological Opinions |
| BMP | best management practice |
| BPP | basin production percentage |
| BSA | Boy Scouts of America |
| CalWEP | California Water Efficiency Partnership |
| CAMP4W | Climate Adaptation Master Plan for Water |
| CDR | Center for Demographic Research at California State University, Fullerton |
| CEE | Consortium for Energy Efficiency |
| cfs | cubic feet per second |
| CII | commercial, industrial, and institutional |
| City | City of Fullerton |
| CPTP | Coastal Pumping Transfer Program |
| CRA | Colorado River Aqueduct |
| CRSS | Colorado River Simulation System |
| CUP | conjunctive use program |
| CUWCC | California Urban Water Conservation Council |
| CVP | Central Valley Project |
| CWC | California Water Code |
| CY | calendar year |
| DCP | Drought Contingency Plan |
| DDW | Division of Drinking Water |
| DIM | dedicated irrigation meter |
| DMM | Demand Management Measures |
| DOF | Department of Finance |
| DRA | Drought Risk Assessment |
| DVL | Diamond Valley Lake |
| DWR | Department of Water Resources |

| | |
|---|---|
| EIR | Environmental Impact Report |
| EO | Executive Order |
| EPA | United States Environmental Protection Agency |
| ESA | Endangered Species Act |
| FIRO | Forecast Informed Reservoir Operation |
| FMD | flow monitoring device |
| FY | fiscal year |
| GAC | granular activated carbon |
| gal | gallon |
| GAP | Green Acres Project |
| GDP | gross domestic product |
| GHG | greenhouse gas |
| GIS | geographic information system |
| GPCD | gallons per capita per day |
| gpf | gallons per flush |
| gpm | gallons per minute |
| GPSCD | gallons per service connection per day |
| GRP | Groundwater Resilience Plan |
| GSA | Groundwater Sustainability Agency |
| GSP | Groundwater Sustainability Plan |
| GWRS | Groundwater Replenishment System |
| HDI | hot-dry index |
| HECW | high efficiency clothes washer |
| HET | high efficiency toilet |
| HRL | Healthy Rivers and Landscapes |
| ICS | Intentionally Created Surplus |
| IPR | indirect potable reuse |
| IRP | Integrated Water Resources Plan |
| ITP | Incidental Take Permit |
| IWCM | Interim Water Control Manual |
| IWRD | Irvine Ranch Water District |
| IX | ion exchange |
| JADU | junior accessory dwelling unit |
| kWh | kilowatt-hour |
| LAM | landscape area measurements |
| LRP | Local Resources Program |
| LVL | Leo J. Vander Lans Advanced Water Treatment Facility |
| M&I | municipal and industrial |
| MAF | million acre-feet |

| | |
|---|---|
| MCL | maximum contaminant level |
| MET | Metropolitan Water District of Southern California |
| MF | microfiltration |
| MG | million gallons |
| mg/L | milligrams per liter |
| mgd | million gallons per day |
| MUM | mixed-use CII meter |
| MWDOC | Municipal Water District of Orange County |
| ND | non-detect |
| NDMA | N-nitrosodimethylamine |
| ng/L | nanograms per liter |
| NPDES | National Pollutant Discharge Elimination System |
| OC Basin | Orange County Groundwater Basin |
| OCSD | Orange County Sanitation District |
| OCWD | Orange County Water District |
| PFAS | per- and polyfluoroalkyl substances |
| PFOA | perfluorooctanoic acid |
| PFOS | perfluorooctane sulfonate |
| PPCP | pharmaceuticals and personal care products |
| ppt | parts per trillion |
| PRISM | Parameter-elevation Regressions on Independent Slopes Model |
| QSA | Quantification Settlement Agreement |
| QWEL | Qualified Water Efficient Landscaper |
| RA | Replenishment Assessment |
| R-GPCD | residential gallons per capita per day |
| RHNA | Regional Housing Needs Assessment |
| RO | reverse osmosis |
| RUWMP | Regional Uban Water Management Plan |
| SARCCUP | Santa Ana River Conservation and Conjunctive Use Program |
| SB | Senate Bill |
| SBVMWD | San Bernardino Valley Municipal Water District |
| SCAB | South Coast Air Basin |
| SCAG | Southern California Association of Governments |
| SDCWA | San Diego County Water Authority |
| SGMA | Sustainable Groundwater Management Act |
| SNWA | Southern Nevada Water Authority |
| STEM | science, technology, engineering, and mathematics |
| Supplier | urban water supplier |
| SWP | State Water Project |

| | |
|---|---|
| SWRCB | California State Water Resources Control Board |
| TAF | thousand acre-feet |
| TAP | Conservation Framework Technical Assistance Program |
| TAZ | traffic analysis zone |
| TDS | total dissolved solids |
| TM | technical memorandum |
| USACE | United States Army Corps of Engineers |
| USBR | United States Bureau of Reclamation |
| USGS | United States Geological Survey |
| UV | ultraviolet |
| UWMP | Urban Water Management Plan |
| UWMP Act or Act | Urban Water Management Plan Act of 1983 |
| UWUO | Urban Water Use Objective |
| Water Code | California Water Code |
| WCM | Water Control Manual |
| WEEA | Water Energy Education Alliance |
| WR P1 | Delta Stewardship Council's Delta Plan Policy WR P1 |
| WRD | Water Replenishment District of Southern California |
| WSAP | Water Supply Allocation Plan |
| WSCP | Water Shortage Contingency Plan |
| WSIP | Water Savings Incentive Program |
| WUE | water use efficiency |

# CHAPTER 1 INTRODUCTION AND UWMP OVERVIEW

The City of Fullerton (City) prepared this 2025 Urban Water Management Plan (UWMP) to submit to the California Department of Water Resources (DWR) to satisfy the UWMP Act of 1983 (UWMP Act or 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, Metropolitan Water District of Southern California (MET) and local groundwater from the Orange County Groundwater Basin (OC Basin), which is managed by the Orange County Water District (OCWD). The City has prepared this 2025 UWMP in collaboration with the Municipal Water District of Orange County (MWDOC), 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 since the 2020 UWMP, MWDOC has been assisting its member agencies and surrounding communities to manage both their water supplies and demands. The water loss audit program, water conservation measures, public outreach and education on conservation and efforts for increased self-reliance to reduce dependency on imported water from the Sacramento-San Joaquin Delta (the "Delta") are some of the water management actions that the City has taken to maintain the reliability of water supply for its service area. In addition, the City has been proactive in managing local water supplies through the installation of two new wells. Lastly, the City has been in close communication with neighboring agencies to maintain strategic pipeline interties for emergency use.

This 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 2020 UWMP on the City's water resource needs, water use efficiency programs, water reliability assessment, and strategies to mitigate water shortage conditions. It also includes the City's updated 2025 Water Shortage Contingency Plan (WSCP) designed to prepare for and respond to water shortages. This 2025 UWMP contains all elements required by the Act.

## 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 six and one.

For this 2025 UWMP cycle, DWR continues to place emphasis on achieving improvements for long term reliability and resilience to drought and climate change in California. Despite there being no new statutory requirements, Suppliers must now report progress on meeting their 2028 Water Loss Standards and continue to state their compliance with Senate Bill (SB) X7-7 2020 Targets. Additional guidance on stored water accounting and recommendations on identifying the need for future or proposed water supply projects are provided by DWR as well.

## 1.2 Urban Water Management Plan Organization

This UWMP is organized into 10 chapters aligned with the DWR Guidebook recommendations. The sections within each chapter are customized to include the City's water supply reliability and future projections as well as plans to overcome any water shortages over a planning horizon of the next 25 years. The chapters for this UWMP are listed below:

**Chapter 1 Introduction and UWMP Overview** gives an overview of the UWMP fundamentals and requirements for the 2025 UWMP.

**Chapter 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.

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

**Chapter 4 Water Use Characterization** provides historical, current, and projected water use by customer category for the next 25 years for the City and the projection methodology used by the City to develop the 25-year projections.

**Chapter 5 Conservation Target Compliance** restates that the City's 2020 per capita water use in gallons per capita per day (gpcd) met the compliance target defined by SB X7-7.

**Chapter 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.

**Chapter 7 Water Service Reliability and Drought Risk Assessment** describes the assessment of the reliability of 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 Drought Risk Assessment (DRA) of all the supply sources for a consecutive five-year drought period beginning 2026.

**Chapter 8 Water Shortage Contingency Planning** is a brief summary of the standalone WSCP document 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.

**Chapter 9 Demand Management Measures** provides a description of the City's current and planned measures and programs to help the retail customers in its service area be water efficient and comply with the City's urban water use reduction targets.

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

# CHAPTER 2 UWMP PREPARATION

The City of Fullerton's (City) 2025 Urban Water Management Plan (UWMP) is prepared to meet the California Water Code (Water Code) compliance as a retail water supplier to its customers. The development of this UWMP involved close coordination with its wholesale partner, the Metropolitan Water District of Southern California (MET) and the regional wholesale supplier for Orange County, the Municipal Water District of Orange County (MWDOC), along with other key entities within the region.

## 2.1 Individual Planning and Compliance

As described in Chapter 1, 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 must prepare, adopt, and file an UWMP with the California Department of Water Resources (DWR) every five years to meet the compliance requirements of the UWMP Act. As shown in Table 2.1, the City meets this requirement as it has 32,050 municipal connections and supplied 22,243 AF in fiscal year (FY) 2025.

Table 2.1 Retail Only: Public Water Systems

| Submittal Table 2-1 Retail: Public Water Systems | | | |
|---|---|---|---|
| Public Water System Number | Public Water System Name | Number of Municipal Connections 2025 | Volume of Water Supplied 2025 (AF) |
| CA3010010 | City of Fullerton | 32,050 | 22,243 |
| | **Total** | 32,050 | 22,243 |
| **DWR NOTES:**<br>**Units of measure (AF, CCF, MG)** must remain consistent throughout the UWMP as reported in Submittal Table 2-3. This table identifies the unit of measure selected in Table 2-3. | | | |

The City opted to prepare its own UWMP (Table 2.2) and comply with the Water Code individually, while closely coordinating with MET, MWDOC, and various key entities as discussed in Chapter 2.2 to streamline regional integration. The UWMP Checklist was completed to confirm the compliance of this UWMP with the Water Code (Appendix A). All DWR standardized tables are provided in Appendix B. The City has selected to report demands and supplies using fiscal year as the basis (Table 2.3).

Table 2.2 Submittal Table 2-2: Plan Identification

| Submittal Table 2-2: Plan Identification | | |
|---|---|---|
| **Select One or Both** | **Type of Plan** | **Name of Regional Alliance or RUWMP** (Drop Down List) |
| ☑ | **Individual UWMP** | |
| | If Water Supplier is also a member of a SB X7-7 Regional Alliance, select name from the drop-down. | Orange County 20x2020 Regional Alliance |
| ☐ | **Regional Urban Water Management Plan (RUWMP)** | |
| | If Supplier selected RUWMP, select name from the drop-down. | |

Table 2.3 Submittal Table 2-3: Supplier Identification

| Submittal Table 2-3: Supplier Identification | |
|---|---|
| Type of Supplier (select one or both) | |
| ☐ | Supplier is a wholesale supplier |
| ☑ | Supplier is a retail supplier |
| 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 |
| **DWR NOTES: Units of measure (AF, CCF, MG)** must remain consistent throughout the UWMP as reported in Submittal Table 2-3. | |

## 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 MET (regional wholesaler for Southern California and the direct supplier of imported water to the City and MWDOC), MWDOC (regional wholesale supplier for Orange County), the Orange County Water District (OCWD) as the manager of the Orange County Groundwater Basin (OC Basin), and its regional wastewater management agency, Orange County Sanitation District (OCSD). While the City is not a member agency of MWDOC, the City developed this Plan in conjunction with other regionally consistent efforts such as population projections from the Center for Demographic Research at California State University, Fullerton (CDR) and the Orange County Water Deland Projection Model Technical Memorandum.

Key planning and reporting documents that were used to develop this UWMP are listed below:

- **MET's 2025 UWMP** uses assumptions that fall within the plausible futures contemplated in MET's Integrated Water Resources Plan to evaluate MET's future imported water supply reliability.
- **MET's 2020 Integrated Water Resources Plan (IRP) Regional Needs Assessment** is a long-term, scenario-based planning document that guides Metropolitan's programs and investments to ensure reliable water supplies in Southern California and provides a basis for water supply reliability in Orange County.
- **MET's Climate Adaptation Master Plan for Water (CAMP4W)** is an ongoing planning and decision-making tool that accounts for the complexities and uncertainties of climate change. Part of the second phase of MET's long-term IRP planning process, CAMP4W incorporates the results and findings of MET's 2020 IRP Regional Needs Assessment into a collaborative process to identify and evaluate integrated regional solutions.
- **MET's 2025 Water Shortage Contingency Plan (WSCP)** provides a water supply availability assessment and guide for MET's intended actions during water shortage conditions.
- **MWDOC's 2025 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.
- **MWDOC's 2023 Orange County Water Reliability Study** is a planning document to help guide planning for future water supply reliability for water providers in Orange County and provide input on regional water supply issues for MET.
- **2025 Orange County Water Demand Projection Model Technical Memorandum** is a collaborative effort amongst MWDOC, OCWD, and all retail water suppliers in Orange County that developed water demand projections to produce regionally consistent forecasts across all Orange County water agencies.
- **OCWD's Groundwater Resilience Plan (GRP - February 2025)** is an adaptive strategies management plan outlining strategic projects to secure reliable future water supplies in the OC Basin.
- **OCWD's 2023-24 Engineer's Report** provides information on the groundwater conditions, water supply, and basin utilization of the OC Basin.

- **2022 Basin 8-1 Alternative** is an alternative to the Groundwater Sustainability Plan (GSP) for the OC Basin, provides significant information related to sustainable management of the basin in the past and hydrogeology of the basin, including groundwater quality and basin characteristics, and addresses DWR's recommendations to ensure long-term basin sustainability.
- **City of Fullerton's 2025 Local Hazard Mitigation Plan** provides the basis for the seismic and other natural and natural disaster risk analysis of the water system facilities.
- **Capital Improvement Program** for the City's service area provides information on water infrastructure planning projects and plans to address any required water system improvements.

#### 2.2.1.1 Statewide Water Planning

In addition to regional coordination with various agencies described above, the City as a retail agency receiving wholesale imported water direction from MET, is currently 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, technology innovation, partner collaborations, and water use efficiency measures. This policy is codified through the Delta Stewardship Council's Delta Plan Policy WR P1 (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. Additionally, with the recent amendments to the Bay Delta Plan, tributary flow objectives to the Delta are being updated to account for quality and habitat improvements for local environmental resources. This results in reduced reliance on Delta water supplies. Since 2022, the Bay-Delta Plan Amendment update has been in development. This effort considers additional tributaries from the southern San Joaquin Valley, triggering a re-evaluation of Delta flow requirements and conservation objectives, which ultimately may impact available supply to the State Water Project (SWP).

Through significant local investment, collaboration at both a local and regional scale and integration with MET's water use efficiency strategies and conservation programs, the City has demonstrated a reduction in Delta reliance. For member agencies that receive imported water from MET, these agencies have passively demonstrated a reduction in Delta reliance and a subsequent improvement in regional self-reliance by participating in MET-led regional strategies. A detailed description and documentation of City's consistency with Delta Plan Policy WR P1 is included in Chapter 7.4 and Appendix C.

### 2.2.2 Wholesale and Retail Coordination

The City developed its UWMP in conjunction with MET's 2025 UWMP. As a retail member agency of MET, the City provided its historical water use and initial water use projections data to MET (Table 2.4). As a water supplier in Orange County, the City also collaborated with other Orange County water agencies on the 2025 Orange County water demand projection efforts led by MWDOC and OCWD.

Table 2.4 Submittal Table 2-4 Retail: Water Supplier Information Exchange

| **Submittal Table 2-4 Retail: Water Supplier Information Exchange<br>Water Code Section 10631(h)** |
|---|
| The retail Supplier has informed the following wholesale supplier(s) of projected water use in accordance with Water Code Section 10631 (h). |
| Wholesale Water Supplier Name |
| Add additional rows as needed |
| Metropolitan Water District of Southern California |
| Orange County Water District |

### 2.2.3 Public Participation

For further coordination with other key agencies, and to encourage public participation in the review and update of this UWMP, the City held a public hearing on May 5, 2026, and notified key entities and the public per the Water Code requirements. Chapters 10.2 and 10.3 describe these efforts in detail.

# CHAPTER 3 SYSTEM DESCRIPTION

The City of Fullerton (City) established its Water Utility in 1906, which functions to provide water to City residents. The City's water service area covers 22.3 square miles, in north Orange County bounded to the north by the Cities of La Habra and Brea, Placentia to the east, Buena Park to the west, and Anaheim to the south. The City's Water Utility operates 15 reservoirs with a capacity of 67.5 million gallons (MG), 12 booster pumping stations, 7 active groundwater wells, 2 inactive groundwater wells and manages about 424-mile water mains system with approximately 32,050 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 a predominantly single and multi-family residential community. Recent and ongoing developments in the City include various residential, commercial, industrial, and mixed-use projects. Moving forward, the City will continue planning for its Regional Housing Needs Assessment (RHNA) allocation requirements and future planned developments may include accessory dwelling units (ADUs). The current population (2025) of 141,277 is projected to increase by 12.5 percent over the next 25 years to 158,923. This equates to an annual growth rate of 0.5 percent.

## 3.1 Agency Overview

This section provides information on the formation and history of the City, its organizational structure, and relationship to the Metropolitan Water District of Southern California (MET).

### 3.1.1 Formation and Purpose

In 1887, the George and Edward Amerige established a settlement, naming it after the President of the Pacific Land and Improvement Co., George H. Fullerton. Agriculture, especially orange growing, became the most prominent industry in the City soon after its founding. Oil production became a leading industry in the City in the late nineteenth and early twentieth centuries, driving much of the early growth of the community. In the mid-twentieth century, the City set aside its southern portion nearest the railway as an industrial-only area, leading to the mass consolidation of manufacturing in the area.

After the Second World War, there was high demand by veterans and their families for new housing in southern California. The City was one of many communities in the area that experienced a construction boom of new housing developments. It was also during this time, in 1957, that the State of California established Orange County State College (today California State University, Fullerton). In the same year, St. Jude Hospital (now St. Jude Medical Center) was opened. This period of intense building and development lasted nearly thirty years, from the late 1940s to the 1970s. In the 1980s and 1990s, the City revitalized its downtown area and upgraded existing and constructed new public facilities, including libraries, parks, natural areas, and general city services. Today, the City is a community with vibrant education and healthcare sectors, a bustling manufacturing area, thousands of homes, and a renewed downtown center. The City's location is shown on Figure 3.1.

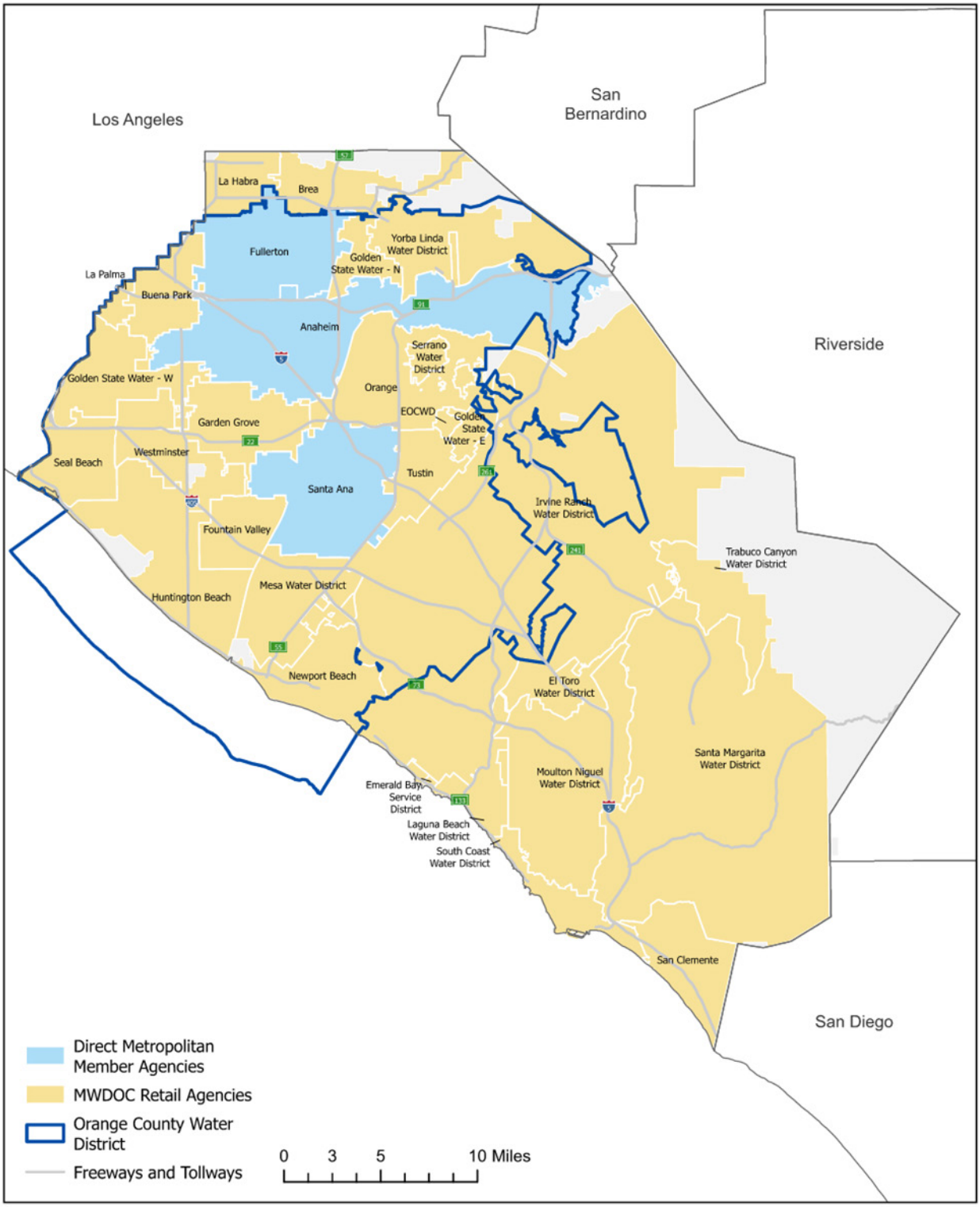



Figure 3.1 Regional Location of the City of Fullerton

### 3.1.2 City Council

The City is governed by a five-member council, each representing their own district, serving four-year staggered terms. City Council selects a Mayor and Mayor Pro Tem from the seated Council Members, each serving one-year terms. As the City's legislative body, the Council is responsible for all municipal programs and services, as well as local policy decisions. Current Council Members include:

- Fred Jung, Mayor - District 1.
- Nicolas Dunlap, Mayor Pro Tem - District 2.
- Shana Charles, Council Member - District 3.
- Jamie Valencia, Council Member - District 4.
- Ahmad Zahra, Council Member - District 5.

### 3.1.3 Relationship to MET

To allow delivery of water sources from outside the area, the City joined with 12 other Southern California cities to form and be an original member agency of the MET on February 27, 1931. MET is a consortium of 26 cities and water agencies that provides supplemental water supplies to parts of Los Angeles, Orange, San Diego, Riverside, San Bernardino, and Ventura Counties. MET's two main sources of supply are the Colorado River and the Sacramento-San Joaquin River Delta. Supplies from these sources are delivered to southern California via the Colorado River Aqueduct (CRA) and the State Water Project (SWP), respectively. The City purchases imported water from these sources from MET and provides retail water services to the public.

## 3.2 Water Service Area and Facilities

The City regards an adequate supply of water as an essential service to support public health and safety, economic growth, and community wellbeing. Water supply goals of the City are as follows:

- Quality - To provide water to the customer that meet or exceeds with State and Federally mandated water quality regulations.
- Reliability - To provide water service with minimum interruptions at acceptable pressures given the existing infrastructure and to make improvements as available funding allows.
- Efficient Operation - To operate the Water Utility in a fiscally responsible manner.

### 3.2.1 Water Service Area

The City is located in north Orange County bounded to the north by the Cities of La Habra and Brea, Placentia to the east, Buena Park to the west, and Anaheim to the south. The City's Water Utility provides water service within its 22.3-square mile service area, which is contiguous with the City boundary. A map of the City's water service area is shown as Figure 3.2.

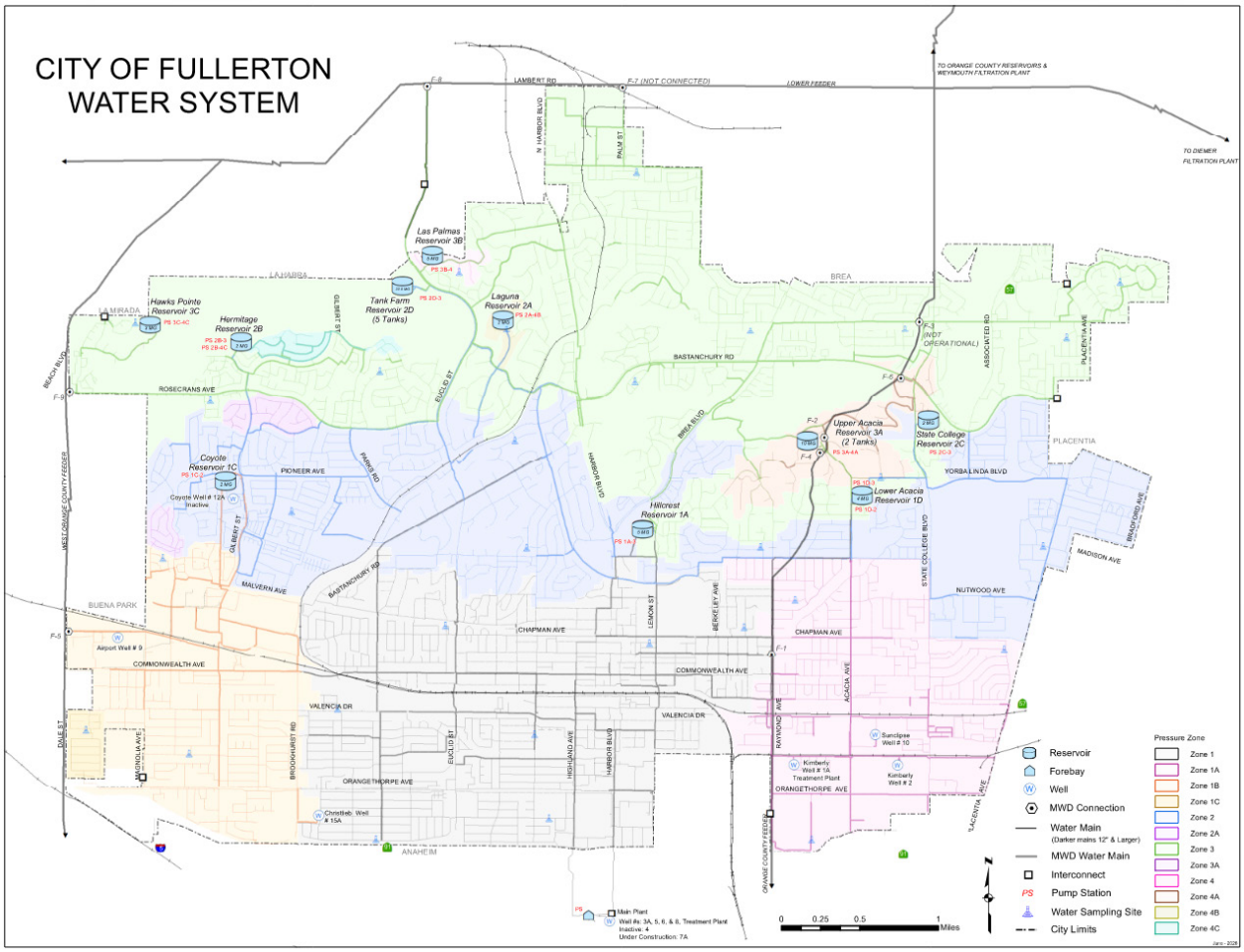



Figure 3.2 City of Fullerton Water Service Area

## 3.2.2 Water Facilities

Since the formation of the City's Water Utility in 1906, millions of dollars of water infrastructure have been installed. Today, the City has about 424 miles of water mains, 15 reservoirs with a capacity of 67.5 MG, 12 booster pumping stations, 7 active wells and 2 inactive wells. The City has seven imported water connections to MET directly and six emergency interconnections with other utilities.

# 3.3 Climate

The City's service area is located within the SCAB that encompasses all of Orange County, and the urban areas of Los Angeles, San Bernardino, and Riverside counties. The climate in the SCAB area 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 the case of landscape irrigation demand. For example, in August 2023, Orange County as a region experienced the lowest seasonal water demand due to significant summer precipitation events from Tropical Storm Hilary. The

increase in precipitation allowed landscape irrigation systems to be turned off, however other municipal and industrial uses (e.g., consumption, processing, and washing still remained the same).

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. Orange County Water District (OCWD) 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 2022 Basin 8-1 Alternative Plan Update, OCWD captured an average annual stormwater volume of approximately 54,000 acre-feet (AF) over the period of five years, from Water Year 2016-17 to 2020-21.

MET's water supplies, SWP and the CRA, are influenced by climate conditions in northern California and the Colorado River Basin, respectively. Both regions have variable hydrologic conditions that can significantly affect MET's supplies from year to year. This past decade has seen dramatic swings in annual precipitation, especially in the form of snowpack, which directly affect SWP supply allocations. Similarly, the Colorado River Basin also experienced year-to-year swings in hydrology ,and due to the prolonged drought conditions since 2000, storage within the Colorado River system has declined to less than half of its reservoir capacity and has been fluctuating at that level (MET, 2025).

## 3.4 Population, Demographics, and Socioeconomics

### 3.4.1 Service Area Population

The City serves a 2025 population of 141,277 according to the Center for Demographic Research at California State University, Fullerton (CDR). Overall, the population is projected to increase 12.5 percent by 2050. Table 3.1 shows the population projections in five-year increments out to the year 2050 within the City's service area.

Table 3.1 Submittal 3-1 Retail: Population - Current and Projected

| Submittal Table 3-1 Retail: Population - Current and Projected<br>Water Code Section 10631(a) | | | | | | |
|---|---|---|---|---|---|---|
| Population Served | 2025 | 2030 | 2035 | 2040 | 2045 | 2050(opt) |
| | 141,277 | 145,489 | 149,567 | 153,732 | 157,380 | 158,923 |
| NOTES:<br>Source: Center for Demographic Research at California State University, Fullerton, 2025 | | | | | | |

### 3.4.2 Demographics and Socioeconomics

As shown below in Table 3.2, the total number of dwelling units in the City service area is expected to increase by 24.5 percent in the next 25 years from 50,612 in 2025 to 63,018 in 2050.

Table 3.2 City of Fullerton Service Area Dwelling Units by Type

| Dwelling Units | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 |
|---|---|---|---|---|---|---|
| Single Family | 25,272 | 25,480 | 25,695 | 25,885 | 26,075 | 26,075 |
| All Other(1) | 25,340 | 29,270 | 31,393 | 33,157 | 35,066 | 36,943 |
| **Total** | **50,612** | **54,750** | **57,088** | **59,042** | **61,141** | **63,018** |

Notes:
Source: CDR, 2025.
(1) 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 the City's water management and planning. Based on the U.S. Census Bureau's 2023 American Community Survey, the City has about 16 percent of population of 65 years and over, 63 percent between the ages of 18 and 64 years, and 21 percent under the age of 18 years. Of the City's population over 25 years of age, 84.7 percent is at minimum a high school graduate, with 41.4 percent of this age group having at least a bachelor's degree.

### 3.4.3 Demographic Projection Methodology

CDR is a collaborative research center established in 1996 to provide accurate and timely demographic data on population, housing, and employment in Orange County. CDR serves as Orange County's authoritative source for demographic information. The City obtains its service area population and dwelling unit data from MWDOC via CDR. MWDOC contracts with CDR to update the 2010 population estimates through the current year and to provide an annual estimate of population served by each of its retail water suppliers within its service area. CDR uses geographic information system (GIS) mapping and data from the 2000, 2010, and 2020 U.S. Decennial Censuses, State Department of Finance (DOF) population estimates, and the CDR annual population estimates and Housing Inventory System (HIS). 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 are 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. It should be noted that the CDR population forecast accounts for both the RHNA allocations and projected increase in accessory dwelling units (ADUs).

Demographic projections used for this UWMP reflect the most recently available set of projections developed by CDR based on its 2022 Orange County Projections. Demographic projections for Orange County are updated every 4 years, with the next set of projections expected in the late fall of 2026. The 2022 Orange County Projections accounted for Draft RHNA rezone sites with jurisdictions including the number of dwelling units that are most likely to occur/get built by the end of 2050 under assumptions and trends existing at the time of the forecasting effort, including a parcel-level inventory of additional housing capacity from sites that were to be rezoned to accommodate the 6th RHNA cycle.

In the summer of 2025, projections by water supplier for population and dwelling units by type were estimated using the 2022 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) data with a 2023 aerial photo. The growth was added to the 2025 estimates for each respective water supplier.

## 3.5 Land Uses

### 3.5.1 Current Land Uses

The City's service area can best be described as a predominantly residential single and multi-family community located along the coast in northern Orange County. Based on the zoning designation collected and aggregated as part of the City's Water Master Plan Update, the current land use within the City's service area can be categorized as follows:

- Low Density Residential - 43.7 percent.
- Low-Medium Density Residential - 4.3 percent.
- Medium Density Residential - 7.3 percent.
- High Density Residential - 0.5 percent.
- Commercial - 5.6 percent.
- Office - 2.2 percent.
- Government Facilities - 1.7 percent.
- School Facilities - 5.6 percent.
- Industrial - 10.2 percent.
- Open Space - 6.7 percent.
- Parks and Recreation - 9.2 percent.
- Road/Railroad/Flood Control - 2.8 percent.
- Urban Center Mixed Use - 0.1 percent.

### 3.5.2 Projected Land Uses

The City has identified several major development projects that will change the City's total water demand in the future. The table shown in Figure 3.3 is directly from the City of Fullerton's Water Master Plan update and lists near-term development projects and anticipated water demands associated with them. It is possible that not every proposed project will get built in the next decade.

**Table 5-15. City's Near-term (by 2035) Development Projects and Demands**

| Project Name | Project Land Use | Area (ac) | Unit Factor (gpd/ac) | Dwelling Units (du) | Unit Factor (gpd/du) | Demand (gpd) | Demand (acre-feet) |
|---|---|---|---|---|---|---|---|
| Shoe City Billboard | Commercial | 6.62 | 2,070 | NA | NA | 13,704 | 15 |
| Commercial Remodel on W. Commonwealth | | | | | | | |
| Remodel of Bowling Alley | | | | | | | |
| New Restaurants on Santa Fe Ave | | | | | | | |
| Parkwest Project | Downtown MU | 4.44 | 7177 | 140 | 159 | 54,126 | 61 |
| Fox Block | | | | | | | |
| Fullerton Fox Theatre | | | | | | | |
| Fox Block Mixed-Use Development | | | | | | | |
| 245 N. State College Blvd. | High Residential | NA | NA | 485 | 133 | 64,505 | 72 |
| The Hub | | | | | | | |
| Casa Bella | | | | | | | |
| Pathways of Hope | | | | | | | |
| Rexford Industrial Project – 1500 S. Raymond | Industrial | 20.6 | 1,258 | NA | NA | 25,935 | 29 |
| Rexford Industrial Project – 1901 Via Burton | | | | | | | |
| Acacia and Kimberly Industrial project | | | | | | | |
| Truck yard | | | | | | | |
| 737 N Highland Avenue | Low Residential | NA | NA | 17 | 425 | 7,225 | 8 |
| Subdivision on Ladera Vista | | | | | | | |
| Parcel Map on Valley View | | | | | | | |
| New Mixed-Use Development, Streetlights | Medium Residential | NA | NA | 405 | 200 | 81,000 | 91 |
| 321 E. Amerige Avenue | | | | | | | |
| Pointe Common | | | | | | | |
| New Residential Townhomes | | | | | | | |
| Law Office on E. Amerige | Office | 1 | 1,735 | NA | NA | 1,735 | 2 |
| Southwest corner of Orangethorpe and Brookhurst | Urban MU | 8.26 | 7177 | 216 | 133 | 88,010 | 99 |
| Hillcrest Project | | | | | | | |
| The Pines | | | | | | | |
| **Total** | | **88** | | **1,263** | | **336,241** | **377** |

Note:
Near-term planning horizon reflects year 2035.
NA = not applicable

*Source: City of Fullerton Water Master Plan Update 2025*

Figure 3.3 City of Fullerton Near-term Development Projects and Demands

It should be noted that the 2025 Orange County Water Demand Projection Model discussed in Chapter 4 was based on CDR's 2022 Orange County projections. The developments listed above may have been added or modified since. As a result, the future demands associated with these developments may increase the City's water demand beyond what is presented in this UWMP.

In addition to the developments listed in Figure 3.3, the City will continue planning for the RHNA allocation imposed by the State. Additionally, new developments may potentially include ADUs, while it is also anticipated that policy changes will make it easier for homeowners to add ADUs to existing residential properties.

The following requirements and changes in laws will impact the City's future land use moving forward:

- **RHNA** - State law requires jurisdictions to provide their share of the RHNA allocation. Southern California Association of Governments (SCAG) determines the housing growth needs by income for local jurisdictions through RHNA. The City's RHNA allocation for 2021-2029 is 13,209 dwelling units. This includes 3,198 units for very low-income households, 1,989 units for low-income households, 2,271 units for moderate-income households, and 5,751 units for above moderate-income households. The City's 2021-2029 Housing Element offers an 8-year roadmap designed to identify the city's housing needs for the 6th RHNA cycle, review past accomplishments, and to develop strategies to encourage new housing development to address these housing needs.
- **ADUs** - 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. Since 2020, several landmark laws were passed by State Legislature, updating ADU law to simplify the construction, rental, and sale of ADUs in California. The most significant laws that have recently come into effect include:
  - AB-1033 Accessory dwelling units: local ordinances: separate sale or conveyance which authorizes local governments to adopt ordinances permitting the sale of ADUs separately from the primary residence as condominiums.
  - AB-976 Accessory dwelling units: owner-occupancy requirements which prohibits a local agency from requiring owner-occupancy for property owners to build and rent an ADU.
  - AB-1154 Junior accessory dwelling units which no longer requires owner-occupancy for junior ADUs (JADUs) as long as they have their own bathroom.
  - AB-1332 Accessory dwelling units: preapproved plans which requires local agencies to develop a program for pre-approved ADU plans, with projects using these plans having to be approved or denied within 30 days.
  - SB-543 Accessory dwelling units and junior accessory dwelling units which requires local agencies to determine if an ADU/JADU application is complete within 15 business days of submittal, revises ADU size to now be measured by "interior livable space", and now re-defines a JADU to be no more than 500 square feet of interior livable space.
  - SB-1211 Land use: accessory dwelling units: ministerial approval which authorizes multi-family property owners to build up to eight detached ADUs on a single lot, provided that the number of ADUs does not exceed the number of existing primary units.
  - AB-2533 Accessory dwelling units: junior accessory dwelling units: unpermitted developments which prohibits local agencies from denying permits for unpermitted ADUs/JADUs constructed before January 1, 2020, based on code violations unless the structure is a health or safety hazard.

In 2024, a total of 6,162 new residential units were permitted in Orange County, including those for ADUs (CDR, 2025). CDR projects that by 2050, approximately 13,000 more ADUs will be built in Orange County, with 30 ADUs expected within the City's service area. The increase in ADUs is likely to result in an increase in number of people per lot of land. Depending on whether the addition of ADUs results in a net replacement of irrigated area (or other high water use features such as swimming pools), ADUs could increase or decrease water demands.

# CHAPTER 4 WATER USE CHARACTERIZATION

One of the main objectives of an Urban Water Management Plan (UWMP) is to provide an insight into the projected future water demands and supplies. This chapter describes the City of Fullerton's (City) current and future water demands for their service area, factors that influence demands, and the methodology used to forecast future water demands over the next 25 years. For the 2025 UWMPs, water demand projections will span from planning year 2025 through planning year 2050.

Known for its suburban coastal communities and densely populated inland areas, Orange County has evolved greatly from its beginnings as an agricultural region. As some of the earliest cities in Orange County, from 1928 to 1931 the Cities of Anaheim, Fullerton, and Santa Ana all joined with 10 other southern California cities to form the Metropolitan Water District of Southern California (MET) with the ambitious dream to bring Colorado River water across the Mojave Desert. The Municipal Water District of Orange County (MWDOC) later joined MET as a member agency in 1951, and with the merger with Coastal Municipal Water District in 2001, now represents the remainder of Orange County to provide and manage the imported water supplies within its service area. Orange County is now mostly comprised of residential, mixed-use, and commercial developments, with less industry in the region. Agriculture in the region has also declined significantly as Orange County has grown more suburban. Thus, modern-day water use within Orange County can be largely summarized by the following four demand sectors:

- Single-family Residential.
- Multi-family Residential.
- Commercial, Industrial, and Institutional (CII).
- Dedicated Irrigation (potable, recycled, and raw water).

Figure 4.1 shows Orange County's overall historical water usage compared to population since 1990, when local water conservation programs were first established. As shown, from the early 1990s through the mid-2000s, Orange County's water usage increased as the population increased. Population figures slowed significantly in 2018 and began to decrease during the COVID-19 Pandemic in 2020-2021. Since 2007, retail, municipal, and industrial water use in Orange County has declined due to multiple contributing factors. Decades of sustained investments in water-use efficiency and public education have led to significant adoption of water-efficient appliances and fixtures, and increased public awareness of the need to use water wisely. Furthermore, in response to recurring droughts, growing urban demand, and increasingly limited water supplies, multiple regulatory requirements to promote water conservation have evolved and been implemented over the past several years throughout California and Orange County.

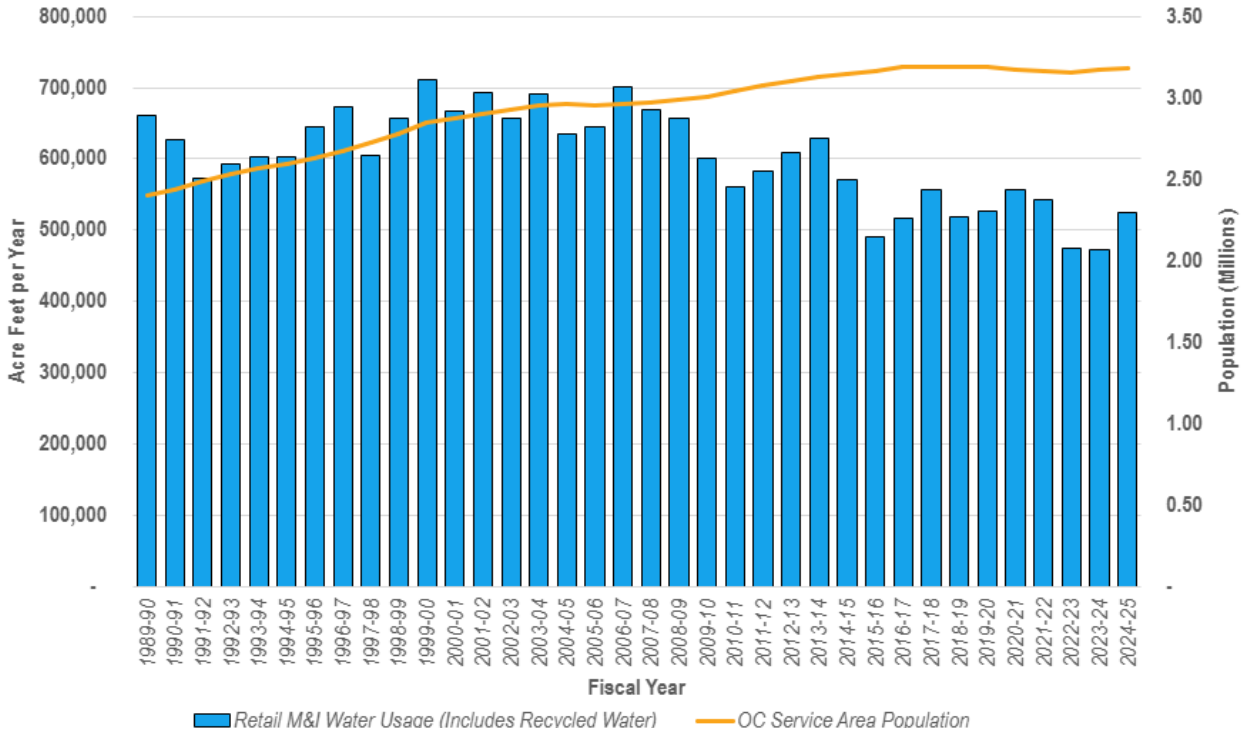



Figure 4.1 Historical Water Use and Population in Orange County

Orange County's trending decline in water usage can most notably be attributed to Orange County water agencies' past efforts to achieve regional and individual compliance with Senate Bill (SB) X7-7, the Water Conservation Act of 2009, through the Orange County 20x2020 Regional Alliance and compliance with Executive Order (EO) B-29-15 mandated 25 percent reduction in potable water use in response to the 2013-2014 drought. Furthermore, Orange County water agencies' ongoing progress towards achieving SB 606 and Assembly Bill (AB) 1668, the "*Making Conservation a California Way of Life*" legislation, water use objectives continue to exemplify Orange County water agencies' commitment to water conservation, water use efficiency, and overall reduction in potable water usage in recent decades.

In 2025, MWDOC and Orange County Water District (OCWD), in collaboration with MWDOC's member agencies and the Cities of Anaheim, Fullerton, and Santa Ana, led the effort to develop the 2025 Orange County Water Demand Projection Model. The Orange County Water Demand Projection Model (MWDOC, 2025) was used to project long-term water demand under three hydrologic conditions (normal year, single dry year, and five consecutive dry years) over a 25-year horizon in 5-year increments, consistent with the 2025 UWMP requirements.

Although Orange County demands are forecast to be relatively flat into the future, with water use efficiency efforts counterbalancing new growth, Figure 4.2 shows that annual variations in weather could cause high fluctuations. Some examples of this are described below:

- Single-family consumption is highly seasonal, and the model correlates well with seasonality and temperature by capturing fluctuations in single-family outdoor irrigation.
- Multi-family use is generally less responsive to weather than single-family demands, as much of multi-family outdoor irrigation has been shifted into the irrigation-specific water use sector (dedicated irrigation meters), and generally newer multi-family dwellings in Orange County have

comparatively less landscaped area than generally older single-family dwellings due to Model Water Efficient Landscape Ordinances (MWELO) mandated since 1993. Seasonal price elasticity varies the least between months for the multi-family sector.

- CII use is positively correlated to each job proportion as well as gross domestic product throughout Orange County, which means a higher amount of CII jobs and production value trend in an increase in water demands.
- Irrigation is the most responsive to temperature and precipitation compared to the other sectors.

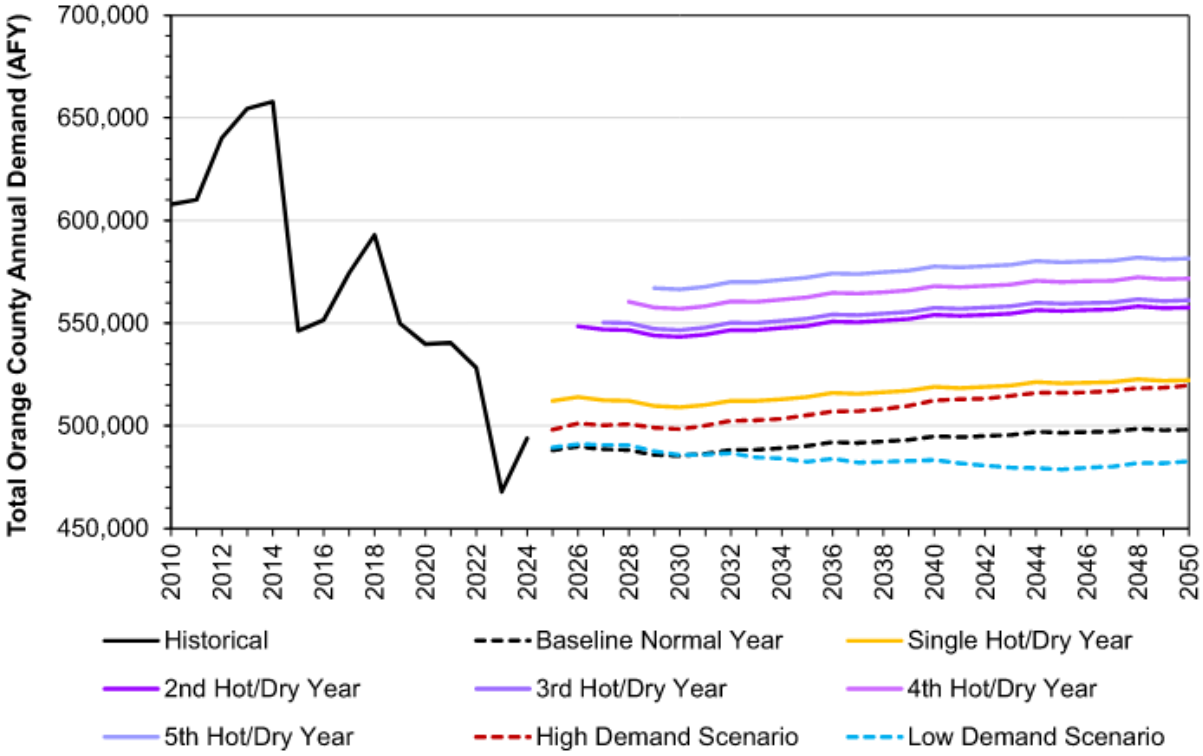



Figure 4.2 Projected Water Use Across All Orange County Water Agencies

In terms of future development, North Orange County is substantially built out, with a majority residential land uses with some mixed-use areas dedicated to commercial, institutional, and governmental uses. Future developments planned in North Orange County are mainly redevelopment and infill projects. As for the City's service area specifically, future developments include a number of infill and redevelopment projects, potential accessory dwelling units (ADUs), and additional residential units to meet the City's Regional Housing Needs Assessment (RHNA) allocation, which will all shape the City's future water use.

Water use within the City's service area has fluctuated in the past five years, with an annual average total water use of approximately 21,112 acre-feet (AF). Following one of the worst droughts in California history between 2017 and 2022, the significant wet year in 2023 saw a noticeable decrease in overall water use from fiscal year (FY) 2021-22 to FY 2022-23 in the City's entire service area.

Water use in FY 2024-25 included 22,243 AF of potable water. The City's water use is primarily residential. The projected water use in 2050 is 21,384 AF for potable water.

## 4.1 Water Use in the Last Five Years

The five-year average water use within the City's service area is approximately 21,112 AF provided by potable sources. Demand trends have regionally remained flat due to water-use efficiency efforts and increased precipitation in recent wet years, such as FY 2023. As mentioned in Chapter 3, the City is almost completely built out, but due to redevelopment and densification its population is projected to increase. However, total demands have remained relatively stable due to ongoing water conservation programs and improved water use efficiency efforts.

FY 2020-21 through FY 2021-22 saw the highest water uses over the last five years due to region-wide drought conditions. FY 2022-23 proved to be one of the wettest years on record in the State and the City saw a general decrease in water demand following this wet year, as precipitation offsets landscape irrigation demands. These year-to-year fluctuations in precipitation will continue to influence the City's annual demands. In general, the City saw a decrease in demands of 9.5 percent over the 5-year reporting period.

Table 4.1 presents the City's service area existing water use by source for direct uses. There are no indirect uses within the City's service area. The City's service area total water usage in FY 2024-25 was 22,243 AF (Table 4.1). The total usage was met through a combination of potable sources, including groundwater and imported water. In FY 2024-25, about 62.8 percent of the total demand was met through the Orange County Groundwater Basin (OC Basin).

Table 4.1 Submittal Table 4-1 Retail: Total Uses for Potable and Non-Potable Water - Actual

| **Submittal Table 4-1 Retail: Total Uses for Potable and Non-Potable Water — Actual Water Code Section 10631(d)(1)** | | | |
|---|---|---|---|
| Use Type | Additional Description (as needed) | 2025 Actual Water Use | |
| **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 | | Level of Treatment When Delivered (OPTIONAL) Drop down list | Volume (AF) |
| Single Family | | Potable | 9,981 |
| Multi-Family | | Potable | 4,206 |
| Commercial | | Potable | 4,124 |
| Industrial | | Potable | 458 |
| Institutional/Governmental | | Potable | 491 |
| Landscape | | Potable | 1,306 |
| Agricultural | | Potable | 2 |
| Other (optional) | | Potable | 31 |
| Distribution System Water Loss | | Potable | 1,644 |
| | | Subtotal Potable | 22,243 |
| | | Subtotal Non-Potable | 0 |
| | | **Total** | 22,243 |
| **DWR NOTES: Units of measure (AF, CCF, MG)** must remain consistent throughout the UWMP as reported in Submittal Table 2-3. This table identifies the unit of measure selected in Submittal Table 2-3. | | | |
| **NOTES:** Distribution system water loss includes 1,030 AF identified by the City of Fullerton and an additional 614 AF unaccounted for. Total distribution system water loss therefore equals 1,644 AF. | | | |

### 4.1.1 Direct Municipal and Industrial Use

Table 4.1 summarizes the City's potable water demand for FY 2024-25; a total of 22,243 AF of potable water was used. The City has a mix of single and multi- family residential water use which account for 63.8 percent of their total potable water demand. Commercial, industrial, and institutional/governmental use accounts for a combined 22.8 percent of total potable demand. Landscape irrigation accounts for 6 percent of total potable demand while agricultural and other uses account for almost 0.1 percent of total potable demand. The total distribution system water loss to match supply and demand was calculated to be 1,644 acre-feet per year (AFY) in FY 2024-25, or 7.4 percent of total potable water demand. It should be noted that this differs from the City's water loss reported in the American Water Works Association (AWWA) Water Loss Audit for Calendar Year (CY) 2024, as this reporting was done for a different timespan.

Since the City is essentially built out with only a number of planned infill and redevelopment projects, demands are not expected to increase significantly. Rather, the City's continual water conservation is expected to slightly decrease demands in the long term.

## 4.2 Projected Water Use

The water use projection for this UWMP is separated into a near-term period covering the next five years (2026-2030) and a long-term period extending from 2030 through 2050.

The water use projection is based on the 2025 Orange County Water Demand Projection Model Technical Memorandum (TM), which is included in Appendix H of this UWMP. The methodology used in this demand forecast links water use statistically to a set of explanatory variables through a regression, or econometric, model. Section 4.3 offers a description of the methodology used to calculate the City's demand projections.

### 4.2.1 Water Use Projections for 2026-2030

Total demands (direct) are met through imported water (treated) and groundwater. The City utilizes the projected total demands to incorporate the best available planning information when projecting the imported water demands of its service area. The City's total water demand projection for the next five years is shown in Table 4.2. As shown below, the City's total service area water demands are expected to gradually decrease in the first two years (2026 to 2027) from a projected decline in the service area's municipal and industrial (M&I) demands, followed by an increase in demands in 2028. M&I demands are projected to decrease from 2028 to 2029 again, followed by a gradual increase in demands projected in the last two years. The City does not project any non-potable demands for its service area in the next five years.

Table 4.2 City of Fullerton's Service Area Total Potable Demand for 2026-2030

| Fiscal Year Ending | 2026 | 2027 | 2028 | 2029 | 2030 |
|---|---|---|---|---|---|
| Total Water Demand (AF) | 20,380 | 20,367 | 20,398 | 20,338 | 20,356 |

### 4.2.2 Water Use Projections for 2030-2050

The City's service area's total water demands (by use type) for the next 25 years are shown in Table 4.3. By 2050, total water demand is projected to be 21,384 AF, a 3.9 percent decrease from the 2025 demand of 22,243 AF. Table 4.4 indicates additional information for both future conservation efforts and low-income water demands included in the projections, while Table 4.5 presents the passive water savings included in Table 4.3 projections for 2030-2050.

Table 4.3 Submittal Table 4-2 Retail: Total Uses of Potable, and Non-Potable Water - Projected

| Submittal Table 4-2 Retail: Total Uses of Potable, and Non-Potable Water - Projected Water Code Section 10631(d)(1) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Use Type** | Additional Description (as needed) | **Projected Water Use** (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 | | **Potable or Non-Potable** (OPTIONAL) Drop down list | **2030 (AF)** | **2035 (AF)** | **2040 (AF)** | **2045 (AF)** | **2050 opt (AF)** |
| Single Family | | Potable | 9,192 | 9,186 | 9,224 | 9,211 | 9,163 |
| Multi-Family | | Potable | 4,286 | 4,481 | 4,655 | 4,800 | 4,930 |
| Commercial | Includes Institutional and Industrial uses | Potable | 4,842 | 5,035 | 5,195 | 5,210 | 5,215 |
| Landscape | Includes Agriculture use | Potable | 1,255 | 1,255 | 1,257 | 1,255 | 1,255 |
| Distribution System Water Loss | Includes Other uses | Potable | 782 | 797 | 812 | 818 | 821 |
| Subtotal Potable | | | 20,356 | 20,753 | 21,143 | 21,294 | 21,384 |
| Subtotal Non-Potable | | | 0 | 0 | 0 | 0 | 0 |
| **Total** | | | 20,356 | 20,753 | 21,143 | 21,294 | 21,384 |
| **DWR NOTES: Units of measure (AF, CCF, MG)** must remain consistent throughout the UWMP as reported in Submittal Table 2-3. This table identifies the unit of measure selected in Submittal Table 2-3. | | | | | | | |
| **NOTES:** Source – 2025 Orange County Water Demand Projection Model Forecast for the City of Fullerton. | | | | | | | |

Table 4.4 Submittal Table 4-3 Retail: Inclusion in Water Use Projections

| Submittal Table 4-3 Retail: Inclusion in Water Use Projections<br>Water Code Section 10631 (a), 10631 (d)(4)(A), and 10631 (d)(4)(B) | |
|---|---|
| **Are Future Water Savings Included in Projections?**<br>(Refer to Appendix K of UWMP Guidebook)<br>**Drop down list (y/n)** | Yes |
| If "Yes" to above:<br>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.<br>**OPTIONAL** Suppliers may complete Optional Submittal Table 4-4 R to quantify the expected savings. | Chapter 4.3 |
| **Are Lower Income Residential Demands Included In Projections?**<br>(Refer to Appendix K of UWMP Guidebook)<br>**Drop down list (y/n)** | Yes |
| **OPTIONAL** If the method for accounting Lower Income Residential Demands has been included, provide page number where this accounting can be found. (An example is included in Appendix K.) | Chapter 4.3 |
| **NOTES:** Future water savings include passive conservation (defined as water savings that occur without incentives). Active conservation (defined as water savings that occur with incentives) is not included in the projections.<br>The demand projection methodology accounted for the entire population of the service area (i.e., all income levels). | |

Table 4.5 Submittal Table 4-4 Retail: Passive Water Savings Projections

| OPTIONAL Submittal Table 4-4 Retail: Passive Water Savings Projections<br>Water Code Section 10631(d)(4)(A) | | | | | |
|---|---|---|---|---|---|
| **Description**<br>(Codes, Standards, Ordinances, or Plans) | Passive savings | | | | |
| | 2030 (AF) | 2035 (AF) | 2040 (AF) | 2045 (AF) | 2050 (opt) (AF) |
| | 257 | 261 | 265 | 268 | 269 |
| **DWR NOTES: Units of measure (AF, CCF, MG)** must remain consistent throughout the UWMP as reported in Submittal Table 2-3. This table identifies the unit of measure selected in Submittal Table 2-3. | | | | | |
| **NOTES:** Passive conservation here is defined as water savings that occur without incentives. Based on the 2025 Orange County Water Demand Projection Model, passive conservation is assumed to equal a 1.9% decrease in residential demand due to conservation by 2030 (linearly extrapolated), then remains constant in subsequent years. | | | | | |

### 4.2.2.1 Direct Municipal and Industrial Use

#### Potable Municipal and Industrial Use

Total potable water demands are projected to increase to 21,384 AF by the year 2050, an increase of about 5 percent between 2030 and 2050 (Table 4.3). It is projected that combined single- and multi-family residential water use will account for 65.9 percent of total potable water demand. Combined commercial, institutional, and industrial water use is expected to account for 24.4 percent, and landscape irrigation

water use will account for 5.9 percent of total potable water use in the City by 2050. Distribution system water loss and other uses is projected to account for 3.8 percent of total potable water demands.

## 4.3 Water Demand Projection Methodology

In 2025, MWDOC and OCWD, in collaboration with MWDOC's member agencies and the Cities of Anaheim, Fullerton, and Santa Ana, led the effort to develop the 2025 Orange County Water Demand Projection Model (MWDOC, 2025). This effort developed a demand model by regressing historical water consumption data provided by each Orange County water agency against several explanatory variables known to influence water demand (including weather, water price, regional economic conditions, and housing density). The water demand projections were for the Orange County region as a whole and provided retail agency specific demands, spanning the years of 2025-2050. The full TM can be found in Appendix H.

The demand projections created four econometric, or regression, demand models representing the following four water billing sectors for each Orange County retail agency:

- Single-family Residential.
- Multi-family Residential.
- CII.
- Dedicated Irrigation (potable, recycled, and raw water).

Prior to developing the forecasts, model calibration and fine tuning for each of the four demand sectors occurred at the individual retail agency level. The demand across all four models, plus other uses for each agency, is summed to a total forecast for each agency, the MWDOC service area, the OCWD service area, and total Orange County.

The demand projection methodology accounted for the entire population of each individual retail agency's service area (i.e., all income levels), thus accounting for the water demand projections for lower income households within the City's service area.

### 4.3.1 Econometric Approach, Data Acquisition, and Model Development

A regression, or econometric, approach to demand forecasting statistically links retail level water use to weather, economic, and socioeconomic factors (explanatory variables). The model relies on a comprehensive dataset of historical water-use data for almost 40 different billing sectors collected from Orange County retail agencies. MWDOC obtained explanatory variables from reputable sources, including weather databases and Census-based reports. The explanatory variables used in the regression were based on industry experience regarding what factors affect water use nationwide and in Southern California.

By statistically linking water use to explanatory variables, the econometric models provide a robust foundation for understanding variability and projecting future consumption patterns. Modeled water use is the product of the driver count (e.g., number of accounts), and the rate of water use per driver:

$$Water\ Use = Driver\ Count\ \times Rate\ of\ Use\ per\ Driver$$

Each of the four demand sectors modeled (single family, multi-family, CII, and irrigation) has a separate equation. Driver units change into the future based on housing, employment, and population projections.

The rate of water use per driver is based on the historical response of the use rate to explanatory variables (measured by coefficients) and the future values of those same explanatory variables.

Linear regression produces the coefficients for each explanatory variable to closely reproduce the historical rate of use per driver unit. The coefficients explain how (both in terms of magnitude and sign) water use responds to changes to explanatory variables.

MWDOC identified driver units based on data provided by agencies and the Center for Demographic Research at California State University, Fullerton (CDR) that can be easily projected into the future. The rate of water use per driver is based on agency provided billing sector uses from 2010 through 2024. Table 4.6 shows the driver units and rate of use for each of the four models.

Table 4.6 Summary of Demand Sectors

| Sector | Driver Units | Rate of Use Definition |
|---|---|---|
| Single-family Residential | Accounts | Gallons/account/day |
| Multi-family Residential | Accounts | Gallons/account/day |
| CII | Jobs | Gallons/job/day |
| Dedicated Irrigation (potable, recycled, and raw water) | Accounts | Gallons/account/day |

The rates of water use for each sector model are based on the historical responses to explanatory variables, and the future values of those explanatory variables. Addressing multiple influences on demand improves the accuracy and precision of all estimated parameters, and the modeling team identified a large range of explanatory variables based on past experience with demand modeling and available data. Table 4.7 displays the explanatory variables.

Table 4.7 Summary of Historical Data Collected for Model Development

| Dataset | Data Source(s) |
|---|---|
| Observed weather (monthly precipitation, monthly maximum temperature) | Parameter-elevation Regressions on Independent Slopes Model (PRISM) |
| Water Price | Retail agency provided (2010 – 2024) |
| Drought Restrictions | State Water Resources Control Board |
| Gross Domestic Product (GDP) | Federal Reserve Bank of St. Louis Real Gross Domestic Product: All Industries in Orange County, California |
| Median Income | US Census American Community Survey (ACS) |
| Housing Density | ACS, CDR, Southern California Association of Governments (SCAG) land use data |
| Persons Per Household | |
| Relative Sectoral Economic Activity | US Census LODES, CDR |
| Passive Efficiency Estimates | Analysis of trend indicators and MWDOC/FLUME insight |
| COVID Binary Indicator | Assumed active from March 2020 - May 2023 |

The MWDOC Water Use Efficiency Group provided annual water savings achieved by various active conservation measures. To avoid potential errors in the classification of historical conservation data, total historical conservation was modeled in each sectoral regression model using a linear trend to capture steady change over time. While historical conservation is captured in a linear trend, projected passive conservation is based on best available data from the 2021 Orange County Residential Water Efficiency Potential and Opportunities Study and assumes a 1.9 percent decrease in annual residential demand

from 2025 to 2030, at which point passive conservation is projected to remain constant. Future active conservation is not accounted for in baseline demand forecast, as water savings from active programs (programs that require customers to change behavior) are highly specific to retail agencies and to the formulation and timing of their implementation.

The process of identifying the explanatory variables to include in the regression equation and developing coefficients that accurately measure the response of water use to changes in these variables is the most time-intensive part of the demand forecasting process.

Prior to developing the forecasts, model calibration and fine tuning for each of the four demand sectors occurred at the individual retail agency level. The modeling team worked with each retail agency to calibrate sectoral model equations and quantify other uses (those not included in the single-family, multi-family, irrigation, or CII demand sectors). Figure 4.3 presents the iterative process undergone to develop the econometric demand forecasts.

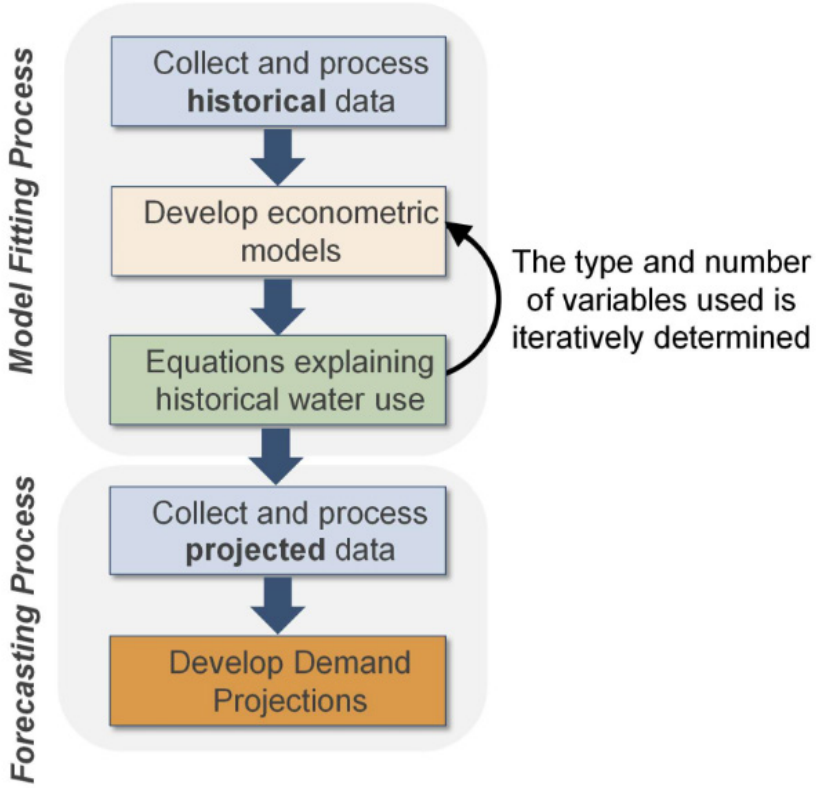



Figure 4.3 Econometric Demand Forecast Development Process

## 4.3.2 Forecasted Demands

Forecasted demand is a function of both the change in driver units into the future as well as the change in explanatory variables. Table 4.8 summarizes the future drivers and variables and assumptions for the baseline forecast. It should be noted that the CDR demographic forecast accounts for both the RHNA allocations and projected increase in Accessory Dwelling Units (ADUs). The 2022 Orange County

Projections accounted for Draft RHNA rezone sites[1] with jurisdictions including the number of dwelling units that are most likely to occur/get built by the end of 2050 under assumptions and trends existing at the time of the forecasting effort.

Table 4.8 Future Model Parameters

| Data Category | Variable | Source | Assumptions |
|---|---|---|---|
| Driver Units | Single-family and multi-family accounts | CDR | Historical households per account; averages are multiplied by households projected by CDR |
| | Irrigation accounts | Agency Billing Data | Accounts are assumed to be constant into the future |
| | Sectoral Employment | CDR | Proportion of jobs within CII sectors projected by CDR |
| Explanatory Variables | Monthly Maximum Temperature and Total Precipitation | PRISM | 30-year historical normal weather |
| | Water Price | Retail Agencies | Prices increase by 3% per year above inflation for 2025-2030 and keeps pace with inflation thereafter (zero difference from inflation trend) |
| | Water Use Restrictions | State and Local Restrictions | None |
| | Seasonality | | Sine/cosine functions to capture monthly pattern |
| | Median Income | US Census | Constant income at 2022 value (real dollars) |
| | Housing Density | CDR | Derived from CDR housing unit projections, assuming residential area remains at 2024 levels |
| | Persons Per Household | CDR | CDR projected demographics |
| | Gross Domestic Product | Federal Reserve | Long-term GDP trend |
| | Relative Sectoral Employment | CDR | Calculated based on CDR projections |
| | Passive Efficiency Estimates | Flume Insight | Assumes a 2% decrease in residential demand due to conservation by 2030 (linearly extrapolated), then no change |
| | COVID Binary Indicator | | None (occurred between March 2020 and May 2023) |

The normal year scenario was provided by the baseline forecast. In this model, the single dry year scenario used a hot-dry index (HDI) to identify the year with the most weather-sensitive demand, with 2014 selected for most agencies. The multiple dry year was developed to describe the potential impact of consecutive dry years.

[1] For the 2022 Orange County Projections, CDR collected initial draft input from local jurisdictions in September 2021 on their anticipated jurisdiction-level housing growth for each projection year. In December 2021-February 2022, CDR reviewed and extracted data from jurisdictions' draft housing elements to create a parcel-level inventory of additional housing capacity from sites that were to be rezoned to accommodate the 6th RHNA cycle. These were reviewed by jurisdictions in spring 2022. Jurisdictions completed the rezoning of the final sites after their housing elements were certified by the State Housing and Community Development Department starting in 2022. The final adopted rezone sites will feed into CDR's 2026 Orange County Projections.

The forecasts for individual agencies, including the City's, were then summed to the regional level, providing regionally consistent forecasts for all of Orange County.

## 4.4 Water Loss

The City has conducted annual water loss audits since 2015 per the AWWA methodology per SB 555 to understand the relationship between water loss, operating costs, and revenue losses. Non-revenue water for CY 2020-2024 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). Table 4.9 summarizes the status of the last five years of water loss audit reporting for the water system. Reports can be found online at WUEdata - Water Audit Plans. 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.

Table 4.9 Submittal Table 4-5 Retail: Water Loss Audit Reporting

| **Submittal Table 4-5 Retail: Water Loss Audit Reporting<br>Water Code Section 10631(d)(3)(A)** | | |
|---|---|---|
| **Public Water System ID # Reported in Table 2-1 R** | Reporting Period | Submitted to DWR Water Loss Audit Program (yes/no) |
| **Report submittal status for all five years for each Public Water System as available.<br>Add rows as needed** | | |
| CA3010010 | 2020 | Yes |
| | 2021 | Yes |
| | 2022 | Yes |
| | 2023 | Yes |
| | 2024 | Yes |
| **DWR NOTES:** Suppliers will provide a link to the WUEdata submittals of their Water Loss Audit Reports. | | |
| **NOTES:** Water Loss Audits reported in Calendar Years (CY). | | |

Signed in 2018 and adopted in 2024, the "*Making Conservation a California Way of Life*" legislation (SB 606 and AB 1668) establishes a new framework for long-term improvements in urban water use efficiency and drought planning as California adapts to climate change impacts. Under the regulation, Suppliers must annually calculate Urban Water Use Objectives based on standards applied at the service area scale, including the Water Loss Performance Standard developed by the State Water Resources Control Board to minimize water waste through system leaks. The Water Loss Performance Standard requires that Suppliers must meet the real water loss standard and apparent water loss standard by 2028.

Table 4.10 presents the City's progress towards compliance with the 2028 Water Loss Standard, as of the time of writing this UWMP. The most recent AWWA Water Loss Audit for CY 2024 was utilized for the calculations presented.

Table 4.10 Submittal Table 4-6 Retail: Progress Towards 2028 Water Loss Standard

**Submittal Table 4-6 Retail: Progress Towards 2028 Water Loss Standard**
**Water Code Section 10631(d)(3)(C)**

| Public Water System ID # Reported in Submittal Table 2-1 R | Did the Water Board Calculate a Water Loss Standard for this Public Water System? (y/n) If no, Supplier will not complete this row. | Real Water Loss | | | | | Apparent Water Loss | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | State Water Board Standard | | Most Recent AWWA Water Loss Audit | | | State Water Board Standard | | Most Recent AWWA Water Loss Audit | | |
| | | 2028 Real Water Loss Standard per Unit per day | Units for Real Water Loss Drop down list | Number of Units (Connections or Miles corresponding with units selected) | Volume of Total Real Loss (from AWWA Water Loss Audit) (AF) | Real Water Loss Per Unit per Day | 2028 Apparent Water Loss Standard per Unit per Day | Units for Apparent Water Loss | Number of Connections | Volume of Total Apparent Loss (from AWWA Water Loss Audit) (AF) | Apparent Water Loss Per Unit per Day |
| CA3010010 | Yes | 14.5 | Gallons per Service Connection per Day (GPSCD) | 32,138 | 208.13 | 5.8 | 13.6 | Gallons per Service Connection per Day (GPSCD) | 32,138 | 446.31 | 12.4 |
| Water Board's Calculated Water Loss Standards | | | | | | | | | | | |

**DWR NOTES: Units of measure (AF, CCF, MG)** for Water Loss **MUST** remain consistent with units reported in Submittal Table 2-3. The units reported in Submittal Table 2-3 are used in this table's calculations.

**NOTES:** Uses the Water Board's calculated water loss standards updated as of 01/30/2026 and AWWA Water Loss Audit for CY 2024. Connection count may differ from what is reported in Table 2-1 R for FY 2025.

# CHAPTER 5 CONSERVATION TARGET COMPLIANCE

The Water Conservation Act of 2009, also known as Senate Bill (SB) X7-7, mandated a 20 percent reduction in urban per capita water use across California by 2020. To achieve this goal, the Act required each retail water supplier to establish an urban water-use target, contributing to the State's collective efforts. The Legislature stated that the combined reductions from all retail suppliers would fulfill the statewide legislative mandate.

The goal of this chapter is to allow the retail water supplier to report on their progress toward meeting their urban water-use targets in their Urban Water Management Plan (UWMP), pursuant to California Water Code (Water Code) Section 10608.40. Suppliers that did not meet their 2020 target in 2020 are required to compare their 2025 water use to the 2020 target.

Retail water suppliers are required to comply with SB X7-7 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.

When determining water use in an UWMP, two terms are often used interchangeably:

- **Daily Per Capita Water Use.** The amount of water used per person per day. In the UWMP calculations, this is total water use within a service area, divided by population, and it is measured in gallons.
- **Gallons Per Capita Per Day (GPCD).** This is the "daily per capita water use" measured in gallons. Therefore, the term commonly used when referring to "daily per capita water use" is "gallons per capita per day" or GPCD.[1]

## 5.1 Reporting Requirements

Municipal Water District of Orange County's (MWDOC's) Water Use Efficiency (WUE) programs helped Orange County meet the state's 20x2020 mandate by coordinating conservation efforts across its member agencies, funding and implementing regionally cost-effective efficiency programs, and enabling compliance through the Orange County 20x2020 Regional Alliance. By aligning its WUE portfolio directly with SB X7-7 requirements, supporting high-impact measures (especially outdoor water savings), documenting eligible indirect potable reuse credits, and centrally handling regional target calculations and reporting, MWDOC allowed participating retailers to comply collectively rather than individually resulting in regional per capita water use well below the required 2020 target.

[1] It is important to distinguish GPCD (as used in UWMPs) from the residential gallons per capita per day (R-GPCD) that is used in some reporting to the California State Water Resources Control Board (SWRCB). GPCD is the total water use from all sectors within a service area (residential, commercial, institutional, and any others) minus allowable exclusions (as defined in SB X7-7), then divided by the population. This is used in UWMPs. R-GPCD is only a part of the GPCD; it is the estimated residential water use in a service area divided by population.

As a result of MWDOC's WUE program, all Orange County water retailers, including all MWDOC's member agencies and the participating cities of Anaheim, Fullerton, and Santa Ana achieved compliance prior to 2020. The following table with information taken from the 2020 UWMP verifies that City of Fullerton met their SB X7-7 requirement. A discussion of programs implemented to support the achievement of the agency's per capita water reduction goals is covered in Chapter 9 - Demand Management Measures of this UWMP.

Table 5.1 Submittal Table 5-1 Retail: SB X7-7 2020 Target Progress

| **Submittal Table 5-1 Retail: SB X7-7 2020 Target Progress**<br>**Water Code Section 10608.40** | | | | | | |
|---|---|---|---|---|---|---|
| ☐ | **Check the box if the Supplier was not an Urban Water Supplier during or before the 2020 UWMP reporting cycle. Proceed to the next table.** | | | | | |
| Was Supplier part of a merger or consolidation since 2020? | Regional Alliance Target or Individual Target?<br>Drop down list | 2020 Target | Actual 2020 GPCD | Did Supplier Achieve Targeted Reduction for 2020? | **Only for suppliers that did not meet the Target in 2020**<br>**See DWR NOTES below.** | |
| | | | | | Actual 2025 GPCD<br>(From SB X7-7 Compliance Form) | Did Supplier meet the 2020 Target in 2025? |
| No | Individual Target | 179 | 111 | Yes | | NA |
| **DWR NOTES:**<br>**Suppliers calculating a 2025 GPCD** will need to complete and submit SB X 7-7 Compliance Tables to verify the use of SB X7-7 Methodologies.<br>**Suppliers that were part of a merger or consolidation since 2020** see Chapter 5 and Appendix P for guidance.<br>NA=Not Applicable | | | | | | |
| **NOTES: Supplier met the 2020 target, actual 2025 GPCD not required.** | | | | | | |

# CHAPTER 6 WATER SUPPLY CHARACTERIZATION

Orange County has a water supply portfolio made up from a variety of local and imported sources. Groundwater is produced from the Orange County Groundwater Basin (OC Basin), which is managed by the Orange County Water District (OCWD). To enhance the reliability of groundwater, OCWD has implemented projects and programs over the years that include: (1) the Groundwater Replenishment System (GWRS), which is the world's largest water purification system for indirect potable reuse; (2) increased stormwater capture for groundwater recharge; and (3) participation in the Santa Ana River Conservation and Conjunctive Use Program (SARCCUP), a collaborative, watershed-scale approach for groundwater basin management, replenishment, and water transfers.

Imported water is provided by the Metropolitan Water District of Southern California (MET), the wholesale water provider to 26 member agencies in Los Angeles, Orange, Riverside, San Bernardino, San Diego, and Ventura Counties. MET's imported water sources are delivered through its own Colorado River Aqueduct (CRA) and the California Aqueduct, under contract with the State Water Project (SWP). To enhance its reliability of its imported water, MET has implemented many programs such as canal lining and transfers of agricultural water, land fallowing programs with irrigation districts, water banking programs, and use of its storage reservoirs.

Local and imported water sources in Orange County are managed in such a way that they complement each other. For example, during wet and normal years additional MET water is purchased for groundwater replenishment in the OC Basin. During dry and drought years, when imported water is more limited, more groundwater can be produced to meet Orange County water demands. This coordinated management of water supplies has resulted in reliable water service even during multi-year droughts. Based on the water supply assessment described in this chapter and in Chapter 7, the Orange County region will continue to receive a reliable water supply through the next 25 years.

Specifically, this chapter includes: (1) descriptions of each water supply source and their management; (2) quantification of water supply sources through 2050 under normal, dry, and multi-dry weather conditions; (3) opportunities for exchanges and transfers; and (4) discussion regarding any planned or potential future water supply projects. This chapter also includes the energy intensity of the water service.

## 6.1 Water Supply Overview

The City of Fullerton (City) meets all of its demands with a combination of imported water and local groundwater to meet its water needs. The City works together with the Municipal Water District of Orange County (MWDOC) and OCWD to deliver a safe and reliable water supply that will continue to serve the community in periods of average, dry and drought hydrologic conditions. MWDOC is the Orange County wholesaler of imported water and one of MET's 26 member agencies. MET's imported water is delivered from the SWP and MET's CRA to Southern California. The City purchases imported water through MET to supplement its local supplies.

Local sources presently account for 63 percent of the City's water supplies, whereby groundwater is the major source of local supply. The primary source of groundwater originates from the OC Basin, which is located in mid-Orange County and is managed by OCWD. The Orange County GWRS is a joint project

between OCWD and the Orange County Sanitation District (OCSD). Using advanced treatment, recycled wastewater is transformed into a high-quality water supply for groundwater replenishment.

The City's main source of water supply is groundwater from the OC Basin. Imported water makes up the rest of the City's water supply portfolio. In fiscal year (FY) 2024-25, the City relied on approximately 63 percent groundwater and 37 percent imported water (Table 6.1). The volume of groundwater decreased in FY 2024-25 from historical averages while volume of imported water increased due to groundwater wells being temporarily taken offline while per-and polyfluoroalkyl substances (PFAS) treatment facilities are constructed to address PFAS contamination of groundwater.

Table 6.1 Water Supplies - 2025 Actual

| Submittal Table 6-8 Retail: Water Supplies — 2025 Actual<br>Water Code Section 10631(b) | | |
|---|---|---|
| Water Supply | Additional Description | 2025 |
| | | **Actual Volume** |
| | | (AF) |
| Groundwater (not desalinated) | Orange County Groundwater Basin | 13,979 |
| Purchased or Imported Water | MET | 8,264 |
| | **Total** | 22,243 |
| **NOTES:** Source - MWDOC, 2025 | | |

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.

In 2025, MWDOC developed a water demand forecast model for its participating water agencies that statistically correlates municipal and industrial (M&I) water use with demographic, socioeconomic, conservation and weather variables—as reported in the 2025 Orange County Water Demand Projection Model Technical Memorandum (TM) (MWDOC, 2025). Because the model isolates weather, future water demand projects can be estimated under single and multiple-year droughts and under future climate change scenarios.

It is projected that by 2050, the City's water portfolio will change to approximately 85 percent groundwater and 15 percent imported water (Figure 6.1 and Table 6.2) as PFAS treatment facilities are completed. It should be noted that these representations of supply match the projected demand. However, the City can purchase more MET imported water, should the need arise. Note that the GWRS supplies are included as part of groundwater pumping numbers.

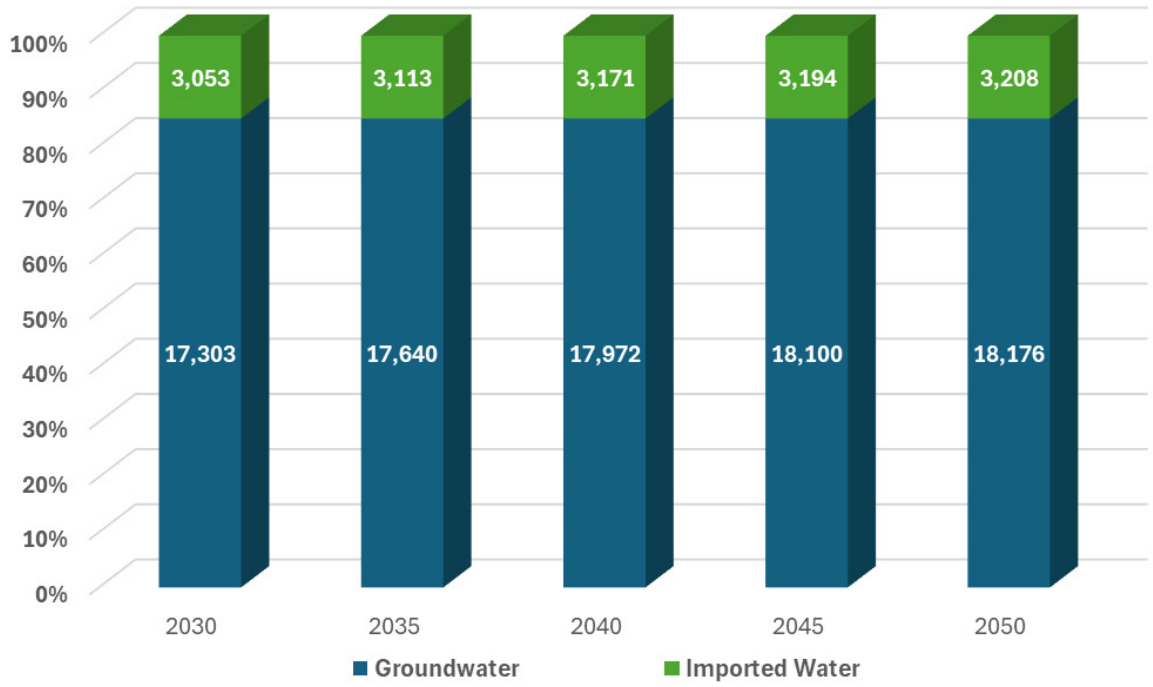



Figure 6.1 City's Projected Water Supply

Table 6.2 Water Supplies - Projected

| Submittal Table 6-9 Retail: Water Supplies — Projected<br>Water Code Section 10631 (b) | | | | | | |
|---|---|---|---|---|---|---|
| Water Supply | Additional Detail on Water Supply | Projected Water Supply (Report to the Extent Practicable) | | | | |
| | | 2030 | 2035 | 2040 | 2045 | 2050 (opt) |
| | | Reasonably Available Volume | Reasonably Available Volume | Reasonably Available Volume | Reasonably Available Volume | Reasonably Available Volume |
| | | (AF) | (AF) | (AF) | (AF) | (AF) |
| Purchased or Imported Water | MWDOC | 3,053 | 3,113 | 3,171 | 3,194 | 3,208 |
| Groundwater (not desalinated) | OC Basin | 17,303 | 17,640 | 17,972 | 18,100 | 18,176 |
| | **Total** | 20,356 | 20,753 | 21,143 | 21,294 | 21,384 |

**NOTES:** Source - MWDOC, 2025.
Groundwater volumes assume OCWD's basin production percentage (BPP) to be 85% for all years. Volumes of groundwater and imported water may vary depending on OCWD's actual BPP projections, which are established annually. Per its purchase agreement with MET, the City is contractually able to purchase more MET water, should the need arise.

## 6.2 Imported Water

The City supplements its water supply with imported water purchased from MET. In FY 2024-25, the City relied on approximately 8,264 acre-feet (AF) per year (AFY)—approximately 37 percent of the City's water supply portfolio for FY 2024-25—of imported water from MET to meet its demands.

MET's two principal sources of water are the Colorado River and the SWP. MET receives water from the Colorado River through the CRA and from the SWP through the California Aqueduct. For Orange County, the water obtained from these sources is treated at the Robert B. Diemer Filtration Plant located in the City of 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.

### 6.2.1 Metropolitan Water District of Southern California

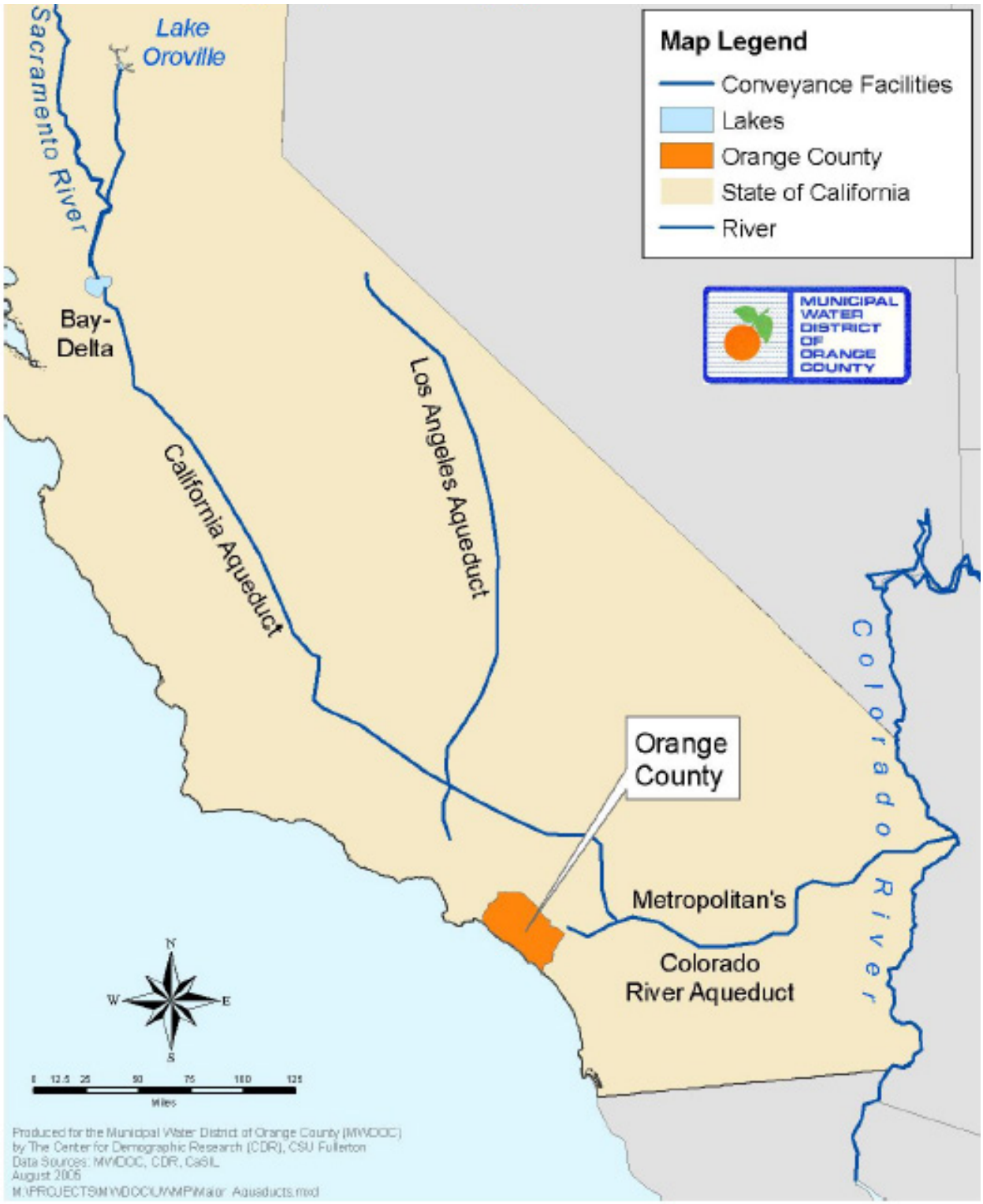
MET is the largest water wholesaler in California, serving approximately 19 million customers in a 5,200 square mile service area. MET wholesales imported water supplies to 26 member agencies located in the six southern California counties of Los Angeles, Orange, Riverside, San Bernardino, San Diego, and Ventura.

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 is determined by each agency's assessed valuation. Each member of the Board is entitled to cast one vote for each ten million dollars of assessed valuation of property taxable for district purposes, in accordance with Section 55 of the Metropolitan Water District Act. Directors may be appointed by the chief executive officer of the member agency or by a majority vote of the agency's governing board. Directors are not compensated by MET for their service (The Metropolitan Water District Act, 1969).

MET is responsible for importing water into the region through its operation of the CRA, which brings Colorado River supply to its service area, and its SWP contract, which brings water from northern California via the California Aqueduct. MET supplements its direct deliveries of imported supplies with its storage reservoirs, water transfers, agricultural irrigation water conservation, and water banking programs. Major imported water aqueducts bringing water to southern California are shown in Figure 6.2. It should be noted that the Los Angeles Aqueduct is owned and operated by the Los Angeles Department of Water and Power and is not part of MET's imported water supplies.

Member agencies receive water from MET through various delivery points and pay for service through a rate structure comprising volumetric rates, capacity charges, and readiness-to-serve charges. Member agencies provide MET with estimates of imported water demand in April each year, indicating the amount of water they anticipate they will need to meet their demands over the next five years.

In Orange County, MWDOC and the cities of Anaheim, Fullerton, and Santa Ana are MET member agencies that purchase imported water directly from MET. Figure 6.3 illustrates the MET feeders and major transmission pipelines that deliver water within Orange County.




*Source: MET, 2025.*

Figure 6.2 Major Aqueducts that Supply Imported Water to Southern California

Figure 6.3 MET Feeders and Transmission Mains that Serve Orange County

## 6.2.2 Colorado River Aqueduct

### 6.2.2.1 Background

The Colorado River was MET's original source of water after MET's establishment in 1928. The original founding members created MET with the goal to build the CRA to bring water to Southern California. 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 potable 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 (QSA) and its related agreements to transfer water from agricultural agencies to urban uses. The 2003 QSA enabled California to implement major Colorado River water conservation and transfer programs to stabilize water supplies and reduce the state's demand on the river to its 4.4 million acre-feet (MAF) entitlement. Colorado River transactions are potentially available to supply additional water up to the CRA capacity of 1.25 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 fourth-priority rights, with 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 exist (MET, 2025):

- 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.

### 6.2.2.2 Current Conditions and Supply

The Colorado River supply faces current and future imbalances between water supply and demand in the Colorado River Basin due to reductions in snowpack, long-term drought conditions, and climate change. The last 25-year period has been called a megadrought, with Lake Mead's elevation dropping from a high of 1,215 feet in 2000 to its lowest level of 1,040 feet in July 2022. While extreme wet conditions resulted in lake levels exceeding 1,077 feet in February 2024, levels have been persistently hovering around 1,057 feet since May of 2025. The United States Bureau of Reclamation (USBR) projects that there is a 53 percent likelihood that Lake Mead elevation could fall below 1,035 feet, which would trigger water shortages for MET under the current operating guidelines. As of August 2025, Lake Mead storage was approximately 31 percent of capacity per USBR's 24-Month Study, which also projected continued Lower Basin shortage conditions in 2026 (MET, 2025).

The current operating guidelines for the Colorado River expire at the end of 2026, and a new, long-term operating plan must be in place by November 2026 to manage the river's water supply. The ongoing Colorado River allocation negotiations are focused on creating a post-2026 operating plan, with states

and the federal government aiming for consensus on how to manage the river's declining water supply due to the severe, prolonged drought in the Colorado River Basin. The drought on the Colorado River began around 2000 and has continued, in various degrees of severity, for over two decades, making it a historic megadrought that has significantly reduced water flow into the river and lowered water levels in reservoirs like Lake Powell and Lake Mead. Although some periods, like the wet winter of 2023, brought temporary relief with increased snowfall, they were not enough to fully replenish the system or overcome the prolonged lack of water and effects of climate change, such as aridification and increased evaporation according to the United States Geological Survey (USGS, 2024). Under the 2007 Interim Guidelines, together with the Lower Basin Drought Contingency Plan (2019), the Intentionally Created Surplus (ICS) program has allowed MET to store conserved water in Lake Mead for subsequent recovery; these frameworks sunset with the Guidelines at the end of 2026 and are expected to be addressed in the post-2026 rules (MET, 2025).

The USBR, which is part of the U.S. Department of the Interior, is the federal agency leading the negotiations and responsible for managing the river system. The ongoing Colorado River negotiations aim to find a fair and sustainable way to allocate the available water, which is significantly less than in the past. Talks are centering on a "natural flow" proposal that divides water based on current river conditions, rather than historical allocations. However, states remain at odds over how much water to allocate to the Upper and Lower Basins, with the federal government planning to impose its own plan if an agreement is not reached by the November 2026 deadline. Some key challenges that remain to be resolved are the different interests of the Upper Basin states (Colorado, Utah, Wyoming, New Mexico) and the Lower Basin states (California, Arizona, Nevada) to reach consensus on how much water the Upper Basin should send downstream. In addition, Tribal nations are also seeking recognition of their rights and a role in the future management of the river. Given MET's junior priority status within California's Colorado River priority system, reductions to MET's supplies are a possibility under future operating criteria; MET's planning reflects this risk (MET, 2025).

Consistent with MET's 2025 Urban Water Management Plan (UWMP), supply capability planning uses USBR's August 2023 Colorado River Simulation System (CRSS) assumptions, including a climate adjusted flow reduction factor of approximately 9.3 percent per 1 degree Celsius (°C) of warming over the planning horizon (2025-2050). MET continues to utilize supply, storage, transfer, and conservation programs, including ICS participation under the current Guidelines, to manage risk and buffer shortages. In addition, conserved QSA-related transfer water delivered at Lake Havasu (including Imperial Irrigation District and canal-lining exchanges) is categorized in MET's 2025 UWMP as Colorado River imported supply (previously treated as local supply), aligning accounting with current practice (MET, 2025).

#### 6.2.2.3 MET Colorado River Current Programs

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 has contributed to achievements such as a record-low diversion of the Colorado River in 2019, a level not seen since the 1950s. Colorado River water management programs include:

- **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 acre-feet (AF) were received in recent years when unused supplies were available.

- **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.
- **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. MET continues to evaluate opportunities to formally account for verified long-term water savings associated with these lands as part of its Colorado River supply reliability strategy.
- **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.
- **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.
- **Lake Mead Storage Program** - Executed in 2006 and subsequently integrated with Lower Basin Drought Contingency Plan (DCP) operations, MET may intentionally leave conserved water in Lake Mead for exclusive future use. MET has significantly expanded its use of intentionally created surplus (ICS) storage in recent years, including record storage creation (450,000 AF) in 2023 under DCP-related conservation programs.
- **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.
- **Bard Seasonal Fallowing Program** - Authorized in 2019, and subsequently expanded, this program allows MET to pay participating farmers in Bard to reduce their water use between the late spring and summer months of selected year. Under expanded program authorizations through 2026 (Quechan Seasonal Fallowing Program), this program can provide up to approximately 12,000 AFY in certain years.
- **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, 2025).
- **Lower Basin Conservation and System Efficiency Programs** - In recent years, MET has participated in new, multi-agency conservation and system efficiency programs implemented between 2023 and 2026. These programs incentivize agricultural conservation, system efficiency improvements, urban conservation, and groundwater storage in the Lower Colorado River Basin, with the goal of reducing system demands and increasing storage in Lake Mead during critically dry conditions. This includes programs such as the Quechan Diversion Forbearance program.

- **Exchange Programs** - MET is involved in separate exchange programs with the USBR, which takes place at the Colorado River Intake and with San Diego County Water Authority (SDCWA), which exchanges conserved Colorado River water.

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 (MET, 2025).

Given these uncertainties, MET plans to continue implementing and expanding Colorado River conservation, storage, exchange, and transfer programs, while also supporting increased water recycling and system efficiency improvements within the Colorado River Basin. MET continues to evaluate additional transfer and conservation opportunities to further enhance regional supply reliability through the 2025 UWMP planning horizon.

## 6.2.3 State Water Project

### 6.2.3.1 Background

The SWP consists of a series of pump stations, reservoirs, aqueducts, tunnels, and power plants operated by California Department of Water Resources (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 Sacramento-San Joaquin Delta ("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 percent of SWP's contracted water supply going to urban users and 30 percent 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, 2025).

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 already below sea level, and the related threat of catastrophic levee failure as water pressure increases or following a major seismic event.

In May 2019, DWR withdrew its permit for the two-tunnel WaterFix project in favor of a smaller one-tunnel project alternative. In July 2022, the draft Environmental Impact Report (EIR) for the recommended Delta Conveyance Project alternative was issued, with the project potentially operational

by 2045 (Delta Conveyance Design and Construction Authority, 2024), though its implementation faces strong opposition by environmental organizations and other interests in the Delta. The maximum value of the Delta Conveyance Project, when coupled with 250,000 AF of new regional storage, is estimated to be 367,000 AFY for MET, with 63,000 AFY of that amount for Orange County. The Delta Conveyance Project also reduces the probability that any shortage occurs by about 10 percent, meaning a doubling of the time between shortage conditions from once every 5 years to once every decade (MWDOC OC Water Reliability Study, 2023).

#### 6.2.3.2 Current Conditions and Supply

Just like the Colorado River, the amount of water that can be delivered from the SWP to its 29 contractors varies annually based on hydrology and reservoir storage along the SWP. The DWR publishes the maximum entitlement of SWP water for each water contracting agency in "Table A." DWR sets these allocations to balance the needs for human health and safety, agricultural, and municipal water, considering factors like reservoir storage, runoff forecasts, and Endangered Species Act (ESA) requirements. The primary drivers that influence allocations are hydrologic conditions (precipitation and snowmelt) along with storage levels, especially in Lake Oroville. Actual deliveries typically average less than 50 percent of Table A due to hydrologic and regulatory constraints (MET, 2025). MET's actual annual allocations based on springtime Table A values for the past UWMP cycles are summarized in Table 6.3.

Table 6.3 MET SWP Program Capabilities

| Year | Average Annual Table A Spring Allocation (MAF) |
|---|---|
| 2015 | 0.38 |
| 2020 | 0.38 |
| 2025 | 0.96 |
| **Percent Change(1)** | +252.6% |

Notes:
(1) Percent change is between the years 2020 and 2025. Source: SWP Allocations 1996-2026.

SWP contractors may additionally 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 (MET, 2025).

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 (MET, 2025).

Turnback pool water is Table A water that has been allocated to SWP contractors who have exceeded their demands. This water can then be purchased by another contractor depending on its availability (MET, 2025).

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 percent. 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 Central Valley Project (CVP). DWR's recent planning documents and the Draft 2025 DCR describe climate-adjusted "existing conditions" baselines and future scenarios used by agencies for UWMPs.
- **Regulatory restrictions on SWP Delta exports:** The Biological Opinions (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:** Following the 2019 withdrawal of WaterFix, DWR certified the Delta Conveyance Project Final EIR and approved the Bethany alignment in December 2023, a key modernization initiative for the SWP. EcoRestore and related habitat efforts continue to advance.
- **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.

It can be concluded that the federal regulatory framework affecting the Bay-Delta's ecosystem, species, and water supply are constantly evolving by adapting to new scientific information, changing climate conditions, and legal challenges. This dynamic and complex regulatory landscape, along with hydrologic and storage conditions along the SWP, continues to result in water supply uncertainties that impact all SWP contractors, including MET, MWDOC, and its member agencies (MET, 2025).

#### 6.2.3.3 State Water Project Programs/Plans

In the past five years, MET has updated and implemented planning, regulatory, infrastructure, and operational programs to improve the reliability of the SWP supplies while addressing environmental, seismic, and climate-related risks in the Sacramento-San Joaquin Delta and along the California Aqueduct. Key SWP programs and planning efforts include:

- **SWP Biological Opinions and California Incidental Take Permit (ITP)** - Updated federal Biological Opinions and a California ITP issued in 2024 provide a new operating framework intended to improve flexibility and species protection. The 2025 MET UWMP characterizes the net reliability benefit at approximately +60,000 AFY relative to prior permits, subject to hydrologic and regulatory conditions.
- **Healthy Rivers and Landscapes (HRL) Voluntary Agreements** - MET supports the State's proposed HRL program, which establishes a voluntary framework for improving Delta ecosystem conditions through coordinated flow contributions and habitat restoration projects. The HRL approach is intended to provide regulatory stability while supporting environmental objectives consistent with SWP operations.

### 6.2.4 Storage, Transfers, and Conveyance Programs

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) depends on its storage resources. Following a significant drawdown during the 2020-2022 drought, MET rebuilt storage as hydrologic conditions improved. By the end of 2023, MET had approximately 3.4 MAF of regional dry-year storage. Storage increased to 3.8 MAF by the end of 2024, with levels projected to reach approximately 3.9 MAF by the end of 2025. MET also maintains approximately 750 thousand acre-feet (TAF) of emergency storage dedicated to catastrophic supply interruption conditions, including a major seismic failure of the Delta levees.

In its 2025 UWMP, MET evaluates storage based on median starting storage at the beginning of each five-year increment, representing a 50 percent probability that actual storage will be higher or lower. This approach differs from earlier UWMPs, which relied on average storage assumptions, and provides a more conservative and realistic representation of storage availability. All storage capability values incorporate conveyance and recovery constraints associated with SWP terminal reservoirs, the CRA, and MET's in-region and out-of-region groundwater banking programs.

Lake Oroville continues to serve as the SWP's largest storage facility with a capacity of approximately 3.5 MAF. Water released from Oroville moves to the Feather River and then to the Sacramento River before being pumped south at the Harvey O. Banks pumping plant into the California Aqueduct. MET's storage portfolio includes surface reservoirs such as Diamond Valley Lake, Lake Mathews, and Lake Skinner; SWP terminal storage in San Luis Reservoir; groundwater banking programs including Semitropic, Arvin-Edison, the High Desert Water Bank, Kern Delta, and Mojave; and ICS storage in Lake Mead. These storage assets provide operational flexibility during dry years and help maintain supplies during extended droughts or emergency events.

MET endeavors to increase the reliability of water supplies through the development of flexible storage and transfer programs including groundwater storage (MET, 2025). These include:

- **Antelope Valley-East Kern (AVEK) Water Agency Exchange and Storage Program** - Under the exchange program, for every 2 AF MET receives, MET returns 1 AF back to AVEK, and MET will also be able to store up to 30,000 AF in the AVEK's groundwater basin, with a dry-year return capability of 10,000 AF.
- **Arvin-Edison Storage Program** - The storage program is estimated to deliver 75,000 AF, 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.

- **Diamond Valley Lake to Rialto Pipeline** - Planned for completion in 2028, this project creates new conveyance that improves the ability to move non-SWP supplies (120 cubic feet per second (cfs), including CRA and banked water) into areas historically dependent on SWP deliveries, increasing drought and seismic resilience.
- **High Desert Water Bank Program** - Developed in partnership with AVEK, this regional groundwater banking program allows MET to store up to 280,000 AF of SWP Table A or other available supplies in the Antelope Valley groundwater basin. The program provides a put-and-take capability of up to approximately 70,000 AFY, with infrastructure including monitoring and production wells, California Aqueduct turnouts, pipelines, recharge basins, and pump facilities. Phase 1 became operational in 2023, with full build-out expected by approximately 2030.
- **Kern-Delta Water District Storage Program** - This groundwater storage program has 250,000 AF 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 390,000 AF. The agreement allows for MET to store water in an exchange account for later return.
- **Richvale & Western Canal Water Transfers** - These multi-year transfer options will provide supplemental dry-year supplies when available, with volumes up to approximately 54,000 AF (2025-2027).
- **San Bernardino Valley MWD Surplus SWP Program** - Programmatic access to surplus SWP supplies (approximately 13 TAF) will be available from SBVMWD under certain hydrologic and operational conditions.
- **Semitropic Storage Program** - The maximum storage capacity of the program is 350,000 AF, and the minimum and maximum annual yields available to MET are 34,700 AF and 236,200 AF, 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.
- **Sepulveda Feeder Pump Stations (Stage 1)** - This program includes pumping improvements that expand westward movement of CRA/SWP/banked supplies across service areas to address localized system constraints. Pumping capacity is expected to be 30 cfs upon completion of Stage 1 in 2027.
- **Yuba Accord Extension** - This project is a continuation of an established dry-year transfer program from the Yuba watershed that can be accessed subject to hydrologic and regulatory conditions. As of 2025, the extension is under negotiation for approximately 250,000 AFY in supply.

### 6.2.5 Untreated Imported Water - Baker Treatment Plant

The Baker Treatment Plant has a treatment capacity of 28.1 million gallons per day (mgd) located at the site of the former Baker Filtration Plant in Lake Forest. The plant was a joint regional project by five South Orange County water districts: ETWD, IRWD, MNWD, SMWD, and TCWD, which have capacity rights of 3.2 mgd, 6.8 mgd, 8.4 mgd, 8.4 mgd, and 1.3 mgd, respectively. The project came online in early 2017 and is managed and operated by IRWD.

The plant has multiple water supply sources that increase water supply reliability, including imported untreated water from MET through the Santiago Lateral and local surface water from Irvine Lake. It provides a reliable local drinking water supply during emergencies or extended facility shutdowns on the MET delivery system (including Diemer Plant interruptions or AMP outages) and increases operational flexibility by creating redundancy within the water conveyance system.

### 6.2.6 Potential Future Water Projects

#### 6.2.6.1 Climate Adaptation Master Plan for Water

In February 2023, the MET's Board directed its staff to integrate water resources planning, climate resilience planning, and financial planning into a *Climate Adaptation Master Plan for Water* (CAMP4W). Then a Joint Task Force of Board Members and Member Agency Managers was convened to facilitate the development of CAMP4W in a timely and transparent process. The main elements of CAMP4W include:

1. Identify climate and growth scenarios, building from analyses conducted for MET's *Integrated Resources Plan* (IRP).
2. Develop time-bound targets for new regional water supplies and system improvements.
3. Establish a framework for decision-making and annual reporting.
4. Form policies, initiatives, and partnerships.
5. Evaluate business models and funding strategies.

Because investments required for regional supply reliability and system resilience are significant, it is important that decisions are made through an adaptive management process to avoid the risks associated with over-investment or under-performance. Tracking signposts and progress towards time-bound targets is therefore critical for CAMP4W's annual reporting. Currently, regional projects being explored by MET include Pure Water Southern California, new reservoir storage in Southern California of up to 155,000 AFY, regional seawater desalination, and participation in California's Delta Conveyance Project. These projects will be scored against the following CAMP4W criteria: (1) reliability; (2) resilience; (3) financial; (4) adaptability/flexibility; (5) equity; and (6) environmental co-benefits.

- **Pure Water Southern California** - The potential Pure Water Southern California program, a partnership with the Sanitation Districts of Los Angeles County, would purify wastewater treatment effluent that currently flows to the ocean to produce high quality recycled water. The purified water would be delivered to Metropolitan's member agencies to meet their groundwater replenishment and storage requirements. It should be noted that the 2025 MET UWMP does not include Pure Water yield in projected supplies (MET, 2025).

- **Sites Reservoir** - This potential project includes a water storage reservoir of 1.5 MAF and would require the construction of two large dams up to 310 feet high and nine smaller saddle dams. The water stored in the reservoir, located north of Sacramento, would be diverted from the Sacramento River during high flow events and returned to the Sacramento River during dry and critical years, thereby providing additional dry-year water for environmental flows and project partners including SWP agencies south of the Delta. The current operations model estimates the annual water yield of the Sites Reservoir Project at approximately 270 TAF per year by 2032, when the Sites Reservoir Project is scheduled to be operational (MET, 2025). It should be noted that the 2025 MET UWMP does not include Sites Reservoir in projected supplies (MET, 2025).
- **Delta Conveyance Project** - Following DWR's withdrawal and subsequent termination of the California WaterFix project, the State advanced a new single-tunnel Delta Conveyance Project to address seismic risk, sea-level rise, extreme weather, and regulatory uncertainty while improving long-term SWP delivery reliability. The environmental review was completed in 2023 and DWR has approved the project. Potential yield used in planning analyses is on the order of approximately 400,000 AFY. It should be noted that the 2025 MET UWMP does not include Delta Conveyance Project yield in projected supplies pending future milestones and contracting decisions (MET, 2025).

## 6.2.7 Supply Reliability Within MET

MET's 2025 UWMP reports on its water reliability and identifies projected supplies to meet the long-term demand within its service area. The MET 2025 UWMP discusses the current water supply conditions and long-term plans for supply implementation and continued development of a diversified resource mix. It describes the programs being implemented, such as the CRA, SWP, Central Valley storage/transfer programs, water use efficiency programs, local resource projects, and in-region storage that will enable the region to meet its water supply needs. MET's 2025 UWMP also presents MET's supply capacities from 2025 through 2050 for average year, single dry year, five consecutive dry years, and more frequent and severe droughts, as specified in the UWMP Act.

Information concerning MET's UWMP, including the background, associated challenges, and long-term development of programs for each of MET's supply sources and capacities have been summarized and included in the following subsections. Additional information on MET can be found directly in MET's 2025 UWMP.

### 6.2.7.1 MET's Water Service Reliability Assessment Results

In MET's 2025 UWMP, MET evaluated supply reliability by projecting supply and demand under a normal year, single-dry year, and five-year consecutive dry years, based on conditions affecting the SWP (MET's largest and most variable supply). For this supply source, the average of 100 historical years 1922-2021 most closely represents water supply conditions in a normal water year, the single driest year was 1977 and the five-year dry period was 1988-1992. The analyses also include Colorado River supplies under the same hydrological variations.

MET also incorporated the SWP and Colorado River's reliability factors, such as water quality objectives set by the California State Water Resources Control Board (SWRCB), BiOps, and amendments to the Coordinated Operations Agreement for the SWP and Quantification Settlement Agreements for the Colorado River into their assessment.

MET has concluded that the region can provide reliable water supplies under normal, single-dry, and five-year consecutive dry conditions, as presented in Table 6.4, Table 6.5, Table 6.6, respectively.

In each of the following tables, "Current Programs" supplies include:

- In-Region Supplies and Programs:
  - Metropolitan Surface Storage (Diamond Valley Lake, Lake Mathews, Lake Skinner).
  - Flexible Storage in Castaic Lake and Perris Lake.
  - Groundwater Storage for Conjunctive Use.
- California Aqueduct (SWP), including Central Valley transfers and storage program supplies conveyed by the aqueduct.
- CRA, including deliveries, programs, and exchanges with SDCWA.

These supplies are impacted—typically reduced—by the single dry year and multiple dry year scenarios. Though demands increase in these drought conditions, MET projects reliable supply, even surplus, through 2050. Fullerton is a MET member agency, and MET's projections take into account the imported demands from Orange County. As such, MET's water reliability assessments are used to determine that demands within Fullerton can be met for all three hydrological conditions.

Table 6.4 MET's Projected Supply Capability and Demands through 2050 for a Normal Year

**Normal Year**
**Supply Capability[1] and Projected Demands**
**Average of 1922-2021 Hydrologies**
(acre-feet per year)

| Forecast Year | 2030 | 2035 | 2040 | 2045 | 2050 |
|---|---|---|---|---|---|
| **Current Programs** | | | | | |
| In-Region Supplies and Programs | 789,000 | 776,000 | 746,000 | 733,000 | 827,000 |
| California Aqueduct[2] | 1,723,000 | 1,694,000 | 1,668,000 | 1,641,000 | 1,641,000 |
| Colorado River Aqueduct | | | | | |
| Total Supply Available[3] | 1,334,700 | 1,358,200 | 1,336,000 | 1,323,500 | 1,345,500 |
| *Aqueduct Capacity Limit[4]* | *1,250,000* | *1,250,000* | *1,250,000* | *1,250,000* | *1,250,000* |
| Colorado River Aqueduct Capability | 1,250,000 | 1,250,000 | 1,250,000 | 1,250,000 | 1,250,000 |
| **Capability of Current Programs** | **3,762,000** | **3,720,000** | **3,664,000** | **3,624,000** | **3,718,000** |
| | | | | | |
| **Demands** | | | | | |
| Total Demands on Metropolitan | 1,225,000 | 1,238,000 | 1,266,000 | 1,285,000 | 1,303,000 |
| Exchange with SDCWA | 278,000 | 278,000 | 278,000 | 278,000 | 278,000 |
| **Total Metropolitan Deliveries[5]** | **1,503,000** | **1,516,000** | **1,544,000** | **1,563,000** | **1,581,000** |
| | | | | | |
| **Surplus** | **2,259,000** | **2,204,000** | **2,120,000** | **2,061,000** | **2,137,000** |
| | | | | | |
| **Programs Under Development** | | | | | |
| In-Region Supplies and Programs | 0 | 0 | 0 | 0 | 0 |
| California Aqueduct | 0 | 0 | 0 | 0 | 0 |
| Colorado River Aqueduct | | | | | |
| Total Supply Available[3] | 0 | 0 | 0 | 0 | 0 |
| *Aqueduct Capacity Limit[4]* | *0* | *0* | *0* | *0* | *0* |
| Colorado River Aqueduct Capability | 0 | 0 | 0 | 0 | 0 |
| **Capability of Proposed Programs** | **0** | **0** | **0** | **0** | **0** |
| | | | | | |
| **Potential Surplus** | **2,259,000** | **2,204,000** | **2,120,000** | **2,061,000** | **2,137,000** |

Notes:
1. Represents Supply Capability for resource programs under listed year type.
2. California Aqueduct includes Central Valley transfers and storage program supplies conveyed by the aqueduct.
3. Colorado River Aqueduct includes programs and Exchange with SDCWA conveyed by the aqueduct.
4. Maximum CRA deliveries limited to 1.25 MAF including Exchange with SDCWA.
5. Total demands are adjusted to include Exchange with SDCWA.

Table 6.5 MET's Projected Supply Capability and Demands through 2050 for a Single Dry Year

**Single Dry Year**
**Supply Capability[1] and Projected Demands**
**Repeat of 1977 Hydrology**
(acre-feet per year)

| Forecast Year | 2030 | 2035 | 2040 | 2045 | 2050 |
|---|---|---|---|---|---|
| **Current Programs** | | | | | |
| In-Region Supplies and Programs | 789,000 | 776,000 | 746,000 | 733,000 | 827,000 |
| California Aqueduct[2] | 662,000 | 649,000 | 635,000 | 622,000 | 622,000 |
| Colorado River Aqueduct | | | | | |
| Total Supply Available[3] | 1,334,700 | 1,358,200 | 1,336,000 | 1,411,000 | 1,433,000 |
| *Aqueduct Capacity Limit[4]* | *1,250,000* | *1,250,000* | *1,250,000* | *1,250,000* | 1,250,000 |
| Colorado River Aqueduct Capability | 1,250,000 | 1,250,000 | 1,250,000 | 1,250,000 | 1,250,000 |
| **Capability of Current Programs** | **2,701,000** | **2,675,000** | **2,631,000** | **2,605,000** | **2,699,000** |
| | | | | | |
| **Demands** | | | | | |
| Total Demands on Metropolitan | 1,356,000 | 1,375,000 | 1,401,000 | 1,419,000 | 1,436,000 |
| Exchange with SDCWA | 278,000 | 278,000 | 278,000 | 278,000 | 278,000 |
| **Total Metropolitan Deliveries[5]** | **1,634,000** | **1,653,000** | **1,679,000** | **1,697,000** | **1,714,000** |
| | | | | | |
| **Surplus** | **1,067,000** | **1,022,000** | **952,000** | **908,000** | **985,000** |
| | | | | | |
| **Programs Under Development** | | | | | |
| In-Region Supplies and Programs | 0 | 0 | 0 | 0 | 0 |
| California Aqueduct | 0 | 0 | 0 | 0 | 0 |
| Colorado River Aqueduct | | | | | |
| Total Supply Available[3] | 0 | 0 | 0 | 0 | 0 |
| *Aqueduct Capacity Limit[4]* | *0* | *0* | *0* | *0* | *0* |
| Colorado River Aqueduct Capability | 0 | 0 | 0 | 0 | 0 |
| **Capability of Proposed Programs** | **0** | **0** | **0** | **0** | **0** |
| | | | | | |
| **Potential Surplus** | **1,067,000** | **1,022,000** | **952,000** | **908,000** | **985,000** |

Notes:
1. Represents Supply Capability for resource programs under listed year type.
2. California Aqueduct includes Central Valley transfers and storage program supplies conveyed by the aqueduct.
3. Colorado River Aqueduct includes programs and Exchange with SDCWA conveyed by the aqueduct.
4. Maximum CRA deliveries limited to 1.25 MAF including Exchange with SDCWA.
5. Total demands are adjusted to include Exchange with SDCWA.

Table 6.6 MET's Projected Supply Capability and Demands through 2050 for a Drought (5 Consecutive Water Years)

**Drought Lasting Five Consecutive Years**
**Supply Capability[1] and Projected Demands**
**Repeat of 1988-1992 Hydrology**
(acre-feet per year)

| Forecast Year | 2030 | 2035 | 2040 | 2045 | 2050 |
|---|---|---|---|---|---|
| **Current Programs** | | | | | |
| In-Region Supplies and Programs | 160,000 | 156,000 | 149,000 | 146,000 | 165,000 |
| California Aqueduct[2] | 733,200 | 720,400 | 690,400 | 660,400 | 579,400 |
| Colorado River Aqueduct | | | | | |
| Total Supply Available[3] | 1,189,200 | 1,241,700 | 1,204,500 | 1,197,000 | 1,245,500 |
| *Aqueduct Capacity Limit[4]* | *1,250,000* | *1,250,000* | *1,250,000* | *1,250,000* | *1,250,000* |
| Colorado River Aqueduct Capability | 1,189,200 | 1,241,700 | 1,204,500 | 1,197,000 | 1,245,500 |
| **Capability of Current Programs** | **2,082,400** | **2,118,100** | **2,043,900** | **2,003,400** | **1,989,900** |
| | | | | | |
| **Demands** | | | | | |
| Total Demands on Metropolitan | 1,324,000 | 1,390,000 | 1,411,000 | 1,434,000 | 1,453,000 |
| Exchange with SDCWA | 278,000 | 278,000 | 278,000 | 278,000 | 278,000 |
| **Total Metropolitan Deliveries[5]** | **1,602,000** | **1,668,000** | **1,689,000** | **1,712,000** | **1,731,000** |
| | | | | | |
| **Surplus** | **480,400** | **450,100** | **354,900** | **291,400** | **258,900** |
| | | | | | |
| **Programs Under Development** | | | | | |
| In-Region Supplies and Programs | 0 | 0 | 0 | 0 | 0 |
| California Aqueduct | 0 | 0 | 0 | 0 | 0 |
| Colorado River Aqueduct | | | | | |
| Total Supply Available[3] | 0 | 0 | 0 | 0 | 0 |
| *Aqueduct Capacity Limit[4]* | *60,800* | *8,300* | *45,500* | *53,000* | *4,500* |
| Colorado River Aqueduct Capability | *0* | *0* | *0* | *0* | *0* |
| **Capability of Proposed Programs** | **0** | **0** | **0** | **0** | **0** |
| | | | | | |
| **Potential Surplus** | **480,400** | **450,100** | **354,900** | **291,400** | **258,900** |

Notes:
1. Represents Supply Capability for resource programs under listed year type.
2. California Aqueduct includes Central Valley transfers and storage program supplies conveyed by the aqueduct.
3. Colorado River Aqueduct includes programs and Exchange with SDCWA conveyed by the aqueduct.
4. Maximum CRA deliveries limited to 1.25 MAF including Exchange with SDCWA.
5. Total demands are adjusted to include Exchange with SDCWA.

### 6.2.7.2 MET's Drought Risk Assessment Results

For its Drought Risk Assessment (DRA), MET assessed the reliability of each individual water supply source over the five-consecutive-year drought through a modeling method using the same historical hydrologic conditions as the water service reliability assessment: 1922 to 2021. MET used the five consecutive years of 1988 to 1992 to complete its DRA, because this represents the driest five-consecutive year historical sequence for MET's supply.

As shown in Table 6.7, MET's total supplies are insufficient to fully meet projected demands under these drought conditions, resulting in annual shortfalls in four of the five years and a cumulative deficit of approximately 1.1 MAF by FY 2029-30. These results indicate that MET's SWP and CRA supplies alone cannot meet demands during this five-year drought period without additional actions. MET's 2025 UWMP

therefore identifies Water Shortage Contingency Plan (WSCP) actions, as necessary tools to close the deficit and maintain service through the modeled drought sequence (Table 6.7).

Table 6.7 MET's Water Use, Supply, and Drought Risk Assessment for 2026-2030

**Metropolitan's Drought Risk Assessment**
**Water Use, Supply, and Risk Assessment for 2026 – 2030**
**(also included as Appendix 11 DWR Submittal Table 7-5)**

| Submittal Table 7-5 Wholesale: Five-Year Drought Risk Assessment<br>Water Code Section 10635(b)(3) | | |
|---|---|---|
| **2026** | | **Total** |
| Total Water Use | (AF) | 1,511,000 |
| Total Supplies | (AF) | 973,000 |
| Surplus/Shortfall w/o WSCP Action | | (538,000) |
| **OPTIONAL Planned WSCP Actions** (use reduction and supply augmentation) | | |
| WSCP - supply augmentation benefit | (AF) | 538,000 |
| WSCP - use reduction savings benefit | (AF) | 0 |
| Revised Surplus/(shortfall) | | 0 |
| **2027** | | **Total** |
| Total Water Use | (AF) | 1,633,000 |
| Total Supplies | (AF) | 2,267,000 |
| Surplus/Shortfall w/o WSCP Action | | 634,000 |
| **OPTIONAL Planned WSCP Actions** (use reduction and supply augmentation) | | |
| WSCP - supply augmentation benefit | (AF) | 0 |
| WSCP - use reduction savings benefit | (AF) | 0 |
| Revised Surplus/(shortfall) | | 634,000 |
| **2028** | | **Total** |
| Total Water Use | (AF) | 1,714,000 |
| Total Supplies | (AF) | 1,169,000 |
| Surplus/Shortfall w/o WSCP Action | | (545,000) |
| **OPTIONAL Planned WSCP Actions** (use reduction and supply augmentation) | | |
| WSCP - supply augmentation benefit | (AF) | 545,000 |
| WSCP - use reduction savings benefit | (AF) | 0 |
| Revised Surplus/(shortfall) | | 0 |
| **2029** | | **Total** |
| Total Water Use | (AF) | 1,561,000 |
| Total Supplies | (AF) | 1,197,000 |
| Surplus/Shortfall w/o WSCP Action | | (364,000) |
| **OPTIONAL Planned WSCP Actions** (use reduction and supply augmentation) | | |
| WSCP - supply augmentation benefit | (AF) | 364,000 |
| WSCP - use reduction savings benefit | (AF) | 0 |
| Revised Surplus/(shortfall) | | 0 |
| **2030** | | **Total** |
| Total Water Use | (AF) | 1,588,000 |
| Total Supplies | (AF) | 1,301,000 |
| Surplus/Shortfall w/o WSCP Action | | (287,000) |
| **OPTIONAL Planned WSCP Actions** (use reduction and supply augmentation) | | |
| WSCP - supply augmentation benefit | (AF) | 287,000 |
| WSCP - use reduction savings benefit | (AF) | |
| Revised Surplus/(shortfall) | | 0 |
| **DWR NOTES: Units of measure (AF, CCF, MG)** must remain consistent throughout the | | |
| NOTES: Totals may not foot due to rounding. See 2025 UWMP discussion in Chapter 2.4 Drought Risk Assessment regarding the supply augmentation actions that may be exercised to meet demands through 2030. | | |

## 6.3 Local Groundwater

Among all local supplies available to the City's service area, groundwater supplies make up the majority, with the primary supply from the OC Basin. The water supply resources within the City's service area are enhanced by the existence of groundwater basins, which provide a reliable local source and, additionally, are used as reservoirs to store water during wet years and draw from storage during dry years. Historically, local groundwater has been the cheapest and most reliable source of supply for the City. The City pumps groundwater through seven active wells. However, the volume of groundwater pumped has decreased starting in 2023 due to PFAS contamination and construction of new treatment facilities. Well 2 and Well 10 are temporarily offline waiting for treatment implementation. Additionally, the City also has two inactive wells (Well 5 and Well 6 offline due to elevated perfluorooctanoic acid (PFOA) levels and are expected to return to service after the construction of treatment facilities. Implementation of PFAS treatment facilities limits the pumping capacity of the wells which is the main issue currently affecting the City's ability to pump from the groundwater supply. Once the treatment facilities are online, the remaining limitation to the pumping capacity is the basin production percentage (BPP) set by OCWD. Table 6.8 shows a breakdown of historical groundwater production by the City.

This section describes the groundwater basin used by the City and provides a 25-year projection of the service area's groundwater supply.

Table 6.8 Groundwater Pumped in the past 5 Years within the City's Service Area (AF)

| Submittal Table 6-1 Retail: Groundwater Volume Pumped<br>Water Code Section 10631(4) and 10631(4)(c) | | | | | | | |
|---|---|---|---|---|---|---|---|
| Groundwater Type | Water Type (Potable/Non-Potable) | Location or Basin Name | 2021 (AF) | 2022 (AF) | 2023 (AF) | 2024 (AF) | 2025 (AF) |
| Alluvial Basin | | Orange County Groundwater Basin | 17,626 | 17,739 | 15,467 | 14,699 | 13,979 |
| | | **Total** | 17,626 | 17,739 | 15,467 | 14,699 | 13,979 |
| **NOTES:** Source - MWDOC, 2025 | | | | | | | |

### 6.3.1 Orange County Groundwater Basin

This section describes the OC Basin and the management measures taken by OCWD, the basin manager and member agency of MWDOC, to optimize local supply and minimize overdraft.

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 percent of the land area of the OC Basin, and 98 percent of all groundwater production occurs within the area. Approximately 2.5 million residents live within OCWD's boundaries and rely upon the basin for their primary water supply. OCWD manages water resource monitoring programs, land use elements related to basin management, groundwater elevation, groundwater quality, and coastal area monitoring through a number of monitoring programs. OCWD monitors the basin by collecting

groundwater elevation and quality data from approximately 400 District-owned 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 (OCWD, 2023). For detailed monitoring programs and management information, refer to the 2017 Basin 8-1 Alternative (Appendix D).

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, a member of agency of MWDOC, purchases untreated water from MET for basin recharge, as needed. In addition, OCWD regulates groundwater levels in the OC Basin by regulating the annual amount of pumping and setting the BPP for the water year. As defined in the District Act, the BPP is the ratio of water produced from groundwater supplies within the OCWD service area to all water produced within the area from both supplemental sources and groundwater within the OCWD (OCWD, 2020a). More information regarding the BPP is discussed in Section 6.3.1.2.

#### 6.3.1.1 Basin Characteristics

The OC Basin underlies the northern 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 on Figure 6.4. 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 estimated full storage 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 can 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 percent 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.

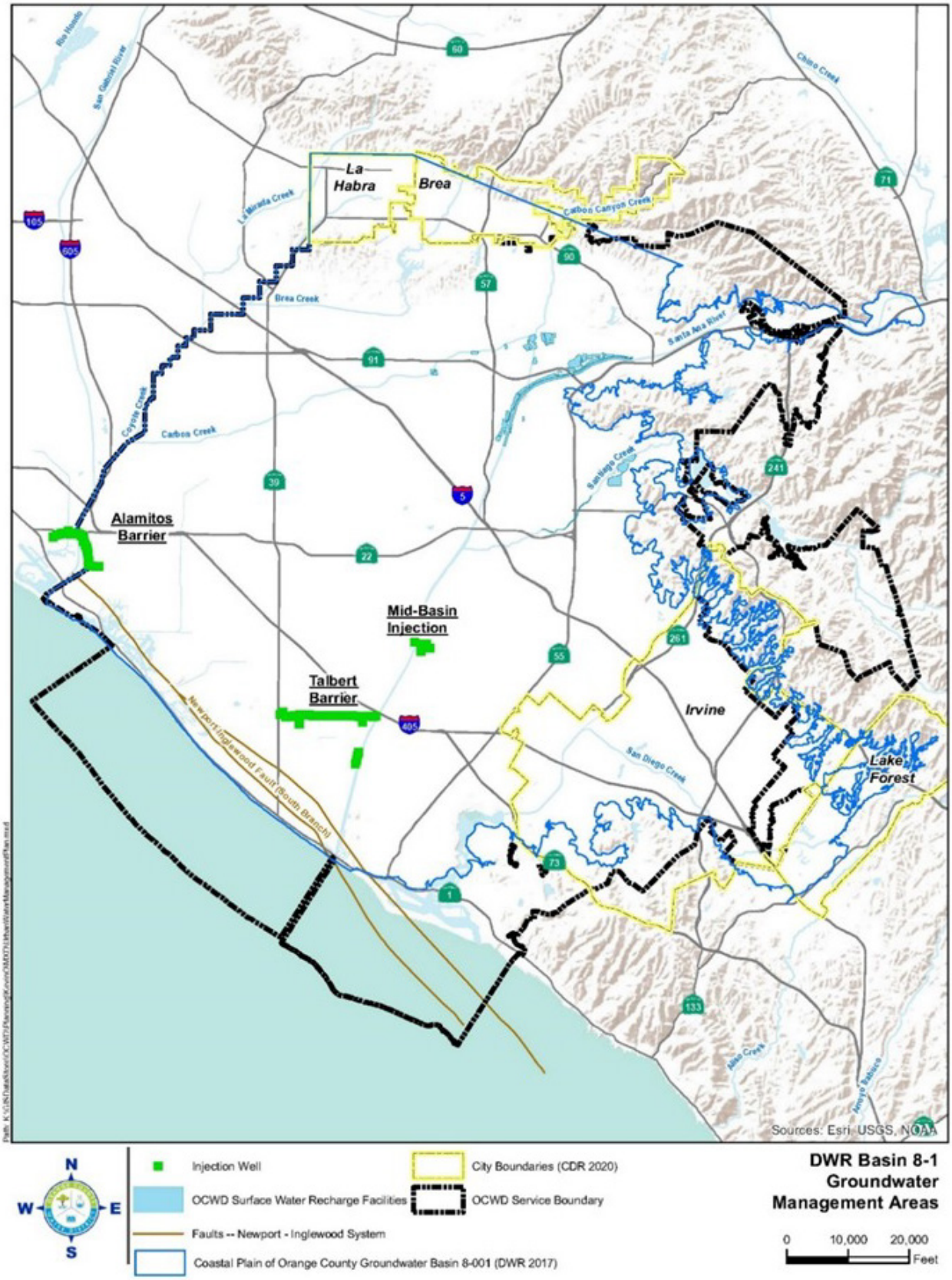



Figure 6.4 Map of the OC Basin (OCWD, 2022)

#### 6.3.1.2 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, to be sustainably managed. DWR designated the Coastal Plain of OC Basin as a medium-priority basin, primarily due to heavy reliance on the OC Basin's groundwater as a source of water supply. Compliance with SGMA can be achieved in one of the following two ways (OCWD, 2023):

1. A Groundwater Sustainability Agency (GSA) is formed and a Groundwater Sustainability Plan (GSP) is adopted.
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, OCWD and La Habra, collaborated to submit the original Alternative to a GSP in 2017, titled the "Basin 8-1 Alternative" to meet SGMA compliance. Under SGMA, alternatives must undergo periodic review and updating at 5-year intervals, analogous to GSP updates. OCWD prepared its first such periodic update, the 2022 update to the Basin 8-1 Alternative, and submitted it around January 2022.

#### 6.3.1.3 Basin Production Percentage

##### Background

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. For the 2025-26 water year, OCWD is set to maintain a BPP of 85 percent. Under normal hydrologic conditions, groundwater production could reach approximately 315,000 AFY. However, OCWD anticipates groundwater production during 2025-26 will be approximately 297,000 AFY due to PFAS related impacts that continue to limit well availability across several producers.

## Basin Production Percentage Adjustments for Basin Management

OCWD has established management guidelines that are used to establish future BPPs, as seen in Table 6.9. 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 is 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 than 5 percent from year to year.

Table 6.9 Management Actions Based on Changes in Groundwater Storage

| Available Storage Space(1) | Basin Management Actions to Consider |
|---|---|
| Less than 100,000 AF | Raise BPP |
| 100,000 to 300,000 AF | Maintain and/or raise BPP towards 85% goal |
| 300,000 to 350,000 AF | Seek additional supplies to refill basin and/or lower the BPP |
| Greater than 350,000 AF | Seek additional supplies to refill basin and lower the BPP |

Notes:
(1) Amount below full basin condition.

The OCWD's GWRS came online in 2008 with a capacity of approximately 70 mgd and was expanded to 100 mgd in 2015. In 2023, it was expanded again to a final capacity of 130 mgd. The GWRS provides a resilient local water supply that recharges the Orange County groundwater basin with advanced treated wastewater. The additional yield supported OCWD's move to raise the BPP from the long-standing ~77 percent level prior to 2023 to 85 percent beginning in February 2023. Monthly water resources reports show agencies achieving 86 to 88 percent pumping shares after the final expansion in late 2024 to early 2025, reflecting how GWRS production has enabled higher local reliance over the last decade, along with 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 current BPP of 85 percent is based on modeling of average annual rainfall weather patterns and estimated groundwater recharge volumes. If OCWD were to experience a relatively dry period, the BPP could be reduced to maintain water storage levels, by as much as 5 percent.

## Basin Equity Assessment Exemptions

In some cases, OCWD encourages treating and pumping groundwater that does not meet drinking water standards 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 (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 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.

### OCWD Groundwater Reliability Plan

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 Groundwater Resilience Plan (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.

The OC Basin is unadjudicated and is therefore subject to implementation of a GSP. DWR approved an alternative to a GSP for the OC Basin. The alternative plan was submitted to DWR to meet requirements of the SGMA and demonstrate how water managers have already achieved or will achieve sustainable groundwater management. DWR received 15 alternative plans and nine were approved. The alternative report that was approved by DWR, entitled Basin 8-1 Alternative, was prepared in collaboration with the City of La Habra and Irvine Ranch Water District. OCWD has an adopted Groundwater Management Plan but elected to create a new report in a format that mirrors a GSP, which is required under SGMA.

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 GWRS since its final expansion in early 2023 to 130 mgd. 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 (USACE) 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. Specifically, in April 2021 USACE modified the Interim Water Control Manual (IWCM) to allow 505 feet year-round, formalizing the higher pool and associated release operations used for conservation. And in February 2025, the USACE approved a new minor deviation permitting temporary storage up to elevation 508 feet, with potential future increases evaluated to 510 to 512 feet, enabling capture of roughly 2 billion gallons more stormwater and corresponding managed release rates tailored to OCWD's recharge capacity.

### OCWD Engineer's Report

The OCWD Engineer's Report documents groundwater conditions and evaluates water supply and basin utilization within OCWD's service area. The most recent report is the 2023-24 Engineer's Report released in February 2025. As reported, the BPP for the 2023-24 water year was established at 85 percent by the OCWD Board of Directors. The overall BPP achieved within OCWD for non-irrigation use was 83.8 percent, with the reduced achievement attributed primarily to PFAS-related well shutdowns. Groundwater stored in the OC Basin increased by 56,000 AF for the 2023-24 water year, and the annual overdraft was 52,800 AF, which reflects the amount by which natural replenishment was exceeded. The increase in storage was supported by total groundwater recharge of 336,421 AF, including significant contributions from supplemental water recharged by the GWRS.

For the 2025-26 water year, OCWD is proposing to maintain a BPP of 85 percent. Under normal hydrologic conditions, groundwater production could reach approximately 315,000 AF; however, OCWD anticipates groundwater production during 2025-26 will be approximately 297,000 AF due to PFAS-related impacts that continue to limit well availability across several producers.

It is estimated that approximately 8,000 AF of additional production above the BPP will be undertaken by the City of Tustin, City of Huntington Beach, Mesa Water District, and Irvine Ranch Water District to support groundwater quality improvement projects. As in prior years, groundwater produced above the BPP for these water-quality projects will be partially or fully exempt from the BEA due to the basin-wide benefit of pumping and treating poor-quality groundwater.

During the 2023-24 water year, MET untreated full-service water supplies were available for groundwater replenishment; however, OCWD did not purchase replenishment water due to favorable basin storage conditions. OCWD likewise does not plan to purchase untreated full-service water for replenishment in 2025-26.

#### 6.3.1.4 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 supplied 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 OC Basin recharge is from two sources. The main source is the GWRS, which completed its final expansion in 2023 and now produces up to 130 mgd of advanced-purified water for recharge at the Talbert Seawater Barrier and in the Kraemer, Miller, Miraloma, and La Palma basins. The second source is recycled water purified at the Water Replenishment District of Southern California's (WRD) Leo J. Vander Lans Advanced Water Treatment Facility (LVL), which provides up to 8 mgd for injection at the Alamitos Seawater Barrier (owned and operated by the Los Angeles County Department of Public Works). In recent years, WRD's upgrades and operations have increased the use of recycled water at the Alamitos Barrier and reduced reliance on imported supplies. Injection of recycled water into these barriers is an ongoing

effort by OCWD (in coordination with WRD and Los Angeles County) to control seawater intrusion into the OC Basin; operation of the injection wells forms a hydraulic barrier to seawater intrusion.

OCWD also purchases imported water for recharge through MWDOC. Untreated imported water can be used to recharge the OC Basin through the surface recharge system at multiple locations, such as Anaheim Lake, the Santa Ana River, Irvine Lake, and San Antonio Creek, while treated imported water may be used for in-lieu recharge when appropriate. For current planning context and detailed recharge management strategies, refer to OCWD's most recent planning documents, including the 2024 OCWD Resilience Plan, in addition to prior foundational documents (Appendix D).

#### 6.3.1.5 MET Imported Water for Groundwater Replenishment

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. Figure 6.5 shows MWDOC's imported water sales to OCWD since FY 1990-91, which averages approximately 27,888 AF per year. In three of the past five water years, OCWD did not need to purchase more imported water to replenish groundwater.

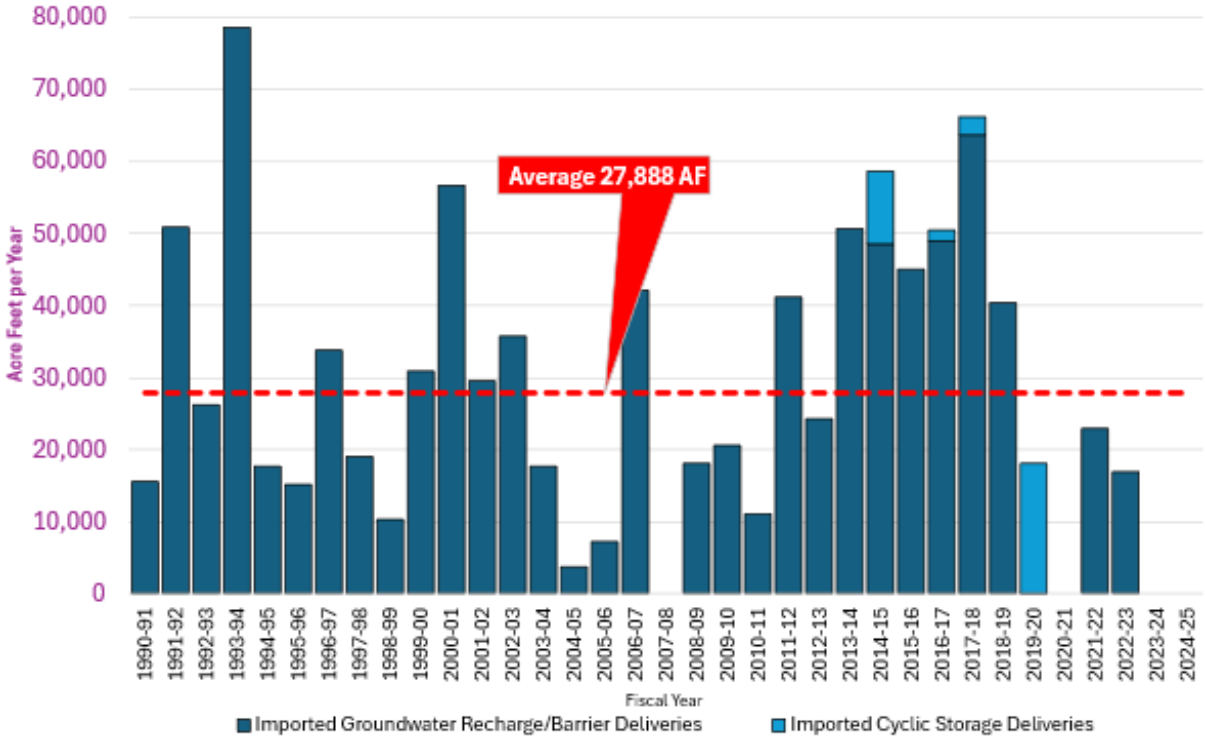



Figure 6.5 MWDOC Imported Water Sales for Groundwater Replenishment

### 6.3.2 Planned Future Groundwater Sources

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

**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 safely impound more stormwater while maintaining equivalent flood risk management capability behind Prado Dam. Analyses indicate that FIRO would increase average annual recharge by approximately 4,000-6,000 AFY, and up to 23,000 AF in very wet years, consistent with earlier preliminary analyses. Federal and local partners have indicated FIRO at Prado Dam is moving from technical assessment toward implementation via Water Control Manual (WCM) updates.

## 6.4 Surface Water

### 6.4.1 Existing Surface Water Sources

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

### 6.4.2 Planned Future Surface Water Sources

As of 2025, there are no planned surface water uses in the City's service area.

## 6.5 Stormwater

### 6.5.1 Existing Stormwater Sources

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

### 6.5.2 Planned Future Stormwater Sources

As of 2025, 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 includes approximately 330 miles of sewer main. The wastewater system serves over 141,000 customers (City of Fullerton, 2020).

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 indirect potable reuse (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 OCSD for treatment and disposal. OCSD provides treated water to OCWD, the manager of the OC Basin. OCWD is the manager of the Orange County Groundwater Basin and 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 OC Basin is available in Section 6.3.1. OCWD and OCSD have jointly constructed and expanded two water recycling projects to meet this goal that include (1) OCWD Green Acres Project (GAP) and (2) OCWD GWRS.

### 6.6.1.1 Orange County Sanitation District

OCSD collects wastewater from residential, commercial, and industrial customers in 21 cities, three special districts, and portions of unincorporated Orange County, totaling 479 square miles that serves more than 2.5 million residents in north and central Orange County. These flows include dry weather urban runoff collected from 15 diversion points and discharged into the sewer system for treatment and Santa Ana River Interceptor flows from the upper Santa Ana watershed (OC San, 2017).

OCSD operates and maintains two treatment plants: Reclamation Plant No. 1, located in Fountain Valley with a capacity of 320 mgd, and Reclamation Plant No. 2 located in Huntington Beach with a capacity of 312 mgd. OCSD also operates 572 miles of collection system pipelines along with 15 offsite pump stations. Approximately 150 mgd of secondary effluent undergoes advanced treatment at the GWRS facility operated by the OCWD and 7 mgd undergoes tertiary treatment at OCWD's GAP facility. Treated wastewater is discharged to the Pacific Ocean via an ocean outfall in compliance with state and federal requirements as set forth in OCSD's National Pollutant Discharge Elimination System (NPDES) permit. OCSD's ocean outfall is 120-inch diameter and extends four miles off the coast of Huntington Beach. A 78-inch diameter emergency outfall also exists that extends 1.3 miles off the coast (OC San, 2017).

**OCSD Reclamation Plant No. 1** - Reclamation Plant No. 1 treats raw wastewater and has a maximum treatment capacity of 320 mgd. The plant provides primary and secondary treatment and supplies secondary effluent to OCWD for further tertiary treatment at their GAP facility and advanced treatment at their GWRS. Reclamation Plant No. 1 is the only plant that provides water to OCWD for additional treatment and recycling. An interplant pipeline allows flows to be conveyed to Treatment Plant No. 2.

**OCSD Treatment Plant No. 2** - Treatment Plant No. 2 provides primary and secondary treatment to raw wastewater and has a maximum treatment capacity of 312 mgd. All secondary effluent from their plant is discharged to the ocean through the ocean outfall.

#### 6.6.1.2 Orange County Water District

OCWD is the manager of the OC Basin and provides water to 19 municipal water agencies and special districts. A full description of the OC Basin is available in Section 6.3.1. OCWD and OCSD have jointly constructed and expanded two water recycling projects that include (1) OCWD GAP and (2) OCWD GWRS.

##### OCWD GAP

OCWD owns and operates the GAP, a water recycling system that treats up to 7.5 mgd and provides 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 customer 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.

##### OCWD GWRS

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 OCSD 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. 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 is described on OCWD's website. (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 OC Basin provides approximately 77 percent 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 OCSD; Phase 2 expansion (33,600 AFY) was funded solely by OCWD.

The Final Expansion of the GWRS is the third and final phase of the project and was completed in 2023. The plant now produces 130 mgd and requires additional treated wastewater from OCSD. This additional water comes from OCSD's Treatment Plant 2, which is in the City of Huntington Beach approximately 3.5 miles south of the GWRS. The Final Expansion project included expanding the existing GWRS treatment facilities, constructing new conveyance facilities at OCSD Plant 2, and rehabilitating an existing pipeline between OCSD Plant 2 and the GWRS. Following completion, the GWRS plant now recycles 100 percent of OCSD's reclaimable sources and produces enough water to meet the needs of over one million people.

### 6.6.2 Wastewater

The City operates and maintains 330 miles of local sewer collection pipes that feed into the OCSD's trunk sewer system to OCSD's extensive system of gravity flow sewers, pump stations, and pressurized sewers. Ultimately, the wastewater is treated at OCSD treatment plants in Fountain Valley (Plant No. 1) and Huntington Beach (Plant No. 2). Table 6.10 summarizes the wastewater collected by the City and transported to OCSD's system in 2025.

Table 6.10 Wastewater Collected within the City's Service Area in 2025

| Submittal Table 6-2 Retail: Wastewater Collected Within Service Area in 2025<br>Water Code Section 10633(a) | | | | |
|---|---|---|---|---|
| Wastewater Collection | | | Recipient of Collected Wastewater | |
| Name of Wastewater Collection Agency | Wastewater Volume Metered or Estimated? | Volume of Wastewater Collected from UWMP Service Area 2025<br>(AF) | Name of Wastewater Treatment Plant (WWTP) and Place ID Number | Is WWTP Located Within UWMP Area? |
| City of Fullerton | Estimated | 14,458 | OCSD Plant 1, Place ID 758392 | No |
| | | | OCSD Plant 2, Place ID 259158 | No |
| **Total Wastewater Received from UWMP Service Area in 2025:** | | 14,458 | | |
| **NOTES:** Assumed a return rate of 65% (City of Fullerton, 2015) | | | | |

### 6.6.3 Current Recycled Water Uses

There are currently no direct 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 OC Basin with water that meets state and federal drinking water standards.

### 6.6.4 Projected Recycled Water Uses

As of April 2019, the State of California amended its recycled water policy to expand its numeric goal of recycled water use to 2.5 million AFY by 2030 and added annual required reporting requirements for wastewater and recycled water. The City does not have any direct non-potable uses within their service area and does not currently have the potential for non-potable reuse because of nonexistent or planned recycled water infrastructure. The City will continue to supply wastewater to support the region's IPR via GWRS.

### 6.6.5 Potential Recycled Water Uses

While the City recognizes the potential for beneficial reuse in their service area, there is no source of recycled water supply in proximity to the City. The City's wastewater is conveyed to OCSD's regional treatment facilities where the wastewater is treated, recycled, or discharged to the ocean. Recycled water

analyses performed over the years have shown that local treatment and reuse facilities are not feasible. The City supports the continued development of recycled water and potential uses throughout the region with OCWD's GWRS.

### 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 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 OCSD to use recycled water as a primary resource for groundwater recharge in Orange County.

#### 6.6.6.1 Financial Incentives

The implementation of recycled water projects involves a substantial upfront capital investment for planning studies, EIRs, engineering design and construction before 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 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.

#### 6.6.6.2 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 compared to purchasing imported water from MET 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 2014, MET modified the provisions of their LRP to include incentives for locally produced seawater desalination projects that reduce the need for imported supplies.

MET's LRP incentivizes participating agencies to explore new local water supply opportunities. Developing local supplies within MET's service area is part of its IRP goal of improving water supply reliability in the region and reducing pressure on imported supplies from the SWP and Colorado River. 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 (but requiring the project to produce local supplies for 25 years), 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.

### 6.7.1 Ocean Water Desalination

There are currently no ocean desalination opportunities in the City's service area.

### 6.7.2 Groundwater Desalination

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

## 6.8 Water Exchanges and Transfers

### 6.8.1 Existing 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. Transfers of water can help with short-term outages but can also be involved with longer term water exchanges to deal with droughts or long-term emergency situations. MET helps its retail agencies develop both local and regional transfer and exchange opportunities that promote reliability within their systems. The City maintains seven emergency interconnections with other utilities from surrounding cities: two with the City of Anaheim, one with the City of La Habra, one with the City of Brea, one with the City of Buena Park, one with Golden State Water Company (City of Placentia), and one with Suburban Water Systems (City of La Mirada). The City serves a small portion of the Cities of Buena Park and La Habra directly and receives service in a small portion from the City of Anaheim, Page Mutual Water Company, and Suburban Water Systems.

### 6.8.2 Planned and Potential Exchanges and Transfers

The City does not currently have plans to introduce new exchanges and transfers. However, MET supports the City in developing both local and regional transfer and exchange opportunities that promote reliability within their systems. Examples of these future projects include:

**SARCCUP** - 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, Orange County Water District, and San Bernardino Valley Municipal Water District). In September 2021, the participating agencies, in coordination with MET, executed a regional agreement framework establishing SARCCUP as a watershed-scale groundwater banking program to improve drought reliability across Orange, Riverside, and San Bernardino counties.

In 2016, SARCCUP received $55 million in Proposition 84 funding from DWR; however, implementation has since advanced with the 2021 agreements and subsequent program updates. The overall SARCCUP program consists of three main elements: (1) Watershed-Scale Cooperative Water Banking Program; (2) Water Use Efficiency-landscape design/irrigation improvements and water budget assistance; and (3) Habitat creation and Arundo donax removal within the Santa Ana River.

The Watershed-Scale Cooperative Water Banking Program is the largest component of SARCCUP. Under MET's arrangement with SBVMWD, when SBVMWD declares surplus SWP water and offers it to MET, MET offers at least 50 percent of an equivalent amount to SARCCUP member agencies for storage and later use in the Santa Ana River watershed, consistent with MET policy. This structure formalizes the purchase and storage pathway that had been under development and aligns with MET's extraordinary supply policy during allocations.

Program capacity planning identifies up to ~137,000 AF of storage across six basins, including up to 36,000 acre-feet in the OC Basin for use in dry years. Stored SARCCUP supplies may be designated "extraordinary supplies" during a MET allocation if managed consistent with MET's Water Supply Allocation Plan, thereby enhancing participating agencies' drought reliability.

Within Orange County, extraordinary supply assignment agreements among MET, MWDOC/OCWD, and certain retail agencies (e.g., Anaheim, Fullerton, Santa Ana) document how SARCCUP extraordinary supply is assigned and delivered locally. Program implementation and participation details continue to be refined among OCWD, retail agencies, and MWDOC.

## 6.9 Future Water Projects

The City has identified the following future water supply projects, which are further summarized in Table 6.11.

**Well Replacement** - Wells 7 and 12A are planned to be replaced by new wells. New Well 7A, which will replace Well 7, is expected to be equipped and fully functional by FY 2026-2027 while the City is scheduled to abandon Well 12A in FY 2029-2030 and start drilling a new replacement well in FY 2029-2030. Both wells are expected to run at 2,500-3,000 gallons per minute (gpm).

Table 6.11 Expected Future Water Supply Projects or Programs

| Submittal Table 6-7 Retail: Expected Future Water Supply Projects or Programs Water Code Section 10631 (f) | | | | | | | |
|---|---|---|---|---|---|---|---|
| Name of Future Projects or Programs | Joint Project with other suppliers? | | Additional Description | Water Type (after treatment if treated) | Planned Implementation Year | Planned for Use in Year Type | Expected Increase in Water Supply to Supplier (This may be a range) |
| | (yes/no) | If Yes, Supplier Name | | | | | |
| New Well (7A) | No | | Construction of a new well to replace well 7 | Potable | FY 2026-2027 | All Year Types | 2,500 - 3,000 gpm |
| New Well | No | | Construction of a new well | Potable | FY 2029-2030 | All Year Types | 2,500 - 3,000 gpm |
| **NOTES:** Source: City of Fullerton 2026 | | | | | | | |

## 6.10 Energy Intensity

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 FY 2025 (July 1, 2024 through June 30, 2025). 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 percent of the total electricity and 30 percent of non-power plant related natural gas consumed in California. In 2015, California issued new rules requiring 50 percent of its power to come from renewables, along with a reduction in greenhouse gas (GHG) emissions to 40 percent 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 FY 2025, the City consumed 434.9 kilowatt-hour (kWh) per AF for water extraction and delivery (Table 6.12). The basis for calculations is provided in more detail in the following subsections.

#### 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 2025 fiscal year. Calendar year is the standard for energy and GHG reporting to the Climate Registry, California Air Resources Board, and the United States Environmental Protection Agency (EPA). 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. However, the water use volumes presented in Table 6-1 are for FY 2025 which aligns with the available energy data for each of the City's water supply processes.

Table 6.12 Energy Intensity - Water Supply Process Approach

| Optional Submittal Table O-1A: Recommended Energy Reporting - SINGLE DELIVERY PRODUCT - WATER SUPPLY PROCESS APPROACH | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Water Delivery Product** | Retail Potable Deliveries | **Only for Water Delivery Products Under the Urban Water Supplier's Operational Control** | | | | | | | | |
| Start Date of Reporting Period | July 1, 2024 | **Water Management Process** | | | | | | | **Non-Consequential Hydropower (if applicable)** | |
| End Date of Reporting Period | June 30, 2025 | | | | | | | | | |
| Is upstream embedded energy included in the values reported? | No | | | | | | | | | |
| | | Units for Water Volume | Extract and Divert | Place into Storage | Conveyance | Treatment | Distribution | **Total Utility** | Hydropower | Net Utility |
| Volume of Water Entering Process | | AF | 13,979 | 0 | 0 | 0 | 22,243 | 22,243 | 0 | 22,243 |
| Energy Consumed (kWh) | | N/A | 7,469,428 | 0 | 0 | 0 | 2,205,146 | 9,674,574 | 0 | 9,674,574 |
| Energy Intensity (kWh/AF) | | N/A | 1,640 | 0.0 | 0.0 | 0.0 | 304 | 1,335 | 0.0 | 1,335 |
| **Quantity of Self-Generated Renewable Energy** | | | | | | | | | | |
| 5,912 | kWh | | | | | | | | | |
| **Data Quality** (drop down) | | | | | | | | | | |
| *Combination of Estimates and Metered Data* | | | | | | | | | | |
| **Data Quality Narrative:** | | | | | | | | | | |
| Energy consumed is based on metered billing data from Southern California Edison and Anaheim Public Utilities. Self-generated renewable energy is difficult to determine because the onsite solar panels are on the same power meter as Well 3A treatment plant. | | | | | | | | | | |
| **Narrative:** | | | | | | | | | | |
| Fullerton relies on imported water and local groundwater to meet customer needs. Operational control is limited to groundwater withdrawals and potable water booster stations. | | | | | | | | | | |

#### 6.10.1.2 Volume of Water Entering Processes

In FY 2025, the City extracted 13,979 AF of groundwater from the OC Basin and distributed 22,243 AF of both groundwater and imported water. Water volume is based on data presented in Table 6-1. The Extract and Divert volume is based on the volume of groundwater withdrawals while distribution is the total volume of water provided to customers. This calculation excludes water losses so that the final energy intensity is based on the water that is actually delivered to customers.

#### 6.10.1.3 Energy Consumption and Generation

According to Southern California Edison and Anaheim Public Utilities electricity bills, groundwater wells consumed 7,469,428 kWh of electricity and pump stations along the distribution system consumed 2,205,146 kWh of electricity. Currently, the City generates renewable energy with solar panels with producing an estimated 5,912 kWh of electricity in FY 2025. Energy consumption is based on metered data but energy production from solar panels is estimated because the solar panels are connected to the same meter as Well 3A treatment plant.

### 6.10.2 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 2025 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. Current efforts could be expanded with the addition of a wastewater energy intensity evaluation.

- 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.

# CHAPTER 7 WATER SERVICE RELIABILITY AND DROUGHT RISK ASSESSMENT

This chapter of the Urban Water Management Plan (UWMP) describes the City of Fullerton's water service reliability assessment for three long-term hydrological conditions: a normal year, a single dry year, and a drought period lasting five consecutive years. The Drought Risk Assessment (DRA) assesses water supply reliability during a severe drought lasting the next five consecutive years, from 2026 to 2030. Factors affecting reliability, such water quality, regulations and climate change, are also summarized in this assessment of reliability.

## 7.1 Water Service Reliability Overview

As part of the UWMP, 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 multiple dry years. Fullerton's water sources are from local groundwater and imported water purchased from the Metropolitan Water District of Southern California (MET), which imports water from the Colorado River through its own Colorado River Aqueduct (CRA) and from Northern California through the California Aqueduct managed by the State Water Project (SWP). Fullerton is one of 26 member agencies of MET. MET has also invested in numerous programs and projects to augment its direct deliveries of imported water such as water transfers, groundwater banking, and use of its reservoir storage as summarized in Chapter 6.

Local groundwater in the Orange County Basin is managed by the Orange County Water District (OCWD). As summarized in Chapter 6, OCWD has developed programs and projects to improve groundwater recharge and augment groundwater through recycled water, conjunctive use, and water transfers. OCWD assesses groundwater conditions and sets its basin production percentage (BPP), which determines how much water will be pumped from the basin year, and the Basin Equity Assessment (BEA), which is a surcharge for exceeding the BPP. Currently, the BPP is set at 85 percent. Likewise MET has also invested in numerous programs and projects to augment its direct deliveries of imported water such as water transfers, groundwater banking, and use of its reservoir storage as summarized in Chapter 6. MET's draft 2025 UWMP demonstrates that MET will be able to meet its projected water demands for the next 25 years under normal, dry, and multiple dry year conditions (MET, 2025).

In 2025, all water agencies in Orange County, in collaboration with their wholesalers, MWDOC and OCWD, developed a water demand forecast model for their service areas that estimated water demand at the individual retail water agency level. The demand model statistically correlates municipal and industrial (M&I) water use with demographic, socioeconomic, conservation, and weather variables as reported in the 2025 Orange County Water Demand Projection Model TM (MWDOC, 2025). Because the model isolates weather, future water demand can be estimated under single and multiple-year droughts and under future climate change scenarios. The model used a 33-year dataset (1991-2024) to estimate demand under average (normal), single-dry year, and five consecutive dry years hydrologic conditions. Correlation coefficients between demand, temperature, and precipitation were applied to the hottest and driest historical sequences to calculate high-demand scenarios, which were expressed as scaling factors relative

to the 33-year average demand. Table 7.1 shows the Retail: Basis of Water Year Data (Reliability Assessment).

Table 7.1 Retail: Basis of Water Year Data (Reliability Assessment)

| OPTIONAL 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 2024-2025, use 2025 | **Available Supplies if Year Type Repeats** | |
| | | ☐ Check the box if quantification of available supplies is not compatible with this table and is provided elsewhere in the UWMP. **Location:** [insert location from UWMP] | |
| | | Quantification of available supplies is provided in this table as either volume only, percent only, or both. | |
| | | **Volume Available** | **% of Average Supply** |
| Average Year | 1991-2024 | | 100% |
| Single-Dry Year | 2014 | | 107% |
| Consecutive Dry Years 1st Year | 1991-2024 | | 107% |
| Consecutive Dry Years 2nd Year | 1991-2024 | | 112% |
| Consecutive Dry Years 3rd Year | 1991-2024 | | 113% |
| Consecutive Dry Years 4th Year | 1991-2024 | | 115% |
| Consecutive Dry Years 5th Year | 1991-2024 | | 117% |

## 7.2 Factors Affecting Water Supply Reliability

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. In May 2025, DWR published a technical addendum to the 2023 State Water Project Delivery Capability Report (DCR) describing the impact of subsidence to future SWP deliveries. The study showed that SWP deliveries could be reduced by future subsidence. DWR recommends using the 2025 DCR to support long-term planning efforts because DWR has planned near-term fixes and is committed to restore the conveyance capacity of the California Aqueduct. MET will continue to stay informed and incorporate any suitable subsidence modeling in the future.

### 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 (CAMP4W, 2025). These areas include:

- A reduction in Sierra Nevada Mountain snowpack.
- Extreme heat threatens both infrastructure and the health and safety of human lives.

- Prolonged drought periods.
- Water quality issues associated with increase in wildfires.
- 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 Central Valley Project (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.
- Alterations to power generation and pumping regime.
- Increases in ocean algal blooms affected seawater desalination supplies.

Without additional surface storage, earlier and heavier runoff will flow to the ocean instead of being held as mountain snowpack, causing California to lose more water. California therefore needs to place a strong emphasis on expanding storage

As described in Chapter 6, 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 affected 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 will likely continue until a long-term solution to these problems is identified and implemented (MET, 2025).

Climate change is also projected to impact future water demands. The 2025 Orange County Water Demand Model TM developed a sensitivity for the water demand forecast based on using future climate variables from a subset of 15 downscaled global climate models (GCMs) from the World Climate Research Program (WCRP) Coupled Model Intercomparison Project (CMIP6). Future weather variables under two climate scenarios were substituted for baseline historical average weather, with the results indicating that projected water demands under one to five consecutive dry years could be 5 to 17 percent greater than baseline demands (MWDOC, 2025).

### 7.2.2 Regulatory and Legal

Ongoing regulatory restrictions, such as those imposed by the Biological Opinions (BiOps) on the effects of SWP and the federal CVP operations on certain marine life, also contribute 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 Endangered Species Act (ESA) and imposed

substantial constraints on Delta water supply operations through requirements for Delta inflow and outflow and export pumping restrictions.

In addition, the State Water Resources Control Board (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 has implemented the new Lower San Joaquin River flow objectives from the Phase 1 Delta Plan amendments through adjudicatory (water rights) and regulatory (water quality) processes. The Lower San Joaquin River flow objectives are estimated to reduce water available for municipal water use. New litigation, listings of additional species under the ESA, 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 Colorado River 2007 Interim Guidelines governing the Lower Basin water supply shortages and the operations of Lakes Mead and Powell are set to expire in 2026, and new operating guidelines will need to be developed for 2027 and beyond. At the time of this 2025 UWMP, negotiations over the successor post-2026 guidelines are ongoing and the outcome is highly uncertain. It is anticipated that California will likely be required to reduce its supplies from the Colorado River, on average, under the new guidelines, and that as the junior priority, MET is at risk. A final EIS with a Selected Alternative is expected in the summer of 2026 with a record of decision to follow.

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. Indirect potable reuse (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, 2025).

### 7.2.3 Water Quality

The following sub-section describes the water quality of the region's water supplies and the measures being taken to continue delivering high-quality drinking water that meets federal and state regulations.

#### 7.2.3.1 Imported Water

MET is responsible for providing high quality potable water throughout its service area. Over 250,000 water quality tests are performed per year on MET's water to test for regulated contaminants and additional contaminants of concern to monitor the safety of its waters (MET, 2025). 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.

Although the CRA and SWP have different water quality characteristics, MET has implemented effective treatment and management strategies to maintain high-quality water. The CRA water source contains higher total dissolved solids (TDS) and the SWP contains higher levels of naturally-occurring 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 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, per- and polyfluoroalkyl substances (PFAS), and 1,4-dioxane (MET, 2025).

PFAS is a group of widely used man-made "forever chemicals" that include both perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS). MET has voluntarily monitored PFAS in its source and treated waters since 2017. Most samples have shown non-detect (ND) for all tested PFAS, including PFOA and PFOS. A limited number of other PFAS—such as PFHxA, PFBA, PFPeA, PFDoA, PFTA, and PFBS, have been detected only at trace levels below their method detection limits. PFOA and PFOS have not been detected in MET's imported or treated water supplies. Some member agencies, however, have detected these compounds in local groundwater wells, which may require treatment or source management to comply with emerging Division of Drinking Water (DDW) regulations. As DDW and the US Environmental Protection Agency (EPA) establish enforceable maximum contaminant levels (MCLs) for PFOA and PFOS, some agencies may supplement their local supplies with increased purchases of MET water (MET, 2025).

EPA finalized the first national drinking water standards for six PFAS compounds in April 2024. These standards include enforceable MCLs for PFOA and PFOS set at 4 parts per trillion (ppt). In May 2025 the EPA announced that it would extend the compliance deadline for PFOA and PFOS from 2029 to 2031 to provide additional time for testing, planning, and installation of treatment technologies. While MET and its member agencies continue to monitor and test PFAS in imported and local sources, the delay in the federal compliance date allows additional time to evaluate treatment options, coordinate funding, and plan system upgrades necessary to meet forthcoming federal PFAS standards.

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 Diamond Valley Lake (DVL) to keep the reservoir free from quagga mussels (MET, 2025).

In addition, Golden Mussels, another invasive species capable of disrupting pipelines and altering ecosystems, were detected in the Sacramento–San Joaquin Delta in October 2024 and are now spreading through the SWP. These mussels pose similar concerns due to their ability to obstruct raw water conveyance facilities and negatively affect aquatic environments. Although their presence does not typically result in violations of drinking water standards, unmanaged infestations can degrade habitats, clog infrastructure, and reduce the aesthetic and recreational value of lakes and reservoirs. State and regional agencies continue to monitor golden mussel movement and evaluate appropriate response strategies to limit their spread (MET, 2025).

#### 7.2.3.2 Groundwater

Groundwater is a reliable component of the water supply for Orange County, and OCWD manages the basin to provide long-term quality and sustainability. The basin supports a significant portion of the region's water demands and is monitored through an extensive network of production, monitoring, and recharge wells that provide data on water levels and water quality conditions across the aquifer system.

##### Orange County Groundwater Basin

OCWD is responsible for managing the Orange County Groundwater Basin (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 groundwater 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). OCWD routinely tests for hundreds of regulated constituents, but the parameters discussed, PFAS, TDS, and nitrate, are of focus because they represent the most relevant regional and regulatory considerations that influence groundwater management and long-term supply planning. These issues do not indicate that the groundwater basin is unsafe; rather, they are discussed because they are key focus areas for state agencies and water suppliers throughout Southern California.

PFAS are of particular concern for groundwater quality, and since the summer of 2019, the DDW requires testing for PFAS compounds in some groundwater production wells in the OCWD area. According to the US Environmental Protection Agency (EPA), the established federal Maximum Contaminant Levels (MCLs) for certain PFAS compounds in drinking water, including 4 nanograms per liter (ng/L), or parts per trillion (ppt), for PFOA and PFOS. In addition, the California State Water Resources Control Board has established health-based Notification Levels (NLs) and Response Levels (RLs) for several PFAS compounds. The current NLs are 4 ng/L for PFOA and 4 ng/L for PFOS, while the RLs are 10 ng/L for PFOA and 40 ng/L for PFOS. If PFAS concentrations exceed the NL, water systems must notify their governing body; if concentrations exceed the RL, water systems are expected to take corrective actions such as removing the source from service or implementing treatment.

PFAS have been detected in the OC Basin in very tiny amounts (parts per trillion), entering primarily via the Santa Ana River whose flows infiltrate into the basin. Despite playing no role in releasing PFAS into the environment, OCWD is working with its cities and retail water districts to remove it from local water supplies in order to comply with new state and federal regulations. More than 100 wells have been impacted due to various state and federal regulations. Fifteen impacted agencies will have to temporarily purchase more costly imported water to replace PFAS contaminated supplies. As of 2025, 53 impacted wells are back online due to close to a billion dollars being spent on state-of-the-art testing, research and piloting of different treatment systems, and design and construction of treatment plants that are now operational.

By 2025, OCWD had restored 49 wells to service with operational treatment systems, with an additional 57 wells in planning, design, or construction stages (ACWA, 2025).These systems continue to rely primarily on granular activated carbon (GAC) and ion-exchange (IX) media operated in lead–lag configuration to

achieve non-detect PFAS levels consistent with evolving state and federal regulatory standards (Santa Ana Regional Water Quality Control Board and Orange County Water District, 2023.)

Groundwater production in FY 2023–24 totaled 280,420 acre-feet (AF), with slight increases projected over the next two years as additional treatment systems come online, showing continued reductions associated with PFAS-impacted wells that remain offline across several agencies. 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 milligrams per liter (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 increased on average from 415 mg/: in 2022-23 to 432 mg/L in 2023-24 (OCWD, 2025).

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, requiring treatment before use as drinking water. The principal aquifer, which supplies most basin pumping, occurs at depths of roughly 300–1,200 feet below ground surface (OCWD, 2025). The total volume of amber-colored groundwater in the deep system is estimated at approximately 1 million acre-feet (MAF).

### 7.2.4 Locally Applicable Criteria

Within Orange County, there are no significant local applicable criteria that directly affect reliability. Over the years, the water agencies in Orange County have made tremendous efforts to integrate their systems to provide flexibility for interchanging with different sources of supply. There are emergency agreements in place to provide adequate supply of water in all parts of the County. In the northern part of the County, agencies can meet most of their demands from groundwater with very little limitation, except for the OCWD BPP. For the agencies in south Orange County, most of their demands are met with imported water, and their limitations are based on the capacity of their systems, which are very robust. However, if a major earthquake on the San Andreas Fault occurs, it can potentially be damaging to key water aqueducts and disrupt imported supplies to the entire Southern California for up to six months. The MET region would likely require a water-use reduction of 10-25 percent 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, 2025).

## 7.3 Water Service Reliability Assessment

This section assesses the reliability of Fullerton's water service to its customers. This is completed by comparing the projected long-term water demand (Chapter 4), to the projected water supply sources available to Fullerton (Chapter 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

In 2025, MWDOC and OCWD in collaboration with Orange County retail agencies, developed water demand forecast models for participating individual retail water agencies in Orange County, as described in detail in Chapter 4. This 25-year demand forecast uses statistical models to account for demographic, socioeconomic, conservation, and weather variables (MWDOC, 2025) For normal year reliability, the demand forecast represents average weather conditions.

Fullerton is 100 percent reliable for normal year demands from 2025 through 2050. Fullerton receives imported water from MET via connection to MET's regional distribution system. Although pipeline and connection capacity rights do not guarantee the availability of water, they do guarantee the ability to convey water into the local system when it is available to the MET distribution system.

A comparison between the supply and demand for projected years between 2030 and 2050 is presented in Table 7.2. The table demonstrates that projected supplies and demands are equal in every planning year, with no anticipated surpluses or shortfalls. As stated above, the available supply will meet projected demands due to a diversified supply and conservation measures limiting and reducing imported demands in the later years. Fullerton's supplies are provided by MET and Orange County Groundwater Basin. In MET's 2025 Urban Water Management Plan, they identify their wholesale supplies as 100 percent reliable under normal-year conditions, with surpluses over 3 MAF across the planning horizon (Submittal Table 7-2; MET, 2025).

Table 7.2 Retail: Normal Year Supply and Use Comparison

| Submittal Table 7-2 Retail: Normal Year Supply and Use Comparison<br>Water Code Section 10635 (a) | | | | | |
|---|---|---|---|---|---|
| | 2030 | 2035 | 2040 | 2045 | 2050 (Opt) |
| | (AF) | (AF) | (AF) | (AF) | (AF) |
| Supply totals<br>(autofill from Submittal Table 6-9 R) | 20,356 | 20,753 | 21,143 | 21,294 | 21,384 |
| Use totals<br>(autofill from Submittal Table 4-2 R) | 20,356 | 20,753 | 21,143 | 21,294 | 21,384 |
| Surplus/(shortfall) | 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. Orange County's water demand projection model (described in Chapter 4), 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 seven percent increase in demand for Fullerton's service area (MWDOC, 2025). Detailed information of the model is included in Appendix E.

Fullerton's has documented that it is 100 percent reliable for single dry year demands from 2025 through 2050. As shown in Table 7.3, projected single dry year supplies and demands are equal from 2030 to 2050, resulting in no anticipated shortages. This assessment incorporates a seven percent increase in demand above normal-year levels and shows the significant reserves and conservation measures available within MET.

Table 7.3 Retail: Single Dry Year Supply and Demand Comparison

| Submittal Table 7-3 Retail: Single Dry Year Supply and Use Comparison<br>Water Code Section 10635(a) | | | | | |
|---|---|---|---|---|---|
| | 2030 | 2035 | 2040 | 2045 | 2050 (Opt) |
| | (AF) | (AF) | (AF) | (AF) | (AF) |
| Supply totals | 21,823 | 22,249 | 22,667 | 22,828 | 22,925 |
| Use totals | 21,823 | 22,249 | 22,667 | 22,828 | 22,925 |
| Surplus/(shortfall) | 0 | 0 | 0 | 0 | 0 |
| **NOTES:** The single dry year projections estimate a 7% increase on imported M&I demand. | | | | | |

### 7.3.3 Multiple Dry Years Reliability

Multiple dry years are defined as five or more consecutive dry years with minimal rainfall within a period of average precipitation. Orange County water demand projection model (described in Chapter 4) 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. During multiple dry years, the UWMP applies dry-year adjustment factors to reflect future climate conditions and retail level water demand. These increase 7 percent in single-dry and first multiple-dry year, going up to 12, 13, 15, and 17 percent in subsequent drought years, relative to average-year demand (see Table 7.1) (MWDOC, 2025). Rather than repeating the single dry year factor for all five years, the five year multi dry year scenario applies the year specific dry year adjustment factors for each consecutive year, reflecting the increasing impacts of extended drought. Fullerton has demonstrated that its water supplies remain fully reliable throughout a five-consecutive-year dry period from 2025 through 2050. Even assuming a conservative demand increase of 7 to 17 percent each year for five consecutive years, Fullerton is capable of meeting all customers' demands from 2025 through 2050 (Table 7.4), with significant reserves held by MET and conservation.

Table 7.4 includes treated and untreated water from MET for M&I and non-M&I demands. The multiple dry-year projections estimate a seven percent increase on imported M&I demand. The 2030 column assesses supply and demand for FY 2025-26 through FY 2029-30; the 2035 column assesses FY 2030-31 through FY 2034-35 and so forth, to end the water service reliability assessment in FY 2045-50.

Table 7.4 Retail: Multiple Dry Years Supply and Demand Comparison

| Submittal Table 7-4 Retail: Multiple Dry Years Supply and Use Comparison<br>Water Code Section 10635(a) | | | | | | |
|---|---|---|---|---|---|---|
| | | 2030 | 2035 | 2040 | 2045 | 2050 (Opt) |
| | | (AF) | (AF) | (AF) | (AF) | (AF) |
| First year | Supply totals | 21,823 | 22,249 | 22,667 | 22,828 | 22,925 |
| | Use totals | 21,823 | 22,249 | 22,667 | 22,828 | 22,925 |
| | Surplus/(shortfall) | 0 | 0 | 0 | 0 | 0 |
| Second year | Supply totals | 22,789 | 23,233 | 23,670 | 23,838 | 23,939 |
| | Use totals | 22,789 | 23,233 | 23,670 | 23,838 | 23,939 |
| | Surplus/(shortfall) | 0 | 0 | 0 | 0 | 0 |
| Third year | Supply totals | 22,931 | 23,378 | 23,817 | 23,987 | 24,088 |
| | Use totals | 22,931 | 23,378 | 23,817 | 23,987 | 24,088 |
| | Surplus/(shortfall) | 0 | 0 | 0 | 0 | 0 |
| Fourth year | Supply totals | 23,365 | 23,820 | 24,268 | 24,440 | 24,544 |
| | Use totals | 23,365 | 23,820 | 24,268 | 24,440 | 24,544 |
| | Surplus/(shortfall) | 0 | 0 | 0 | 0 | 0 |
| Fifth year | Supply totals | 23,761 | 24,225 | 24,680 | 24,855 | 24,961 |
| | Use totals | 23,761 | 24,225 | 24,680 | 24,855 | 24,961 |
| | Surplus/(shortfall) | 0 | 0 | 0 | 0 | 0 |
| **NOTES:** The 2030 column assesses supply and demand for FY 2025-26 through FY 2029-30; the 2035 column assesses FY 2030-31 through FY 2034-35 and so forth, in order to end the water service reliability assessment in FY 2049-50. | | | | | | |

## 7.4 Management Tools and Options

Existing and planned water management tools and options that seek to maximize local resources and results 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. Similarly, Orange County water agencies have further invested in water use efficiency, local water supply projects, and advanced water technologies to increase regional self-reliance. In the near term (2030), regional self-reliance during a normal water year for the entire MET service area is projected to increase by approximately 601 TAF compared to the 2010 baseline, an improvement equal to nearly 20 percent of projected 2030 retail demands.

Looking ahead to 2050, normal year regional self- reliance is expected to grow by more than 1.0 MAF above the 2010 baseline, representing an increase of roughly 20 percent of projected 2050 retail demands (MET, 2025).

- **The continued and planned use of groundwater:** The water supply resources within Fullerton's service area are enhanced by the existence of groundwater basins that account for the majority of local supplies available. As described in Chapter 4, the OC Basin is also used as reservoirs to store water during wet years and draw from storage during dry years, subsequently minimizing Fullerton's service area'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 Fullerton does not manage any of the service area's groundwater basins, as a groundwater producer, Fullerton supports and partners in the efforts to maintain the health of the local basins through local groundwater recharge efforts such as OCWD's GWRS Groundwater Replenishment System (GWRS) program.
- **Groundwater storage and transfer programs:** Fullerton and OCWD's involvement in Santa Ana River Conservation and Conjunctive Use Program (SARCCUP) includes participation in a conjunctive use program that improves water supply resiliency and increases available dry-year yield from local groundwater basins. The groundwater bank has 137,000 AF of storage (Inland Empire Utilities Agency, 2021). MET has numerous groundwater storage and transfer programs in which MET endeavors to increase the reliability of water supplies, including the Antelope Valley-East Kern (AVEK) Water Agency Exchange and Storage Program and the High Desert Water Bank Program. 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.
- **Increased use of recycled water:** OCWD's GWRS and Green Acres Project (GAP) help southern California reduce its reliance on imported water by providing a local, reliable water supply that meets or exceeds all federal and state drinking water standards. OCWD is currently expanding the GWRS to increase production to 130 MGD, further strengthening regional water self-sufficiency.
- **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 Fullerton's overall demands on MET and reliance on imported water. Fullerton met its conservation of the 20 percent by 2020 as part of the Orange County Regional Alliance as well as individually.

## 7.5 Drought Risk Assessment

California Water Code (CWC) Section 10635(b) requires every urban water supplier to include a DRA for its water service as part of information considered in developing its demand management measures and water supply projects and programs. The DRA is a specific planning action that assumes Fullerton is experiencing a drought over the next five years and addresses water supply reliability in the context of presumed drought conditions. Together, the water service reliability assessment, DRA, and Water Shortage Contingency Plan (WSCP) allow Fullerton 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.

CWC Section 10612 requires the DRA to be based on the driest five-year historical sequence for Fullerton's water supply. However, CWC 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 methodology and results from Fullerton's DRA.

## 7.5.1 Methodology

As described in more detail in Chapter 4, the water demand forecasting model prepared for Fullerton isolated the impacts that weather and future climate can have on water demand through the use of an econometric model. In addition to weather related factors, the model incorporates explanatory variables that influence both historical and projected water use, including water price, gross domestic product (GDP), median household income, housing density, persons per household, households per account, sectoral employment mix (for commercial, industrial, and institutional [CII] demand), seasonal patterns, historical conservation trends, drought restrictions, and COVID19 behavioral effects. These variables allow the model to separately quantify how economic conditions, demographic shifts, land use characteristics, and institutional constraints affect demand across residential, CII, and irrigation sectors (MWDOC, 2025).

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 seven percent increase in demand for Fullerton's service area (MWDOC, 2025). The model used a 33-year dataset (1991-2024) to estimate demand under average (normal), single-dry year, and five consecutive dry years hydrologic conditions. Correlation coefficients between demand, temperature, and precipitation were applied to the hottest and driest historical sequences to calculate high-demand scenarios, which were expressed as scaling factors relative to the 33-year average demand.

For Fullerton, the five consecutive dry year demand scenario is based on the demand model's multiple dry year methodology. In accordance with the econometric demand model approach used to develop UWMP demand projections, a single hot/dry year was first identified based on weather conditions that produced the greatest demand response. Consecutive dry years were then represented by applying incremental scaling factors to this single hot/dry year demand to account for the compounding effects of persistent warm and dry conditions over time. These scaling factors show long-term relationships between regional water use and multi-year temperature and precipitation deficits and are applied sequentially to simulate second through fifth consecutive dry years. This approach is consistent with the demand modeling framework summarized in Tables 7.1 and 7.5.

### 7.5.1.1 Water Demand Characterization

All of Fullerton's water supplies are purchased from MET, regardless of hydrologic conditions. As described in Chapter 6, MET's supplies are from the Colorado River, SWP, and in-region storage. In MET's 2025 UWMP, the DRA concluded that even without activating WSCP actions. Beyond this, MET's DRA indicated a surplus of supplies that would be available to all of its member agencies, including Fullerton, should the need arise. Therefore, any increase in demand that is experienced in Fullerton's service area is assumed to be met by MET's water supplies.

Based on the water demand projection model discussed in more detail in Chapter 4, in a single dry year, demand is expected to increase by 7 percent above a normal year (see Table 7.1). Fullerton's DRA

conservatively assumes that a drought from FY 2025-26 through FY 2029-30 is based on the FY 2025 normal year supply with the five-year consecutive dry year hydrology (from Table 7.1) (MWDOC, 2025).

#### 7.5.1.2 Water Supply Characterization

Fullerton's assumptions for its supply capabilities are discussed and presented in 5-year increments under its water reliability assessment in Section 7.3. For Fullerton's DRA, these supply capabilities are further refined and presented annually for the years 2026 to 2030, which the Orange County Demand Model (2025) applied a historical dry-year sequence from within 1991-2024 dataset as an analog for five consecutive dry years. Groundwater is sustainably managed through the BPP and robust management measures (Section 6.3.4 and Appendix G), direct and indirect recycled water uses provide additional local supply (Section 6.6), and based on MET's UWMP, imported water is available to close any local water supply gap (Section 7.5.1). For its DRA, the model assessed the reliability of supplies available to Orange County through MET using historical supply availability under dry-year conditions. MET's supply sources under the CR, 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. In addition, Fullerton may benefit from MET-implemented supply augmentation actions during regional shortages. These actions are planned and exercised by MET based on regional conditions and in accordance with the Water Supply Contingency Plan (WSCP) and are not assumed as baseline or guaranteed supplies for Fullerton. Such actions may include the use of supplies and storage programs within the Colorado River, SWP, and in-region storage portfolios.

### 7.5.2 Total Water Supply and Use Comparison

Fullerton's anticipated total water use and supply under a five-year drought from FY 2025-26 through FY 2029-30, are compared in Table 7.5. Fullerton's assessment reveals that its supply capabilities are expected to balance with its projected water use for the next five years, from 2026 to 2030.

Table 7.5 Retail: Five-Year Drought Risk Assessment

| Submittal Table 7-5 Retail: Five-Year Drought Risk Assessment<br>Water Code Section 10635(b)(3) | | |
|---|---|---|
| **2026** | | **Total** |
| Total Water Use | (AF) | 23,846 |
| Total Supplies | (AF) | 23,846 |
| Surplus/Shortfall w/o WSCP Action | | 0 |
| **2027** | | **Total** |
| Total Water Use | (AF) | 24,901 |
| Total Supplies | (AF) | 24,901 |
| Surplus/Shortfall w/o WSCP Action | | 0 |
| **2028** | | **Total** |
| Total Water Use | (AF) | 25,056 |
| Total Supplies | (AF) | 25,056 |
| Surplus/Shortfall w/o WSCP Action | | 0 |

| Submittal Table 7-5 Retail: Five-Year Drought Risk Assessment<br>Water Code Section 10635(b)(3) | | |
|---|---|---|
| **2029** | | **Total** |
| Total Water Use | (AF) | 25,530 |
| Total Supplies | (AF) | 25,530 |
| Surplus/Shortfall w/o WSCP Action | | 0 |
| **2030** | | **Total** |
| Total Water Use | (AF) | 25,964 |
| Total Supplies | (AF) | 25,964 |
| Surplus/Shortfall w/o WSCP Action | | 0 |

### 7.5.3 Water Source Reliability

Fullerton's water supply portfolio is predominantly supported by the OC Basin, which provides roughly 85 percent of Fullerton's water under the FY 2025–26 BPP and is expected to remain a reliable source through FY 2029–30. OCWD's active basin management, such as adjusting the BPP and securing supplemental recharge supplies, helps maintain long-term groundwater reliability. Local supply is further strengthened by Fullerton's use of indirect potable reuse water from OCWD's GWRS, which enhances drought resilience. While emergency interconnections with neighboring agencies are not part of the normal supply mix, they offer additional backup capacity if ever needed. Fullerton's DRA concludes that available supplies meet projected demands during a modeled five-year drought, with the ability to increase MET purchases if necessary.

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

# CHAPTER 8 WATER SHORTAGE CONTINGENCY PLANNING

## 8.1 Background

Water shortage contingency planning is a strategic planning process that the City of Fullerton (City) engages to prepare for and respond to water shortages. A water shortage is defined when water supply available is insufficient to meet the customer demand at a given point in time. This may occur due to water supply availability changes, water quality changes, and/or catastrophic events (e.g., earthquake). The Water Shortage Contingency Plan (WSCP), included in Appendix F and summarized in this chapter, provides a water supply availability assessment and structured steps designed to respond to actual conditions. This level of detailed planning and preparation is intended to 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 acre-feet (AF) per year (AFY) or has more than 3,000 connections prepared adopt a standalone WSCP as part of its Urban Water Management Plan (UWMP). The WSCP is required to plan for a greater than 50 percent supply shortage. The WSCP may require updating based on new Department of Water Resources (DWR) requirements every five years and will be adopted as a current update for submission to DWR by July 1, 2026.

## 8.2 Overview of the Water Shortage Contingency Plan

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 defines the processes and procedures that would be deployed when shortage conditions arise so that 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 for the degree of water shortfall anticipated. The relationship between the three procedural documents related to planning for and responding to water shortages is graphically depicted in Figure 8.1.

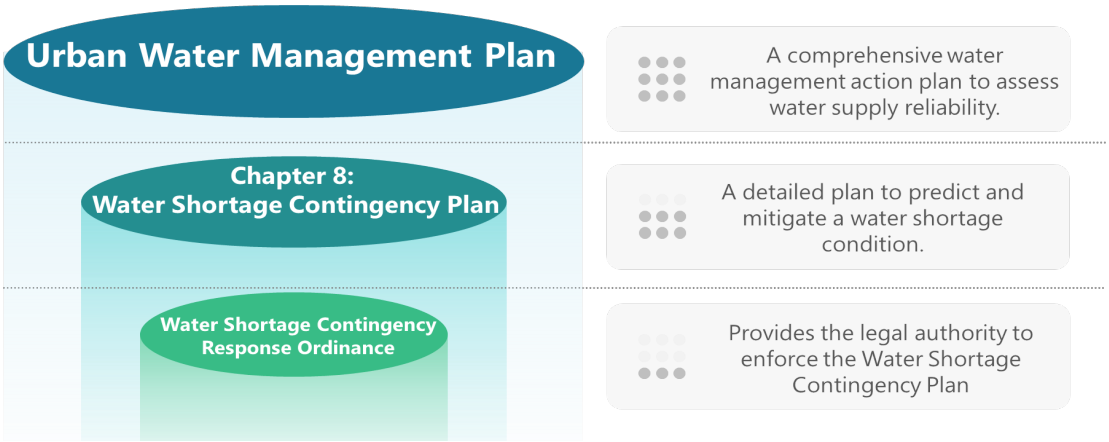



Figure 8.1 Purpose and Relationships of the UWMP, WSCP, and Water Shortage Response Ordinance

A complete version of the City's WSCP is provided in Appendix F and includes the steps to assess if a water shortage is occurring, and what level of demand reduction actions to trigger the most appropriate response to the water shortage conditions. The WSCP has prescriptive elements, including an analysis of water supply reliability; the drought shortage actions that align with water shortage levels that correspond to water shortage percentages ranging from 10 percent to greater than 50 percent; 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

The WSCP is organized into the following three main sections with Section 3 aligned with the California Water Code Section 16032 requirements.

- **Section 1 Introduction and WSCP Overview** gives an overview of the WSCP fundamentals.
- **Section 2 Background Information** 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 2025 UWMP.
- **Section 3.2 Annual Water Supply and Demand Assessment Procedures** provides a description of procedures to conduct and approve the AWSDA.
- **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 percent 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** describes 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** provides a required definition for inclusion in a WSCP per the Water Code.
- **Section 3.12 Plan Adoption, Submittal, and Availability** describes the process the City followed to adopt 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 aim to make the relevant stakeholders understand what to expect during a water shortage situation. The City adopted water shortage levels consistent with the requirements identified in Water Code Section 10632 (a)(3)(A) (Table 8.1).

The six shortage levels the City uses in their water shortage planning and documented in their WSCP are the same as DWR's six standard shortage levels, as indicated in Table 8.1. The water supply augmentation measures that align with each agency shortage level are described in Table 8.2. This table also estimates the extent to which that action will augment supplies to reduce the gap between supplies and demands. The demand reduction action measures that align with each shortage level and how each measure will reduce the shortage gap between expected supplies and the shortage level is summarized in Table 8.3. The purpose of Table 8.2 and 8.3 is to demonstrate the results the City can expect once shortage level actions are implemented to deliver the expected outcomes necessary to meet the requirements of a given shortage level.

Table 8.1 Cross-Reference for Standard vs. Supplier Shortage Levels

| Submittal Table 8-1: Cross-reference for Standard vs Supplier Shortage Levels<br>Water Code Section 10632(a)(3)(B) | | | |
|---|---|---|---|
| ☑ | Check the box if the Supplier uses the Standard six levels of water shortage.<br>Proceed to the next table. | | |
| **Standard Shortage Levels** | **Percent Shortage Range** | **Suppliers Shortage Levels** | **Percent Shortage Range** |
| 1 | Up to 10% | | |
| 2 | Up to 20% | | |
| 3 | Up to 30% | | |
| 4 | Up to 40% | | |
| 5 | Up to 50% | | |
| 6 | >50% | | |
| **NOTES:** | | | |

Table 8.2 Supply Augmentation and Other Actions

| Submittal Table 8-2 Retail: Supply Augmentation and Other Actions<br>Water Code Section 10632(a)(4)(A),(C) and (E) | | | | |
|---|---|---|---|---|
| Yes | Is the Supplier completing this table using the standard six levels? (yes/no) | | | |
| Shortage Level | Supply Augmentation Methods and Other Actions by Water Supplier<br>**Drop down list**<br>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? | | Additional Explanation or Reference (OPTIONAL) |
| | | Volume or Percentage Drop down | Shortage Gap Reduction Value (May be a range)<br>(AF) | |
| Add additional rows as needed | | | | |
| 0-6 | Other Actions (describe) | Percentage | 0-100% | Pump additional groundwater from OC Basin (short-term shortage) with rate penalty |
| 0-6 | Other Actions (describe) | Percentage | 1-100% | Purchase additional imported water from MET with rate penalty |
| **DWR NOTES: Units of measure (AF, CCF, MG)** must remain consistent throughout the UWMP as reported in Submittal Table 2-3. | | | | |
| **NOTES:** Both additional pumped groundwater and purchased imported water are subject to rate penalties from OCWD and MET. | | | | |

Table 8.3 Demand Reduction Actions

| Submittal Table 8-3 Retail: Demand Reduction Actions<br>Water Code Section 10632(a)(4)(B) and (E) | | | | | |
|---|---|---|---|---|---|
| Yes | Is the Supplier completing this table using the standard six levels? (yes/no) | | | | |
| 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? | | Additional Explanation or Reference (OPTIONAL) | Penalty, Charge, or Other Enforcement? **For Retail Suppliers Only** Drop Down List |
| | | Volume or Percentage Drop down | Shortage Gap Reduction Value (May be a range) (AF) | | |
| Add additional rows as needed | | | | | |
| 0 | Landscape - Prohibit certain types of landscape irrigation | | Statewide Prohibition is Required | Watering or irrigation of nonfunctional turf (NFT) on State and local government properties, commercial, industrial, and institutional owned landscapes, homeowners' associations common area landscapes, and local government facilities in disadvantaged communities (DAC) is prohibited. See Note 1 below. | No |
| 0 | Other water feature or swimming pool restriction | Percentage | 0 | All decorative water features must re-circulate water or users mist secure a waiver from the City. | Yes |
| 0 | Other | Percentage | 0 | Washing or hosing down vehicles is prohibited except by use of a hand held container, hose with an automatic shut off device, or at a commercial car wash. | Yes |
| 0 | Other - Prohibit use of potable water for washing hard surfaces | Percentage | 0 | Washing hard or paved surfaces is prohibited except to alleviate safety or sanitary hazards using a hand held container, hose with an automatic shut off device, or a low-volume high pressure cleaning machine that recycles used water. | Yes |
| 0 | Landscape - Restrict or prohibit runoff from landscape irrigation | Percentage | 0 | Watering vegetated areas in a manner that causes excessive water flow or runoff onto an adjoining sidewalk, driveway, street, alley, gutter, or ditch is prohibited. | Yes |
| 0 | Landscape - Other landscape restriction or prohibition | Percentage | 0 | Irrigating ornamental turf on public street medians is prohibited. No landscape watering shall occur within 48 hours after measurable precipitation. | Yes |
| 0 | Landscape - Limit landscape irrigation to specific times | Percentage | 0 | Watering or irrigation with a device that is not continuously attended to is limited to 15 minutes per day per valve. Low flow drip type systems, water efficient steam rotor systems. | Yes |
| 0 | Other - Customers must repair leaks, breaks, and malfunctions in a timely manner | Percentage | 0 | Fix leaks or faulty sprinkler promptly/within 3 days. | Yes |
| 0 | CII - Other CII restriction or prohibition | Percentage | 0 | No single pass cooling systems may be installed in new or remodeled buildings. | Yes |
| 0 | CII - Commercial kitchens required to use pre-rinse spray valves | Percentage | 0 | All new commercial car wash and laundry facilities must recirculate the wash waster or obtain a waiver from the City. | Yes |
| 0 | Other - Require automatic shut of hoses | Percentage | 0 | Use a shutoff nozzle on hoses. | Yes |
| 0 | Other - Prohibit vehicle washing except at facilities using recycled or recirculating water | Percentage | 0 | Food preparation establishments must use water efficient kitchen spray valves. | Yes |
| 0 | Other | Percentage | 0 | Unauthorized use of hydrants is prohibited. Authorization for use must be obtained from water supplier. | Yes |
| 1 | Expand Public Information Campaign | Percentage | 0-1% | Community outreach and messaging (Expand public information campaign), Encourage customers to wash only full loads when washing dished or clothes, Encourage customers to use pool covers to minimize evaporation. | Yes |
| 1 | Landscape - Limit landscape irrigation to specific times | Percentage | 0-5% | Watering or irrigation of vegetated areas is prohibited between 9 am and 6 pm except by use of a hand held device, hose equipped with an automatic shutoff device, or for adjusting. | Yes |
| 1 | CII - Restaurants may only serve water upon request | Percentage | 0-1% | CII- Restaurants may only serve water upon request. | Yes |
| 1 | CII - Lodging establishment must offer opt out of linen service | Percentage | 0-1% | CII- Lodging establishment must offer opt out of linen service. | Yes |
| 1 | CII - Other CII restriction or prohibition | Percentage | 0-1% | Commercial, industrial, institutional equipment must be properly maintained and in full working order. | Yes |
| 1 | Landscape - Prohibit certain types of landscape irrigation | Percentage | 0-1% | All non-essential water use for nurseries, public entities, and commercial and industrial use should cease. | Yes |
| 1 | Offer Water Use Surveys | Percentage | 0-1% | Offer water use surveys (offered through MET). | Yes |

| Submittal Table 8-3 Retail: Demand Reduction Actions<br>Water Code Section 10632(a)(4)(B) and (E) | | | | | |
|---|---|---|---|---|---|
| Yes | Is the Supplier completing this table using the standard six levels? (yes/no) | | | | |
| 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? | | Additional Explanation or Reference (OPTIONAL) | Penalty, Charge, or Other Enforcement? **For Retail Suppliers Only** Drop Down List |
| | | Volume or Percentage Drop down | Shortage Gap Reduction Value (May be a range) (AF) | | |
| 1 | Provide Rebates on Plumbing Fixtures and Devices | Percentage | 0-1% | Provide rebates on plumbing fixtures and devices (offered through MET). | Yes |
| 1 | Provide Rebates for Landscape Irrigation Efficiency | Percentage | 0-1% | Provide rebates for turf replacement (offered through MET). | Yes |
| 1 | Increase Water Waste Patrols | Percentage | 0-1% | Increase water waste patrols. | Yes |
| 1 | Other | Percentage | 5-10% | Other prohibited uses: the city may implement other prohibited water uses as determined by the City, after notice to customers. | Yes |
| 2 | Landscape - Limit landscape irrigation to specific days | Percentage | 5-10% | Irrigation shall be limited to 3 days per week turf watering when using potable water. Plant containers, trees, shrubs, and vegetable gardens may be watered additional days using only drip irrigation or hand watering. | Yes |
| 2 | Water Features - Restrict water use for decorative water features, such as fountains | Percentage | 0-1% | Filling or refilling ornamental lakes and ponds is prohibited. Ornamental lakes and ponds that sustain aquatic life of significant value and were actively managed prior to the storage declaration are exempt. | Yes |
| 2 | Decrease Line Flushing | Percentage | 0-1% | Decrease line flushing. | Yes |
| 2 | Reduce System Water Loss | Percentage | 0-5% | Real loss reduction - Pressure management and more aggressive leak detection and repair. | Yes |
| 2 | Pools and Spas - Require covers for pools and spas | Percentage | 0-1% | Pools and Spas - Require covers for pools and spas. | Yes |
| 2 | Pools - Allow filling of swimming pools only when an appropriate cover is in place. | Percentage | 0-1% | Pools - allow filling of swimming pools only when appropriate cover is in place. | Yes |
| 2 | Other | Percentage | 5-10% | Other prohibited uses: the city may implement other prohibited water uses as determined by the City, after notice to customers. | Yes |
| 3 | Other water feature or swimming pool restriction | Percentage | 0-1% | Decorative water features that use potable water must be drained and kept dry. | Yes |
| 3 | Other - Prohibit vehicle washing except at facilities using recycled or recirculating water | Percentage | 0-1% | Car washing is only permitted using a commercial carwash that recirculates water or by high pressure/low volume wash systems. | Yes |
| 3 | Other - Prohibit use of potable water for construction and dust control | Percentage | 0-1% | Require a construction water use plan be submitted to the water supplier that addresses how impacts to existing water users will be mitigated (such as a dust control). | Yes |
| 3 | Landscape - Other landscape restriction or prohibition | Percentage | 0-1% | With the exception of landscapes watered with non-potable water, limit the installation of new landscaping to drought tolerant trees, shrubs, and groundcover. Prohibit installation of new turf. | Yes |
| 3 | Landscape - Limit landscape irrigation to specific days | Percentage | 10-25% | Irrigation shall be limited to 2 days per week turf watering when using potable water. Plant containers, trees, shrubs, and vegetable gardens may be watered additional days using only drip irrigation or hand watering. | Yes |
| 3 | Other | Percentage | 5-10% | Other prohibited uses: the city may implement other prohibited water uses as determined by the City, after notice to customers. | Yes |
| 4 | Other - Customers must repair leaks, breaks, and malfunctions in a timely manner | Percentage | 0-1% | Fix leaks or faulty sprinkler promptly/within 2 days. | Yes |
| 4 | Other water feature or swimming pool restriction | Percentage | 0-1% | No new permits for pools will be issued. | Yes |
| 4 | Landscape - Other landscape restriction or prohibition | Percentage | 0-1% | No new landscape installations or renovations will be permitted. | Yes |
| 4 | Landscape - Prohibit all landscape irrigation | Percentage | 0-1% | Previous waivers for watering during established period will be revoked. | Yes |
| 4 | Landscape - Limit landscape irrigation to specific days | Percentage | 5-20% | Irrigation shall be limited to 1 days per week turf watering when using potable water. Plant containers, trees, shrubs, and vegetable gardens may be watered additional days using only. | Yes |

| Submittal Table 8-3 Retail: Demand Reduction Actions<br>Water Code Section 10632(a)(4)(B) and (E) | | | | | |
|---|---|---|---|---|---|
| Yes | Is the Supplier completing this table using the standard six levels? (yes/no) | | | | |
| 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? | | Additional Explanation or Reference (OPTIONAL) | Penalty, Charge, or Other Enforcement? **For Retail Suppliers Only** Drop Down List |
| | | Volume or Percentage Drop down | Shortage Gap Reduction Value (May be a range) (AF) | | |
| 4 | Other | Percentage | 5-10% | Other prohibited uses: the city may implement other prohibited water uses as determined by the City, after notice to customers. | Yes |
| 5 | Other - Customers must repair leaks, breaks, and malfunctions in a timely manner | Percentage | 0-1% | Fix leaks or faulty sprinklers within 1 day. | Yes |
| 5 | Other | Percentage | 0-50% | Water for agricultural or commercial nursery purposes, except for livestock watering, is prohibited. Water use for public health safety purposes only. | Yes |
| 5 | Landscape - Prohibit all landscape irrigation | Percentage | 0-1% | All irrigation is prohibited. | Yes |
| 5 | Landscape - Prohibit certain types of landscape irrigation | Percentage | 0-1% | Watering of all golf course areas, parks, schools grounds is prohibited, except for rare plant or animal species. | Yes |
| 5 | Moratorium or Net Zero Demand Increase on New Connections | Percentage | 0-2% | Moratorium or net zero demand increase on new connections. | Yes |
| 6 | Other | Percentage | 0-1% | The City may discontinue service to consumers who willfully violate any water conservation provisions. | Yes |
| 6 | Landscape - Prohibit all landscape irrigation | Percentage | 0-5% | The City may shut off all non-essential water services. All irrigation is prohibited. | Yes |
| 6 | CII - Other CII restriction or prohibition | Percentage | 0-15% | Water for commercial, manufacturing, or processing purposes shall be reduced in volume by up to 50% or exceeded if necessary for public health and safety purposes. | Yes |
| 6 | Other | Percentage | 0-70% | Water use for public health and safety purposes only. Customer rationing may be implemented. Other prohibited uses: The City may implement other prohibited water uses as determined by the City, after notice to customers. | Yes |
| **DWR NOTES: Units of measure (AF, CCF, MG)** must remain consistent throughout the UWMP as reported in Submittal Table 2-3. | | | | | |
| **NOTES:** Note 1: NFT irrigation requirements begin January 1, 2027 for State and local government properties, January 1, 2028 for commercial, industrial, and institutional owned landscapes, January 1, 2029 for homeowners' associations common area landscapes, and January 1, 2031 for local government properties in disadvantaged communities (DAC). | | | | | |

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# CHAPTER 9 DEMAND MANAGEMENT MEASURES

Over the past several decades, water use efficiency and conservation have evolved from voluntary best practices into core regulatory requirements shaping urban water management throughout California and Orange County. In response to recurring droughts, growing urban demand, and increasing competition for limited water supplies, the California Urban Water Conservation Council (CUWCC) was formed in 1991 to promote statewide cooperation on urban water conservation. Through the development and implementation of the CUWCC Best Management Practices, water agencies established a consistent, voluntary framework for improving efficiency through locally tailored programs. This early foundation was later strengthened by legislative actions, most notably Senate Bill (SB) X7-7, the Water Conservation Act of 2009, which set enforceable urban water use reduction targets to cut per capita use by 20 percent by 2020 and required retail water suppliers to actively manage demand as part of long-term water planning. All Orange County water agencies came together to create the Orange County 20x2020 Regional Alliance and met compliance as a region. The City of Fullerton (City) also met compliance individually. These efforts reflected a growing recognition that efficient water use is essential to ensuring reliability amid population growth, limited supplies, and increasing climate variability.

Recurring drought conditions have further accelerated the pace and scale of conservation efforts in the last decade. The 2013–2014 drought prompted a statewide emergency response, culminating in an executive order mandating a 25 percent reduction in urban water use across California. All Orange County Water Agencies, including the City, met this reduction target as reported in Chapter 5 of this 2025 Urban Water Management Plan (UWMP). More recently, the 2021–2022 drought reinforced the need for sustained efficiency gains and durable demand management strategies beyond temporary emergency actions. These regulatory and hydrologic drivers ultimately led to the passing and adoption of SB 606 and Assembly Bill (AB) 1668, the "Making Conservation a California Way of Life" legislation (passed in 2018 and adopted in 2024). The legislation establishes long-term water use objectives for individual water suppliers and reinforces conservation as a permanent element of water management. Together, these milestones underscore the necessity for the Metropolitan Water District of Southern California (MET), the Municipal Water District of Orange County (MWDOC), and the City to implement comprehensive demand management measures and meet established urban water use reduction targets to ensure regional water supply resilience.

The goal of the Demand Management Measures (DMM) chapter is to provide a comprehensive description of the water use efficiency programs that the City has implemented in the most recent five years, is currently implementing, and plans to implement to meet its urban water use reduction targets. Per the "Making California a Conservation Way of Life" Framework (Conservation Framework), each Urban Water Supplier is required to calculate and report their Urban Water Use Objective (UWUO) and to stay within their calculated annual water budget. The UWUO is an aggregate efficient water use of:

- Indoor Residential Use (population x gallons per capita per day (GPCD) standard).
- Outdoor Residential Use (measurements of irrigated/irrigable area, local weather data, and a landscape efficiency factor).
- Outdoor Use with Dedicated Irrigation Meters (measurements of irrigated area, local weather data, and a landscape efficiency factor).

- Distribution System Water Losses.
- Approved Variances.
- Potable Reuse Bonus.

Additionally, the Conservation Framework includes commercial, industrial, and institutional (CII) non-volumetric Performance Measures, including CII customer account classifications, thresholds for converting mixed-use CII meters (MUMs) irrigating over half an acre of landscape to dedicated irrigation meters (DIMs) or in lieu technologies, CII best management practices (BMPs), and identification of and information sharing with disclosable buildings.

One of the City's top priorities since the adoption of the "Making California a Conservation Way of Life" Framework has been to make progress toward compliance with the Conservation Framework. This chapter will describe the City's DMM activities, including those administered by its wholesaler MET and regional partner MWDOC as well as supplemental programs administered locally at the retail-level.

## 9.1 City of Fullerton Demand Management Measures

This section describes the specific DMMs performed by the City, including DMMs offered in partnership with MET, its wholesaler, and with MWDOC, to encourage water conservation within their service area. Table 9.1 summarizes DMM implementation by the City as well as responsibilities of MET and MWDOC.

Table 9.1 DMM Implementation Responsibility and Regional Programs in Orange County

| Efficiency Measure | Responsibility of: | | MWDOC Regional Program and Activities |
|---|---|---|---|
| | Retailer | MET as a Wholesaler | |
| **Operations Practices** | | | |
| Wholesale and Regional Agency Assistance Programs | - | ✓ | ✓ |
| Conservation Pricing | ✓ | - | ✓ |
| Conservation Coordinator | ✓ | - | ✓ |
| Water Waste Prevention | ✓ | ✓ | ✓ |
| Water Loss Control (System Water Audits, Leak Detection and Repair) | ✓ | ✓ | ✓ |
| Metering with Commodity Rates | ✓ | ✓ | (1) |
| **Education and Outreach** | | | |
| Public Outreach Programs | ✓ | ✓ | ✓ |
| K-20 Water Education Initiatives and K-12 School Programs | ✓ | - | ✓ |
| OC Scouts Boy Scouts of America (BSA) and OC Girl Scouts Programs | ✓ | - | ✓ |
| Water Awareness Poster Contest | ✓ | ✓ | ✓ |
| Water Energy Education Alliance | ✓ | - | ✓ |
| Qualified Water Efficient Landscaper (QWEL) Training Program | ✓ | ✓ | ✓ |

| Efficiency Measure | Responsibility of: | | MWDOC Regional Program and Activities |
|---|---|---|---|
| | Retailer | MET as a Wholesaler | |
| **Residential Indoor Implementation** | | | |
| Residential Indoor Rebates | ✓ | ✓ | ✓ |
| Flow Monitor Device Rebates | ✓ | ✓ | ✓ |
| **Commercial, Industrial, and Institutional Implementation** | | | |
| Water Savings Incentive Program | ✓ | ✓ | ✓ |
| On-site Retrofit Program | ✓ | ✓ | ✓ |
| CII Indoor Rebates (High Efficiency Toilets and Urinals, Plumbing Flow Control Valves, Connectionless Food Steamers, Air-cooled Ice Machines, Food Defrosters, Cooling Tower Conductivity Controllers and pH Controllers, Dry Vacuum Pumps, Laminar Flow Restrictors) | ✓ | ✓ | ✓ |
| **Landscape Programs** | | | |
| Turf Replacement Program (including Tree Rebate) | ✓ | ✓ | ✓ |
| Spray-to-Drip Irrigation Rebate Program | ✓ | - | ✓ |
| Landscape Rebates (Smart Timers, High Efficiency Sprinkler Nozzles, Large Rotary Nozzles, In-stem Flow Regulators) | ✓ | ✓ | ✓ |
| Residential Landscape Design Assistance Program | ✓ | - | ✓ |

Notes:
(1) MWDOC does not own or operate a distribution system; water wholesaled by MWDOC is delivered through the MET distribution system and meters.

## 9.1.1 Operations Practices

### 9.1.1.1 Wholesale and Regional Agency Assistance Programs

MWDOC's Assistance Programs are described in Section 9.3.

### 9.1.1.2 Conservation Pricing

The City's water rate schedules consist of two component charges: the customer charge, which varies by the size of the meter; and the water commodity charge, which depends on the actual consumption of water. Commodity charges are based on an increasing block rate for single-family and multi-family residential customers and uniform rate for CII customers, including dedicated landscape. The City's water rates effective as of July 1, 2023, are included (Table 9.2).

Table 9.2 City of Fullerton Commodity Charges

| Customer Class | Tier | Commodity Charge |
|---|---|---|
| Single-Family Residential | I | $3.58 per 1,000 gallons (gal) for first 12,800 gal/month |
| | II | $6.90 per 1,000 gal for next 20,200 gal/month |
| | III | $7.42 per 1,000 gal for over 33,000 gal/month |
| Multi-Family Residential | I | $3.58 per 1,000 gal for first 5,100 gal/month |
| | II | $6.90 per 1,000 gal for next 6,700 gal/month |
| | III | $7.42 per 1,000 gal for over 11,800 gal/month |
| Commercial/Industrial/Agricultural/Municipal/ Dedicated Irrigation | | $4.45 per 1,000 gal |

#### 9.1.1.3 Conservation Coordinator

The City has assigned staff with the responsibilities of handling water conservation programs. During droughts, these responsibilities increase, and additional staff are provided, as needed. Presently, the City has designated the water conservation coordinator's responsibilities to existing staff. The water conservation coordinator is responsible for managing and implementing the City's Water Use Efficiency Program, as well as coordinating and working closely with the California Department of Water Resources (DWR), MWDOC, MET, Orange County Water District (OCWD), and the California Water Efficiency Partnership (CalWEP). The water fund supports the City's water conservation program.

#### 9.1.1.4 Water Waste Prevention Ordinances

City Council adopted a Water Supply Shortage Conservation Plan also known as the Emergency Water Conservation Plan (Ordinance No. 3118 and Municipal Code Section 12.06) in 2008. The municipal code established provisions for prohibitions against waste and water supply shortage implementations. 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 further establishes six levels of water supply shortage response actions to be implemented during times of declared water shortage or declared water shortage emergency, with increasing restrictions on water use in response to worsening drought or emergency conditions and decreasing supplies. The provisions and water conservation measures to be implemented in response to each shortage level are described in the City's Water Shortage Contingency Plan (WSCP).

In accordance with Ordinance, the following uses of water are prohibited at all times:

- Permitting the excess use or loss of water through breaks, leaks, or other malfunctions in the water user's plumbing or distribution system for any period of time after such loss of water should have reasonably been discovered and corrected.
- No water runoff from landscaped areas into adjoining streets, sidewalks, or other paved areas due to incorrectly directed or incorrectly maintained sprinklers or excessive watering shall be allowed.
- No water shall be used to clean, fill, or maintain levels in decorative fountains, or other similar aesthetic structures, unless such water is part of a recycling system.

- Washing of motor vehicles, trailers, boats, and other types of mobile equipment shall be done only with a hand-held water container or a hose equipped with a positive shut-off nozzle for quick rinses, except for washing done at the immediate premises of a commercial car wash or with reclaimed water.
- Installation of single pass cooling systems in buildings requesting new water connections.
- Installation of non-recirculating systems in new conveyor car wash systems and new commercial laundry systems.

#### 9.1.1.5 Water Loss Control

The City recognizes that water auditing is the basis for effective water loss control.

SB 555 signed into law in 2015 requires urban water suppliers to submit annual, validated water loss audit reports to the California Department of Water Resources (DWR). Water auditing is the basis for effective water loss control. DWR's UWMP Guidebook includes a water audit manual intended to help water utilities complete the AWWA Water Audit on an annual basis. Audits must be validated by a certified water auditor to ensure accuracy.

The City has developed and maintained a water system hydraulic model to evaluate and assess where water loss projects should be performed. 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 City also conducts leak detection on an annual basis.

#### 9.1.1.6 Metering

The City understands that meters are an important component of effective water measurement and management. All water service connections supplied by the City are fully metered and customers are billed by volume of water used. The City's on-going large water meter (3-inch and larger) testing program and overall meter replacement program has been the single most important factor in reducing unaccounted water losses to below 5 percent. The City replaces 1-inch and smaller meters and 3-inch and larger meters every 20 years and 1 1/2-inch and 2-inch meters every 15 years. The City has a meter testing schedule in place: 2-inch meters are tested every three years and meters 3-inch or larger are tested annually. The meters of the top 5 water users are tested every 6 months. Beginning in 2021, the City is conducting a pilot project with 10 units to test and evaluate the capabilities of a cellular based Advanced Metering Infrastructure (AMI) system. The pilot is targeting a mix of commercial and light industrial accounts of various sizes.

### 9.1.2 Public Education and Outreach

The City implements several public education and outreach measures, including the programs administered by MWDOC and MET. The City develops, coordinates, and delivers a substantial amount 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 benefits all of the City's residents, businesses, and industries across all demographics. An outline of the City's public education initiatives is below.

#### 9.1.2.1 City of Fullerton Public Outreach Events

The City proudly engages with the community through vibrant outreach at events like the City of Fullerton Night Market, Airport Day, Love City of Fullerton, and Earth Day. At each of these gatherings, City staff connect directly with residents, answering questions, sharing valuable information about water services, and offering guidance on available rebates and conservation programs. Visitors can pick up helpful outreach materials, explore sustainability resources, and learn more about how the City supports a resilient, informed, and connected community. These events are a vital opportunity to meet people where they are and promote awareness through meaningful, face-to-face engagement.

Figure 9.1 Fullerton College Earth Day Event

Figure 9.2 City of Fullerton Night Market

### 9.1.2.2 K-20 Water Education Initiatives and K-12 School Programs

Over the past several years, MWDOC's investment in K-20 water education has significantly grown, evolving to include programs and activities that support environmental literacy for all Orange County students. The effort has expanded beyond K-12 water education programs to include career and workforce development initiatives in higher education through the Water Energy Education Alliance (WEEA) described in more detail in Section 9.1.2.4.

MWDOC's K-12 Water Education School Programs bring standards-aligned, engaging water lessons directly into classrooms and connect water to every part of students' lives. All elementary, middle, and high school programs meet California State Standards and Next Generation Science Standards, providing students with high-quality, relevant learning experiences that build both academic and real-world understanding. This includes a Grab-and-Go Water Activities program, developed in partnership with the Orange County Department of Education, that provides free, self-guided water activities for K-12 teachers, parents, and students.

#### 9.1.2.3 OC Scouts Boy Scouts of America and OC Girl Scouts Programs

The City, in partnership with MWDOC, hosts multiple water education workshops each year to help Scouts BSA earn the *Soil & Water Conservation Merit Badge* and Girl Scouts earn the *MWDOC Water Resources & Conservation Patch*. These hands-on science, technology, engineering, and mathematics (STEM) clinics teach children of all ages where their water comes from, how to use water more efficiently, and how all life depends on the health and security of our natural resources, fostering water awareness and responsibility through fun, activity-based learning.

#### 9.1.2.4 Water Awareness Poster Contest

The City participates in MWDOC's annual Water Awareness Poster Contest, offered for students in grades K-12. The Poster Contest presents children with an opportunity to use their artistic talents to express the importance and value of water through artwork. Each year, hundreds of entries are collected from students and classrooms across the county, and from these entries, 40 winners are selected.

#### 9.1.2.5 Water Energy Education Alliance

WEEA unites over 260 water, energy, and education leaders across the state to build and strengthen career pathways for all California students. Administered and led by the MWDOC, WEEA is comprised of a powerful statewide coalition of education leaders, workforce advocates, and industry experts to raise student awareness, forge strong partnerships, and cultivate a diverse, highly skilled talent pipeline. By connecting students with high-impact opportunities, WEEA is shaping a workforce that fuels industry success, enhances worker well-being, and ensures a resilient, thriving California.

#### 9.1.2.6 Qualified Water Efficient Landscaper Training Program

Since 2018, MWDOC along with the City, has offered free 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 QWEL. 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 the US Environmental Protection Agency's (EPA's) 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.

### 9.1.3 Residential Indoor Rebate Programs

The City partners with MWDOC and MET to implement residential measures that target indoor water use efficiency for single family and multifamily residential customers. These rebate programs are administered through the SoCal Water$mart website.

#### 9.1.3.1 High Efficiency Clothes Washer and Toilet Rebate Programs

The High Efficiency Clothes Washer (HECW) Rebate Program provides residential customers with rebates starting at $85 for purchasing and installing HECWs that use 35-50 percent less water than standard washer models. 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.

The Premium High Efficiency Toilet (HET) Rebate Program offers residential customers rebates starting at $40 for replacing their toilets using 1.6 gallons per flush (gpf) with Premium HETs. Premium HETs use just 1.1 gpf or less, which is 20 percent less water than WaterSense standard toilets.

#### 9.1.3.2 Flow Monitor Device Pilot

This pilot program provides rebates starting at $100, or more in select areas, per flow monitor device installed. These devices monitor a home's water use and can help detect leaks, making them a proactive tool for preventing expensive water bills and water damage due to unforeseen leaks. A list of residential rebate-eligible flow monitoring devices is provided.

### 9.1.4 CII Programs

The City provides a variety of financial incentives, in partnership with MWDOC and MET, to help 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.

#### 9.1.4.1 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 actual amount of water saved by the customers. This "pay-for-performance" design lets customers implement custom projects for their sites. The City partners with MWDOC and MET to offer this program.

Projects must save at least 10 million gallons (MG) of water to qualify for the Program and incentives are paid by MET based on the amount of water saved. Payment amount is up to $0.60 per 1,000 gallons saved per year over the project life, up to a maximum of 10 years. Payments are limited to 50 percent of the eligible project costs while funding is available. Additional funding may be available through MWDOC, but it is limited. Examples of successful projects include but are not limited to changing industrial process system water to capture and reuse process wastewater, capturing condensation, and using it to

supplement cooling tower water supply, and replacing water-using equipment with more efficient products.

#### 9.1.4.2 Recycled Water On-site Retrofit Program

Through the Recycled Water On-site Retrofit Program, the City in partnership with MWDOC and MET, offers incentives for CII properties to convert potable water irrigation or industrial systems to recycled water. Financial incentives of up to $1,950 per acre-foot of potable water saved are available for the customer-side on the meter retrofits. Projects may also be eligible for up to an additional $325 per acre-foot (AF) of annual water savings from MWDOC. Recycled water conversion projects can help to ensure a more reliable water future for Orange County.

#### 9.1.4.3 CII Rebates

The City 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. Devices include High Efficiency Toilets and Urinals, Plumbing Flow Control Valves, Connectionless Food Steamers, Air-cooled Ice Machines, Food Defrosters, Cooling Tower Conductivity Controllers and pH Controllers, Dry Vacuum Pumps, and Laminar Flow Restrictors.

### 9.1.5 Landscape Programs

Some of the most active and effective water use efficiency programs the City provides are those that target the reduction of outdoor water use. With a large proportion of water consumed outdoors via landscape demands, this sector has been and will continue to be a focus for MWDOC and the City.

#### 9.1.5.1 Turf Replacement Program

The Orange County Turf Replacement Program offers incentives to replace existing turf grass with California-native, drought-tolerant plants and landscaping. Residential, commercial, and public properties in the City's service area are all eligible for this program. 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 are encouraged to utilize smart irrigation timers and 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 reduce dry and wet weather runoff, increase urban biomass, and sequester more carbon than turf landscapes.

Additionally, MWDOC is piloting a tree program that allows eligible trees to qualify as a sustainability feature in Turf Replacement projects. Beginning March 4, 2024, Turf Replacement Program participants became eligible for an additional incentive for planting trees as part of their Turf Replacement project. Participants can receive up to $100 per tree, for up to 5 trees ($500), in addition to the Turf Replacement rebate. The pilot goals include increasing the presence of trees in Turf Replacement projects and breaking down barriers to participation. It is anticipated that the pilot will be evaluated in 2026.

#### 9.1.5.2 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. The City partners with MWDOC to provide $1 per square foot of conversion area when replaced with eligible drip irrigation products.

#### 9.1.5.3 SoCal Water$mart Rebate Program for Landscape

The City also offers financial incentives under the SoCal Water$mart Rebate Program for a variety of water efficient landscape devices, such as Smart Irrigation Timers and Central Computer Irrigation Controllers, large rotary nozzles and rotating sprinkler nozzles, soil moisture sensors, irrigation master valves, and in-stem flow regulators.

#### 9.1.5.4 Landscape Design Assistance Rebate

This program is offered for residential customers who are participating in the turf replacement program and are seeking professional design services. Participants must hire a landscape design professional to provide a design that meets the rebate eligible design requirements. Participants will receive up to $1,000 upon completion of their turf replacement project if they have used a professional designer.

## 9.2 City of Fullerton DMM Implementation (2020-2025)

During the past five years, fiscal year (FY) 2020-21 to 2024-25, the City, with the assistance of MET and MWDOC, has continued water use efficiency programs for its residential, CII, and landscape customers with the participation shown in Table 9.3. The City will continue to implement all applicable programs in the next five years.

Table 9.3 City of Fullerton Water Use Efficiency Program Participation

| Program | FY20/21 | FY21/22 | FY22/23 | FY23/24 | FY24/25 |
|---|---|---|---|---|---|
| HECWs | 95 | 66 | 70 | 51 | 39 |
| HETs | 4 | 5 | 11 | 35 | 5 |
| Flow Monitoring Devices (FMD) | -- | 3 | 12 | 8 | 16 |
| Commercial Plumbing Fixtures (CII) | 0 | 0 | 331 | 839 | 0 |
| WSIP | 0 | 0 | 0 | 0 | 0 |
| Turf Replacement (Res.) | 0 | 0 | 0 | 0 | 0 |
| Turf Replacement (Comm.) | 0 | 0 | 0 | 0 | 0 |
| Landscape Design Rebate Program (LDAP) | 0 | 0 | 0 | 0 | 0 |
| Landscape Design Rebate Program (LMAP) | 0 | 0 | 0 | 0 | 0 |
| Spray-to-Drip (Res.) | 0 | 0 | 0 | 0 | 0 |
| Spray-to-Drip (Comm.) | 0 | 0 | 0 | 0 | 0 |

| Program | FY20/21 | FY21/22 | FY22/23 | FY23/24 | FY24/25 |
|---|---|---|---|---|---|
| Rotating Nozzles (Small Res.) | 60 | 131 | 152 | 66 | 0 |
| Rotating Nozzles (Small Comm.) | 0 | 0 | 0 | 0 | 0 |
| Rotating Nozzles (Large Comm.) | 0 | 0 | 0 | 0 | 0 |
| Smart Timers (Res.) | 93 | 50 | 42 | 59 | 24 |
| Smart Timers (Comm.) | 2 | 17 | 0 | 0 | 13 |
| Rain Barrels | 4 | 0 | 6 | 4 | 4 |
| Recycled Water Onsite Retrofits | 0 | 0 | 0 | 0 | 0 |

## 9.3 MWDOC Demand Management Implementation Assistance Programs

To help facilitate implementation of DMMs throughout Orange County, MWDOC's wholesale efforts focus on the following three areas: (1) State Water Conservation Compliance Assistance (e.g., Conservation Framework and Non-Functional Turf); (2) Regional Rebate Programs and Local Program Assistance; and (3) Research and Evaluation. This both complies with and goes beyond the Foundational BMPs of Utility Operations Programs requirements.

### 9.3.1 State Water Conservation Compliance Assistance

To support Orange County retailers with compliance of SB 606 and AB 1668, MWDOC is providing multi-level support to assist agencies in meeting the primary goals of the legislation, including to use water more wisely and to eliminate water waste. Beginning in 2023, urban water suppliers were required to calculate and report their annual UWUO, submit validated water audits annually, and implement and report BMP CII performance measures.

MWDOC offers Orange County water suppliers a "Conservation Framework Technical Assistance Program (TAP)" and "Meter Area Measurements Program" to assist them with compliance with the Conservation Framework.

#### 9.3.1.1 Conservation Framework Technical Assistance Program

This program provides Orange County water suppliers with support on tasks that are required as part of the Conservation Framework. An agency may opt in to receive support with any of the following:

- Readiness Assessment - perform a retailer-specific readiness assessment, including task recommendations and pricing to help retail agencies understand what areas need to be addressed.
- Conservation Framework Compliance Plan - create a customized Framework Compliance Plan that outlines (1) what the retailer needs to do to prepare for compliance; and (2) what needs to be implemented to achieve the water savings necessary to comply with the UWUO.
- Annual Report Compilation and Data Management - support the retailer with Annual Report preparation and assistance; and organize and manage data needed to comply with the reporting requirements of the Regulation.
- CII Account Classification - classify CII customer accounts according to the Regulation requirements and create a guidance plan to keep classifications at 95 percent (or higher).

- CII BMPs and In-Lieu Technologies Implementation Plan - create a customized implementation plan mapping compliance with the Conservation Framework regulation, including the CII BMP requirements of §974, the in-lieu technologies and accompanying BMP requirements in §973, and disclosable buildings requirements in §974a.
- Miscellaneous Framework Technical Assistance - various activities such as:
  - Development of Development of metrics and annual targets to demonstrate progress.
  - Additional training or technical support.
  - Workshop or webinar facilitation to spur cross-team collaborations.
  - Develop outreach and engagement plans and implement meetings to support engagement of internal and external collaborators.

#### 9.3.1.2 Meter Area Measurements Program

The Program assists Orange County water supplier in providing (1) landscape area measurements (LAM) associated with DIMs, which may include the creation of water efficiency budgets for dedicated landscape meter customers; (2) identification of MUMs irrigating landscapes greater than half acre and subject to the regulation; and (3) reconciliation of DIM and residential LAMs where areas may overlap.

### 9.3.2 Regional Rebate Programs and Local Program Assistance

MWDOC develops, obtains funding for, and implements regional water savings rebate programs on behalf of all retail water agencies in Orange County, such as the Turf Replacement Program. This approach minimizes confusion for consumers by providing the same programs with the same participation guidelines, maintains a consistent message to the public to use water efficiently, and provides support to retail water agencies by acting as program administrators for the region. As a leader of water efficiency in Orange County, MWDOC provides a holistic suite of programs that are accessible to all consumer groups in the region. When requested, MWDOC also assists retail agencies in developing and implementing local programs within their service areas. This assistance includes collaboration with each retail agency to design a program that fits that agency's local needs, including providing staffing, targeting customer classes, acquiring grant funding from a variety of sources, and implementing, marketing, reporting, and evaluating the program.

On behalf of its member agencies, MWDOC also organizes and provides the following:

- Monthly coordinator meetings.
- Marketing materials.
- Public speaking.
- Community events.

### 9.3.3 Research and Evaluation

An essential part of MWDOC's regional water use efficiency program is the ongoing research and evaluation of both existing and potential initiatives. Research allows an agency to measure the water savings benefits of a specific program and compare those benefits to the costs of implementing the program. This allows the agency to evaluate the economic feasibility of the program when compared to

other efficiency projects or existing or potential sources of supply, before investing in new initiatives or continuing to implement existing programs. MWDOC routinely conducts statistical water savings (impact) evaluations and process evaluations to guide strategic investment and ensure the effective management of its regional water use efficiency programs.

From 2021 to 2025, MWDOC conducted several research initiatives to support informed decision-making. In partnership with Flume Data Labs, MWDOC completed its Residential End Use Study in 2021, with subsequent updates in 2022 and 2024. This study provided detailed insights into disaggregated residential indoor and outdoor water use, significantly enhancing the understanding of water use patterns across Orange County. In 2023, MWDOC released its Potential and Opportunities study, which quantified the remaining water savings potential in the Orange County residential market, identified the most promising and cost-effective methods for reducing residential demand, and made recommendations on how best to direct financial and technical assistance to Retail Agencies and consumers for implementing residential water efficiency upgrades.

To assess the economic impact of the Conservation Framework, MWDOC worked with M.Cubed and in 2023 published the Draft Water Use Efficiency Standards Economic Analysis: Impact Assessment of State-Mandated Urban Water Use Objectives. MWDOC continues to evaluate the impact of the regulation and Orange County retailer compliance.

Additionally, MWDOC is piloting a tree program that allows eligible trees to qualify as a sustainability feature in Turf Replacement projects. Pilot goals include increasing the presence of trees in Turf Replacement projects and breaking down barriers to participation. It is anticipated that the pilot will be evaluated in 2026. A pilot research program investigating water savings associated with the replacement of broken pressure regulating valves at residential homes wrapped up in 2025. The results of this study are expected in 2027.

## 9.4 Urban Water Use Objective and CII Performance Measure Compliance

A large focus for the City is to implement DMMs that will help them to meet the requirements of the Conservation Framework. DMMs described in this chapter may help to support member agencies with meeting their required UWUO and achieving CII Performance Measure Compliance. In addition, MWDOC provides support to agencies to assist with the calculation of UWUOs and compliance with CII Performance measures via the Meter Area Measurement and TAP Programs, as described in section 9.3.

### 9.4.1 UWUO Components

Table 9.4 describes MWDOC's programs that will assist agencies in meeting their UWUO, through both direct measures (programs/activities that result in directly quantifiable water savings) and indirect measures (programs that provide resources promoting water efficiencies to the public that are impactful but not directly measurable). Additionally, MWDOC provides technical assistance to support water suppliers with compliance.

Table 9.4 MWDOC Programs to Help OC Retail Agencies Meet their Urban Water Use Objectives

| UWUO Component | Calculation | Program | Impact |
|---|---|---|---|
| **Indoor Residential** | Population and GPCD standard | **Direct Impact**<br>▪ High efficiency indoor fixtures and appliance rebates | **Direct Impact**<br>▪ Increased indoor residential efficiencies and reductions of GPCD use |
| **Outdoor Residential** | Irrigated/irrigable area measurement and a landscape efficiency factor of local ETo and effective precipitation | **Direct Impact**<br>▪ Turf Replacement<br>▪ High efficiency irrigation rebates<br>**Indirect Impact**<br>▪ Online resources such as OC Friendly Gardens Webpage<br>▪ Educational classes | **Direct Impact**<br>▪ Increase outdoor residential efficiencies and reductions of gallons per square foot of irrigated/ irrigable area used<br>**Indirect Impact**<br>▪ Provide information, resources, and education to promote efficiencies in the landscape |
| **Outdoor Dedicated Irrigation Meters** | Irrigated area measurement and a landscape efficiency factor of local ETo and effective precipitation | **Technical Assistance**<br>▪ DIM landscape classification and measurement<br>**Direct Impact**<br>▪ Turf Replacement<br>▪ High efficiency irrigation rebates<br>**Indirect Impact**<br>▪ OC Friendly Gardens Webpage<br>▪ Educational training and resources | **Technical Assistance**<br>▪ Classification and measurement of landscapes associated with DIMs are required to complete the calculation<br>**Direct Impact**<br>▪ Increase outdoor residential efficiencies and reductions of gallons per square foot of irrigated/ irrigable area used<br>**Indirect Impact**<br>▪ Provide information, resources, and education to promote landscape efficiencies |
| **Water Loss** | Agency-specific loss factor and number of connections | **Technical Assistance**<br>▪ Water Balance Validation<br>▪ Customer Meter Accuracy Testing<br>▪ Distribution System Pressure Surveys<br>**Direct Impact**<br>▪ Distribution System Leak Detection | **Technical Assistance**<br>▪ The accuracy of the water loss audit is validated for submission to the State<br>**Direct Impact**<br>▪ Identify areas of the distribution system that need repair, replacement, or other actions to limit water loss |
| **Bonus Incentives** | Volume of indirect potable reuse water applied to residential and DIM irrigation uses; not to exceed 15% of UWUO | **Direct Impact**<br>▪ Groundwater replenishment system (GWRS) | **Direct Impact**<br>▪ The GWRS (run by OCWD) recharges the groundwater basin with purified, highly treated wastewater, allowing OCWD-member agencies to access indirect potable reuse |

### 9.4.2 CII Performance Measures

Urban water supplies are required to report BMPs for CII customers. The City, in partnership with MET and MWDOC, offers a broad variety of programs and incentives to help CII customers implement BMPs and increase their water efficiencies (Table 9.5).

Table 9.5 City of Fullerton CII BMP and Water Efficiency Programs and Incentives

| Component | Requirement | Program Offered | Impact |
|---|---|---|---|
| **CII Customer Account Classifications** | Classify each CII water user, based on the end-use of water for the water user, in accordance with Energy Star Portfolio Manager's 18 broad categories, in addition to 4 other categories | **Technical Assistance**<br>▪ CII Customer Account Classification | **Technical Assistance**<br>▪ Classify customer accounts according to the specified categories to comply with the regulation |
| **Large Landscape Identification** | Identify all CII water users associated with large landscapes – landscapes irrigated with a mixed-use meter greater than half an acre | **Technical Assistance**<br>▪ Large Landscape identification | **Technical Assistance**<br>▪ Identify and map landscapes associated with MUM landscapes that are greater than half an acre to comply with the regulation |
| **BMPs** | Offer CII BMPs for customers that exceed the recommended size, volume of water use, or another threshold | **Technical Assistance**<br>▪ BMP Implementation Plan | **Technical Assistance**<br>▪ Provide a BMP Implementation Plan to guide water suppliers with a roadmap to compliance with the regulation |
| **Disclosable Buildings** | Identify disclosable buildings in service area according to the list provided by the California Energy Commission | **Technical Assistance**<br>▪ Disclosable buildings list | **Technical Assistance**<br>▪ Provide the California Energy Commission list of disclosable buildings by water supplier to comply with the regulation |

# CHAPTER 10 PLAN ADOPTION, SUBMITTAL, AND IMPLEMENTATION

The Water Code requires the Urban Water Management Plan (UWMP) to be adopted by the City of Fullerton's (City) governing body. Before the adoption, the City must hold a public hearing allowing members of the public to provide input on the UWMP. Prior to the public hearing, the City must notify the public and surrounding cities, counties, and water agencies within its service area of the scheduled public hearing. Upon completion of the public hearing, the City's governing body shall vote to adopt the UWMP. Post adoption, the City submits the UWMP to the Department of Water Resources (DWR) while also making it available for public access.

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 to develop and update this planning document. The City also encouraged public involvement through its public review and 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 city or county within supplier's service area that water supplier is preparing an updated UWMP (at least 60 days prior to public hearing) | 2/9/2026 | Appendix I |
| Public Hearing Notice | 4/20/2026 & 4/27/2026 | Appendix I |
| Held Public Hearing | 5/5/2026 | |
| Adopted UWMP and Water Shortage Contingency Plan (WSCP) | 5/5/2026 | Appendix J |
| Submitted UWMP to DWR (no later than 30 days after adoption) | 6/4/2026 | |
| Submitted UWMP to the California State Library (no later than 30 days after adoption) | 6/4/2026 | |
| Submitted UWMP to the cities and county within the supplier's service area (no later than 30 days after adoption) | 6/4/2026 | |

This UWMP was adopted by the City Council on May 5, 2026. A copy of the adopted resolution is provided in Appendix J.

## 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 and the cities within its service area on February 9, 2026, to state that it was in the process of preparing an updated UWMP. This notice of preparation is included in Appendix I.

Table 10.2 Submittal Table 10-1 Retail: Notification to Cities and Counties

| Submittal Table 10-1 Retail: Notification to Cities and Counties<br>Water Code Section 10621(b) and 10642 | | |
|---|---|---|
| City Name | 60 Day Notice<br>**Drop Down (yes/no)** | Notice of Public Hearing<br>**Drop Down (yes/no)** |
| Anaheim | Yes | Yes |
| Brea | Yes | Yes |
| Buena Park | Yes | Yes |
| La Habra | Yes | Yes |
| La Mirada | Yes | Yes |
| Placentia | Yes | Yes |
| GSWC | Yes | Yes |
| Suburban Water Systems | Yes | Yes |
| MWDOC | Yes | Yes |
| MET | Yes | Yes |
| OCWD | Yes | Yes |
| County Name<br>**Drop Down List** | 60 Day Notice<br>**Drop Down (yes/no)** | Notice of Public Hearing<br>**Drop Down (yes/no)** |
| Orange County | Yes | Yes |
| **NOTES:** | | |

The City's water supply planning relates to the policies, rules, and regulations of its regional and local water providers. The City is dependent on imported water from Metropolitan Water District of Southern California (MET), its regional wholesaler. The City is also dependent on groundwater from Orange County Water District (OCWD), the agency that manages the Orange County Groundwater Basin (OC Basin). As such, the City involved the relevant agencies in this 2025 UWMP at various levels of contribution as described below.

The City's 2025 UWMP leveraged data and regionally consistent analyses supplied by the Municipal Water District of Orange County (MWDOC), such as population projections from the California State University, Fullerton Center for Demographic Research, and the information quantifying water availability to meet the City's projected demands for the next 25 years, in five-year increments. This 2025 UWMP was developed in collaboration with MWDOC's 2025 UWMP to ensure consistency between the two documents.

As a groundwater producer who relies on supplies from the OCWD managed Orange County Basin, the City coordinated the preparation of this 2025 UWMP with OCWD. Several OCWD documents, such as the Groundwater Reliability Plan, Engineer's Report, and 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 Chapter 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 May 5, 2026. As part of the public hearing, the City discussed adoption of the UWMP, key components of the UWMP and the conclusions that served as the basis of the UWMP. Copies of the draft 2025 UWMP were placed for public review at the City Clerk's and Utilities Department offices.

Public hearing notifications were published in local newspapers. A copy of the Notice of Public Hearing is included in Appendix I.

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

## 10.4 UWMP Submittal

The City Council reviewed and approved the 2025 UWMP at its May 5, 2026, meeting after the public hearing. See Appendix J for the resolution approving the Plan.

By June 4, 2026, the City's adopted 2025 UWMP was filed with DWR and sent directly to the California State Library, the County of Orange, and the cities within its service area. The submission to DWR was done electronically through the online submittal tool, Water Use Efficiency (WUE) Data Portal. The City will make the UWMP 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.

# CHAPTER 11 REFERENCES

California Department of Water Resources (DWR). (2026, January). *Final Urban Water Management Plan Guidebook 2025*. https://cwc.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Water-Use-And-Efficiency/Urban-Water-Use-Efficiency/Urban-Water-Management-Plans/Final-2025-UWMP-Guidebook/Final-2025-UWMP-Guidebook-Accessible.pdf

Center for Demographic Research (CDR). (2025, July). *Orange County Progress Report 2025 Volume 54*.

City of Fullerton (2025). *Local Hazard Mitigation Plan*. https://www.cityoffullerton.com/government/departments/fire/prevention/fire-hazard-mitigation/2025-local-hazard-mitigation-plan

City of Fullerton. (2025, March). *Water Master Plan Update*. https://www.cityoffullerton.com/home/showpublisheddocument/9908/638866372075300000

City of Fullerton (2021, June). 2020 Urban Water Management Plan. https://www.cityoffullerton.com/government/departments/public-works/water-system/urban-water-management-plan

City of Fullerton. (2020, May). *City of General Plan*. https://www.cityoffullerton.com/government/departments/community-and-economic-development/planning-zoning/general-plan

Metropolitan Water District of Southern California (MET). (2025, December). *2025 Urban Water Management Plan Draft. https://www-admin.mwdh2o.com/media/5ralzxit/public-review-draft-february-2026-uwmp.pdf*.

Metropolitan Water District of Southern California (MET). (2025, April). *CAMP4W Climate Adaptation Master Plan for Water*. https://cawaterlibrary.net/wp-content/uploads/2025/03/CAMP4W-Climate-Adaptation-Management-Plan-for-Water.pdf

Metropolitan Water District of Southern California (MET). (2020, April). *2020 Integrated Water Resources Plan – Regional Needs Assessment*. https://d1q0afiq12ywwq.cloudfront.net/media/sgvlkith/2020_irp_needs_assessment.pdf

Municipal Water District of Orange County (MWDOC). (2023, July). *Orange County Water Reliability Study. https://www.mwdoc.com/wp-content/uploads/2025/06/MWDOC_2023-OC-Water-Reliability-Study-Final.pdf*

Municipal Water District of Orange County (MWDOC), Orange County Water District (OCWD), Hazen & Sawer. (2025, December). *2025 Orange County Water Demand Projection Model Technical Memorandum*. https://www.mwdoc.com/your-water/water-reliability-planning/

Orange County Water District (OCWD). (2025, February). *OCWD Resilience Plan – Adaptive Strategies for Securing Abundant and Reliable Water Supplies*. https://www.ocwd.com/wp-content/uploads/OCWD-Resilience-Plan.pdf

Orange County Water District (OCWD). (2025, February). *Engineer's Report on Groundwater Conditions, Water Supply and Basin Utilization in The Orange County Water District*. https://www.ocwd.com/wp-content/uploads/2023-24-Engineers-Report_Final.pdf

Orange County Water District (OCWD), City of La Habra, Irvine Ranch Water District. (2022, February). *Basin 8-1 Alternative 2022 Update*. https://www.ocwd.com/wp-content/uploads/05cbasin-8-1-alternative-2022-update.pdf

Southern California Association of Governments (SCAG). (2024, April). *Connect SoCal 2024.* https://scag.ca.gov/sites/default/files/2024-05/23-2987-connect-socal-2024-final-complete-040424.pdf

APPENDIX A

# UWMP WATER CODE CHECKLIST

| Retail (x = required) | Wholesale (x = required) | Order | 2025 Guidebook Location | Water Code Section | Summary as Applies to UWMP | Subject | Relevant Submittal Table | 2025 UWMP Location |
|---|---|---|---|---|---|---|---|---|
| x | x | 1 | Chapter 1 | 10615 | A plan shall describe and evaluate sources of supply, reasonable and practical efficient uses, reclamation and demand management activities. | Introduction and overview | n/a | Section 1.2 |
| x | x | 1 | Chapter 1 | 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. | Plan preparation | n/a | Executive Summary, Chapters 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 |
| x | x | 2.1 | Section 2.1 | 10620(b) | Every person that becomes a Supplier shall adopt UWMP within one year after it has become a Supplier. | Plan preparation | n/a | Chapter 1 and Section 2.1 |
| x | n/a | 2.5 | Section 2.5 | 10644 | Supplier shall report the Public Water Systems number, volume of delivered water, and number of connections that are included in this UWMP. | Plan preparation | 2-1 | Section 2.1 |
| x | x | 2.5 | Section 2.5 | 10644 | Supplier shall report if this UWMP is an individual UWMP and whether the Supplier belongs to a regional UWMP or regional alliance. | Plan preparation | 2-2 | Section 2.1 |
| x | x | 2.5 | Section 2.5 | 10644 | Supplier shall report whether the data is in fiscal or calendar years and the units of measure used for reporting water volumes. | Plan preparation | 2-3 | Section 2.1 |
| x | x | 2.4 | Section 2.4 | 10642 | Provide supporting documentation that the 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 | n/a | Sections 2.2.3, 10.1 and 10.3, Appendix I |
| x | x | 2.4 | Section 2.4.2 | 10620(d)(3) | Coordinate the preparation of its plan with other appropriate agencies in the area, including other Suppliers that share a common source, water management agencies, and relevant public agencies, to the extent practicable. | Plan preparation | n/a | Sections 2.2.1 and 10.2 |
| x | n/a | 2.4 | Section 2.4.1 | 10631(h) | Retail Suppliers will include documentation that they have provided their Wholesale Supplier(s)—if any—with water use projections from that source. | Plan preparation | 2-4 R | Sections 2.2.2 and 4.2 |
| n/a | x | 2.4 | Section 2.4.1 | 10631(h) | Wholesale Suppliers will provide their Suppliers with identification and quantification of the existing and planned sources of water available from the Wholesale Supplier to the Supplier during various water year types. | Plan preparation | 2-4 W | N/A for Retailers |
| x | x | 3 | Chapter 3.0 | 10631(a) | Describe the Supplier service area. | System description | n/a | Section 3.2 |
| x | x | 3.3 | Section 3.3 | 10631(a) | Describe the climate of the Supplier's service area. | System description | n/a | Section 3.3 |
| x | x | 3.4 | Section 3.4.1 | 10631(a) | Provide the current and projected service area populations for 2030, 2035, 2040, 2045 and optionally 2050. | System description | 3-1 | Section 3.4 |
| x | x | 3.4 | Section 3.4.2 | 10631(a) | Describe other social, economic, and demographic factors affecting the Supplier's water management planning. | System description | n/a | Section 3.4.2 |
| x | x | 3.5 | Section 3.5 | 10631(a) | Describe the land uses within the service area… include the current and projected land uses within the existing or anticipated service area affecting the Supplier's water management planning. Describe the land uses within the service area. | System description and baselines | n/a | Section 3.5 |
| x | Optional | 4.2 | Sections 4.2.3 and 4.2.4 | 10631(d)(1) | Quantify past, current, and projected water use, identifying the uses among water use sectors. | System water use | 4-1 and 4-2 | Sections 4.1 and 4.2 |
| x | Optional | 4.3 | Section 4.3.1 | 10631(d)(3)(A) | Report the distribution system water loss for each of the five years preceding the plan update. | System water use | 4-5 | Section 4.4 and Appendix D |
| x | n/a | 4.3 | Section 4.3.2 | 10631(d)(3)(C) | Retail Suppliers shall provide data to show the distribution loss standards were met. | System water use | 4-6 | Section 4.4 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| x | n/a | 4.2 | Section 4.2.5.4 | 10631.1(a) | Include projected water use needed for lower income housing projected in the service area of the Supplier. | System water use | 4-3 | Section 4.3 |
| x | n/a | 4.2 | Section 4.2.5.3 | 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 | 4-3 | Section 4.2 |
| x | n/a | 4.2 | Section 4.2.5.3 | 10631(d)(4)(B) | Provide citations of codes, standards, ordinances, or plans used to make water use projections. | System water use | 4-3 | Section 4.3 and Appendix H |
| x | n/a | 4.2 | Section 4.2.5.3 | 10631(d)(4)(B)(ii) | To the extent that a Supplier reports the information described in subparagraph (A), an urban water Supplier shall… Indicate the extent that the water use projections consider savings from codes, standards, ordinances, or transportation and land use plans. Water use projections that do not account for these water savings shall be noted of that fact. | System water use | 4-3 | Section 4.3.1 |
| x | x | 4.2 | Section 4.2.5.6 | 10635(b) | Demands under climate change considerations must be included as part of the drought risk assessment. | System water use | n/a | Section 4.3.2 and Appendix H |
| n/a | x | 5.1 | Section 5.1 | 10608.36 | Wholesale Suppliers shall include an assessment of present and proposed future measures, programs, and policies to help their Retail Suppliers achieve targeted water use reductions. | Baselines and targets | n/a | N/A for Retailers |
| x | n/a | 5.2 | Section 5.2 | 10608.4 | Retail Suppliers shall report on their compliance in meeting their water use targets. Reporting requirements will vary depending on whether the Supplier:<br>- Was considered an urban retail water supplier in 2020,<br>- Met its 2020 target in 2020, or<br>- Was part of a merger or consolidation since 2020.<br>Chapter 5 Subsections 5.2.1, 5.2.2, and 5.2.3 address each of these situations. | Baselines and targets | 5-1 | Section 5.1 |
| x | x | 6.1 | Section 6.1 | 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 | n/a | Sections 6.1, 6.2, 6.3, 6.6, and 6.8 |
| x | x | 6.1 | Sections 6.1 and 6.2 | 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 | n/a | Sections 7.1, 7.2, 7.3, and 7.5 |
| x | x | 6.2 | Section 6.2.2 | 10631(b)(4)(C) | Indicate whether groundwater is an existing or planned source of water available to the Supplier. If groundwater is identified as an existing or planned source of water… (include) a detailed description and analysis of the location, amount and sufficiency of groundwater pumped by the Supplier for the past five years. | Water supplies and recycled water | 6-1 | Section 6.3 |
| x | x | 6.2 | Section 6.2.2 | 10631(b)(4)(A) | Indicate whether a groundwater sustainability plan or groundwater management plan has been adopted by the Supplier or if there is any other specific authorization for groundwater management. Include a copy of the plan or authorization. | System supplies | n/a | Section 6.3.1.2 and Appendix E |
| x | x | 6.2 | Section 6.2.2 | 10631(b)(4)(B) | Describe the groundwater basin. | System supplies | n/a | Section 6.3.1.1 |
| x | x | 6.2 | Section 6.2.2 | 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 | n/a | Sections 6.3.1.2 and 6.3.1.3 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| x | x | 6.2 | Section 6.2.2 | 10631(b)(4)(B) | For unadjudicated basins… (include) information as to whether DWR has identified the basin as a high- or medium-priority basin in the most current official departmental bulletin | Water supplies and recycled water | n/a | Section 6.3.1.2 |
| x | x | 6.2 | Section 6.2.2 | 10631(b)(4)(B) | For unadjudicated basins… describe efforts by the Supplier to coordinate with sustainability or groundwater agencies to achieve sustainable groundwater conditions. | Water supplies and recycled water | n/a | Sections 6.3.1.2, 6.3.1.3, 6.3.1.4, and 6.3.1.5 |
| x | x | 6.2 | Section 6.2.2. | 10631(b)(4)(C) | If groundwater is identified as an existing or planned source of water… (include) a detailed description and analysis of the location, amount and sufficiency of groundwater pumped by the Supplier for the past five years | System supplies | n/a | Sections 6.3 and 6.3.1 |
| x | x | 6.2 | Section 6.2.2 | 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 | 6-9 | Sections 6.1, 6.3.1.1, 6.3.2 |
| x | x | 6.1 | Section 6.1 | 10631(b) | Identify and quantify the existing and planned sources of water available for 2025, 2030, 2035, 2040, 2045 and optionally 2050. | System supplies | 6-8 and 6-9 | Sections 6.1, 6.2, 6.3, 6.6, and 6.8 |
| x | x | 6.2 | Section 6.2.7 | 10631(c) | Describe the opportunities for exchanges or transfers of water on a short-term or long-term basis. | System supplies | n/a | Section 6.8 |
| x | n/a | 6.2 | Section 6.2.5 | 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) | 6-2 | Section 6.6.2 |
| x | x | 6.2 | Section 6.2.5 | 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) | 6-3 | Section 6.6.2 |
| x | x | 6.2 | Section 6.2.5 | 10633(c) | Describe the recycled water currently being used in the Supplier's service area. | System supplies (recycled water) | 6-4 | Section 6.6.3 |
| x | x | 6.2 | Section 6.2.5 | 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) | 6-4 | Section 6.6.5 |
| x | x | 6.2 | Section 6.2.5 | 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 describe the actual use of recycled water in comparison to uses previously projected. | System supplies (recycled water) | 6-4 and 6-5 | Section 6.6.4 |
| x | x | 6.2 | Section 6.2.5 | 10633(f) | Describe the actions that may be taken to encourage the use of recycled water and the projected results of these actions in terms of acre-feet of recycled water used per year. | System supplies (recycled water) | 6-6 | Section 6.6.4 |
| x | x | 6.2 | Section 6.2.5 | 10633(g) | Provide a plan for optimizing the use of recycled water in the Supplier's service area. | System supplies (recycled water) | n/a | Section 6.6.6 |
| x | x | 6.2 | Section 6.2.6 | 10631(g) | Describe desalinated water project opportunities for long-term supply. | System supplies | 6-7 | Section 6.7 |
| x | x | 6.2 | Section 6.2.10 | 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 five consecutive water years | System supplies | 6-7 | Sections 6.2.6, 6.3.2, 6.6.4, 6.8.2 |
| x | x | 6.3 | Section 6.3 and Appendix O | 10631.2(a) | The UWMP must include energy information, as stated in the code, that a Supplier can readily obtain. | System suppliers, energy intensity | O-1A, O-1B, O-1C, and O-2 | Section 6.10 |
| x | | 7.1 | Section 7.1 | 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 | n/a | Section 7.2.3 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| x | x | 7.2 | Section 7.2 | 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 Supplier with the total projected water use over the next 20 years. | Water supply reliability assessment | 7-2, 7-3, and 7-4 | Section 7.3 |
| x | x | 7.2 | Section 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 | n/a | Section 7.4 |
| x | x | 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 | n/a | Section 7.5 |
| x | x | 7.3 | Section 7.3 | 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 five consecutive years. | Water supply reliability assessment | n/a | Section 7.5.1 |
| x | x | 7.3 | Section 7.3 | 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 | n/a | Sections 7.3, 7.5.2, 7.5.3 |
| x | x | 7.3 | Section 7.3 | 10635(b)(3) | Include a comparison of the total water supply sources available to the Supplier with the total projected water use for the drought period. | Water supply reliability assessment | 7-5 | Section 7.5.2 |
| x | x | 7.3 | Section 7.3 | 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 | n/a | Sections 7.2 and 7.5.1 |
| x | x | 8 | Chapter 8 | 10632(a) | Provide a water shortage contingency plan (WSCP) with specified elements below. | Water shortage contingency planning | n/a | 2025 UWMP Appendix F - WSCP |
| x | x | 8 | Chapter 8 | 10632(a)(1) | Provide an analysis of water supply reliability (from Guidebook Chapter 7) in the WSCP. | Water shortage contingency planning | n/a | 2025 UWMP Appendix F - WSCP (Section 3.1) |
| x | x | 8.2 | Section 8.2 | 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 | n/a | 2025 UWMP Appendix F - WSCP (Section 3.2.1) |
| x | x | 8.2 | Section 8.2 | 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 | n/a | 2025 UWMP Appendix F - WSCP (Section 3.2.2) |
| x | x | 8.3 | Section 8.3 | 10632(a)(3)(A) | Define six standard water shortage levels of 10%, 20%, 30%, 40%, 50% shortage, and greater than 50% 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 | n/a | 2025 UWMP Appendix F - WSCP (Section 3.3) |
| x | x | 8.3 | Section 8.3 | 10632(a)(3)(B) | Suppliers with an existing WSCP that uses different water shortage levels must cross reference their categories with the six standard categories. | Water shortage contingency planning | 8-1 | 2025 UWMP Appendix F - WSCP (Section 3.3) |
| x | x | 8.4 | Section 8.4 | 10632(a)(4)(A) | Suppliers with WSCPs that align with the defined shortage levels must specify locally appropriate supply augmentation actions. | Water shortage contingency planning | 8-2 | 2025 UWMP Appendix F - WSCP (Section 3.4) |
| x | x | 8.4 | Section 8.4 | 10632(a)(4)(B) | Specify locally appropriate demand reduction actions to adequately respond to shortages. | Water shortage contingency planning | 8-3 | 2025 UWMP Appendix F - WSCP (Section 3.4.2) |
| x | x | 8.4 | Section 8.4 | 10632(a)(4)(C) | Specify locally appropriate operational changes. | Water shortage contingency planning | 8-2 | 2025 UWMP Appendix F - WSCP (Section 3.4.3) |
| x | x | 8.4 | Section 8.4 | 10632(a)(4)(D) | Specify additional mandatory prohibitions against specific water use practices that are in addition to State-mandated prohibitions are appropriate to local conditions. | Water shortage contingency planning | Table 8-3 | 2025 UWMP Appendix F - WSCP (Section 3.4.4) |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| x | x | 8.4 | Section 8.4 | 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 | 8-2 and 8-3 | 2025 UWMP Appendix F - WSCP (Appendix A) |
| x | x | 8.4 | Section 8.4.6 | 10632.5 | The UWMP shall include a seismic risk assessment and mitigation plan. | Water shortage contingency plan | n/a | 2025 UWMP Appendix F - WSCP (Section 3.4.6) |
| x | x | 8.5 | Section 8.5 | 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 | n/a | 2025 UWMP Appendix F - WSCP (Section 3.5) |
| x | x | 8.5 | Section 8.5 | 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 | n/a | 2025 UWMP Appendix F - WSCP (Section 3.6) |
| x | n/a | 8.6 | Section 8.6 | 10632(a)(6) | Retail Supplier must describe how it will ensure compliance with and enforce provisions of the WSCP. | Water shortage contingency planning | n/a | 2025 UWMP Appendix F - WSCP (Section 3.6) |
| x | x | 8.7 | Section 8.7 | 10632(a)(7)(A) | Describe the legal authority that empowers the Supplier to enforce shortage response actions. | Water shortage contingency planning | n/a | 2025 UWMP Appendix F - WSCP (Section 3.7) |
| x | x | 8.7 | Section 8.7 | 10632(a)(7)(B) | Provide a statement that the Supplier will declare a water shortage emergency per Water Code Chapter 3. *Water Shortage Emergencies* . | Water shortage contingency planning | n/a | 2025 UWMP Appendix F - WSCP (Section 3.7) |
| x | x | 8.7 | Section 8.7 | 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 | n/a | 2025 UWMP Appendix F - WSCP (Section 3.7) |
| x | x | 8.8 | Section 8.8 | 10632(a)(8)(A) | Describe the potential revenue reductions and expense increases associated with activated shortage response actions. | Water shortage contingency planning | n/a | 2025 UWMP Appendix F - WSCP (Section 3.8) |
| x | x | 8.8 | Section 8.8 | 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 | n/a | 2025 UWMP Appendix F - WSCP (Section 3.8) |
| x | n/a | 8.8 | Section 8.8 | 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 | n/a | 2025 UWMP Appendix F - WSCP (Section 3.8) |
| x | n/a | 8.9 | Section 8.9 | 10632(a)(9) | Retail Suppliers must describe the monitoring and reporting requirements and procedures that ensure appropriate data are collected, tracked, and analyzed for purposes of monitoring customer compliance. | Water shortage contingency planning | n/a | 2025 UWMP Appendix F - WSCP (Section 3.9) |
| x | x | 8.10 | Section 8.10 | 10632(a)(10) | Describe reevaluation and improvement procedures for monitoring and evaluation the WSCP to ensure risk tolerance is adequate and appropriate water shortage mitigation strategies are implemented. | Water shortage contingency planning | n/a | 2025 UWMP Appendix F - WSCP (Section 3.10) |
| x | n/a | 8.11 | Section 8.11 | 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 | n/a | 2025 UWMP Appendix F - WSCP (Section 3.11) |
| x | x | 8.12 | Section 8.12 | 10632(c) | Make available the WSCP to customers and any city or county where it provides water within 30 days after adoption of the plan. | Water shortage contingency planning | n/a | 2025 UWMP Appendix F - WSCP (Section 3.12) |
| x | n/a | 9.1 | Sections 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 address specific measures listed in code. | Demand management measures | n/a | Section 9.2 |
| n/a | x | 9.2 | Sections 9.2 | 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 | n/a | N/A for Retailers |
| x | n/a | 10 | Chapter 10 | 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 | n/a | Sections 2.2.3, 10.1, and 10.3 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| x | x | 10.2 | Section 10.2.1 | 10621(b) | Notify, at least 60 days prior to the public hearing, any city or county within which the Supplier provides water that the Supplier will be reviewing the UWMP and considering amendments or changes to the plan. | Plan adoption, submittal, and implementation | 10-1 | Sections 10.1 and 10.2, Appendix I |
| x | x | 10.4 | Section 10.4 | 10621(f) | Each urban water Supplier shall update and submit its 2025 plan to DWR by July 1, 202 6. | Plan adoption, submittal, and implementation | n/a | Sections 10.1 and 10.4 |
| x | x | 10.2 | Sections 10.2.2, 10.3, and 10.5 | 10642 | Provide supporting documentation that the Supplier made the UWMP and WSCP available for public inspection, published notice of the public hearing, and held a public hearing about the UWMP and WSCP. | Plan adoption, submittal, and implementation | n/a | Sections 2.2.3, 10.1 and 10.3, Appendix I |
| x | x | 10.2 | Section 10.2.2 | 10642 | The 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 | 10-1 | Appendix I |
| x | x | 10.3 | Section 10.3.2 | 10642 | Provide supporting documentation that the UWMP and WSCP has been adopted as prepared or modified. | Plan adoption, submittal, and implementation | n/a | Appendix J of UWMP and Appendix E of WSCP |
| x | x | 10.4 | Section 10.4 | 10644(a) | Provide supporting documentation that the Supplier has submitted their UWMP to the California State Library. | Plan adoption, submittal, and implementation | n/a | Sections 10.1 and 10.4 |
| x | x | 10.4 | Section 10.4 | 10644(a)(1) | Provide supporting documentation that the Supplier has submitted their UWMP to any city or county within which the Supplier provides water no later than 30 days after adoption. | Plan adoption, submittal, and implementation | n/a | Sections 10.1 and 10.4 |
| x | x | 10.4 | Sections 10.4.1 and 10.4.2 | 10644(a)(2) | The UWMP, or amendments to the UWMP, submitted to DWR shall be submitted electronically. | Plan adoption, submittal, and implementation | n/a | Section 10.5 |
| x | x | 10.7 | Section 10.7.2 | 10644(b) | If revised, submit a copy of the WSCP to DWR within 30 days of adoption. | Plan adoption, submittal, and implementation | n/a | Section 10.5 of UWMP and Section 3.12 of WSCP |
| x | x | 10.5 | Section 10.5 | 10645(a) | Provide supporting documentation that, not later than 30 days after filing a copy of its UWMP with DWR, the Supplier has or will make the plan available for public review during normal business hours. | Plan adoption, submittal, and implementation | n/a | Sections 10.1 and 10.4 |
| x | x | 10.5 | Section 10.5 | 10645(b) | Provide supporting documentation that, not later than 30 days after filing a copy of its WSCP with DWR, the Supplier has or will make the plan available for public review during normal business hours. | Plan adoption, submittal, and implementation | n/a | Sections 10.1 and 10.4, Appendix F |
| x | x | 10.6 | Section 10.6 | 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 | n/a | N/A - Supplier is not regulated by the Public Utilities Commission |

APPENDIX B

# DEPARTMENT OF WATER RESOURCES (DWR) STANDARDIZED TABLES

| Submittal Table 2-1 Retail: Public Water Systems | | | |
|---|---|---|---|
| Public Water System Number | Public Water System Name | Number of Municipal Connections 2025 | Volume of Water Supplied 2025 (AF) |
| Add additional rows as needed | | | |
| CA3010010 | City of Fullerton | 32,050 | 22,243 |
| | **Total** | 32,050 | 22,243 |
| **DWR NOTES:**<br>**Units of measure (AF, CCF, MG)** must remain consistent throughout the UWMP as reported in Submittal Table 2-3. This table identifies the unit of measure selected in Submittal Table 2-3. | | | |
| **NOTES:** | | | |

| Submittal Table 2-2: Plan Identification | | |
|---|---|---|
| **Select One** | **Type of Plan** | **Name of Regional Alliance or RUWMP** (Drop Down List) |
| ☑ | **Individual UWMP** | |
| | If Water Supplier is also a member of a SB X7-7 Regional Alliance, select name from the drop-down. | Orange County 20x2020 Regional Alliance |
| ☐ | **Regional Urban Water Management Plan (RUWMP)** | |
| | If Supplier selected RUWMP, select name from the drop-down. | |
| **NOTES:** | | |

| Submittal Table 2-3: Supplier Identification | |
|---|---|
| Type of Supplier (select one or both) | |
| ☐ | Supplier is a wholesale supplier |
| ☑ | Supplier is a retail supplier |
| 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<br>(Select from the drop down list). | |
| Unit | AF |
| **DWR NOTES:**<br>**Units of measure (AF, CCF, MG)** must remain consistent throughout the UWMP as reported in Submittal Table 2-3. | |
| **NOTES:** | |

| **Submittal Table 2-4 Retail: Water Supplier Information Exchange**<br>**Water Code Section 10631(h)** |
| --- |
| The retail Supplier has informed the following wholesale supplier(s) of projected water use. |
| Wholesale Water Supplier Name |
| Add additional rows as needed |
| Metropolitan Water District of Southern California |
| Orange County Water District |
| **NOTES:** |

| Submittal Table 3-1 Retail: Population - Current and Projected<br>Water Code Section 10631(a) | | | | | | |
|---|---|---|---|---|---|---|
| Population Served | 2025 | 2030 | 2035 | 2040 | 2045 | 2050(opt) |
| | 141,277 | 145,489 | 149,567 | 153,732 | 157,380 | 158,923 |

**NOTES:**

Source: Center for Demographic Research at California State University, Fullerton, 2025

| Submittal Table 4-1 Retail: Total Uses for Potable and Non-Potable Water — Actual<br>Water Code Section 10631(d)(1) | | | |
|---|---|---|---|
| Use Type | Additional Description (as needed) | 2025 Actual Water Use | |
| **Drop down list**<br>May select each use multiple times<br>These are the only use types that will be recognized by the WUEdata online submittal tool | | **Potable or Non-Potable**<br>(OPTIONAL)<br>Drop down list | Volume (AF) |
| Add additional rows as needed | | | |
| Single Family | | Potable | 9,981 |
| Multi-Family | | Potable | 4,206 |
| Commercial | | Potable | 4,124 |
| Industrial | | Potable | 458 |
| Institutional/Governmental | | Potable | 491 |
| Landscape | | Potable | 1,306 |
| Agricultural | | Potable | 2 |
| Other (optional) | | Potable | 31 |
| Distribution System Water Loss | | Potable | 1,644 |
| | | Subtotal Potable | 22,243 |
| | | Subtotal Non-Potable | 0 |
| | | **Total** | 22,243 |
| **DWR NOTES: Units of measure (AF, CCF, MG)** must remain consistent throughout the UWMP as reported in Submittal Table 2-3. This table identifies the unit of measure selected in Submittal Table 2-3. | | | |
| **NOTES:** Distribution system water loss includes 1,029.94 AF identified by the City of Fullerton and an additional 614 AF unaccounted for. Total distribution system water loss therefore equals 1,644 AF. | | | |

| Submittal Table 4-2 Retail: Total Uses for Potable, and Non-Potable Water — Projected<br>Water Code Section 10631(d)(1) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Use Type** | Additional Description (as needed) | **Projected Water Use** (Report To the Extent that Records are Available) | | | | | |
| **Drop down list**<br>May select each use multiple times<br>These are the only Use Types that will be recognized by the WUEdata online submittal tool | | **Potable or Non-Potable** (OPTIONAL) Drop down list | **2030 (AF)** | **2035 (AF)** | **2040 (AF)** | **2045 (AF)** | **2050 opt (AF)** |
| Add additional rows as needed. | | | | | | | |
| Single Family | | Potable | 9,192 | 9,186 | 9,224 | 9,211 | 9,163 |
| Multi-Family | | Potable | 4,286 | 4,481 | 4,655 | 4,800 | 4,930 |
| Commercial | Includes Institutional and Industrial uses | Potable | 4,842 | 5,035 | 5,195 | 5,210 | 5,215 |
| Landscape | Includes Agriculture use | Potable | 1,255 | 1,255 | 1,257 | 1,255 | 1,255 |
| Distribution System Water Loss | Includes Other uses | Potable | 782 | 797 | 812 | 818 | 821 |
| | | Subtotal Potable | 20,356 | 20,753 | 21,143 | 21,294 | 21,384 |
| | | Subtotal Non-Potable | 0 | 0 | 0 | 0 | 0 |
| | | **Total** | 20,356 | 20,753 | 21,143 | 21,294 | 21,384 |
| **DWR NOTES: Units of measure (AF, CCF, MG)** must remain consistent throughout the UWMP as reported in Submittal Table 2-3. This table identifies the unit of measure selected in Submittal Table 2-3. | | | | | | | |
| **NOTES:** Source – 2025 Orange County Water Demand Projection Model Forecast for the City of Fullerton | | | | | | | |

| Submittal Table 4-3 Retail: Inclusion in Water Use Projections<br>Water Code Section 10631 (a), 10631 (d)(4)(A), and 10631 (d)(4)(B) | |
|---|---|
| **Are Future Water Savings Included in Projections?**<br>**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.<br>***Optional*** Suppliers may complete Optional Submittal Table 4-4 R to quantify the expected savings. | Chapter 4.3 |
| **Are Lower Income Residential Demands Included In Projections?**<br>**Drop down list (y/n)** | Yes |
| ***Optional*** If the method for accounting Lower Income Residential Demands has been included, provide page number where this accounting can be found. | Chapter 4.3 |
| **DWR NOTES:** Additional guidance is provided in Appendix K. | |
| **NOTES:** Future water savings include passive conservation (defined as water savings that occur without incentives). Active conservation (defined as water savings that occur with incentives) is not included in the projections.<br><br>The demand projection methodology accounted for the entire population of the service area (i.e. all income levels). | |

| *Optional* Submittal Table 4-4 Retail: Passive Water Savings Projections<br>Water Code Section 10631(d)(4)(A) | | | | | |
|---|---|---|---|---|---|
| **Description**<br>(Codes, Standards, Ordinances, or Plans) | Passive savings | | | | |
| | **2030 (AF)** | **2035 (AF)** | **2040 (AF)** | **2045 (AF)** | **2050 opt (AF)** |
| Add additional rows as needed | | | | | |
| | 257 | 261 | 265 | 268 | 269 |
| **DWR NOTES: Units of measure (AF, CCF, MG)** must remain consistent throughout the UWMP as reported in Submittal Table 2-3. This table identifies the unit of measure selected in Submittal Table 2-3. | | | | | |
| **NOTES:** Passive conservation here is defined as water savings that occur without incentives. Based on the Demand Projection TM, passive conservation is assumed to equal a 1.9% decrease in residential demand due to conservation by 2030 (linearly extrapolated), then remains constant in subsequent years. | | | | | |

| Submittal Table 4-5 Retail: Water Loss Audit Reporting<br>Water Code Section 10631(d)(3)(A) | | |
|---|---|---|
| **Public Water System ID # Reported in Table 2-1 R** | Reporting Period | Submitted to DWR Water Loss Audit Program (yes/no) |
| **Report submittal status for all five years for each Public Water System as available. Add rows as needed** | | |
| CA3010010 | **2020** | Yes |
| | **2021** | Yes |
| | **2022** | Yes |
| | **2023** | Yes |
| | **2024** | Yes |
| **DWR NOTES:** Suppliers will provide a link to the WUEdata submittals of their Water Loss Audit Reports. | | |
| **NOTES:** Water Loss Audits reported in Calendar Years (CY). | | |

**Submittal Table 4-6 Retail: Progress Towards 2028 Water Loss Standard**
**Water Code Section 10631(d)(3)(C)**

| Public Water System ID # Reported in Submittal Table 2-1 R | Did the Water Board Calculate a Water Loss Standard for this Public Water System? (y/n) If no, Supplier will not complete this row. | Real Water Loss | | | | | Apparent Water Loss | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | State Water Board Standard | | Most Recent AWWA Water Loss Audit | | | State Water Board Standard | | Most Recent AWWA Water Loss Audit | | |
| | | 2028 Real Water Loss Standard per Unit per day | Units for Real Water Loss Drop down list | Number of Units (Connections or Miles corresponding with units selected) | Volume of Total Real Loss (from AWWA Water Loss Audit) (AF) | Real Water Loss Per Unit per Day | 2028 Apparent Water Loss Standard per Unit per Day | Units for Apparent Water Loss | Number of Connections | Volume of Total Apparent Loss (from AWWA Water Loss Audit) (AF) | Apparent Water Loss Per Unit per Day |
| Add additional rows as needed. | | | | | | | | | | | |
| CA3010010 | Yes | 14.5 | Gallons per Service Connection per Day (GPSCD) | 32,138 | 208.13 | 5.8 | 13.6 | Gallons per Service Connection per Day (GPSCD) | 32,138 | 446.31 | 12.4 |
| Water Board's Calculated Water Loss Standards | | | | | | | | | | | |

**DWR NOTES: Units of measure (AF, CCF, MG)** for Water Loss **MUST** remain consistent with units reported in Submittal Table 2-3. The units reported in Submittal Table 2-3 are used in this table's calculations.

**NOTES:**

Uses the Water Board's calculated water loss standards updated as of 01/30/2026 and AWWA Water Loss Audit for CY 2024. Connection count may differ from what is reported in Table 2-1 R for FY 2025.

| Submittal Table 5-1 Retail: SB X7-7 2020 Target Progress<br>Water Code Section 10608.40 | | | | | | |
|---|---|---|---|---|---|---|
| ☐ | **Check the box if the Supplier was not an Urban Water Supplier during or before the 2020 UWMP reporting cycle. Proceed to the next table.** | | | | | |
| Was Supplier part of a merger or consolidation since 2020? | Regional Alliance Target or Individual Target?<br>Drop down list | 2020 Target | Actual 2020 GPCD | Did Supplier Achieve Targeted Reduction for 2020? | **Only for suppliers that did not meet the Target in 2020**<br>**See DWR NOTES below.** | |
| | | | | | Actual 2025 GPCD<br>(From SB X7-7 Compliance Form) | Did Supplier meet the 2020 Target in 2025? |
| No | Individual Target | 179 | 111 | Yes | | NA |

**DWR NOTES:**
**Suppliers calculating a 2025 GPCD** will need to complete and submit SB X 7-7 Compliance Tables to verify the use of SB X7-7 Methodologies.
**Suppliers that were part of a merger or consolidation since 2020** see Chapter 5 and Appendix P for guidance.
NA=Not Applicable

**NOTES:** Supplier met the 2020 target, actual 2025 GPCD not required.

| Submittal Table 6-1 Retail: Groundwater Volume Pumped<br>Water Code Section 10631(4) and 10631(4)(c) | | | | | | | |
|---|---|---|---|---|---|---|---|
| ☐ | Check the box if the Supplier does not pump groundwater.<br>Proceed to the next table. | | | | | | |
| ☐ | Check the box if all or part of the groundwater described below is desalinated. (OPTIONAL) | | | | | | |
| Groundwater Type<br>**Drop Down List**<br>May use each category multiple times | Potable or Non-Potable<br>(OPTIONAL)<br>**Drop down list** | Location or Basin Name | 2021 (AF) | 2022 (AF) | 2023 (AF) | 2024 (AF) | 2025 (AF) |
| **Add additional rows as needed** | | | | | | | |
| Alluvial Basin | | Orange County Groundwater Basin | 17,626 | 17,739 | 15,467 | 14,699 | 13,979 |
| | | **Total** | 17,626 | 17,739 | 15,467 | 14,699 | 13,979 |

**DWR NOTES:**
**Units of measure (AF, CCF, MG)** must remain consistent throughout the UWMP as reported in Submittal Table 2-3. This table identifies the unit of measure selected in Submittal Table 2-3.

**NOTES:** Source - MWDOC, 2025

| Submittal Table 6-2 Retail: Wastewater Collected Within Service Area<br>Water Code Section 10633(a) | | | | |
|---|---|---|---|---|
| ☐ | Check the box if there is no wastewater collection system.<br>Proceed to the next table. | | | |
| | Percentage of 2025 service area served by wastewater collection system (OPTIONAL) | | | |
| | Percentage of 2025 service area population served by wastewater collection system (OPTIONAL) | | | |
| **Wastewater Collection** | | | **Recipient of Collected Wastewater** | |
| Name of Wastewater Collection Agency | Wastewater Volume Metered or Estimated?<br>OPTIONAL<br>**Drop Down List** | Volume of Wastewater Collected from UWMP Service Area 2025 (AF) | Name of Wastewater Treatment Plant (WWTP) and Place ID Number<br>**Drop down list** | Is WWTP Located Within UWMP Area?<br>**Drop Down List** |
| Add additional rows as needed | | | | |
| City of Fullerton | Estimated | 14,458 | OCSD Plant 1, Place ID 758392 | No |
| | | | OCSD Plant 2, Place ID 259158 | No |
| **Total Wastewater Received from UWMP Service Area in 2025:** | | 14,458 | | |

**DWR NOTES: Units of measure (AF, CCF, MG)** must remain consistent throughout the UWMP as reported in Submittal Table 2-3. This table identifies the unit of measure selected in Submittal Table 2-3.
**Additional Guidance**: See Appendix M, Section M.21 for detailed guidance on this table.

**NOTES:** Additional information needed.
Assumed a return rate of 65% (City of Fullerton, 2015)

**Submittal Table 6-3 Retail: Wastewater Treatment and Outcomes Within UWMP Service Area**
**Water Code Section 10633(b)**

| | |
|---|---|
| ☑ | **Check the box if no wastewater is treated or disposed of within the UWMP service area.**<br>Proceed to the next table. |

| Wastewater Treatment Plant Name and Place ID Number **Drop down list** | Does This Plant Treat Wastewater Generated Outside the UWMP Service Area? (OPTIONAL) **Drop down list** | 2025 Volume of Wastewater Received from UWMP Service Area (As Reported in Submittal Table 6-2 R) (AF) | Total 2025 Volume of Water Treated (AF) | **2025 Outcomes of Treated Wastewater** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | **Water Recycled Within UWMP Service Area** (enter data as applicable) | | **Water Recycled Outside of UWMP Service Area** (enter data as applicable) | | **Effluent Discharge that is not a Permitted Recycled Water Use** (enter data as applicable) | | **Required Discharge for Instream Flow** (enter data as applicable) | | **Delivered to Another Entity for Additional Treatment** (enter data as applicable) | | |
| | | | | Treatment Level **Drop down list** | Volume (AF) | Treatment Level **Drop down list** | Volume (AF) | Treatment Level **Drop down list** | Volume (AF) | Treatment Level **Drop down list** | Volume (AF) | Treatment Level **Drop down list** | Volume (AF) | Name of other entity |
| Add additional rows as needed | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | **Total** | 0 | - | | 0 | | 0 | | 0 | | 0 | | 0 | |

**DWR NOTES:**
**Units of measure (AF, CCF, MG)** must remain consistent throughout the UWMP as reported in Submittal Table 2-3. This table identifies the unit of measure selected in Submittal Table 2-3.
**IPR:** Indirect Potable Reuse would have the treatment level of its end use requirement in the Level of Treatment drop-down.
**Additional Guidance:** See Appendix M, Section M.21 for detailed guidance on this table.

**NOTES:**

**Submittal Table 6-4 Retail: Recycled Water Direct Beneficial Uses Within Service Area**
**Water Code Section 10633 (c),(d),(e)**

| | |
|---|---|
| ☑ | Check box if recycled water is not used and is not planned for use within the service area of the supplier. The supplier will only complete the column on "Potential Recycled Water Use" and submit an accompanying narrative on the feasibility of that potential recycled water use. |

| | |
|---|---|
| Name(s) of Facility/ies Producing (Treating) the Recycled Water (OPTIONAL) : | |
| Name of Supplier Operating the Recycled Water Distribution System (OPTIONAL) : | |
| Volume of Supplemental Water Added in 2025 (OPTIONAL) : | |
| Source of 2025 Supplemental Water (OPTIONAL) : | |

| Use Type<br>**Drop down list** | **Potable or Non-Potable**<br>(after treatment if treated)<br>(OPTIONAL)<br>Drop down list | Additional Information<br>(as needed) | 2025 (AF) | 2030 (AF) | 2035 (AF) | 2040 (AF) | 2045 (AF) | 2050 (AF) | **Potential Recycled Water Use** | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Volume | Narrative page number<br>(OPTIONAL) |
| Add additional rows as needed | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | Subtotal Potable | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | | Subtotal Non-Potable | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | | **Total** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**DWR NOTES: Units of measure (AF, CCF, MG)** must remain consistent throughout the UWMP as reported in Submittal Table 2-3. This table identifies the unit of measure selected in Submittal Table 2-3.
**Additional Guidance:** See Appendix M, Section M.21 for detailed guidance on this table.
**Potential recycled water use:** a description of the feasibility of these uses must be included in the narrative.
**Multiple Producers:** If you have multiple recycled water producers, submit a separate table for each.

**NOTES:**

| Submittal Table 6-5 Retail: 2020 UWMP Recycled Water Use Projection Compared to 2025 Actual<br>Water Code Section 10633(e) | | |
|---|---|---|
| ☑ | Check the box if recycled water was not used in 2025 nor previously projected for use in 2020.<br>Proceed to the next table. | |
| **Use Type**<br>Drop Down list | 2020 Projection for 2025 (AF) | 2025 Actual Use (AF) |
| Add additional rows as needed | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| **Total** | 0 | 0 |

**DWR NOTES:**
**Units of measure (AF, CCF, MG)** must remain consistent throughout the UWMP as reported in Submittal Table 2-3. This table identifies the unit of measure reported in Submittal Table 2-3
**Additional Guidance:** See Appendix M, Section M.21 for detailed guidance on this table.

**NOTES:**

| Submittal Table 6-6 Retail: Methods to Encourage Future Recycled Water Use<br>Water Code Section 10633(f) | | | |
|---|---|---|---|
| ☑ | Check the box if the 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 the UWMP | | |
| Name of Action | Description | Planned Implementation Year | Expected Increase in Recycled Water Use (AF) |
| Add additional rows as needed | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | **Total (AF)** | 0 |
| | | **Unit Conversion to AF** | 0 |

**DWR NOTES:**
**Units of measure** (AF, CCF, MG) MUST remain consistent with units reported in Submittal Table 2-3. This table identifies the unit of measure selected in Submittal Table 2-3.
**The unit conversion to Acre Feet** addresses the Water Code's requirement that this value be provided in acre-feet.

**NOTES:**

| Submittal Table 6-7 Retail: Expected Future Water Supply Projects or Programs<br>Water Code Section 10631(f) | | | | | | | |
|---|---|---|---|---|---|---|---|
| ☐ | Check the box if there are no expected future water supply projects or programs that provide a quantifiable increase to the agency's water supply. Proceed to the next table. | | | | | | |
| ☐ | Check the box if 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? | | Additional Description (as needed) | **Potable or Non-Potable** (after treatment if treated) (OPTIONAL) Drop Down list | Planned Implementation Year | Planned for Use in Year Type **Drop Down List** | Expected Increase in Water Supply to Supplier (This may be a range) (AF) |
| | **Drop Down List (yes/no)** | If Yes, Supplier Name | | | | | |
| Add additional rows as needed | | | | | | | |
| New Well (7A) | No | | Construction of a new well to replace well 7 | Potable | 2026-2027 | All Year Types | 2,500 - 3,000 gpm |
| New Well | No | | Construction of a new well | Potable | FY 2029-30 | All Year Types | 2,500 - 3,000 gpm |
| | | | | | | | |
| **DWR NOTES:**<br>**Units of measure (AF, CCF, MG)** must remain consistent throughout the UWMP as reported in Submittal Table 2-3. This table identifies the unit of measure reported in Submittal Table 2-3. | | | | | | | |
| **NOTES:** Source: City of Fullerton 2026 | | | | | | | |

| Submittal Table 6-8 Retail: Water Supplies — Actual<br>Water Code Section 10631(b) | | | | |
|---|---|---|---|---|
| **Water Supply** | | **2025** | | |
| **Drop down list**<br>May use each category multiple times. These are the only water supply categories that will be recognized by the WUEdata online submittal tool | Additional Description<br>(as needed) | **Potable or Non-Potable**<br>(after treatment if treated)<br>(OPTIONAL)<br>Drop Down list | Actual Volume<br>(AF) | Total Entitlement<br>(OPTIONAL)<br>See 'DWR Notes' below<br>(AF) |
| Add additional rows as needed | | | | |
| Groundwater (not desalinated) | Orange County Groundwater Basin | | 13,979 | |
| Purchased or Imported Water | MWD | | 8,264 | |
| | | | | |
| | | | | |
| | | Subtotal Potable | 0 | 0 |
| | | Subtotal Non-Potable | 0 | 0 |
| | | **Total** | 22,243 | 0 |

**DWR NOTES:**
**Units of measure (AF, CCF, MG)** must remain consistent throughout the UWMP as reported in Submittal Table 2-3. This table identifies the unit of measure selected in Submittal Table 2-3.
**Total Entitlement:** e.g. Water Right, Groundwater Allocation, Contracted Amount.

**NOTES**: Source - MWDOC, 2025

**Submittal Table 6-9 Retail: Water Supplies — Projected**
**Water Code Section 10631 (b)**

| Water Supply | | | Projected Water Supply (Report to the Extent Practicable) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **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 | Additional Detail on Water Supply | **Potable or Non-Potable** (after treatment if treated) (OPTIONAL) Drop Down list | **2030** | | **2035** | | **2040** | | **2045** | | **2050 (opt)** | |
| | | | Reasonably Available Volume (AF) | Total Entitlement (OPTIONAL) See 'DWR Notes' below (AF) | Reasonably Available Volume (AF) | Total Entitlement (OPTIONAL) See 'DWR Notes' below (AF) | Reasonably Available Volume (AF) | Total Entitlement (OPTIONAL) See 'DWR Notes' below (AF) | Reasonably Available Volume (AF) | Total Entitlement (OPTIONAL) See 'DWR Notes' below (AF) | Reasonably Available Volume (AF) | Total Entitlement (OPTIONAL) See 'DWR Notes' below (AF) |
| Add additional rows as needed | | | | | | | | | | | | |
| Purchased or Imported Water | MWDOC | Potable | 3,053 | | 3,113 | | 3,171 | | 3,194 | | 3,208 | |
| Groundwater (not desalinated) | Orange County Groundwater Basin | Potable | 17,303 | | 17,640 | | 17,972 | | 18,100 | | 18,176 | |
| Recycled Water | | Non-Potable | 0 | | 0 | | 0 | | 0 | | 0 | |
| | | Subtotal Potable | 20,356 | 0 | 20,753 | 0 | 21,143 | 0 | 21,294 | 0 | 21,384 | 0 |
| | | Subtotal Non-Potable | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | **Total** | 20,356 | 0 | 20,753 | 0 | 21,143 | 0 | 21,294 | 0 | 21,384 | 0 |

**DWR NOTES:**
**Units of measure (AF, CCF, MG)** must remain consistent throughout the UWMP as reported in Submittal Table 2-3.
**Total Entitlement:** e.g. Water Right, Groundwater Allocation, Contracted Amount.

**NOTES**: Source - MWDOC, 2025.

## *Optional* Submittal Table O-1A: Recommended Energy Reporting - SINGLE DELIVERY PRODUCT - WATER SUPPLY PROCESS APPROACH

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Water Delivery Product** drop down list (If delivering more than one type of product recommend using Table O-1C) | Retail Potable Deliveries | **Only for Water Delivery Products Under the Urban Water Supplier's Operational Control** | | | | | | | | |
| Start Date of Reporting Period | July 1 2024 | **Water Management Process** | | | | | | | **Non-Consequential Hydropower (if applicable)** | |
| End Date of Reporting Period | June 30 2025 | | | | | | | | | |
| Is upstream embedded energy included in the values reported? | No | | | | | | | | | |
| | | Units for Water Volume | Extract and Divert | Place into Storage | Conveyance | Treatment | Distribution | **Total Utility** See DWR NOTES | Hydropower | Net Utility |
| Volume of Water Entering Process | | AF | 13,979 | | | | 22,243 | 22,243 | 0 | 22,243 |
| Energy Consumed (kWh) | | N/A | 7,469,428 | | | | 2,205,146 | 9,674,574 | | 9,674,574 |
| Energy Intensity (kWh/vol. converted to MG) | | N/A | 1640 | 0 | 0 | 0 | 304 | 1335 | 0 | 1335 |

**DWR NOTES: Total Utility:**The volume of water entered in the "Total Utility" column should equal the volume of water entering the distribution system (excluding recycled water); in most cases, this is the total volume calculated in UWMP Table 4-1: 2025 Actual Total Uses for Potable and Non-Potable Water. Note if recycled water is included in your Submittal Table 4-1, you must exclude it from your volume in this table.

**Quantity of Self-Generated Renewable Energy**

5,912 kWh

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

*Combination of Estimates and Metered Data*

**Data Quality Narrative:**

Energy consumed is based on metered billing data from Southern California Edison and Anaheim Public Utilities. Self-generated renewable energy is difficult to determine because the onsite solar panels are on the same power meter as Well 3A treatment plant.

**Narrative:**

The City relies on imported water and local groundwater to meet customer needs. Operational control is limited to groundwater withdrawals and potable water booster stations.

**NOTES:**

| *Optional* Submittal Table 7-1 Retail: Basis of Water Year Data (Reliability Assessment) | | | |
|---|---|---|---|
| **Year Type** | **Base Year**<br>If not using a calendar year, type in the last year of the fiscal, water year, or range of years, for example, water year 2024-2025, use 2025 | **Available Supplies if Year Type Repeats** | |
| | | ☐ Check the box if quantification of available supplies is not compatible with this table and is provided elsewhere in the UWMP.<br>**Location:** [insert location from UWMP] | |
| | | Quantification of available supplies is provided in this table as either volume only, percent only, or both. | |
| | | **Volume Available (AF)** | **% of Average Supply** |
| Average Year | 1991-2024 | | 100% |
| Single-Dry Year | 2014 | | 107% |
| Consecutive Dry Years 1st Year | 1991-2024 | | 107% |
| Consecutive Dry Years 2nd Year | 1991-2024 | | 112% |
| Consecutive Dry Years 3rd Year | 1991-2024 | | 113% |
| Consecutive Dry Years 4th Year | 1991-2024 | | 115% |
| Consecutive Dry Years 5th Year | 1991-2024 | | 117% |

**DWR NOTES:** Supplier may use multiple versions of Submittal Table 7-1 R 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 Submittal Table 7-1 R, in the "Note" section of each submittal table, state that multiple versions of Submittal Table 7-1 R are being used and identify the particular water source that is being reported in each submittal table.
**Units of measure (AF, CCF, MG**) must remain consistent throughout the UWMP as reported in Submittal Table 2-3. This table reports the units of measure reported in Submittal Table 2-3.

**NOTES:**

| Submittal Table 7-2 Retail: Normal Year Supply and Use Comparison<br>Water Code Section 10635 (a) | | | | | |
|---|---|---|---|---|---|
| | 2030 (AF) | 2035 (AF) | 2040 (AF) | 2045 (AF) | 2050 (AF) |
| Supply totals (autofill from Submittal Table 6-9 R) | 20,356 | 20,753 | 21,143 | 21,294 | 21,384 |
| Use totals (autofill from Submittal Table 4-2 R) | 20,356 | 20,753 | 21,143 | 21,294 | 21,384 |
| Surplus/(shortfall) | 0 | 0 | 0 | 0 | 0 |
| **OPTIONAL Planned WSCP Actions** | | | | | |
| WSCP - supply augmentation benefit | | | | | |
| WSCP - use reduction savings benefit | | | | | |
| Revised Surplus/(shortfall) | | | | | |
| **DWR NOTES : Units of measure (AF, CCF, MG)** must remain consistent throughout the UWMP as reported in Submittal Table 2-3. | | | | | |
| **NOTES:** | | | | | |

**If you choose to fill these optional tables, please paste the combined information in the submittal table to the left.**

| OPTIONAL Submittal Table 7-2 Retail: Normal Year Supply and Use Comparison - POTABLE | | | | | |
|---|---|---|---|---|---|
| | 2030 (AF) | 2035 (AF) | 2040 (AF) | 2045 (AF) | 2050 (AF) |
| Supply totals (autofill from Submittal Table 6-9 R) | 20,356 | 20,753 | 21,143 | 21,294 | 21,384 |
| Use totals (autofill from Submittal Table 4-2 R) | 20,356 | 20,753 | 21,143 | 21,294 | 21,384 |
| Surplus/(shortfall) | 0 | 0 | 0 | 0 | 0 |
| **OPTIONAL Planned WSCP Actions** | | | | | |
| WSCP - supply augmentation benefit | | | | | |
| WSCP - use reduction savings benefit | | | | | |
| Revised Surplus/(shortfall) | | | | | |
| NOTES: | | | | | |

| OPTIONAL Submittal Table 7-2 Retail: Normal Year Supply and Use Comparison - NON-POTABLE | | | | | |
|---|---|---|---|---|---|
| | 2030 (AF) | 2035 (AF) | 2040 (AF) | 2045 (AF) | 2050 (AF) |
| Supply totals (autofill from Submittal Table 6-9 R) | 0 | 0 | 0 | 0 | 0 |
| Use totals (autofill from Submittal Table 4-2 R) | 0 | 0 | 0 | 0 | 0 |
| Surplus/(shortfall) | 0 | 0 | 0 | 0 | 0 |
| **OPTIONAL Planned WSCP Actions** | | | | | |
| WSCP - supply augmentation benefit | | | | | |
| WSCP - use reduction savings benefit | | | | | |
| Revised Surplus/(shortfall) | | | | | |
| NOTES: | | | | | |

| Submittal Table 7-3 Retail: Single Dry Year Supply and Use Comparison<br>Water Code Section 10635(a) | | | | | |
|---|---|---|---|---|---|
| | **2030 (AF)** | **2035 (AF)** | **2040 (AF)** | **2045 (AF)** | **2050 (AF)** |
| Supply totals | 21,823 | 22,249 | 22,667 | 22,828 | 22,925 |
| Use totals | 21,823 | 22,249 | 22,667 | 22,828 | 22,925 |
| Surplus/(shortfall) | 0 | 0 | 0 | 0 | 0 |
| **OPTIONAL Planned WSCP Actions** | | | | | |
| WSCP - supply augmentation benefit | | | | | |
| WSCP - use reduction savings benefit | | | | | |
| Revised Surplus/(shortfall) | | | | | |
| **DWR NOTES : Units of measure (AF, CCF, MG)** must remain consistent throughout the UWMP as reported in Submittal Table 2-3. | | | | | |
| NOTES: The single dry year projections estimate a 7% increase on imported M&I demand. | | | | | |

| Submittal Table 7-4 Retail: Multiple Dry Years Supply and Use Comparison<br>Water Code Section 10635(a) | | | | | | |
|---|---|---|---|---|---|---|
| | | 2030 (AF) | 2035 (AF) | 2040 (AF) | 2045 (AF) | 2050 (AF) |
| First year | Supply totals | 21823 | 22249 | 22667 | 22828 | 22925 |
| | Use totals | 21,823 | 22,249 | 22,667 | 22,828 | 22,925 |
| | Surplus/(shortfall) | 0 | 0 | 0 | 0 | 0 |
| | **OPTIONAL Planned WSCP Actions** | | | | | |
| | WSCP - supply augmentation benefit | | | | | |
| | WSCP - use reduction savings benefit | | | | | |
| | Revised Surplus/(shortfall) | | | | | |
| Second year | Supply totals | 22789 | 23233 | 23670 | 23838 | 23939 |
| | Use totals | 22,789 | 23,233 | 23,670 | 23,838 | 23,939 |
| | Surplus/(shortfall) | 0 | 0 | 0 | 0 | 0 |
| | **OPTIONAL WSCP Actions** | | | | | |
| | WSCP - supply augmentation benefit | | | | | |
| | WSCP - use reduction savings benefit | | | | | |
| | Revised Surplus/(shortfall) | | | | | |
| Third year | Supply totals | 22931 | 23378 | 23817 | 23987 | 24088 |
| | Use totals | 22,931 | 23,378 | 23,817 | 23,987 | 24,088 |
| | Surplus/(shortfall) | 0 | 0 | 0 | 0 | 0 |
| | **OPTIONAL Planned WSCP Actions** | | | | | |
| | WSCP - supply augmentation benefit | | | | | |
| | WSCP - use reduction savings benefit | | | | | |
| | Revised Surplus/(shortfall) | | | | | |
| Fourth year | Supply totals | 23365 | 23820 | 24268 | 24440 | 24544 |
| | Use totals | 23,365 | 23,820 | 24,268 | 24,440 | 24,544 |
| | Surplus/(shortfall) | 0 | 0 | 0 | 0 | 0 |
| | **OPTIONAL Planned WSCP Actions** | | | | | |
| | WSCP - supply augmentation benefit | | | | | |
| | WSCP - use reduction savings benefit | | | | | |
| | Revised Surplus/(shortfall) | | | | | |
| Fifth year | Supply totals | 23761 | 24225 | 24680 | 24855 | 24961 |
| | Use totals | 23,761 | 24,225 | 24,680 | 24,855 | 24,961 |
| | Surplus/(shortfall) | 0 | 0 | 0 | 0 | 0 |
| | **OPTIONAL Planned WSCP Actions** | | | | | |
| | WSCP - supply augmentation benefit | | | | | |
| | WSCP - use reduction savings benefit | | | | | |
| | Revised Surplus/(shortfall) | | | | | |

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

NOTES: The 2030 column assesses supply and demand for FY 2025-26 through FY 2029-30; the 2035 column assesses FY 2030-31 through FY 2034-35 and so forth, in order to end the water service reliability assessment in FY 2049-50.

| Submittal Table 7-5 Retail: Five-Year Drought Risk Assessment Water Code Section 10635(b)(3) | |
|---|---|
| **2026** | **Total** |
| Total Water Use (AF) | 23,846 |
| Total Supplies (AF) | 23,846 |
| Surplus/Shortfall w/o WSCP Action | 0 |
| **OPTIONAL Planned WSCP Actions** (use reduction and supply augmentation) | |
| WSCP - supply augmentation benefit (AF) | |
| WSCP - use reduction savings benefit (AF) | |
| Revised Surplus/(shortfall) | |
| **2027** | **Total** |
| Total Water Use (AF) | 24,901 |
| Total Supplies (AF) | 24,901 |
| Surplus/Shortfall w/o WSCP Action | 0 |
| **OPTIONAL Planned WSCP Actions** (use reduction and supply augmentation) | |
| WSCP - supply augmentation benefit (AF) | |
| WSCP - use reduction savings benefit (AF) | |
| Revised Surplus/(shortfall) | |
| **2028** | **Total** |
| Total Water Use (AF) | 25,056 |
| Total Supplies (AF) | 25,056 |
| Surplus/Shortfall w/o WSCP Action | 0 |
| **OPTIONAL Planned WSCP Actions** (use reduction and supply augmentation) | |
| WSCP - supply augmentation benefit (AF) | |
| WSCP - use reduction savings benefit (AF) | |
| Revised Surplus/(shortfall) | |
| **2029** | **Total** |
| Total Water Use (AF) | 25,530 |
| Total Supplies (AF) | 25,530 |
| Surplus/Shortfall w/o WSCP Action | 0 |
| **OPTIONAL Planned WSCP Actions** (use reduction and supply augmentation) | |
| WSCP - supply augmentation benefit (AF) | |
| WSCP - use reduction savings benefit (AF) | |
| Revised Surplus/(shortfall) | |
| **2030** | **Total** |
| Total Water Use (AF) | 25,964 |
| Total Supplies (AF) | 25,964 |
| Surplus/Shortfall w/o WSCP Action | 0 |
| **OPTIONAL Planned WSCP Actions** (use reduction and supply augmentation) | |
| WSCP - supply augmentation benefit (AF) | |
| WSCP - use reduction savings benefit (AF) | |
| Revised Surplus/(shortfall) | |
| **DWR NOTES: Units of measure (AF, CCF, MG)** must remain consistent throughout the UWMP as reported in Submittal Table 2-3. | |
| **NOTES:** | |

| Submittal Table 8-1: Cross-reference for Standard vs Supplier Shortage Levels<br>Water Code Section 10632(a)(3)(B) | | | |
|---|---|---|---|
| ☑ | Check the box if the Supplier uses the Standard six levels of water shortage.<br>Proceed to the next table. | | |
| **Standard Shortage Levels** | **Percent Shortage Range** | **Suppliers Shortage Levels** | **Percent Shortage Range** |
| 1 | Up to 10% | | |
| 2 | Up to 20% | | |
| 3 | Up to 30% | | |
| 4 | Up to 40% | | |
| 5 | Up to 50% | | |
| 6 | >50% | | |
| **NOTES:** | | | |

| Submittal Table 8-2 Retail: Supply Augmentation and Other Actions<br>Water Code Section 10632(a)(4)(A),(C) and (E) | | | | |
|---|---|---|---|---|
| Yes | Is the Supplier completing this table using the standard six levels? (yes/no) | | | |
| Shortage Level | Supply Augmentation Methods and Other Actions by Water Supplier<br>**Drop down list**<br>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? | | Additional Explanation or Reference<br>(OPTIONAL) |
| | | Volume or Percentage<br>Drop down | Shortage Gap Reduction Value<br>(May be a range) (AF) | |
| Add additional rows as needed | | | | |
| 0-6 | Other Actions (describe) | Percentage | 0-100% | Pump additional groundwater from OC Groundwater Basin (short-term shortage) with rate penalty |
| 0-6 | Other Actions (describe) | Percentage | 1-100% | Purchase additional imported water from MET with rate penalty |
| **DWR NOTES: Units of measure (AF, CCF, MG)** must remain consistent throughout the UWMP as reported in Submittal Table 2-3. | | | | |
| NOTES: Both additional pumped groundwater and purchased imported water are subject to rate penalties from OCWD and MET. | | | | |

| Submittal Table 8-3 Retail: Demand Reduction Actions<br>Water Code Section 10632(a)(4)(B) and (E) | | | | | |
|---|---|---|---|---|---|
| Yes | Is the Supplier completing this table using the standard six levels? (yes/no) | | | | |
| Shortage Level | Demand Reduction Actions<br>**Drop down list**<br>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? | | Additional Explanation or Reference (OPTIONAL) | Penalty, Charge, or Other Enforcement?<br>**For Retail Suppliers Only**<br>Drop Down List |
| | | Volume or Percentage<br>Drop down | Shortage Gap Reduction Value<br>(May be a range)<br>(AF) | | |
| Add additional rows as needed | | | | | |
| 0 | Landscape - Prohibit certain types of landscape irrigation | | Statewide Prohibition is Required | Watering or irrigation of nonfunctional turf (NFT) on State and local government properties, commercial, industrial and institutional owned landscapes, homeowners' associations common area landscapes, and local government facilities in disadvantaged communities (DAC) is prohibited. See Note 1 below | No |
| 0 | Other water feature or swimming pool restriction | Percentage | 0 | All decorative water features must re-circulate water or users mist secure a waiver from the City. | Yes |
| 0 | Other | Percentage | 0 | Washing or hosing down vehicles is prohibited except by use of a hand held contianer, hose with an automatic shut off device, or at a commercial car wash. | Yes |
| 0 | Other - Prohibit use of potable water for washing hard surfaces | Percentage | 0 | Washing hard or paved surfaces is prohibited except to alleviate safety or sanitary hazards using a hand held container, hose with an automatic shut off device, or a low-volume high pressure cleaning machine that recycles used water. | Yes |
| 0 | Landscape - Restrict or prohibit runoff from landscape irrigation | Percentage | 0 | Watering vegetated areas in a manner that causes excessive water flow or runoff onto an adjoining sidewalk, driveway, street, alley, gutter or ditch is prohibited. | Yes |
| 0 | Landscape - Other landscape | Percentage | 0 | Irrigating ornamental turf on public street medians | Yes |
| 0 | Landscape - Limit landscape irrigation to specific times | Percentage | 0 | Watering or irrigation with a device that is not contiguously attended to is limited to fifteen (15) | Yes |
| 0 | Other - Customers must repair leaks, breaks, and malfunctions in a timely manner | Percentage | 0 | Fix leaks or faulty sprinkler promptly/within 3 day(s) | Yes |
| 0 | CII - Other CII restriction or prohibition | Percentage | 0 | No single pass cooling systems may be installed in new or remodeled buildings. | Yes |
| 0 | CII - Commercial kitchens required to | Percentage | 0 | All new commercial car wash and laundry facilities | Yes |
| 0 | Other - Require automatic shut of | Percentage | 0 | Use a shutoff nozzle on hoses. | Yes |
| 0 | Other - Prohibit vehicle washing | Percentage | 0 | Food preparation establishments must use water | Yes |
| 0 | Other | Percentage | 0 | Unauthorized use of hydrants is prohibited. Authorization for use must be obtained from water supplier. | Yes |
| 1 | Expand Public Information Campaign | Percentage | 0-1% | Community outreach and messaging (Expand public | Yes |
| 1 | Landscape - Limit landscape irrigation | Percentage | 0-5% | watering or irrigation of vegetated areas is | Yes |
| 1 | CII - Restaurants may only serve water upon request | Percentage | 0-1% | CII- Restaurants may only serve water upon request. | Yes |
| 1 | CII - Lodging establishment must offer opt out of linen service | Percentage | 0-1% | CII- Lodging establishment must offer opt out of linen service | Yes |
| 1 | CII - Other CII restriction or prohibition | Percentage | 0-1% | Commercial, industrial, institutional equipment must be properly maintained and in full working order. | Yes |
| 1 | Landscape - Prohibit certain types of landscape irrigation | Percentage | 0-1% | All non-essential water use for nurseries, public entities, and commerical and industiral use should cease. | Yes |
| 1 | Offer Water Use Surveys | Percentage | 0-1% | Offer water use surveys (offered through MET) | Yes |
| 1 | Provide Rebates on Plumbing Fixtures and Devices | Percentage | 0-1% | Provide Rebates on Plumbing Fixtures and Decives (offered through MET) | Yes |
| 1 | Provide Rebates for Landscape Irrigation Efficiency | Percentage | 0-1% | Provide Rebates for turf replacement (offered through MET) | Yes |
| 1 | Increase Water Waste Patrols | Percentage | 0-1% | Increase water waste patrols | Yes |
| 1 | Other | Percentage | 5-10% | Other prohibited uses: the city may implement other prohibited water uses as determined by the City, after notice to customers. | Yes |
| 2 | Landscape - Limit landscape irrigation to specific days | Percentage | 5-10% | Irrigation shall be limited to 3 days per week turf watering when using potable water. Plant containers, trees, shrubs, and vegatable gardens may be watered additional days using only drip irrigation or hand watering. | Yes |
| 2 | Water Features - Restrict water use for decorative water features, such as fountains | Percentage | 0-1% | Filling or refilling ornamental lakes and ponds is prohibited. Ornamental lakes and ponds that sustain aquatic life of significant value and were actively managed prior to the storage declaration are exempt. | Yes |
| 2 | Decrease Line Flushing | Percentage | 0-1% | Decrease Line Flushing | Yes |
| 2 | Reduce System Water Loss | Percentage | 0-5% | Real loss reduction - Pressure management and more aggressive leak detection and repair | Yes |
| 2 | Pools and Spas - Require covers for pools and spas | Percentage | 0-1% | Pools and Spas - Require covers for pools and spas | Yes |
| 2 | Pools - Allow filling of swimming pools only when an appropriate cover is in place. | Percentage | 0-1% | Pools- allow filling of swimming pools only when appropriate cover is in place. | Yes |
| 2 | Other | Percentage | 5-10% | Other prohibited uses: the city may implement other prohibited water uses as determined by the City, after notice to customers. | Yes |
| 3 | Other water feature or swimming pool restriction | Percentage | 0-1% | Decorative water features that use potable warer must be drained and kept dry. | Yes |
| 3 | Other - Prohibit vehicle washing except at facilities using recycled or recirculating water | Percentage | 0-1% | Car washing is only permitted using a commerical carwash that recirculates water or by high pressure/low volume wash systems. | Yes |
| 3 | Other - Prohibit use of potable water for construction and dust control | Percentage | 0-1% | Require a construction water use plan be submitted to the water supplier that addresses how impacts to exsisting water users will be mitigated (such as a dust control) | Yes |
| 3 | Landscape - Other landscape restriction or prohibition | Percentage | 0-1% | With the exception of landscapes watered with non-potable water, limit the installation of new landscaping to drought tolerant trees, shrubs and groundcover. Prohibit installation of new turf. | Yes |
| 3 | Landscape - Limit landscape irrigation to specific days | Percentage | 10-25% | Irrigation shall be limited to 2 days per week turf watering when using potable water. Plant containers, trees, shrubs, and vegatable gardens may be watered additional days using only drip irrigation or hand watering. | Yes |
| 3 | Other | Percentage | 5-10% | Other prohibited uses: the city may implement other prohibited water uses as determined by the City, after notice to customers. | Yes |
| 4 | Other - Customers must repair leaks, breaks, and malfunctions in a timely manner | Percentage | 0-1% | Fix leaks or faulty sprinkler promptly/within 2 day(s) | Yes |
| 4 | Other water feature or swimming pool restriction | Percentage | 0-1% | No new permits for pools will be issued. | Yes |
| 4 | Landscape - Other landscape restriction or prohibition | Percentage | 0-1% | No new landscape installations or renovations will be permitted. | Yes |
| 4 | Landscape - Prohibit all landscape irrigation | Percentage | 0-1% | Previous waivers for wateriubng during established period will be revoked. | Yes |
| 4 | Landscape - Limit landscape irrigation to specific days | Percentage | 5-20% | Irrigation shall be limited to 1 days per week turf watering when using potable water. Plant containers, trees, shrubs, and vegatable gardens may be watered additional days using only. | Yes |
| 4 | Other | Percentage | 5-10% | Other prohibited uses: the city may implement other prohibited water uses as determined by the City, after notice to customers. | Yes |
| 5 | Other - Customers must repair leaks, breaks, and malfunctions in a timely manner | Percentage | 0-1% | Fix leaks or faulty sprinklers within 1 day(s) | Yes |
| 5 | Other | Percentage | 0-50% | Water for agricultural or commercial nursery purposes, except for livestock watering, is prohibited. Water use for public health safety purposes only. | Yes |
| 5 | Landscape - Prohibit all landscape irrigation | Percentage | 0-1% | All irrigatoin is prohibited. | Yes |
| 5 | Landscape - Prohibit certain types of landscape irrigation | Percentage | 0-1% | Watering of all golf course areas, parks, schools grounds is prohibited, except for rare plant or animal species. | Yes |
| 5 | Moratorium or Net Zero Demand Increase on New Connections | Percentage | 0-2% | Moratorium or Net Zero Demand Increase on new connections | Yes |
| 6 | Other | Percentage | 0-1% | The City may discontinue service to consumers who willfully violate any water conservation provisions. | Yes |
| 6 | Landscape - Prohibit all landscape irrigation | Percentage | 0-5% | The City may shut off all non-essential water services. All irrigation is prohibited. | Yes |
| 6 | CII - Other CII restriction or prohibition | Percentage | 0-15% | Water for commercial, maufacturing, or processing purposes shall be reduced in volume by up to 50% or exceeded if necessary for public health and safety purposes. | Yes |
| 6 | Other | Percentage | 0-70% | Water use for public health and safety purposes only. Customer rationing may be implemented. Other prohibited uses: The City may implement other prohibited water uses as determined by the City, after notice to customers. | Yes |
| **DWR NOTES: Units of measure (AF, CCF, MG)** must remain consistent throughout the UWMP as reported in Submittal Table 2-3. | | | | | |
| NOTES: Note 1: NFT irrigation requirements begin January 1, 2027 for State and local government properties, January 1, 2028 for commercial, industrial and institutional owned landscapes, January 1, 2029 for homeowners' associations common area landscapes, and January 1, 2031 for local government properties in disadvantaged communities (DAC). | | | | | |

| Submittal Table 10-1 Retail: Notification to Cities and Counties<br>Water Code Section 10621(b) and 10642 | | |
|---|---|---|
| City Name | 60 Day Notice<br>**Drop Down (yes/no)** | Notice of Public Hearing<br>**Drop Down (yes/no)** |
| Add additional rows as needed | | |
| Anaheim | Yes | Yes |
| Brea | Yes | Yes |
| Buena Park | Yes | Yes |
| La Habra | Yes | Yes |
| La Mirada | Yes | Yes |
| Placentia | Yes | Yes |
| GSWC | Yes | Yes |
| Suburban Water Systems | Yes | Yes |
| MWDOC | Yes | Yes |
| MET | Yes | Yes |
| OCWD | Yes | Yes |
| County Name<br>**Drop Down List** | 60 Day Notice<br>**Drop Down (yes/no)** | Notice of Public Hearing<br>**Drop Down (yes/no)** |
| Add additional rows as needed | | |
| Orange County | Yes | Yes |
| **NOTES:** | | |

APPENDIX C

# REDUCED DELTA RELIANCE REPORTING

# Appendix C
# 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 beyond 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*
> *(1) 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 Fullerton's (City) regional self-reliance were developed using the approach and guidance described in Appendix C of DWR's Urban Water Management Plan Guidebook 2025 – Final Draft (Guidebook Appendix C) issued in January 2026. The data used in this analysis represent the total regional efforts of Metropolitan 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 (2030) and long-term (2050) expected outcomes for the City's Delta reliance and regional self-reliance. The results show that as a region, 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 (2030) – Normal water year regional self-reliance is expected to increase by 15.3 TAF from the 2010 baseline; this represents an increase of about 39.2 percent of 2030 normal water year retail demands (Table C-2).
- Long-term (2050) – Normal water year regional self-reliance is expected to increase by nearly 18.5 TAF from the 2010 baseline; this represents an increase of about 39.5 percent of 2050 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 2025 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 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, 2020, and 2025 were taken from the City's 2010, 2015, and 2020 UWMPs, respectively. Expected outcomes for 2030-2050 are from the current 2025 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 as a source of water supply, water suppliers such as the City needs 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. Tables C-1 and C-2 show the results of this adjustment for the City. Supporting narratives and documentation for the data shown in Tables C-1 and C-2 are provided below.

## Table C-1: Calculation of Water Use Efficiency

| Service Area Water Use Efficiency Demands (Acre-Feet) | Baseline (2010) | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 (Optional) |
|---|---|---|---|---|---|---|---|---|---|
| Service Area Water Demands with Water Use Efficiency Accounted For | 33,100 | 32,305 | 26,699 | 25,655 | 20,356 | 20,753 | 21,143 | 21,294 | 21,384 |
| Non-Potable Water Demands | - | - | - | - | - | - | - | - | - |
| Potable Service Area Demands with Water Use Efficiency Accounted For | 33,100 | 32,305 | 26,699 | 25,655 | 20,356 | 20,753 | 21,143 | 21,294 | 21,384 |

| Total Service Area Population | Baseline (2010) | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 (Optional) |
|---|---|---|---|---|---|---|---|---|---|
| Service Area Population | 135,051 | 142,164 | 143,980 | 141,277 | 145,489 | 149,567 | 153,732 | 157,380 | 158,923 |

| Water Use Efficiency Since Baseline (Acre-Feet) | Baseline (2010) | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 (Optional) |
|---|---|---|---|---|---|---|---|---|---|
| Per Capita Water Use (GPCD) | 219 | 203 | 166 | 162 | 125 | 124 | 123 | 121 | 120 |
| Change in Per Capita Water Use from Baseline (GPCD) | | (16) | (53) | (57) | (94) | (95) | (96) | (98) | (99) |
| Estimated Water Use Efficiency Since Baseline | | 2,538 | 8,589 | 8,971 | 15,302 | 15,905 | 16,536 | 17,279 | 17,567 |

## Table C -2: Calculation of Service Area Water Demands Without Water Use Efficiency

| Total Service Area Water Demands (Acre-Feet) | Baseline (2010) | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 (Optional) |
|---|---|---|---|---|---|---|---|---|---|
| Service Area Water Demands with Water Use Efficiency Accounted For | 33,100 | 32,305 | 26,699 | 25,655 | 20,356 | 20,753 | 21,143 | 21,294 | 21,384 |
| Reported Water Use Efficiency or Estimated Water Use Efficiency Since Baseline | | 2,538 | 8,589 | 8,971 | 15,302 | 15,905 | 16,536 | 17,279 | 17,567 |
| Service Area Water Demands without Water Use Efficiency Accounted For | 33,100 | 34,843 | 35,288 | 34,626 | 35,658 | 36,658 | 37,679 | 38,573 | 38,951 |

*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 municipal and industrial demands, agricultural demands, recycled, seawater barrier demands, and storage replenishment demands. These demand types and the modeling methodologies used to calculate them are described in Section 4.3 of the City's 2025 UWMP.

*Non-Potable Water Demands*

The non-potable water demands shown in Table C-1 represent demands for non-potable recycled water and non-potable groundwater for irrigation. In accordance with section C.3.6 of the UWMP Guidebook, the City characterizes demands for groundwater basin recharge and seawater barrier demands as indirect uses of water. In order to avoid double counting of water use these supplies are generally excluded from demand projections, since they are already captured as part of the City's retail water demand. 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.

*Total Service Area Population*

The City's total service area population as shown in Table C-1 comes from the Center for Demographic Research, with actuals and projections further described in Section 3.4 of the City's 2025 UWMP.

*Water Use Efficiency Since Baseline*

The water use efficiency numbers shown in Table C-1 and C-2 represent the formulation that the 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 City's following sources:

- Baseline (2010) values – 2005 UWMP
- 2015 values – 2010 UWMP
- 2020 values – 2015 UWMP
- 2025 values – 2020 UWMP
- 2030-2050 values – 2025 UWMP

It should be noted that the results of this calculation differ from what the City calculated under Chapter 5 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-3 shows expected outcomes for supplies contributing to regional self-reliance both in amount and as a percentage. The numbers shown in Table C-3 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 data shown in Table C-3 are provided below.

The results shown in Table C-3 demonstrate that the City's service area is measurably improving its regional self-reliance. In the near-term (2030), the expected outcome for normal water year regional self-reliance increases by 15.3 TAF from the 2010 baseline; this represents an increase of about 39.2 percent of 2030 normal water year retail demands. In the long-term (2050), normal water year regional self-reliance is expected to increase by more than 18.4 TAF from the 2010 baseline; this represents an increase of about 39.5 percent of 2050 normal water year retail demands.

# Table C-3: Supplies Contributing to Regional Self-Reliance

| Water Supplies Contributing to Regional Self-Reliance (Acre-Feet) | Baseline (2010) | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 (Optional) |
|---|---|---|---|---|---|---|---|---|---|
| Water Use Efficiency | - | 2,538 | 8,589 | 8,971 | 15,302 | 15,905 | 16,536 | 17,279 | 17,567 |
| Water Recycling | | | | | | | | | |
| Stormwater Capture and Use | | | | | | | | | |
| Advanced Water Technologies | | | | | | | | | |
| Conjunctive Use Projects | | | | | | | | | |
| Local and Regional Water Supply and Storage Projects | 17,284 | 18,943 | 18,761 | 21,807 | 17,303 | 17,640 | 17,972 | 18,100 | 18,176 |
| Other Programs and Projects the Contribute to Regional Self-Reliance | | | | | | | | | |
| Water Supplies Contributing to Regional Self-Reliance | 17,284 | 21,481 | 27,350 | 30,778 | 32,605 | 33,545 | 34,508 | 35,379 | 35,743 |

| Service Area Water Demands without Water Use Efficiency (Acre-Feet) | Baseline (2010) | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 (Optional) |
|---|---|---|---|---|---|---|---|---|---|
| Service Area Water Demands without Water Use Efficiency Accounted For | 33,100 | 34,843 | 35,288 | 34,626 | 35,658 | 36,658 | 37,679 | 38,573 | 38,951 |

| Change in Regional Self Reliance (Acre-Feet) | Baseline (2010) | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 (Optional) |
|---|---|---|---|---|---|---|---|---|---|
| Water Supplies Contributing to Regional Self-Reliance | 17,284 | 21,481 | 27,350 | 30,778 | 32,605 | 33,545 | 34,508 | 35,379 | 35,743 |
| Change in Water Supplies Contributing to Regional Self-Reliance | | 4,197 | 10,066 | 13,494 | 15,321 | 16,261 | 17,224 | 18,095 | 18,459 |

| Percent Change in Regional Self Reliance (As Percent of Demand w/out WUE) | Baseline (2010) | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 (Optional) |
|---|---|---|---|---|---|---|---|---|---|
| Percent of Water Supplies Contributing to Regional Self-Reliance | 52.2% | 61.7% | 77.5% | 88.9% | 91.4% | 91.5% | 91.6% | 91.7% | 91.8% |
| Change in Percent of Water Supplies Contributing to Regional Self-Reliance | | 9.4% | 25.3% | 36.7% | 39.2% | 39.3% | 39.4% | 39.5% | 39.5% |

*Water Use Efficiency*

The water use efficiency information shown in Table C-3 is taken directly from Tables C-1 and C-2 above.

*Water Recycling*

The City does not have recycled water production.

*Local and Regional Water Supply and Storage Projects*

The values shown in Table C-3 reflect groundwater production from the Orange County Groundwater Basin (OC Basin) as described in Section 6.3 of the City's 2025 UWMP.

*Advanced Water Technologies*

The OC Basin is augmented by advanced treated recycled water from the Orange County Water District's Groundwater Replenishment System (GWRS). The amount of indirect potable reuse in the OC Basin has increased over time to account for about 35 percent of total OC Basin production. The City's total groundwater production is captured as "Local Water Supply Project." Supplies contributed from indirect potable reuse are not reported to avoid double-counting.

## 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 C-4 (from Metropolitan's Table A.10-3) demonstrate that Metropolitan's service area, which includes the City, is measurably reducing its Delta reliance. In the near-term (2030), the expected outcome for normal water year reliance on supplies from the Delta watershed decreased by 466 TAF or 6.5 percent from the 2010 baseline. In the long-term (2050), normal water year reliance on supplies from the Delta watershed is expected to decrease by 537 TAF or 9.4 percent from the 2010 baseline.

# Table C-4: Metropolitan's 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 | 2050 |
|---|---|---|---|---|---|---|---|---|---|
| CVP/SWP Contract Supplies | 1,472,000 | 1,029,000 | 984,000 | 1,133,000 | 949,000 | 924,000 | 901,000 | 877,000 | 877,000 |
| Delta/Delta Tributary Diversions | - | - | - | - | - | - | - | - | - |
| Transfers and Exchanges of Supplies from the Delta Watershed | 20,000 | 44,000 | 91,000 | 58,000 | 77,000 | 77,000 | 78,000 | 78,000 | 78,000 |
| 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** | **1,026,000** | **1,001,000** | **979,000** | **955,000** | **955,000** |

| Service Area Demands without Water Use Efficiency (Acre-Feet) | Baseline (2010) | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 |
|---|---|---|---|---|---|---|---|---|---|
| Service Area Demands without Water Use Efficiency Accounted For | 5,493,000 | 5,499,000 | 5,219,000 | 4,925,000 | 4,969,000 | 5,102,000 | 5,209,000 | 5,302,000 | 5,391,000 |

| Change in Supplies from the Delta Watershed (Acre-Feet) | Baseline (2010) | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 |
|---|---|---|---|---|---|---|---|---|---|
| Water Supplies from the Delta Watershed | 1,492,000 | 1,073,000 | 1,075,000 | 1,191,000 | 1,026,000 | 1,001,000 | 979,000 | 955,000 | 955,000 |
| **Change in Supplies from the Delta Watershed** | **NA** | **(419,000)** | **(417,000)** | **(301,000)** | **(466,000)** | **(491,000)** | **(513,000)** | **(537,000)** | **(537,000)** |
| **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** | **2050** |
| Percent of Supplies from the Delta Watershed | 27.2% | 19.5% | 20.6% | 24.2% | 20.6% | 19.6% | 18.8% | 18.0% | 17.7% |
| **Change in Percent of Supplies from the Delta Watershed** | **NA** | **-7.6%** | **-6.6%** | **-3.0%** | **-6.5%** | **-7.5%** | **-8.4%** | **-9.1%** | **-9.4%** |

## C.6 Metropolitan Member and Sub-Member Agency Infeasibility of Accounting Supplies from the Delta Watershed

Metropolitan's member agencies and retail subagencies individually contribute to reduced reliance on the Delta in two ways. First, through the development of local projects and demand management measures in their own service areas, and second, through their investments in regional projects and programs through Metropolitan. Regional investments are funded through revenues from water purchases from Metropolitan or one or more of its member agencies. Metropolitan uses a portion of revenues from those purchases to fund projects and programs that contribute to the region's reduced reliance on Delta water supplies. Because some or all of these regional investments may not be constructed or implemented directly in a particular water supplier's service area, a water supplier's demands on Metropolitan or one or more of its member agencies will not accurately reflect that water supplier's total contributions to reduced reliance on supplies from the Delta watershed. It is infeasible for a water supplier that makes investments in regional projects and programs to quantify its individual contributions to reduced reliance and reflect them properly in its demands on Metropolitan or one or more of Metropolitan's member agencies.

The following discussions outline how regional funding is provided through Metropolitan's local resources and conservation incentive programs and how funding for those programs is collected through Metropolitan's water rates. The history and participation of Metropolitan's member agencies and the local agencies that purchase water from Metropolitan's members in local resource and demand management in the region have spanned more than four decades, and thus make accounting of these contributions at the individual agency level infeasible for those agencies to calculate.

### 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 and was funded, in part, by Metropolitan's local resource program and its Member Agencies. With the latest expansion, GWRS is capable of producing approximately 130,000 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. GWRS is a premier example of a regional project that significantly reduced the need to utilize imported water for groundwater replenishment in the Metropolitan Service area, increasing regional and local supply reliability and reducing the region's reliance on imported supplies, including supplies from the State Water Project. Today, nearly one-half of the total recycled water and groundwater recovery production in the region is developed with an LRP incentive by Metropolitan.

Metropolitan's local resource incentive programs have evolved since 1982 to encourage member agencies to develop local supplies – including recycled water, groundwater recovery, seawater desalination, and stormwater capture to reduce reliance on imported water. Over the decades, programs have evolved to meet regional water needs. Key current program elements include:

- **Local Resources Program (LRP):** Sliding scale or fixed incentives for recycled water, recovered groundwater, and seawater desalination projects.
- **On-Site Retrofit Program (ORP):** Funding for small-scale infrastructure upgrades to connect end-users to existing recycled water systems.
- **Stormwater Pilot Programs:** Financial incentives to study and develop stormwater capture projects for direct use or groundwater recharge.

## Water Use Efficiency Programs

Metropolitan's Water Use Efficiency programs reflect a longstanding recognition that managing demands is as important as securing supply. By reducing retail water consumption across the service area, these programs help decrease reliance on imported water, lower infrastructure costs, and free up conveyance capacity – benefits that extend to all member agencies regardless of where savings occur.

Metropolitan's incentive-based conservation efforts operate through several complementary programs. The Conservation Credits Program provides member agencies with financial assistance for conservation projects that reduce imported water demand. The Member Agency Administered Program allows agencies to implement locally tailored rebate programs with Metropolitan funding, provided they supplement rather than duplicate regional offerings. The Water Savings Incentive Program (WSIP) targets commercial and industrial users with custom efficiency projects that fall outside the standard rebate structures.

Beyond rebates, Metropolitan also pursues non-incentive conservation efforts, including landscape training, large-scale water audits, technology research, public outreach and education, and advocacy for water-efficient building codes and legislation. Together, these programs have driven significant cumulative water savings, representing a major long-term investment in regional water supply reliability. Chapter 9 of this UWMP provides details on the array of water use efficiency programs the City has implemented in its service area, which have contributed to the region's overall success in reducing reliance on imported water.

## Infeasibility of Accounting

The accounting of the regional investments that contribute to reducing Metropolitan's reliance on the Delta is straightforward to calculate and report at the regional aggregate level. However, any similar accounting is infeasible at the individual member or sub-member agency level. As described above, the region (through Metropolitan) makes significant investments in resources and programs 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 (and their subagencies) through rates and charges. The relative contributions for a member agency may be able to be approximately quantified or estimated by proxy through relative water purchases, however making an estimate of any quantifiable savings in gallons or acre-feet is not feasible. Water purchases cannot, with any accuracy or precision, be tied to the actual projects or programs that deliver water to the collective member agencies and their subagencies. Additionally, using water purchases as a proxy for member agencies and subagencies would result in projects and programs done outside of the Metropolitan incentive programs to be omitted and discounted. Accounting at the regional level allows for the incorporation of these local supplies and water use efficiency programs implemented by member agencies and subagencies in both the regional programs and their own specific local programs. Projects and programs each have different online dates, useful lives, production, incentive rates, and contributions that cannot be matched to the demands or supply production history of an individual agency, or consistently across the agencies within Metropolitan's service area. As shown above, despite that infeasibility, Metropolitan's members and their subagencies have together made substantial contributions to the region's reduced reliance.

APPENDIX D

# AWWA WATER LOSS AUDITS

# AWWA Free Water Audit Software v5.0

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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: | Gar Huang |
| Email Address: | garh@ci.fullerton.ca.us |
| Telephone \| Ext.: | 714-738-6895 |
| Name of City / Utility: | City of Fullerton |
| City/Town/Municipality: | Fullerton |
| State / Province: | California (CA) |
| Country: | USA |
| Year: | 2020 Calendar Year |
| Audit Preparation Date: | 8/17/2021 |
| Volume Reporting Units: | Acre-feet |
| PWSID / Other ID: | CA3010010 |

**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
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? Click to access
+ Click to add a

**Water Audit Report for:** City of Fullerton (CA3010010)
**Reporting Year:** 2020 | 1/2020 - 12/2020

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**

| | | | | | Pcnt: | Value: | |
|---|---|---|---|---|---|---|---|
| Volume from own sources: | 9 | 17,813.829 | acre-ft/yr | 3 | | -0.173 | acre-ft/yr |
| Water imported: | 7 | 5,807.111 | acre-ft/yr | 5 | | | acre-ft/yr |
| Water exported: | n/a | | acre-ft/yr | | | | acre-ft/yr |

Enter negative % or value for under-registration
Enter positive % or value for over-registration

**WATER SUPPLIED:** 23,621.113 acre-ft/yr

**AUTHORIZED CONSUMPTION**

Click here: ? for help using option

| | | | | Pcnt: | Value: | |
|---|---|---|---|---|---|---|
| Billed metered: | 7 | 22,753.277 | acre-ft/yr | | | |
| Billed unmetered: | n/a | | acre-ft/yr | | | |
| Unbilled metered: | n/a | | acre-ft/yr | | | |
| Unbilled unmetered: | 5 | 59.053 | acre-ft/yr | | 59.053 | acre-ft/yr |

Use buttons to select percentage of water supplied **OR** value

**AUTHORIZED CONSUMPTION:** 22,812.329 acre-ft/yr

**WATER LOSSES (Water Supplied - Authorized Consumption)** 808.783 acre-ft/yr

**Apparent Losses**

| | | | | Pcnt: | Value: | |
|---|---|---|---|---|---|---|
| Unauthorized consumption: | | 59.053 | 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: | 7 | 391.858 | acre-ft/yr | | 391.858 | acre-ft/yr |
| Systematic data handling errors: | | 56.883 | 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:** 507.794 acre-ft/yr

**Real Losses (Current Annual Real Losses or CARL)**

**Real Losses = Water Losses - Apparent Losses:** 300.990 acre-ft/yr

**WATER LOSSES:** 808.783 acre-ft/yr

**NON-REVENUE WATER**

**NON-REVENUE WATER:** 867.836 acre-ft/yr

= Water Losses + Unbilled Metered + Unbilled Unmetered

**SYSTEM DATA**

| | | | |
|---|---|---|---|
| Length of mains: | 9 | 431.5 | miles |
| Number of active AND inactive service connections: | 10 | 32,059 | |
| Service connection density: | | 74 | 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 | 78.4 psi

**COST DATA**

| | | | |
|---|---|---|---|
| Total annual cost of operating water system: | 10 | $34,371,979 | $/Year |
| Customer retail unit cost (applied to Apparent Losses): | 10 | $2.30 | $/100 cubic feet (ccf) |
| Variable production cost (applied to Real Losses): | 5 | $725.59 | $/acre-ft |

☐ Use Customer Retail Unit Cost to value real losses

**WATER AUDIT DATA VALIDITY SCORE:**

***** YOUR SCORE IS: 77 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: Variable production cost (applied to Real Losses)
2: Billed metered
3: Unauthorized consumption

# AWWA Free Water Audit Software:
## System Attributes and Performance Indicators

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**Water Audit Report for:** City of Fullerton (CA3010010)
**Reporting Year:** 2020 | 1/2020 - 12/2020

***** YOUR WATER AUDIT DATA VALIDITY SCORE IS: 77 out of 100 *****

**System Attributes:**

| | | | |
|---|---|---|---|
| | Apparent Losses: | 507.794 | acre-ft/yr |
| + | Real Losses: | 300.990 | acre-ft/yr |
| = | **Water Losses:** | **808.783** | acre-ft/yr |
| | Unavoidable Annual Real Losses (UARL): | 627.31 | acre-ft/yr |
| | Annual cost of Apparent Losses: | $508,510 | |
| | Annual cost of Real Losses: | $218,396 | 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: | 3.7% | |
| | Non-revenue water as percent by cost of operating system: | 2.2% | Real Losses valued at Variable Production Cost |
| Operational | Apparent Losses per service connection per day: | 14.14 | gallons/connection/day |
| | Real Losses per service connection per day: | 8.38 | gallons/connection/day |
| | Real Losses per length of main per day*: | N/A | |
| | Real Losses per service connection per day per psi pressure: | 0.11 | gallons/connection/day/psi |
| | From Above, Real Losses = Current Annual Real Losses (CARL): | 300.99 | acre-feet/year |
| ? | Infrastructure Leakage Index (ILI) [CARL/UARL]: | 0.48 | |

* 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: | Total volume from wells recorded in Production Data Collection Form |
| Vol. from own sources: Master meter error adjustment: | Storage change calculated using Production Data Collection Form |
| Water imported: | Total volume from MWD connections recorded in Production Data Collection Form |
| Water imported: master meter error adjustment: | |
| Water exported: | |
| Water exported: master meter error adjustment: | |
| Billed metered: | All customers are metered and billed. |
| Billed unmetered: | |
| Unbilled metered: | |

| Audit Item | Comment |
|---|---|
| Unbilled unmetered: | |
| Unauthorized consumption: | |
| Customer metering inaccuracies: | |
| Systematic data handling errors: | |
| Length of mains: | Calculated using GIS output provided in Mains by Pressure Zone.xlsx |
| Number of active AND inactive service connections: | Number of meters in billing system |
| Average length of customer service line: | |
| Average operating pressure: | |
| Total annual cost of operating water system: | |
| Customer retail unit cost (applied to Apparent Losses): | |
| Variable production cost (applied to Real Losses): | |

| Audit Item | Comment |
| --- | --- |

| Audit Item | Comment |
| --- | --- |

| Audit Item | Comment |
| --- | --- |

| Audit Item | Comment |
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| Audit Item | Comment |
| --- | --- |

| Audit Item | Comment |
| --- | --- |

# AWWA Free Water Audit Software: Water Balance

WAS
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| | |
|---|---|
| Water Audit Report for: | City of Fullerton (CA3010010) |
| Reporting Year: | 2020 — 1/2020 - 12/2020 |
| Data Validity Score: | 77 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Own Sources (Adjusted for known errors) 17,814.002 | System Input 23,621.113 | Water Exported 0.000 | | | Billed Water Exported | Revenue Water 0.000 |
| | | Water Supplied 23,621.113 | Authorized Consumption 22,812.329 | Billed Authorized Consumption 22,753.277 | Billed Metered Consumption (water exported is removed) 22,753.277 | Revenue Water 22,753.277 |
| | | | | | Billed Unmetered Consumption 0.000 | |
| | | | | Unbilled Authorized Consumption 59.053 | Unbilled Metered Consumption 0.000 | Non-Revenue Water (NRW) 867.836 |
| | | | | | Unbilled Unmetered Consumption 59.053 | |
| | | | Water Losses 808.783 | Apparent Losses 507.794 | Unauthorized Consumption 59.053 | |
| | | | | | Customer Metering Inaccuracies 391.858 | |
| | | | | | Systematic Data Handling Errors 56.883 | |
| Water Imported 5,807.111 | | | | Real Losses 300.990 | 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

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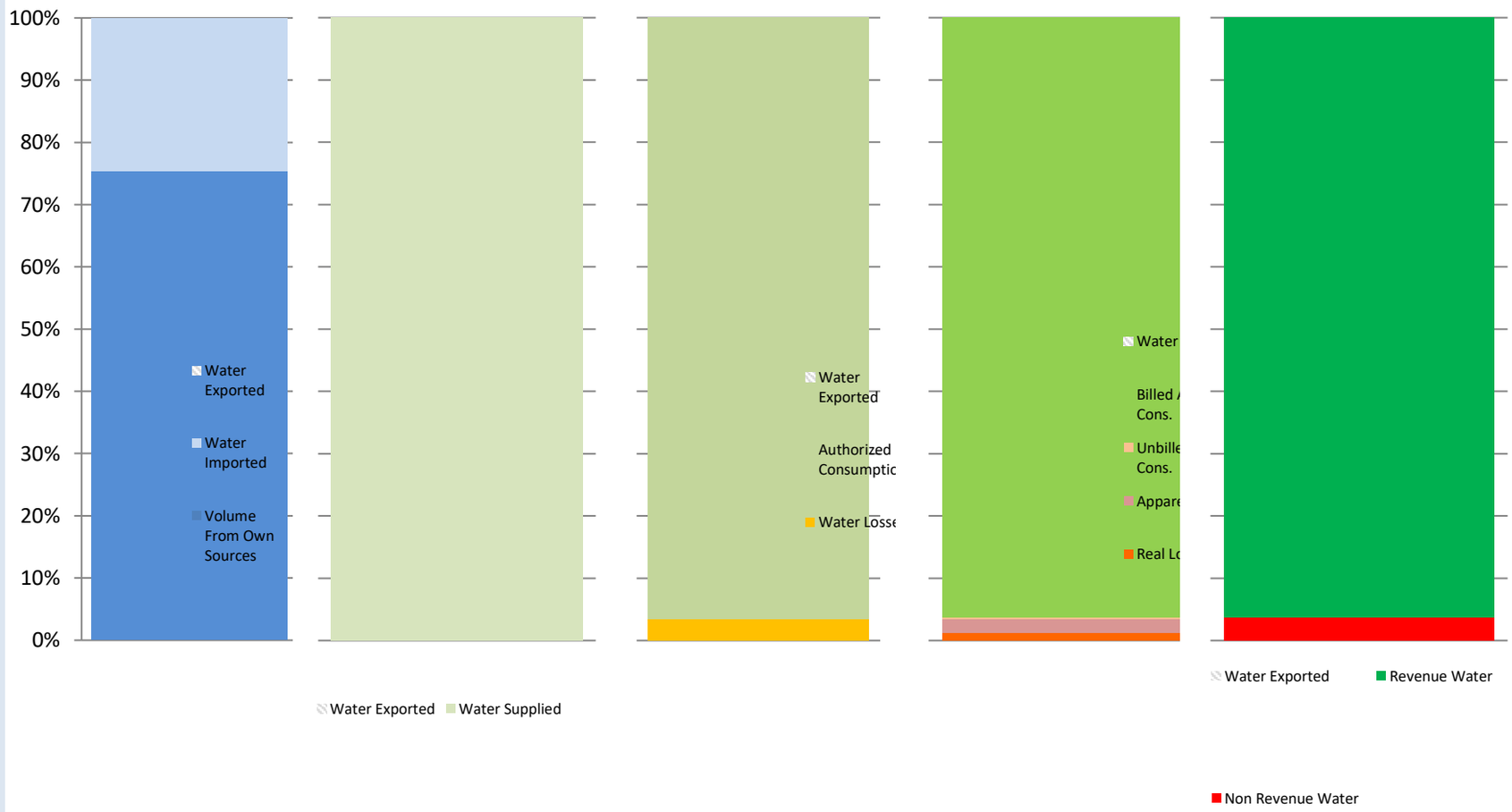
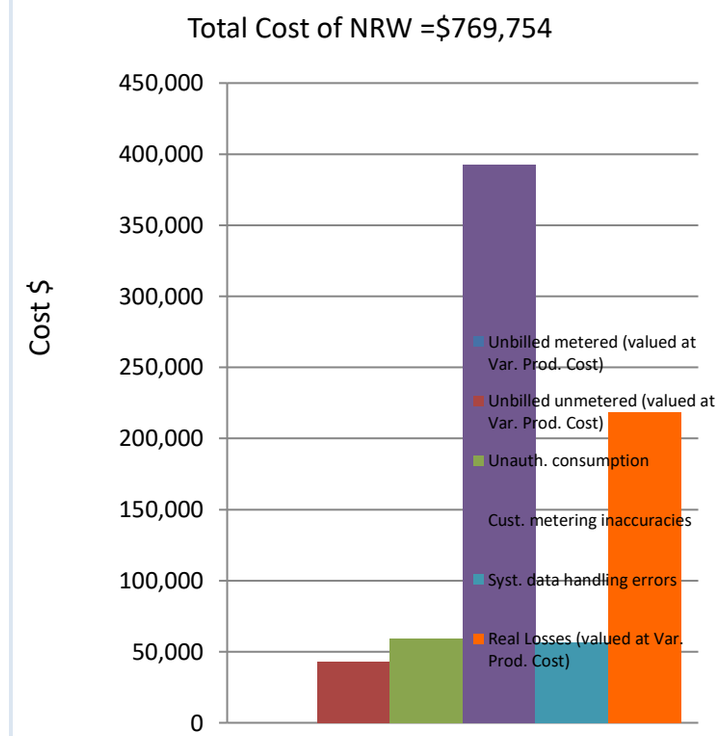
The graphic below is a visual representation of the Water Balance with bar heights propotional to the

**Water Audit Report for:** City of Fullerton (CA3010010)
**Reporting Year:** 2020 | 1/2020 - 12/2020
**Data Validity Score:** 77

○ Show me the VOLUME of Non-Revenue Water
◉ Show me the COST of Non-Revenue Water



# AWWA Free Water Audit Software: Grading Matrix

WAS 5.0

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The grading assigned to each audit component and the corresponding recommended improvements and actions are highlighted in yellow. Audit accuracy is likely to be improved by prioritizing those items shown in red

| Grading >>> | n/a | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **WATER SUPPLIED** | | | | | | | | | | | |
| Volume from own sources: | Select this grading only if the water utility purchases/imports all of its water resources (i.e. has no sources of its own) | Less than 25% of water production sources are metered, remaining sources are estimated. No regular meter accuracy testing or electronic calibration conducted. | 25% - 50% of treated water production sources are metered; other sources estimated. No regular meter accuracy testing or electronic calibration conducted. | Conditions between 2 and 4 | 50% - 75% of treated water production sources are metered, other sources estimated. Occasional meter accuracy testing or electronic calibration conducted. | Conditions between 4 and 6 | At least 75% of treated water production sources are metered, or at least 90% of the source flow is derived from metered sources. Meter accuracy testing and/or electronic calibration of related instrumentation is conducted annually. Less than 25% of tested meters are found outside of +/- 6% accuracy. | Conditions between 6 and 8 | 100% of treated water production sources are metered, meter accuracy testing and electronic calibration of related instrumentation is conducted annually, less than 10% of meters are found outside of +/- 6% accuracy | Conditions between 8 and 10 | 100% of treated water production sources are metered, meter accuracy testing and electronic calibration of related instrumentation is conducted semi-annually, with less than 10% found outside of +/- 3% accuracy. Procedures are reviewed by a third party knowledgeable in the M36 methodology. |
| Improvements to attain higher data grading for "Volume from own Sources" component: | | to qualify for 2: Organize and launch efforts to collect data for determining volume from own sources | to qualify for 4: Locate all water production sources on maps and in the field, launch meter accuracy testing for existing meters, begin to install meters on unmetered water production sources and replace any obsolete/defective meters. | | to qualify for 6: Formalize annual meter accuracy testing for all source meters; specify the frequency of testing. Complete installation of meters on unmetered water production sources and complete replacement of all obsolete/defective meters. | | to qualify for 8: Conduct annual meter accuracy testing and calibration of related instrumentation on all meter installations on a regular basis. Complete project to install new, or replace defective existing, meters so that entire production meter population is metered. Repair or replace meters outside of +/- 6% accuracy. | | to qualify for 10: Maintain annual meter accuracy testing and calibration of related instrumentation for all meter installations. Repair or replace meters outside of +/- 3% accuracy. Investigate new meter technology; pilot one or more replacements with innovative meters in attempt to further improve meter accuracy. | | to maintain 10: Standardize meter accuracy test frequency to semi-annual, or more frequent, for all meters. Repair or replace meters outside of +/- 3% accuracy. Continually investigate/pilot improving metering technology. |
| Volume from own sources master meter and supply error adjustment: | Select n/a only if the water utility fails to have meters on its sources of supply | Inventory information on meters and paper records of measured volumes exist but are incomplete and/or in a very crude condition; data error cannot be determined | No automatic datalogging of production volumes; daily readings are scribed on paper records without any accountability controls. Flows are not balanced across the water distribution system: tank/storage elevation changes are not employed in calculating the "Volume from own sources" component and archived flow data is adjusted only when grossly evident data error occurs. | Conditions between 2 and 4 | Production meter data is logged automatically in electronic format and reviewed at least on a monthly basis with necessary corrections implemented. "Volume from own sources" tabulations include estimate of daily changes in tanks/storage facilities. Meter data is adjusted when gross data errors occur, or occasional meter testing deems this necessary. | Conditions between 4 and 6 | Hourly production meter data logged automatically & reviewed on at least a weekly basis. Data is adjusted to correct gross error when meter/instrumentation equipment malfunction is detected; and/or error is confirmed by meter accuracy testing. Tank/storage facility elevation changes are automatically used in calculating a balanced "Volume from own sources" component, and data gaps in the archived data are corrected on at least a weekly basis. | Conditions between 6 and 8 | Continuous production meter data is logged automatically & reviewed each business day. Data is adjusted to correct gross error from detected meter/instrumentation equipment malfunction and/or results of meter accuracy testing. Tank/storage facility elevation changes are automatically used in "Volume from own sources" tabulations and data gaps in the archived data are corrected on a daily basis. | Conditions between 8 and 10 | Computerized system (SCADA or similar) automatically balances flows from all sources and storages; results are reviewed each business day. Tight accountability controls ensure that all data gaps that occur in the archived flow data are quickly detected and corrected. Regular calibrations between SCADA and sources meters ensures minimal data transfer error. |
| Improvements to attain higher data grading for "Master meter and supply error adjustment" component: | | to qualify for 2: Develop a plan to restructure recordkeeping system to capture all flow data; set a procedure to review flow data on a daily basis to detect input errors. Obtain more reliable information about existing meters by conducting field inspections of meters and related instrumentation, and obtaining manufacturer literature. | to qualify for 4: Install automatic datalogging equipment on production meters. Complete installation of level instrumentation at all tanks/storage facilities and include tank level data in automatic calculation routine in a computerized system. Construct a computerized listing or spreadsheet to archive input volumes, tank/storage volume changes and import/export flows in order to determine the composite "Water Supplied" volume for the distribution system. Set a procedure to review this data on a monthly basis to detect gross anomalies and data gaps. | | to qualify for 6: Refine computerized data collection and archive to include hourly production meter data that is reviewed at least on a weekly basis to detect specific data anomalies and gaps. Use daily net storage change to balance flows in calculating "Water Supplied" volume. Necessary corrections to data errors are implemented on a weekly basis. | | to qualify for 8: Ensure that all flow data is collected and archived on at least an hourly basis. All data is reviewed and detected errors corrected each business day. Tank/storage levels variations are employed in calculating balanced "Water Supplied" component. Adjust production meter data for gross error and inaccuracy confirmed by testing. | | to qualify for 10: Link all production and tank/storage facility elevation change data to a Supervisory Control & Data Acquisition (SCADA) System, or similar computerized monitoring/control system, and establish automatic flow balancing algorithm and regularly calibrate between SCADA and source meters. Data is reviewed and corrected each business day. | | to maintain 10: Monitor meter innovations for development of more accurate and less expensive flowmeters. Continue to replace or repair meters as they perform outside of desired accuracy limits. Stay abreast of new and more accurate water level instruments to better record tank/storage levels and archive the variations in storage volume. Keep current with SCADA and data management systems to ensure that archived data is well-managed and error free. |
| Water Imported: | Select n/a if the water utility's supply is exclusively from its own water resources (no bulk purchased/ imported water) | Less than 25% of imported water sources are metered, remaining sources are estimated. No regular meter accuracy testing. | 25% - 50% of imported water sources are metered; other sources estimated. No regular meter accuracy testing. | Conditions between 2 and 4 | 50% - 75% of imported water sources are metered, other sources estimated. Occasional meter accuracy testing conducted. | Conditions between 4 and 6 | At least 75% of imported water sources are metered, meter accuracy testing and/or electronic calibration of related instrumentation is conducted annually for all meter installations. Less than 25% of tested meters are found outside of +/- 6% accuracy. | Conditions between 6 and 8 | 100% of imported water sources are metered, meter accuracy testing and electronic calibration of related instrumentation is conducted annually, less than 10% of meters are found outside of +/- 6% accuracy | Conditions between 8 and 10 | 100% of imported water sources are metered, meter accuracy testing and electronic calibration of related instrumentation is conducted semi-annually for all meter installations, with less than 10% of accuracy tests found outside of +/- 3% accuracy. |
| Improvements to attain higher data grading for "Water Imported Volume" component: *(Note: usually the water supplier selling the water - "the Exporter" - to the utility being audited is responsible to maintain the metering installation measuring the imported volume. The utility should coordinate carefully with the Exporter to ensure that adequate meter upkeep takes place and an accurate measure of the Water Imported volume is quantified.)* | | to qualify for 2: Review bulk water purchase agreements with partner suppliers; confirm requirements for use and maintenance of accurate metering. Identify needs for new or replacement meters with goal to meter all imported water sources. | To qualify for 4: Locate all imported water sources on maps and in the field, launch meter accuracy testing for existing meters, begin to install meters on unmetered imported water interconnections and replace obsolete/defective meters. | | to qualify for 6: Formalize annual meter accuracy testing for all imported water meters, planning for both regular meter accuracy testing and calibration of the related instrumentation. Continue installation of meters on unmetered imported water interconnections and replacement of obsolete/defective meters. | | to qualify for 8: Complete project to install new, or replace defective, meters on all imported water interconnections. Maintain annual meter accuracy testing for all imported water meters and conduct calibration of related instrumentation at least annually. Repair or replace meters outside of +/- 6% accuracy. | | to qualify for 10: Conduct meter accuracy testing for all meters on a semi-annual basis, along with calibration of all related instrumentation. Repair or replace meters outside of +/- 3% accuracy. Investigate new meter technology; pilot one or more replacements with innovative meters in attempt to improve meter accuracy. | | to maintain 10: Standardize meter accuracy test frequency to semi-annual, or more frequent, for all meters. Continue to conduct calibration of related instrumentation on a semi-annual basis. Repair or replace meters outside of +/- 3% accuracy. Continually investigate/pilot improving metering technology. |

| Grading >>> | n/a | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Water imported master meter and supply error adjustment: | Select n/a if the Imported water supply is unmetered, with Imported water quantities estimated on the billing invoices sent by the Exporter to the purchasing Utility. | Inventory information on imported meters and paper records of measured volumes exist but are incomplete and/or in a very crude condition; data error cannot be determined Written agreement(s) with water Exporter(s) are missing or written in vague language concerning meter management and testing. | No automatic datalogging of imported supply volumes; daily readings are scribed on paper records without any accountability controls to confirm data accuracy and the absence of errors and data gaps in recorded volumes. Written agreement requires meter accuracy testing but is vague on the details of how and who conducts the testing. | Conditions between 2 and 4 | Imported supply metered flow data is logged automatically in electronic format and reviewed at least on a monthly basis by the Exporter with necessary corrections implemented. Meter data is adjusted by the Exporter when gross data errors are detected. A coherent data trail exists for this process to protect both the selling and the purchasing Utility. Written agreement exists and clearly states requirements and roles for meter accuracy testing and data management. | Conditions between 4 and 6 | Hourly Imported supply metered data is logged automatically & reviewed on at least a weekly basis by the Exporter. Data is adjusted to correct gross error when meter/instrumentation equipment malfunction is detected; and to correct for error confirmed by meter accuracy testing. Any data gaps in the archived data are detected and corrected during the weekly review. A coherent data trail exists for this process to protect both the selling and the purchasing Utility. | Conditions between 6 and 8 | Continuous Imported supply metered flow data is logged automatically & reviewed each business day by the Exporter. Data is adjusted to correct gross error from detected meter/instrumentation equipment malfunction and/or results of meter accuracy testing. Any data errors/gaps are detected and corrected on a daily basis. A data trail exists for the process to protect both the selling and the purchasing Utility. | Conditions between 8 and 10 | Computerized system (SCADA or similar) automatically records data which is reviewed each business day by the Exporter. Tight accountability controls ensure that all error/data gaps that occur in the archived flow data are quickly detected and corrected. A reliable data trail exists and contract provisions for meter testing and data management are reviewed by the selling and purchasing Utility at least once every five years. |
| Improvements to attain higher data grading for "Water imported master meter and supply error adjustment" component: | | to qualify for 2: Develop a plan to restructure recordkeeping system to capture all flow data; set a procedure to review flow data on a daily basis to detect input errors. Obtain more reliable information about existing meters by conducting field inspections of meters and related instrumentation, and obtaining manufacturer literature. Review the written agreement between the selling and purchasing Utility. | to qualify for 4: Install automatic datalogging equipment on Imported supply meters. Set a procedure to review this data on a monthly basis to detect gross anomalies and data gaps. Launch discussions with the Exporters to jointly review terms of the written agreements regarding meter accuracy testing and data management; revise the terms as necessary. | | to qualify for 6: Refine computerized data collection and archive to include hourly Imported supply metered flow data that is reviewed at least on a weekly basis to detect specific data anomalies and gaps. Make necessary corrections to errors/data errors on a weekly basis. | | to qualify for 8: Ensure that all Imported supply metered flow data is collected and archived on at least an hourly basis. All data is reviewed and errors/data gaps are corrected each business day. | | to qualify for 10: Conduct accountability checks to confirm that all Imported supply metered data is reviewed and corrected each business day by the Exporter. Results of all meter accuracy tests and data corrections should be available for sharing between the Exporter and the purchasing Utility. Establish a schedule for a regular review and updating of the contractual language in the written agreement between the selling and the purchasing Utility; at least every five years. | | to maintain 10: Monitor meter innovations for development of more accurate and less expensive flowmeters; work with the Exporter to help identify meter replacement needs. Keep communication lines with Exporters open and maintain productive relations. Keep the written agreement current with clear and explicit language that meets the ongoing needs of all parties. |
| Water Exported: | Select n/a if the water utility sells no bulk water to neighboring water utilities (no exported water sales) | Less than 25% of exported water sources are metered, remaining sources are estimated. No regular meter accuracy testing. | 25% - 50% of exported water sources are metered; other sources estimated. No regular meter accuracy testing. | Conditions between 2 and 4 | 50% - 75% of exported water sources are metered, other sources estimated. Occasional meter accuracy testing conducted. | Conditions between 4 and 6 | At least 75% of exported water sources are metered, meter accuracy testing and/or electronic calibration conducted annually. Less than 25% of tested meters are found outside of +/- 6% accuracy. | Conditions between 6 and 8 | 100% of exported water sources are metered, meter accuracy testing and electronic calibration of related instrumentation is conducted annually, less than 10% of meters are found outside of +/- 6% accuracy | Conditions between 8 and 10 | 100% of exported water sources are metered, meter accuracy testing and electronic calibration of related instrumentation is conducted semi-annually for all meter installations, with less than 10% of accuracy tests found outside of +/- 3% accuracy. |
| Improvements to attain higher data grading for "Water Exported Volume" component: (*Note: usually, if the water utility being audited sells (Exports) water to a neighboring purchasing Utility, it is the responsibility of the utility exporting the water to maintain the metering installation measuring the Exported volume. The utility exporting the water should ensure that adequate meter upkeep takes place and an accurate measure of the Water Exported volume is quantified.*) | | to qualify for 2: Review bulk water sales agreements with purchasing utilities; confirm requirements for use & upkeep of accurate metering. Identify needs to install new, or replace defective meters as needed. | To qualify for 4: Locate all exported water sources on maps and in field, launch meter accuracy testing for existing meters, begin to install meters on unmetered exported water interconnections and replace obsolete/defective meters | | to qualify for 6: Formalize annual meter accuracy testing for all exported water meters. Continue installation of meters on unmetered exported water interconnections and replacement of obsolete/defective meters. | | to qualify for 8: Complete project to install new, or replace defective, meters on all exported water interconnections. Maintain annual meter accuracy testing for all exported water meters. Repair or replace meters outside of +/- 6% accuracy. | | to qualify for 10: Maintain annual meter accuracy testing for all meters. Repair or replace meters outside of +/- 3% accuracy. Investigate new meter technology; pilot one or more replacements with innovative meters in attempt to improve meter accuracy. | | to maintain 10: Standardize meter accuracy test frequency to semi-annual, or more frequent, for all meters. Repair or replace meters outside of +/- 3% accuracy. Continually investigate/pilot improving metering technology. |
| Water exported master meter and supply error adjustment: | Select n/a only if the water utility fails to have meters on its exported supply interconnections. | Inventory information on exported meters and paper records of measured volumes exist but are incomplete and/or in a very crude condition; data error cannot be determined Written agreement(s) with the utility purchasing the water are missing or written in vague language concerning meter management and testing. | No automatic datalogging of exported supply volumes; daily readings are scribed on paper records without any accountability controls to confirm data accuracy and the absence of errors and data gaps in recorded volumes. Written agreement requires meter accuracy testing but is vague on the details of how and who conducts the testing. | Conditions between 2 and 4 | Exported metered flow data is logged automatically in electronic format and reviewed at least on a monthly basis, with necessary corrections implemented. Meter data is adjusted by the utility selling (exporting) the water when gross data errors are detected. A coherent data trail exists for this process to protect both the utility exporting the water and the purchasing Utility. Written agreement exists and clearly states requirements and roles for meter accuracy testing and data management. | Conditions between 4 and 6 | Hourly exported supply metered data is logged automatically & reviewed on at least a weekly basis by the utility selling the water. Data is adjusted to correct gross error when meter/instrumentation equipment malfunction is detected; and to correct for error found by meter accuracy testing. Any data gaps in the archived data are detected and corrected during the weekly review. A coherent data trail exists for this process to protect both the selling (exporting) utility and the purchasing Utility. | Conditions between 6 and 8 | Continuous exported supply metered flow data is logged automatically & reviewed each business day by the utility selling (exporting) the water. Data is adjusted to correct gross error from detected meter/instrumentation equipment malfunction and any error confirmed by meter accuracy testing. Any data errors/gaps are detected and corrected on a daily basis. A data trail exists for the process to protect both the selling (exporting) Utility and the purchasing Utility. | Conditions between 8 and 10 | Computerized system (SCADA or similar) automatically records data which is reviewed each business day by the utility selling (exporting) the water. Tight accountability controls ensure that all error/data gaps that occur in the archived flow data are quickly detected and corrected. A reliable data trail exists and contract provisions for meter testing and data management are reviewed by the selling Utility and purchasing Utility at least once every five years. |

| Grading >>> | n/a | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
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| Improvements to attain higher data grading for "Water exported master meter and supply error adjustment" component: | | to qualify for 2: Develop a plan to restructure recordkeeping system to capture all flow data; set a procedure to review flow data on a daily basis to detect input errors. Obtain more reliable information about existing meters by conducting field inspections of meters and related instrumentation, and obtaining manufacturer literature. Review the written agreement between the utility selling (exporting) the water and the purchasing Utility. | to qualify for 4: Install automatic datalogging equipment on exported supply meters. Set a procedure to review this data on a monthly basis to detect gross anomalies and data gaps. Launch discussions with the purchasing utilities to jointly review terms of the written agreements regarding meter accuracy testing and data management; revise the terms as necessary. | | to qualify for 6: Refine computerized data collection and archive to include hourly exported supply metered flow data that is reviewed at least on a weekly basis to detect specific data anomalies and gaps. Make necessary corrections to errors/data errors on a weekly basis. | | to qualify for 8: Ensure that all exported metered flow data is collected and archived on at least an hourly basis. All data is reviewed and errors/data gaps are corrected each business day. | | to qualify for 10: Conduct accountability checks to confirm that all exported metered flow data is reviewed and corrected each business day by the utility selling the water. Results of all meter accuracy tests and data corrections should be available for sharing between the utility and the purchasing Utility. Establish a schedule for a regular review and updating of the contractual language in the written agreements with the purchasing utilities; at least every five years. | | to maintain 10: Monitor meter innovations for development of more accurate and less expensive flowmeters; work with the purchasing utilities to help identify meter replacement needs. Keep communication lines with the purchasing utilities open and maintain productive relations. Keep the written agreement current with clear and explicit language that meets the ongoing needs of all parties. |
| **AUTHORIZED CONSUMPTION** | | | | | | | | | | | |
| **Billed metered:** | n/a (not applicable). Select n/a only if the entire customer population is not metered and is billed for water service on a flat or fixed rate basis. In such a case the volume entered must be zero. | Less than 50% of customers with volume-based billings from meter readings; flat or fixed rate billing exists for the majority of the customer population | At least 50% of customers with volume-based billing from meter reads; flat rate billing for others. Manual meter reading is conducted, with less than 50% meter read success rate, remaining accounts' consumption is estimated. Limited meter records, no regular meter testing or replacement. Billing data maintained on paper records, with no auditing. | Conditions between 2 and 4 | At least 75% of customers with volume-based, billing from meter reads; flat or fixed rate billing for remaining accounts. Manual meter reading is conducted with at least 50% meter read success rate; consumption for accounts with failed reads is estimated. Purchase records verify age of customer meters; only very limited meter accuracy testing is conducted. Customer meters are replaced only upon complete failure. Computerized billing records exist, but only sporadic internal auditing conducted. | Conditions between 4 and 6 | At least 90% of customers with volume-based billing from meter reads; consumption for remaining accounts is estimated. Manual customer meter reading gives at least 80% customer meter reading success rate; consumption for accounts with failed reads is estimated. Good customer meter records eixst, but only limited meter accuracy testing is conducted. Regular replacement is conducted for the oldest meters. Computerized billing records exist with annual auditing of summary statistics conducting by utility personnel. | Conditions between 6 and 8 | At least 97% of customers exist with volume-based billing from meter reads. At least 90% customer meter reading success rate; or at least 80% read success rate with planning and budgeting for trials of Automatic Meter Reading (AMR) or Advanced Metering Infrastructure (AMI) in one or more pilot areas. Good customer meter records. Regular meter accuracy testing guides replacement of statistically significant number of meters each year. Routine auditing of computerized billing records for global and detailed statistics occurs annually by utility personnel, and is verified by third party at least once every five years. | Conditions between 8 and 10 | At least 99% of customers exist with volume-based billing from meter reads. At least 95% customer meter reading success rate; or minimum 80% meter reading success rate, with Automatic Meter Reading (AMR) or Advanced Metering Infrastructure (AMI) trials underway. Statistically significant customer meter testing and replacement program in place on a continuous basis. Computerized billing with routine, detailed auditing, including field investigation of representative sample of accounts undertaken annually by utility personnel. Audit is conducted by third party auditors at least once every three years. |
| Improvements to attain higher data grading for "Billed Metered Consumption" component: | If n/a is selected because the customer meter population is unmetered, consider establishing a new policy to meter the customer population and employ water rates based upon metered volumes. | to qualify for 2: Conduct investigations or trials of customer meters to select appropriate meter models. Budget funding for meter installations. Investigate volume based water rate structures. | to qualify for 4: Purchase and install meters on unmetered accounts. Implement policies to improve meter reading success. Catalog meter information during meter read visits to identify age/model of existing meters. Test a minimal number of meters for accuracy. Install computerized billing system. | | to qualify for 6: Purchase and install meters on unmetered accounts. Eliminate flat fee billing and establish appropriate water rate structure based upon measured consumption. Continue to achieve verifiable success in removing manual meter reading barriers. Expand meter accuracy testing. Launch regular meter replacement program. Launch a program of annual auditing of global billing statistics by utility personnel. | | to qualify for 8: Purchase and install meters on unmetered accounts. If customer meter reading success rate is less than 97%, assess cost-effectiveness of Automatic Meter Reading (AMR) or Advanced Metering Infrastructure (AMI) system for portion or entire system; or otherwise achieve ongoing improvements in manual meter reading success rate to 97% or higher. Refine meter accuracy testing program. Set meter replacement goals based upon accuracy test results. Implement annual auditing of detailed billing records by utility personnel and implement third party auditing at least once every five years. | | to qualify for 10: Purchase and install meters on unmetered accounts. Launch Automatic Meter Reading (AMR) or Advanced Metering Infrastructure (AMI) system trials if manual meter reading success rate of at least 99% is not achieved within a five-year program. Continue meter accuracy testing program. Conduct planning and budgeting for large scale meter replacement based upon meter life cycle analysis using cumulative flow target. Continue annual detailed billing data auditing by utility personnel and conduct third party auditing at least once every three years. | | to maintain 10: Continue annual internal billing data auditing, and third party auditing at least every three years. Continue customer meter accuracy testing to ensure that accurate customer meter readings are obtained and entered as the basis for volume based billing. Stay abreast of improvements in Automatic Meter Reading (AMR) and Advanced Metering Infrastructure (AMI) and information management. Plan and budget for justified upgrades in metering, meter reading and billing data management to maintain very high accuracy in customer metering and billing. |
| Billed unmetered: | Select n/a if it is the policy of the water utility to meter all customer connections and it has been confirmed by detailed auditing that all customers do indeed have a water meter; i.e. no intentionally unmetered accounts exist | Water utility policy does not require customer metering; flat or fixed fee billing is employed. No data is collected on customer consumption. The only estimates of customer population consumption available are derived from data estimation methods using average fixture count multiplied by number of connections, or similar approach. | Water utility policy does not require customer metering; flat or fixed fee billing is employed. Some metered accounts exist in parts of the system (pilot areas or District Metered Areas) with consumption read periodically or recorded on portable dataloggers over one, three, or seven day periods. Data from these sample meters are used to infer consumption for the total customer population. Site specific estimation methods are used for unusual buildings/water uses. | Conditions between 2 and 4 | Water utility policy does require metering and volume based billing in general. However, a liberal amount of exemptions and a lack of clearly written and communicated procedures result in up to 20% of billed accounts believed to be unmetered by exemption; or the water utility is in transition to becoming fully metered, and a large number of customers remain unmetered. A rough estimate of the annual consumption for all unmetered accounts is included in the annual water audit, with no inspection of individual unmetered accounts. | Conditions between 4 and 6 | Water utility policy does require metering and volume based billing but established exemptions exist for a portion of accounts such as municipal buildings. As many as 15% of billed accounts are unmetered due to this exemption or meter installation difficulties. Only a group estimate of annual consumption for all unmetered accounts is included in the annual water audit, with no inspection of individual unmetered accounts. | Conditions between 6 and 8 | Water utility policy does require metering and volume based billing for all customer accounts. However, less than 5% of billed accounts remain unmetered because meter installation is hindered by unusual circumstances. The goal is to minimize the number of unmetered accounts. Reliable estimates of consumption are obtained for these unmetered accounts via site specific estimation methods. | Conditions between 8 and 10 | Water utility policy does require metering and volume based billing for all customer accounts. Less than 2% of billed accounts are unmetered and exist because meter installation is hindered by unusual circumstances. The goal exists to minimize the number of unmetered accounts to the extent that is economical. Reliable estimates of consumption are obtained at these accounts via site specific estimation methods. |

| Grading >>> | n/a | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
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| Improvements to attain higher data grading for "Billed Unmetered Consumption" component: | | to qualify for 2: Conduct research and evaluate cost/benefit of a new water utility policy to require metering of the customer population; thereby greatly reducing or eliminating unmetered accounts. Conduct pilot metering project by installing water meters in small sample of customer accounts and periodically reading the meters or datalogging the water consumption over one, three, or seven day periods. | to qualify for 4: Implement a new water utility policy requiring customer metering. Launch or expand pilot metering study to include several different meter types, which will provide data for economic assessment of full scale metering options. Assess sites with access difficulties to devise means to obtain water consumption volumes. Begin customer meter installation. | | to qualify for 6: Refine policy and procedures to improve customer metering participation for all but solidly exempt accounts. Assign staff resources to review billing records to identify errant unmetered properties. Specify metering needs and funding requirements to install sufficient meters to significant reduce the number of unmetered accounts | | to qualify for 8: Push to install customer meters on a full scale basis. Refine metering policy and procedures to ensure that all accounts, including municipal properties, are designated for meters. Plan special efforts to address "hard-to-access" accounts. Implement procedures to obtain a reliable consumption estimate for the remaining few unmetered accounts awaiting meter installation. | | to qualify for 10: Continue customer meter installation throughout the service area, with a goal to minimize unmetered accounts. Sustain the effort to investigate accounts with access difficulties, and devise means to install water meters or otherwise measure water consumption. | | to maintain 10: Continue to refine estimation methods for unmetered consumption and explore means to establish metering, for as many billed remaining unmetered accounts as is economically feasible. |
| Unbilled metered: | select n/a if all billing-exempt consumption is unmetered. | Billing practices exempt certain accounts, such as municipal buildings, but written policies do not exist; and a reliable count of unbilled metered accounts is unavailable. Meter upkeep and meter reading on these accounts is rare and not considered a priority. Due to poor recordkeeping and lack of auditing, water consumption for all such accounts is purely guesstimated. | Billing practices exempt certain accounts, such as municipal buildings, but only scattered, dated written directives exist to justify this practice. A reliable count of unbilled metered accounts is unavailable. Sporadic meter replacement and meter reading occurs on an as-needed basis. The total annual water consumption for all unbilled, metered accounts is estimated based upon approximating the number of accounts and assigning consumption from actively billed accounts of same meter size. | Conditions between 2 and 4 | Dated written procedures permit billing exemption for specific accounts, such as municipal properties, but are unclear regarding certain other types of accounts. Meter reading is given low priority and is sporadic. Consumption is quantified from meter readings where available. The total number of unbilled, unmetered accounts must be estimated along with consumption volumes. | Conditions between 4 and 6 | Written policies regarding billing exemptions exist but adherence in practice is questionable. Metering and meter reading for municipal buildings is reliable but sporadic for other unbilled metered accounts. Periodic auditing of such accounts is conducted. Water consumption is quantified directly from meter readings where available, but the majority of the consumption is estimated. | Conditions between 6 and 8 | Written policy identifies the types of accounts granted a billing exemption. Customer meter management and meter reading are considered secondary priorities, but meter reading is conducted at least annually to obtain consumption volumes for the annual water audit. High level auditing of billing records ensures that a reliable census of such accounts exists. | Conditions between 8 and 10 | Clearly written policy identifies the types of accounts given a billing exemption, with emphasis on keeping such accounts to a minimum. Customer meter management and meter reading for these accounts is given proper priority and is reliably conducted. Regular auditing confirms this. Total water consumption for these accounts is taken from reliable readings from accurate meters. |
| Improvements to attain higher data grading for "Unbilled Metered Consumption" component: | | to qualify for 2: Reassess the water utility's policy allowing certain accounts to be granted a billing exemption. Draft an outline of a new written policy for billing exemptions, with clear justification as to why any accounts should be exempt from billing, and with the intention to keep the number of such accounts to a minimum. | to qualify for 4: Review historic written directives and policy documents allowing certain accounts to be billing-exempt. Draft an outline of a written policy for billing exemptions, identify criteria that grants an exemption, with a goal of keeping this number of accounts to a minimum. Consider increasing the priority of reading meters on unbilled accounts at least annually. | | to qualify for 6: Draft a new written policy regarding billing exemptions based upon consensus criteria allowing this occurrence. Assign resources to audit meter records and billing records to obtain census of unbilled metered accounts. Gradually include a greater number of these metered accounts to the routes for regular meter reading. | | to qualify for 8: Communicate billing exemption policy throughout the organization and implement procedures that ensure proper account management. Conduct inspections of accounts confirmed in unbilled metered status and verify that accurate meters exist and are scheduled for routine meter readings. Gradually increase the number of unbilled metered accounts that are included in regular meter reading routes. | | to qualify for 10: Ensure that meter management (meter accuracy testing, meter replacement) and meter reading activities for unbilled accounts are accorded the same priority as billed accounts. Establish ongoing annual auditing process to ensure that water consumption is reliably collected and provided to the annual water audit process. | | to maintain 10: Reassess the utility's philosophy in allowing any water uses to go "unbilled". It is possible to meter and bill all accounts, even if the fee charged for water consumption is discounted or waived. Metering and billing all accounts ensures that water consumption is tracked and water waste from plumbing leaks is detected and minimized. |
| Unbilled unmetered: | | Extent of unbilled, unmetered consumption is unknown due to unclear policies and poor recordkeeping. Total consumption is quantified based upon a purely subjective estimate. | Clear extent of unbilled, unmetered consumption is unknown, but a number of events are randomly documented each year, confirming existence of such consumption, but without sufficient documentation to quantify an accurate estimate of the annual volume consumed. | Conditions between 2 and 4 | Extent of unbilled, unmetered consumption is partially known, and procedures exist to document certain events such as miscellaneous fire hydrant uses. Formulae is used to quantify the consumption from such events (time running multiplied by typical flowrate, multiplied by number of events). | Default value of 1.25% of system input volume is employed | Coherent policies exist for some forms of unbilled, unmetered consumption but others await closer evaluation. Reasonable recordkeeping for the managed uses exists and allows for annual volumes to be quantified by inference, but unsupervised uses are guesstimated. | Conditions between 6 and 8 | Clear policies and good recordkeeping exist for some uses (ex: water used in periodic testing of unmetered fire connections), but other uses (ex: miscellaneous uses of fire hydrants) have limited oversight. Total consumption is a mix of well quantified use such as from formulae (time running multiplied by typical flow, multiplied by number of events) or temporary meters, and relatively subjective estimates of less regulated use. | Conditions between 8 and 10 | Clear policies exist to identify permitted use of water in unbilled, unmetered fashion, with the intention of minimizing this type of consumption. Good records document each occurrence and consumption is quantified via formulae (time running multiplied by typical flow, multiplied by number of events) or use of temporary meters. |
| Improvements to attain higher data grading for "Unbilled Unmetered Consumption" component: | | to qualify for 5: Utilize the accepted default value of 1.25% of the volume of water supplied as an expedient means to gain a reasonable quantification of this use. to qualify for 2: Establish a policy regarding what water uses should be allowed to remain as unbilled and unmetered. Consider tracking a small sample of one such use (ex: fire hydrant flushings). | to qualify for 5: Utilize accepted default value of 1.25% of the volume of water supplied as an expedient means to gain a reasonable quantification of this use. to qualify for 4: Evaluate the documentation of events that have been observed. Meet with user groups (ex: for fire hydrants - fire departments, contractors to ascertain their need and/or volume requirements for water from fire hydrants). | | to qualify for 5: Utilize accepted default value of 1.25% of the volume of water supplied as an expedient means to gain a reasonable quantification of all such use. This is particularly appropriate for water utilities who are in the early stages of the water auditing process, and should focus on other components since the volume of unbilled, umetered consumption is usually a relatively small quatity component, and other larger-quantity components should take priority. | to qualify for 6 or greater: Finalize policy and begin to conduct field checks to better establish and quantify such usage. Proceed if top-down audit exists and/or a great volume of such use is suspected. | to qualify for 8: Assess water utility policy and procedures for various unmetered usages. For example, ensure that a policy exists and permits are issued for use of fire hydrants by persons outside of the utility. Create written procedures for use and documentation of fire hydrants by water utility personnel. Use same approach for other types of unbilled, unmetered water usage. | | to qualify for 10: Refine written procedures to ensure that all uses of unbilled, unmetered water are overseen by a structured permitting process managed by water utility personnel. Reassess policy to determine if some of these uses have value in being converted to billed and/or metered status. | | to maintain 10: Continue to refine policy and procedures with intention of reducing the number of allowable uses of water in unbilled and unmetered fashion. Any uses that can feasibly become billed and metered should be converted eventually. |
| **APPARENT LOSSES** | | | | | | | | | | | |

| Grading >>> | n/a | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
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| **Unauthorized consumption:** | | Extent of unauthorized consumption is unknown due to unclear policies and poor recordkeeping. Total unauthorized consumption is guesstimated. | Unauthorized consumption is a known occurrence, but its extent is a mystery. There are no requirements to document observed events, but periodic field reports capture some of these occurrences. Total unauthorized consumption is approximated from this limited data. | conditions between 2 and 4 | Procedures exist to document some unauthorized consumption such as observed unauthorized fire hydrant openings. Use formulae to quantify this consumption (time running multiplied typical flowrate, multiplied by number of events). | Default value of 0.25% of volume of water supplied is employed | Coherent policies exist for some forms of unauthorized consumption (more than simply fire hydrant misuse) but others await closer evaluation. Reasonable surveillance and recordkeeping exist for occurrences that fall under the policy. Volumes quantified by inference from these records. | Conditions between 6 and 8 | Clear policies and good auditable recordkeeping exist for certain events (ex: tampering with water meters, illegal bypasses of customer meters); but other occurrences have limited oversight. Total consumption is a combination of volumes from formulae (time x typical flow) and subjective estimates of unconfirmed consumption. | Conditions between 8 and 10 | Clear policies exist to identify all known unauthorized uses of water. Staff and procedures exist to provide enforcement of policies and detect violations. Each occurrence is recorded and quantified via formulae (estimated time running multiplied by typical flow) or similar methods. All records and calculations should exist in a form that can be audited by a third party. |
| Improvements to attain higher data grading for "Unauthorized Consumption" component: | | to qualify for 5: Use accepted default of 0.25% of volume of water supplied. to qualify for 2: Review utility policy regarding what water uses are considered unauthorized, and consider tracking a small sample of one such occurrence (ex: unauthorized fire hydrant openings) | to qualify for 5: Use accepted default of 0.25% of system input volume to qualify for 4: Review utility policy regarding what water uses are considered unauthorized, and consider tracking a small sample of one such occurrence (ex: unauthorized fire hydrant openings) | | to qualify for 5: Utilize accepted default value of 0.25% of volume of water supplied as an expedient means to gain a reasonable quantification of all such use. This is particularly appropriate for water utilities who are in the early stages of the water auditing process. | to qualify for 6 or greater: Finalize policy updates to clearly identify the types of water consumption that are authorized from those usages that fall outside of this policy and are, therefore, unauthorized. Begin to conduct regular field checks. Proceed if the top-down audit already exists and/or a great volume of such use is suspected. | to quality for 8: Assess water utility policies to ensure that all known occurrences of unauthorized consumption are outlawed, and that appropriate penalties are prescribed. Create written procedures for detection and documentation of various occurrences of unauthorized consumption as they are uncovered. | | to qualify for 10: Refine written procedures and assign staff to seek out likely occurrences of unauthorized consumption. Explore new locking devices, monitors and other technologies designed to detect and thwart unauthorized consumption. | | to maintain 10: Continue to refine policy and procedures to eliminate any loopholes that allow or tacitly encourage unauthorized consumption. Continue to be vigilant in detection, documentation and enforcement efforts. |
| Customer metering inaccuracies: | select n/a only if the entire customer population is unmetered. In such a case the volume entered must be zero. | Customer meters exist, but with unorganized paper records on meters; no meter accuracy testing or meter replacement program for any size of retail meter. Metering workflow is driven chaotically with no proactive management. Loss volume due to aggregate meter inaccuracy is guesstimated. | Poor recordkeeping and meter oversight is recognized by water utility management who has allotted staff and funding resources to organize improved recordkeeping and start meter accuracy testing. Existing paper records gathered and organized to provide cursory disposition of meter population. Customer meters are tested for accuracy only upon customer request. | Conditions between 2 and 4 | Reliable recordkeeping exists; meter information is improving as meters are replaced. Meter accuracy testing is conducted annually for a small number of meters (more than just customer requests, but less than 1% of inventory). A limited number of the oldest meters are replaced each year. Inaccuracy volume is largely an estimate, but refined based upon limited testing data. | Conditions between 4 and 6 | A reliable electronic recordkeeping system for meters exists. The meter population includes a mix of new high performing meters and dated meters with suspect accuracy. Routine, but limited, meter accuracy testing and meter replacement occur. Inaccuracy volume is quantified using a mix of reliable and less certain data. | Conditions between 6 and 8 | Ongoing meter replacement and accuracy testing result in highly accurate customer meter population. Testing is conducted on samples of meters of varying age and accumulated volume of throughput to determine optimum replacement time for various types of meters. | Ongoing meter replacement and accuracy testing result in highly accurate customer meter population. Statistically significant number of meters are tested in audit year. This testing is conducted on samples of meters of varying age and accumulated volume of throughput to determine optimum replacement time for these meters. | Good records of all active customer meters exist and include as a minimum: meter number, account number/location, type, size and manufacturer. Ongoing meter replacement occurs according to a targeted and justified basis. Regular meter accuracy testing gives a reliable measure of composite inaccuracy volume for the customer meter population. New metering technology is embraced to keep overall accuracy improving. Procedures are reviewed by a third party knowledgeable in the M36 methodology. |
| Improvements to attain higher data grading for "Customer meter inaccuracy volume" component: | If n/a is selected because the customer meter population is unmetered, consider establishing a new policy to meter the customer population and employ water rates based upon metered volumes. | to qualify for 2: Gather available meter purchase records. Conduct testing on a small number of meters believed to be the most inaccurate. Review staffing needs of the metering group and budget for necessary resources to better organize meter management. | to qualify for 4: Implement a reliable record keeping system for customer meter histories, preferably using electronic methods typically linked to, or part of, the Customer Billing System or Customer Information System. Expand meter accuracy testing to a larger group of meters. | | to qualify for 6: Standardize the procedures for meter recordkeeping within an electronic information system. Accelerate meter accuracy testing and meter replacements guided by testing results. | | to qualify for 8: Expand annual meter accuracy testing to evaluate a statistically significant number of meter makes/models. Expand meter replacement program to replace statistically significant number of poor performing meters each year. | | to qualify for 9: Continue efforts to manage meter population with reliable recordkeeping. Test a statistically significant number of meters each year and analyze test results in an ongoing manner to serve as a basis for a target meter replacement strategy based upon accumulated volume throughput. | to qualify for 10: Continue efforts to manage meter population with reliable recordkeeping, meter testing and replacement. Evaluate new meter types and install one or more types in 5-10 customer accounts each year in order to pilot improving metering technology. | to maintain 10: Increase the number of meters tested and replaced as justified by meter accuracy test data. Continually monitor development of new metering technology and Advanced Metering Infrastructure (AMI) to grasp opportunities for greater accuracy in metering of water flow and management of customer consumption data. |

| Grading >>> | n/a | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
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| Systematic Data Handling Errors: | Note: all water utilities incur some amount of this error. Even in water utilities with unmetered customer populations and fixed rate billing, errors occur in annual billing tabulations. Enter a positive value for the volume and select a grading. | Policies and procedures for activation of new customer water billing accounts are vague and lack accountability. Billing data is maintained on paper records which are not well organized. No auditing is conducted to confirm billing data handling efficiency. An unknown number of customers escape routine billing due to lack of billing process oversight. | Policy and procedures for activation of new customer accounts and oversight of billing records exist but need refinement. Billing data is maintained on paper records or insufficiently capable electronic database. Only periodic unstructured auditing work is conducted to confirm billing data handling efficiency. The volume of unbilled water due to billing lapses is a guess. | Conditions between 2 and 4 | Policy and procedures for new account activation and oversight of billing operations exist but needs refinement. Computerized billing system exists, but is dated or lacks needed functionality. Periodic, limited internal audits conducted and confirm with approximate accuracy the consumption volumes lost to billing lapses. | Conditions between 4 and 6 | Policy and procedures for new account activation and oversight of billing operations is adequate and reviewed periodically. Computerized billing system is in use with basic reporting available. Any effect of billing adjustments on measured consumption volumes is well understood. Internal checks of billing data error conducted annually. Reasonably accurate quantification of consumption volume lost to billing lapses is obtained. | Conditions between 6 and 8 | New account activation and billing operations policy and procedures are reviewed at least biannually. Computerized billing system includes an array of reports to confirm billing data and system functionality. Checks are conducted routinely to flag and explain zero consumption accounts. Annual internal checks conducted with third party audit conducted at least once every five years. Accountability checks flag billing lapses. Consumption lost to billing lapses is well quantified and reducing year-by-year. | Conditions between 8 and 10 | Sound written policy and procedures exist for new account activation and oversight of customer billing operations. Robust computerized billing system gives high functionality and reporting capabilities which are utilized, analyzed and the results reported each billing cycle. Assessment of policy and data handling errors are conducted internally and audited by third party at least once every three years, ensuring consumption lost to billing lapses is minimized and detected as it occurs. |
| Improvements to attain higher data grading for "Systematic Data Handling Error volume" component: | | to qualify for 2: Draft written policy and procedures for activating new water billing accounts and oversight of billing operations. Investigate and budget for computerized customer billing system. Conduct initial audit of billing records by flow-charting the basic business processes of the customer account/billing function. | to qualify for 4: Finalize written policy and procedures for activation of new billing acocunts and overall billing operations management. Implement a computerized customer billing system. Conduct initial audit of billing records as part of this process. | | to qualify for 6: Refine new account activation and billing operations procedures and ensure consistency with the utility policy regarding billing, and minimize opportunity for missed billings. Upgrade or replace customer billing system for needed functionality - ensure that billing adjustments don't corrupt the value of consumption volumes. Procedurize internal annual audit process. | | to qualify for 8: Formalize regular review of new account activation process and general billing practices. Enhance reporting capability of computerized billing system. Formalize regular auditing process to reveal scope of data handling error. Plan for periodic third party audit to occur at least once every five years. | | to qualify for 10: Close policy/procedure loopholes that allow some customer accounts to go unbilled, or data handling errors to exist. Ensure that billing system reports are utilized, analyzed and reported every billing cycle. Ensure that internal and third party audits are conducted at least once every three years. | | to maintain 10: Stay abreast of customer information management developments and innovations. Monitor developments of Advanced Metering Infrastructure (AMI) and integrate technology to ensure that customer endpoint information is well-monitored and errors/lapses are at an economic minimum. |
| **SYSTEM DATA** | | | | | | | | | | | |
| Length of mains: | | Poorly assembled and maintained paper as-built records of existing water main installations makes accurate determination of system pipe length impossible. Length of mains is guesstimated. | Paper records in poor or uncertain condition (no annual tracking of installations & abandonments). Poor procedures to ensure that new water mains installed by developers are accurately documented. | Conditions between 2 and 4 | Sound written policy and procedures exist for documenting new water main installations, but gaps in management result in a uncertain degree of error in tabulation of mains length. | Conditions between 4 and 6 | Sound written policy and procedures exist for permitting and commissioning new water mains. Highly accurate paper records with regular field validation; or electronic records and asset management system in good condition. Includes system backup. | Conditions between 6 and 8 | Sound written policy and procedures exist for permitting and commissioning new water mains. Electronic recordkeeping such as a Geographical Information System (GIS) and asset management system are used to store and manage data. | Conditions between 8 and 10 | Sound written policy exists for managing water mains extensions and replacements. Geographic Information System (GIS) data and asset management database agree and random field validation proves truth of databases. Records of annual field validation should be available for review. |
| Improvements to attain higher data grading for "Length of Water Mains" component: | | to qualify for 2: Assign personnel to inventory current as-built records and compare with customer billing system records and highway plans in order to verify poorly documented pipelines. Assemble policy documents regarding permitting and documentation of water main installations by the utility and building developers; identify gaps in procedures that result in poor documentation of new water main installations. | to qualify for 4: Complete inventory of paper records of water main installations for several years prior to audit year. Review policy and procedures for commissioning and documenting new water main installation. | | to qualify for 6: Finalize updates/improvements to written policy and procedures for permitting/commissioning new main installations. Confirm inventory of records for five years prior to audit year; correct any errors or omissions. | | to qualify for 8: Launch random field checks of limited number of locations. Convert to electronic database such as a Geographic Information System (GIS) with backup as justified. Develop written policy and procedures. | | to qualify for 10: Link Geographic Information System (GIS) and asset management databases, conduct field verification of data. Record field verification information at least annually. | | to maintain 10: Continue with standardization and random field validation to improve the completeness and accuracy of the system. |
| Number of active AND inactive service connections: | | Vague permitting (of new service connections) policy and poor paper recordkeeping of customer connections/billings result in suspect determination of the number of service connections, which may be 10-15% in error from actual count. | General permitting policy exists but paper records, procedural gaps, and weak oversight result in questionable total for number of connections, which may vary 5-10% of actual count. | Conditions between 2 and 4 | Written account activation policy and procedures exist, but with some gaps in performance and oversight. Computerized information management system is being brought online to replace dated paper recordkeeping system. Reasonably accurate tracking of service connection installations & abandonments; but count can be up to 5% in error from actual total. | Conditions between 4 and 6 | Written new account activation and overall billing policies and procedures are adequate and reviewed periodically. Computerized information management system is in use with annual installations & abandonments totaled. Very limited field verifications and audits. Error in count of number of service connections is believed to be no more than 3%. | Conditions between 6 and 8 | Policies and procedures for new account activation and overall billing operations are written, well-structured and reviewed at least biannually. Well-managed computerized information management system exists and routine, periodic field checks and internal system audits are conducted. Counts of connections are no more than 2% in error. | Conditions between 8 and 10 | Sound written policy and well managed and audited procedures ensure reliable management of service connection population. Computerized information management system, Customer Billing System, and Geographic Information System (GIS) information agree; field validation proves truth of databases. Count of connections recorded as being in error is less than 1% of the entire population. |
| Improvements to attain higher data grading for "Number of Active and Inactive Service Connections" component: | **Note: The number of Service Connections does not include fire hydrant leads/lines connecting the hydrant to the water main** | to qualify for 2: Draft new policy and procedures for new account activation and overall billing operations. Research and collect paper records of installations & abandonments for several years prior to audit year. | to qualify for 4: Refine policy and procedures for new account activation and overall billing operations. Research computerized recordkeeping system (Customer Information System or Customer Billing System) to improve documentation format for service connections. | | to qualify for 6: Refine procedures to ensure consistency with new account activation and overall billing policy to establish new service connections or decommission existing connections. Improve process to include all totals for at least five years prior to audit year. | | to qualify for 8: Formalize regular review of new account activation and overall billing operations policies and procedures. Launch random field checks of limited number of locations. Develop reports and auditing mechanisms for computerized information management system. | | to qualify for 10: Close any procedural loopholes that allow installations to go undocumented. Link computerized information management system with Geographic Information System (GIS) and formalize field inspection and information system auditing processes. Documentation of new or decommissioned service connections encounters several levels of checks and balances. | | to maintain 10: Continue with standardization and random field validation to improve knowledge of system. |
| | Note: if customer water | Gradings 1-9 apply if customer properties are unmetered, if customer meters exist and are located inside the customer building premises, or if the water utility owns and is responsible for the entire service connection piping from the water main to the customer building. In any of these cases the average distance between the curb stop or boundary separating utility/customer responsibility for service connection piping, and the typical first point of use (ex: faucet) or the customer meter must be quantified. Gradings of 1-9 are used to grade the validity of the means to quantify this value. (See the "Service Connection Diagram" worksheet) | | | | | | | | | Either of two conditions can be met for a grading of 10: |

| Grading >>> | n/a | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
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| Average length of customer service line: | meters are located outside of the customer building next to the curb stop or boundary separating utility/customer responsibility, then the auditor should answer "Yes" to the question on the Reporting Worksheet asking about this. If the answer is Yes, the grading description listed under the Grading of 10(a) will be followed, with a value of zero automatically entered at a Grading of 10. See the Service Connection Diagram worksheet for a visual presentation of this distance. | Vague policy exists to define the delineation of water utility ownership and customer ownership of the service connection piping. Curb stops are perceived as the breakpoint but these have not been well-maintained or documented. Most are buried or obscured. Their location varies widely from site-to-site, and estimating this distance is arbitrary due to the unknown location of many curb stops. | Policy requires that the curb stop serves as the delineation point between water utility ownership and customer ownership of the service connection piping. The piping from the water main to the curb stop is the property of the water utility; and the piping from the curb stop to the customer building is owned by the customer. Curb stop locations are not well documented and the average distance is based upon a limited number of locations measured in the field. | Conditions between 2 and 4 | Good policy requires that the curb stop serves as the delineation point between water utility ownership and customer ownership of the service connection piping. Curb stops are generally installed as needed and are reasonably documented. Their location varies widely from site-to-site, and an estimate of this distance is hindered by the availability of paper records of limited accuracy. | Conditions between 4 and 6 | Clear written policy exists to define utility/customer responsibility for service connection piping. Accurate, well-maintained paper or basic electronic recordkeeping system exists. Periodic field checks confirm piping lengths for a sample of customer properties. | Conditions between 6 and 8 | Clearly worded policy standardizes the location of curb stops and meters, which are inspected upon installation. Accurate and well maintained electronic records exist with periodic field checks to confirm locations of service lines, curb stops and customer meter pits. An accurate number of customer properties from the customer billing system allows for reliable averaging of this length. | Conditions between 8 and 10 | a) Customer water meters exist outside of customer buildings next to the curb stop or boundary separating utility/customer responsibility for service connection piping. If so, answer "Yes" to the question on the Reporting Working asking about this condition. A value of zero and a Grading of 10 are automatically entered in the Reporting Worksheet .<br>b). Meters exist inside customer buildings, or properties are unmetered. In either case, answer "No" to the Reporting Worksheet question on meter location, and enter a distance determined by the auditor. For a Grading of 10 this value must be a very reliable number from a Geographic Information System (GIS) and confirmed by a statistically valid number of field checks. |
| Improvements to attain higher data grading for "Average Length of Customer Service Line" component: | | to qualify for 2: Research and collect paper records of service line installations. Inspect several sites in the field using pipe locators to locate curb stops. Obtain the length of this small sample of connections in this manner. | to qualify for 4: Formalize and communicate policy delineating utility/customer responsibilities for service connection piping. Assess accuracy of paper records by field inspection of a small sample of service connections using pipe locators as needed. Research the potential migration to a computerized information management system to store service connection data. | | to qualify for 6: Establish coherent procedures to ensure that policy for curb stop, meter installation and documentation is followed. Gain consensus within the water utility for the establishment of a computerized information management system. | | to qualify for 8: Implement an electronic means of recordkeeping, typically via a customer information system, customer billing system, or Geographic Information System (GIS). Standardize the process to conduct field checks of a limited number of locations. | | to qualify for 10: Link customer information management system and Geographic Information System (GIS), standardize process for field verification of data. | | to maintain 10: Continue with standardization and random field validation to improve knowledge of service connection configurations and customer meter locations. |
| Average operating pressure: | | Available records are poorly assembled and maintained paper records of supply pump characteristics and water distribution system operating conditions. Average pressure is guesstimated based upon this information and ground elevations from crude topographical maps. Widely varying distribution system pressures due to undulating terrain, high system head loss and weak/erratic pressure controls further compromise the validity of the average pressure calculation. | Limited telemetry monitoring of scattered pumping station and water storage tank sites provides some static pressure data, which is recorded in handwritten logbooks. Pressure data is gathered at individual sites only when low pressure complaints arise. Average pressure is determined by averaging relatively crude data, and is affected by significant variation in ground elevations, system head loss and gaps in pressure controls in the distribution system. | Conditions between 2 and 4 | Effective pressure controls separate different pressure zones; moderate pressure variation across the system, occasional open boundary valves are discovered that breech pressure zones. Basic telemetry monitoring of the distribution system logs pressure data electronically. Pressure data gathered by gauges or dataloggers at fire hydrants or buildings when low pressure complaints arise, and during fire flow tests and system flushing. Reliable topographical data exists. Average pressure is calculated using this mix of data. | Conditions between 4 and 6 | Reliable pressure controls separate distinct pressure zones; only very occasional open boundary valves are encountered that breech pressure zones. Well-covered telemetry monitoring of the distribution system (not just pumping at source treatment plants or wells) logs extensive pressure data electronically. Pressure gathered by gauges/dataloggers at fire hydrants and buildings when low pressure complaints arise, and during fire flow tests and system flushing. Average pressure is determined by using this mix of reliable data. | Conditions between 6 and 8 | Well-managed, discrete pressure zones exist with generally predictable pressure fluctuations. A current full-scale SCADA System or similar realtime monitoring system exists to monitor the water distribution system and collect data, including real time pressure readings at representative sites across the system. The average system pressure is determined from reliable monitoring system data. | Conditions between 8 and 10 | Well-managed pressure districts/zones, SCADA System and hydraulic model exist to give very precise pressure data across the water distribution system. Average system pressure is reliably calculated from extensive, reliable, and cross-checked data. Calculations are reported on an annual basis as a minimum. |
| Improvements to attain higher data grading for "Average Operating Pressure" component: | | to qualify for 2: Employ pressure gauging and/or datalogging equipment to obtain pressure measurements from fire hydrants. Locate accurate topographical maps of service area in order to confirm ground elevations. Research pump data sheets to find pump pressure/flow characteristics | to qualify for 4: Formalize a procedure to use pressure gauging/datalogging equipment to gather pressure data during various system events such as low pressure complaints, or operational testing. Gather pump pressure and flow data at different flow regimes. Identify faulty pressure controls (pressure reducing valves, altitude valves, partially open boundary valves) and plan to properly configure pressure zones. Make all pressure data from these efforts available to generate system-wide average pressure. | | to qualify for 6: Expand the use of pressure gauging/datalogging equipment to gather scattered pressure data at a representative set of sites, based upon pressure zones or areas. Utilize pump pressure and flow data to determine supply head entering each pressure zone or district. Correct any faulty pressure controls (pressure reducing valves, altitude valves, partially open boundary valves) to ensure properly configured pressure zones. Use expanded pressure dataset from these activities to generate system-wide average pressure. | | to qualify for 8: Install a Supervisory Control and Data Acquisition (SCADA) System, or similar realtime monitoring system, to monitor system parameters and control operations. Set regular calibration schedule for instrumentation to insure data accuracy. Obtain accurate topographical data and utilize pressure data gathered from field surveys to provide extensive, reliable data for pressure averaging. | | to qualify for 10: Annually, obtain a system-wide average pressure value from the hydraulic model of the distribution system that has been calibrated via field measurements in the water distribution system and confirmed in comparisons with SCADA System data. | | to maintain 10: Continue to refine the hydraulic model of the distribution system and consider linking it with SCADA System for real-time pressure data calibration, and averaging. |

| Grading >>> | n/a | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
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| **COST DATA** | | | | | | | | | | | |
| Total annual cost of operating water system: | | Incomplete paper records and lack of financial accounting documentation on many operating functions makes calculation of water system operating costs a pure guesstimate | Reasonably maintained, but incomplete, paper or electronic accounting provides data to estimate the major portion of water system operating costs. | Conditions between 2 and 4 | Electronic, industry-standard cost accounting system in place. However, gaps in data are known to exist, periodic internal reviews are conducted but not a structured financial audit. | Conditions between 4 and 6 | Reliable electronic, industry-standard cost accounting system in place, with all pertinent water system operating costs tracked. Data audited periodically by utility personnel, but not a Certified Public Accountant (CPA). | Conditions between 6 and 8 | Reliable electronic, industry-standard cost accounting system in place, with all pertinent water system operating costs tracked. Data audited at least annually by utility personnel, and at least once every three years by third-party CPA. | Conditions between 8 and 10 | Reliable electronic, industry-standard cost accounting system in place, with all pertinent water system operating costs tracked. Data audited annually by utility personnel and annually also by third-party CPA. |
| Improvements to attain higher data grading for "Total Annual Cost of Operating the Water System" component: | | to qualify for 2: Gather available records, institute new financial accounting procedures to regularly collect and audit basic cost data of most important operations functions. | to qualify for 4: Implement an electronic cost accounting system, structured according to accounting standards for water utilities | | to qualify for 6: Establish process for periodic internal audit of water system operating costs; identify cost data gaps and institute procedures for tracking these outstanding costs. | | to qualify for 8: Standardize the process to conduct routine financial audit on an annual basis. Arrange for CPA audit of financial records at least once every three years. | | to qualify for 10: Standardize the process to conduct a third-party financial audit by a CPA on an annual basis. | | to maintain 10: Maintain program, stay abreast of expenses subject to erratic cost changes and long-term cost trend, and budget/track costs proactively |
| Customer retail unit cost (applied to Apparent Losses): | Customer population unmetered, and/or only a fixed fee is charged for consumption. | Antiquated, cumbersome water rate structure is used, with periodic historic amendments that were poorly documented and implemented; resulting in classes of customers being billed inconsistent charges. The actual composite billing rate likely differs significantly from the published water rate structure, but a lack of auditing leaves the degree of error indeterminate. | Dated, cumbersome water rate structure, not always employed consistently in actual billing operations. The actual composite billing rate is known to differ from the published water rate structure, and a reasonably accurate estimate of the degree of error is determined, allowing a composite billing rate to be quantified. | Conditions between 2 and 4 | Straight-forward water rate structure in use, but not updated in several years. Billing operations reliably employ the rate structure. The composite billing rate is derived from a single customer class such as residential customer accounts, neglecting the effect of different rates from varying customer classes. | Conditions between 4 and 6 | Clearly written, up-to-date water rate structure is in force and is applied reliably in billing operations. Composite customer rate is determined using a weighted average residential rate using volumes of water in each rate block. | Conditions between 6 and 8 | Effective water rate structure is in force and is applied reliably in billing operations. Composite customer rate is determined using a weighted average composite consumption rate, which includes residential, commercial, industrial, institutional (CII), and any other distinct customer classes within the water rate structure. | Conditions between 8 and 10 | Current, effective water rate structure is in force and applied reliably in billing operations. The rate structure and calculations of composite rate - which includes residential, commercial, industrial, institutional (CII), and other distinct customer classes - are reviewed by a third party knowledgeable in the M36 methodology at least once every five years. |
| Improvements to attain higher data grading for "Customer Retail Unit Cost" component: | | to qualify for 2: Formalize the process to implement water rates, including a secure documentation procedure. Create a current, formal water rate document and gain approval from all stakeholders. | to qualify for 4: Review the water rate structure and update/formalize as needed. Assess billing operations to ensure that actual billing operations incorporate the established water rate structure. | | to qualify for 6: Evaluate volume of water used in each usage block by residential users. Multiply volumes by full rate structure. | Launch effort to fully meter the customer population and charge rates based upon water volumes | to qualify for 8: Evaluate volume of water used in each usage block by all classifications of users. Multiply volumes by full rate structure. | | to qualify for 10: Conduct a periodic third-party audit of water used in each usage block by all classifications of users. Multiply volumes by full rate structure. | | to maintain 10: Keep water rate structure current in addressing the water utility's revenue needs. Update the calculation of the customer unit rate as new rate components, customer classes, or other components are modified. |
| **Variable production cost (applied to Real Losses):** | Note: if the water utility purchases/imports its entire water supply, then enter the unit purchase cost of the bulk water supply in the Reporting Worksheet with a grading of 10 | Incomplete paper records and lack of documentation on primary operating functions (electric power and treatment costs most importantly) makes calculation of variable production costs a pure guesstimate | Reasonably maintained, but incomplete, paper or electronic accounting provides data to roughly estimate the basic operations costs (pumping power costs and treatment costs) and calculate a unit variable production cost. | Conditions between 2 and 4 | Electronic, industry-standard cost accounting system in place. Electric power and treatment costs are reliably tracked and allow accurate weighted calculation of unit variable production costs based on these two inputs and water imported purchase costs (if applicable). All costs are audited internally on a periodic basis. | Conditions between 4 and 6 | Reliable electronic, industry-standard cost accounting system in place, with all pertinent water system operating costs tracked. Pertinent additional costs beyond power, treatment and water imported purchase costs (if applicable) such as liability, residuals management, wear and tear on equipment, impending expansion of supply, are included in the unit variable production cost, as applicable. The data is audited at least annually by utility personnel. | Conditions between 6 and 8 | Reliable electronic, industry-standard cost accounting system in place, with all pertinent primary and secondary variable production and water imported purchase (if applicable) costs tracked. The data is audited at least annually by utility personnel, and at least once every three years by a third-party knowledgeable in the M36 methodology. | Conditions between 8 and 10 | Either of two conditions can be met to obtain a grading of 10: 1) Third party CPA audit of all pertinent primary and secondary variable production and water imported purchase (if applicable) costs on an annual basis. or: 2) Water supply is entirely purchased as bulk water imported, and the unit purchase cost - including all applicable marginal supply costs - serves as the variable production cost. If all applicable marginal supply costs are not included in this figure, a grade of 10 should not be selected. |
| Improvements to attain higher data grading for "Variable Production Cost" component: | | to qualify for 2: Gather available records, institute new procedures to regularly collect and audit basic cost data and most important operations functions. | to qualify for 4: Implement an electronic cost accounting system, structured according to accounting standards for water utilities | | to qualify for 6: Formalize process for regular internal audits of production costs. Assess whether additional costs (liability, residuals management, equipment wear, impending infrastructure expansion) should be included to calculate a more representative variable production cost. | | to qualify for 8: Formalize the accounting process to include direct cost components (power, treatment) as well as indirect cost components (liability, residuals management, etc.) Arrange to conduct audits by a knowledgable third-party at least once every three years. | | to qualify for 10: Standardize the process to conduct a third-party financial audit by a CPA on an annual basis. | | to maintain 10: Maintain program, stay abreast of expenses subject to erratic cost changes and budget/track costs proactively |

# AWWA Free Water Audit Software: Customer Service Line Diagrams

American Water Works Association.
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**Average Length of Customer Service Line**

The three figures shown on this worksheet display the assignment of the Average Length of Customer Service Line, Lp, for the three most common piping configurations.

**Figure 1** shows the configuration of the water meter outside of the customer building next to the curb stop valve. In this configuration Lp = 0 since the distance between the curb stop and the customer metering point is essentially zero.

**Figure 2** shows the configuration of the customer water meter located inside the customer building, where Lp is the distance from the curb stop to the water meter.

**Figure 3** shows the configuration of an unmetered customer building , where Lp is the distance from the curb stop to the first point of customer water consumption, or, more simply, the building line.

In any water system the Lp will vary notably in a community of different structures, therefore the average Lp value is used and this should be approximated or calculated if a sample of service line measurements has been gathered.

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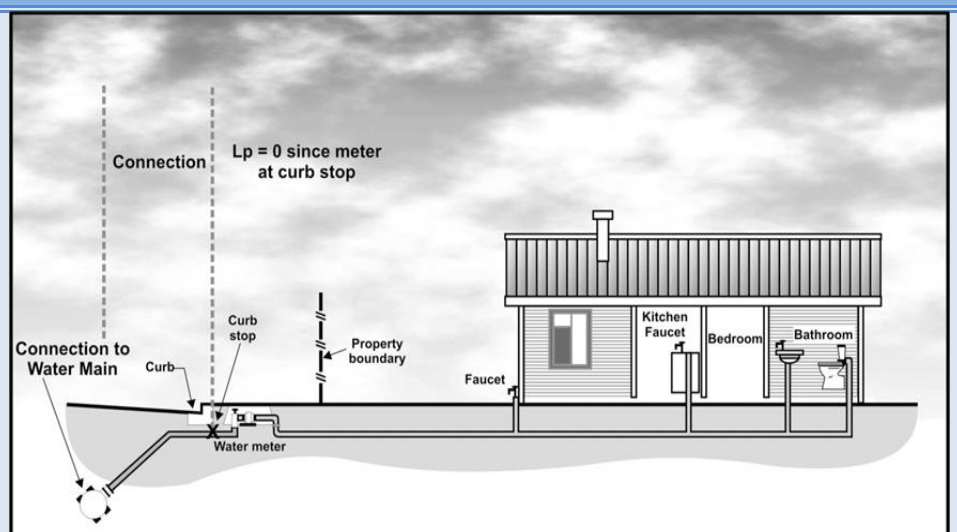


Figure 1 **Typical house connection: Meter at curb stop**
Not to scale

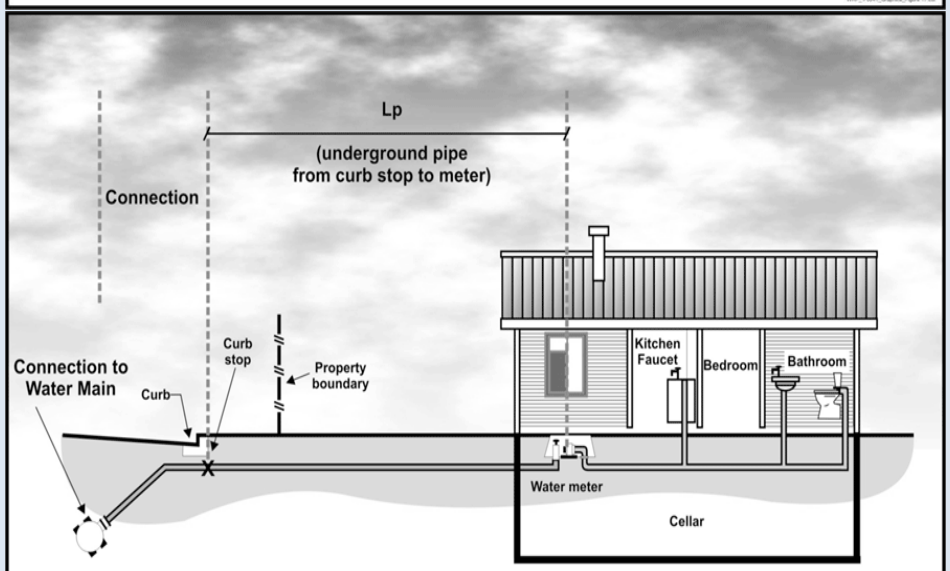


Figure 2 **Typical house connection: Meter inside property**
Not to scale

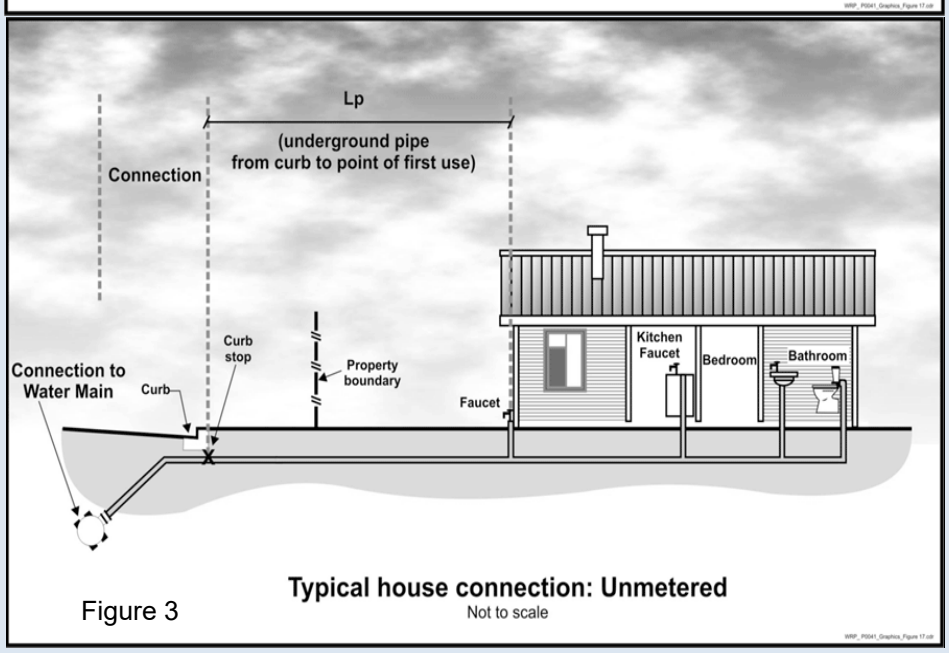


Figure 3 **Typical house connection: Unmetered**
Not to scale

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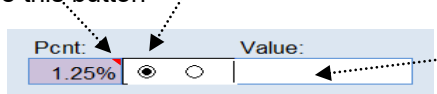
| Item Name | Description |
|---|---|
| Apparent Losses<br>Find | = unauthorized consumption + customer metering inaccuracies + systematic data handling errors<br><br>Apparent Losses include all types of inaccuracies associated with customer metering (worn meters as well as improperly sized meters or wrong type of meter for the water usage profile) as well as systematic data handling errors (meter reading, billing, archiving and reporting), plus unauthorized consumption (theft or illegal use).<br>NOTE: Over-estimation of Apparent Losses results in under-estimation of Real Losses. Under-estimation of Apparent Losses results in over-estimation of Real Losses. |
| Find<br>AUTHORIZED CONSUMPTION | = billed water exported + billed metered + billed unmetered + unbilled metered + unbilled unmetered consumption<br><br>The volume of metered and/or unmetered water taken by registered customers, the water utility's own uses, and uses of others who are implicitly or explicitly authorized to do so by the water utility; for residential, commercial, industrial and public-minded purposes.<br><br>Typical retail customers' consumption is tabulated usually from established customer accounts as billed metered consumption, or - for unmetered customers - billed unmetered consumption. These types of consumption, along with billed water exported, provide revenue potential for the water utility. **Be certain to tabulate the water exported volume as a separate component and do not "double-count" it by including in the billed metered consumption component as well as the water exported component.**<br><br>Unbilled authorized consumption occurs typically in non-account uses, including water for fire fighting and training, flushing of water mains and sewers, street cleaning, watering of municipal gardens, public fountains, or similar public-minded uses. Occasionally these uses may be metered and billed (or charged a flat fee), but usually they are unmetered and unbilled. In the latter case, the water auditor may use a default value to estimate this quantity, or implement procedures for the reliable quantification of these uses. This starts with documenting usage events as they occur and estimating the amount of water used in each event. (See Unbilled unmetered consumption) |
| View Service Connection<br>**Average length of customer service line**<br>Find | This is the average length of customer service line, Lp, that is owned and maintained by the customer; from the point of ownership transfer to the customer water meter, or building line (if unmetered). The quantity is one of the data inputs for the calculation of Unavoidable Annual Real Losses (UARL), which serves as the denominator of the performance indicator: Infrastructure Leakage Index (ILI). The value of Lp is multiplied by the number of customer service connections to obtain a total length of customer owned piping in the system. The purpose of this parameter is to account for the unmetered service line infrastructure that is the responsibility of the customer for arranging repairs of leaks that occur on their lines. In many cases leak repairs arranged by customers take longer to be executed than leak repairs arranged by the water utility on utility-maintained piping. Leaks run longer - and lose more water - on customer-owned service piping, than utility owned piping.<br><br>If the customer water meter exists near the ownership transfer point (usually the curb stop located between the water main and the customer premises) this distance is zero because the meter and transfer point are the same. This is the often encountered configuration of customer water meters located in an underground meter box or "pit" outside of the customer's building. The Free Water Audit Software asks a "Yes/No" question about the meter at this location. If the auditor selects "Yes" then this distance is set to zero and the data grading score for this component is set to 10.<br><br>If water meters are typically located inside the customer premise/building, or properties are unmetered, it is up to the water auditor to estimate a system-wide average Lp length based upon the various customer land parcel sizes and building locations in the service area. Lp will be a shorter length in areas of high density housing, and a longer length in areas of low density housing and varied commercial and industrial buildings. General parcel demographics should be employed to obtain a composite average Lp length for the entire system.<br><br>Refer to the "Service Connection Diagram" worksheet for a depiction of the service line/metering configurations that typically exist in water utilities. This worksheet gives guidance on the determination of the Average Length, Lp, for each configuration. |
| **Average operating pressure**<br>Find | This is the average pressure in the distribution system that is the subject of the water audit. Many water utilities have a calibrated hydraulic model of their water distribution system. For these utilities, the hydraulic model can be utilized to obtain a very accurate quantity of average pressure. In the absence of a hydraulic model, the average pressure may be approximated by obtaining readings of static water pressure from a representative sample of fire hydrants or other system access points evenly located across the system. A weighted average of the pressure can be assembled; but be sure to take into account the elevation of the fire hydrants, which typically exist several feet higher than the level of buried water pipelines. If the water utility is compiling the water audit for the first time, the average pressure can be approximated, but with a low data grading. In subsequent years of auditing, effort should be made to improve the accuracy of the average pressure quantity. This will then qualify the value for a higher data grading. |
| **Billed Authorized Consumption** | All consumption that is billed and authorized by the utility. This may include both metered and unmetered consumption. See "Authorized Consumption" for more information. |
| **Billed metered consumption**<br>Find | All metered consumption which is billed to retail customers, including all groups of customers such as domestic, commercial, industrial or institutional. **It does NOT include water supplied to neighboring utilities (water exported) which is metered and billed. Be sure to subtract any consumption for exported water sales that may be included in these billing roles. Water supplied as exports to neighboring water utilities should be included only in the Water Exported component.** The metered consumption data can be taken directly from billing records for the water audit period. The accuracy of yearly metered consumption data can be refined by including an adjustment to account for customer meter reading lag time since not all customer meters are read on the same day of the meter reading period. However additional analysis is necessary to determine the lag time adjustment value, which may or may not be significant. |
| **Billed unmetered consumption**<br>Find | All billed consumption which is calculated based on estimates or norms from water usage sites that have been determined by utility policy to be left unmetered. This is typically a very small component in systems that maintain a policy to meter their customer population. However, this quantity can be the key consumption component in utilities that have not adopted a universal metering policy. **This component should NOT include any water that is supplied to neighboring utilities (water exported) which is unmetered but billed. Water supplied as exports to neighboring water utilities should be included only in the Water Exported component.** |

| Item Name | Description |
|---|---|
| Customer metering inaccuracies | Apparent water losses caused by the collective under-registration of customer water meters. Many customer water meters gradually wear as large cumulative volumes of water are passed through them over time. This causes the meters to under-register the flow of water. This occurrence is common with smaller residential meters of sizes 5/8-inch and 3/4 inch after they have registered very large cumulative volumes of water, which generally occurs only after periods of years. For meters sized 1-inch and larger - typical of multi-unit residential, commercial and industrial accounts - meter under-registration can occur from wear or from the improper application of the meter; i.e. installing the wrong type of meter or the wrong size of meter, for the flow pattern (profile) of the consumer. For instance, many larger meters have reduced accuracy at low flows. If an oversized meter is installed, most of the time the routine flow will occur in the low flow range of the meter, and a significant portion of it may not be registered. It is important to properly select and install all meters, but particularly large customer meters, size 1-inch and larger.<br><br>The auditor has two options for entering data for this component of the audit. The auditor can enter a percentage under-registration (typically an estimated value), this will apply the selected percentage to the two categories of metered consumption to determine the volume of water not recorded due to customer meter inaccuracy. Note that this percentage is a composite average inaccuracy for <u>all</u> customer meters in the entire meter population. The percentage will be multiplied by the sum of the volumes in the Billed Metered and Unbilled Metered components. Alternatively, if the auditor has substantial data from meter testing activities, he or she can calculate their own loss volumes, and this volume may be entered directly.<br><br>Note that a value of zero will be accepted but an alert will appear asking if the customer population is unmetered. Since all metered systems have some degree of inaccuracy, a positive value should be entered. A value of zero in this component is valid only if the water utility does not meter its customer population. |
| Customer retail unit cost | The Customer Retail Unit Cost represents the charge that customers pay for water service. This unit cost is applied routinely to the components of Apparent Loss, since these losses represent water reaching customers but not (fully) paid for. Since most water utilities have a rate structure that includes a variety of different costs based upon class of customer, a weighted average of individual costs and number of customer accounts in each class can be calculated to determine a single composite cost that should be entered into this cell. Finally, the weighted average cost should also include additional charges for sewer, storm water or biosolids processing, <u>but only if</u> these charges are based upon the volume of potable water consumed.<br><br>For water utilities in regions with limited water resources and a questionable ability to meet the drinking water demands in the future, the Customer Retail Unit Cost might also be applied to value the Real Losses; instead of applying the Variable Production Cost to Real Losses. In this way, it is assumed that every unit volume of leakage reduced by leakage management activities will be sold to a customer.<br><br>Note: the Free Water Audit Software allows the user to select the units that are charged to customers (either $/1,000 gallons, $/hundred cubic feet, or $/1,000 litres) and automatically converts these units to the units that appear in the "WATER SUPPLIED" box. The monetary units are United States dollars, $. |
| Infrastructure Leakage Index (ILI) | The ratio of the Current Annual Real Losses (Real Losses) to the Unavoidable Annual Real Losses (UARL). The ILI is a highly effective performance indicator for comparing (benchmarking) the performance of utilities in operational management of real losses. |
| Length of mains | Length of all pipelines (except service connections) in the system starting from the point of system input metering (for example at the outlet of the treatment plant). It is also recommended to include in this measure the total length of fire hydrant lead pipe. Hydrant lead pipe is the pipe branching from the water main to the fire hydrant. Fire hydrant leads are typically of a sufficiently large size that is more representative of a pipeline than a service connection. The average length of hydrant leads across the entire system can be assumed if not known, and multiplied by the number of fire hydrants in the system, which can also be assumed if not known. This value can then be added to the total pipeline length. Total length of mains can therefore be calculated as:<br><br>Length of Mains, miles = (total pipeline length, miles) + [ {(average fire hydrant lead length, ft) x (number of fire hydrants)} / 5,280 ft/mile ]<br>or<br>Length of Mains, kilometres = (total pipeline length, kilometres) + [ {(average fire hydrant lead length, metres) x (number of fire hydrants)} / 1,000 metres/kilometre ] |
| NON-REVENUE WATER | = Apparent Losses + Real Losses + Unbilled Metered Consumption + Unbilled Unmetered Consumption. This is water which does not provide revenue potential to the utility. |
| Number of <u>active AND inactive</u> service connections | Number of customer service connections, extending from the water main to supply water to a customer. Please note that this includes the actual number of distinct piping connections, including fire connections, whether active or inactive. This may differ substantially from the number of customers (or number of accounts). **Note: this number does not include the pipeline leads to fire hydrants - the total length of piping supplying fire hyrants should be included in the "Length of mains" parameter.** |
| Real Losses | Physical water losses from the pressurized system (water mains and customer service connections) and the utility's storage tanks, up to the point of customer consumption. In metered systems this is the customer meter, in unmetered situations this is the first point of consumption (stop tap/tap) within the property. The annual volume lost through all types of leaks, breaks and overflows depends on frequencies, flow rates, and average duration of individual leaks, breaks and overflows. |
| Revenue Water | Those components of System Input Volume that are billed and have the potential to produce revenue. |
| Service Connection Density | =number of customer service connections / length of mains |

| Item Name | Description |
|---|---|
| Find<br><br>**Systematic data handling errors** | Apparent losses caused by accounting omissions, errant computer programming, gaps in policy, procedure, and permitting/activation of new accounts; and any type of data lapse that results in under-stated customer water consumption in summary billing reports.<br><br>**Systematic Data Handling Errors result in a direct loss of revenue potential. Water utilities can find "lost" revenue by keying on this component.**<br><br>Utilities typically measure water consumption registered by water meters at customer premises. The meter should be read routinely (ex: monthly) and the data transferred to the Customer Billing System, which generates and sends a bill to the customer. Data Transfer Errors result in the consumption value being less than the actual consumption, creating an apparent loss. Such error might occur from illegible and mis-recorded hand-written readings compiled by meter readers, inputting an incorrect meter register unit conversion factor in the automatic meter reading equipment, or a variety of similar errors.<br><br>Apparent losses also occur from Data Analysis Errors in the archival and data reporting processes of the Customer Billing System. Inaccurate estimates used for accounts that fail to produce a meter reading are a common source of error. Billing adjustments may award customers a rightful monetary credit, but do so by creating a negative value of consumption, thus under-stating the actual consumption. Account activation lapses may allow new buildings to use water for months without meter readings and billing. Poor permitting and construction inspection practices can result in a new building lacking a billing account, a water meter and meter reading; i.e., the customer is unknown to the utility's billing system.<br><br>Close auditing of the permitting, metering, meter reading, billing and reporting processes of the water consumption data trail can uncover data management gaps that create volumes of systematic data handling error. Utilities should routinely analyze customer billing records to detect data anomalies and quantify these losses. For example, a billing account that registers zero consumption for two or more billing cycles should be checked to explain why usage has seemingly halted. Given the revenue loss impacts of these losses, water utilities are well-justified in providing continuous oversight and timely correction of data transfer errors & data handling errors.<br><br>If the water auditor has not yet gathered detailed data or assessment of systematic data handling error, it is recommended that the auditor apply the default value of 0.25% of the the Billed Authorized Consumption volume. However, if the auditor has investigated the billing system and its controls, and has well validated data that indicates the volume from systematic data handling error is substantially higher or lower than that generated by the default value, then the auditor should enter a quantity that was derived from the utility investigations and select an appropriate grading. Note: negative values are not allowed for this audit component. If the auditor enters zero for this component then a grading of 1 will be automatically assigned. |
| **Total annual cost of operating the** Find | These costs include those for operations, maintenance and any annually incurred costs for long-term upkeep of the drinking water supply and distribution system. It should include the costs of day-to-day upkeep and long-term financing such as repayment of capital bonds for infrastructure expansion or improvement. Typical costs include employee salaries and benefits, materials, equipment, insurance, fees, administrative costs and all other costs that exist to sustain the drinking water supply. Depending upon water utility accounting procedures or regulatory agency requirements, it may be appropriate to include depreciation in the total of this cost. This cost should not include any costs to operate wastewater, biosolids or other systems outside of drinking water. |
| Find<br>**consumption** | Includes water illegally withdrawn from fire hydrants, illegal connections, bypasses to customer consumption meters, or tampering with metering or meter reading equipment; as well as any other ways to receive water while thwarting the water utility's ability to collect revenue for the water. Unauthorized consumption results in uncaptured revenue and creates an error that understates customer consumption. In most water utilities this volume is low and, if the water auditor has not yet gathered detailed data for these loss occurrences, it is recommended that the auditor apply a default value of 0.25% of the volume of water supplied. However, if the auditor has investigated unauthorized occurrences, and has well validated data that indicates the volume from unauthorized consumption is substantially higher or lower than that generated by the default value, then the auditor should enter a quantity that was derived from the utility investigations. Note that a value of zero will not be accepted since all water utilities have some volume of unauthorized consumption occurring in their system.<br><br>Note: if the auditor selects the default value for unauthorized consumption, a data grading of 5 is automatically assigned, but not displayed on the Reporting Worksheet. |
| **Unavoidable Annual Real Losses (UARL)** Find | UARL (gallons)=(5.41Lm + 0.15Nc + 7.5Lc) xP,<br>or<br>UARL (litres)=(18.0Lm + 0.8Nc + 25.0Lc) xP<br><br>where:<br>Lm = length of mains (miles or kilometres)<br>Nc = number of customer service connections<br>Lp = the average distance of customer service connection piping (feet or metres)<br>(see the Worksheet "Service Connection Diagram" for guidance on deterring the value of Lp)<br>Lc = total length of customer service connection piping (miles or km)<br>Lc = Nc X Lp (miles or kilometres)<br>P = Pressure (psi or metres)<br><br>The UARL is a theoretical reference value representing the technical low limit of leakage that could be achieved if all of today's best technology could be successfully applied. It is a key variable in the calculation of the Infrastructure Leakage Index (ILI). Striving to reduce system leakage to a level close to the UARL is usually not needed unless the water supply is unusually expensive, scarce or both.<br><br>NOTE: The UARL calculation has not yet been proven as fully valid for very small, or low pressure water distribution systems. If,<br>in gallons:<br>(Lm x 32) + Nc < 3000 or<br>P <35psi<br>in litres:<br>(Lm x 20) + Nc < 3000 or<br>P < 25m<br>then the calculated UARL value may not be valid. The software does not display a value of UARL or ILI if either of these conditions is true. |

| Item Name | Description |
|---|---|
| **Unbilled Authorized Consumption** | All consumption that is unbilled, but still authorized by the utility. This includes Unbilled Metered Consumption + Unbilled Unmetered Consumption. See "Authorized Consumption" for more information. For Unbilled Unmetered Consumption, the Free Water Audit Software provides the auditor the option to select a default value if they have not audited unmetered activities in detail. The default calculates a volume that is 1.25% of the Water Supplied volume. If the auditor has carefully audited the various unbilled, unmetered, authorized uses of water, and has established reliable estimates of this collective volume, then he or she may enter the volume directly for this component, and not use the default value. |
| **Unbilled metered consumption** Find | Metered consumption which is authorized by the water utility, but, for any reason, is deemed by utility policy to be unbilled. This might for example include metered water consumed by the utility itself in treatment or distribution operations, or metered water provided to civic institutions free of charge. **It does not include water supplied to neighboring utilities (water exported) which may be metered but not billed.** |
| **Unbilled unmetered consumption** Find | Any kind of Authorized Consumption which is neither billed or metered. This component typically includes water used in activities such as fire fighting, flushing of water mains and sewers, street cleaning, fire flow tests conducted by the water utility, etc. In most water utilities it is a small component which is very often substantially overestimated. **It does NOT include water supplied to neighboring utilities (water exported) which is unmetered and unbilled – an unlikely case.** This component has many sub-components of water use which are often tedious to identify and quantify. Because of this, and the fact that it is usually a small portion of the water supplied, it is recommended that the auditor apply the default value, which is 1.25% of the Water Supplied volume. Select the default percentage to enter this value.<br><br>If the water utility has carefully audited the unbilled, unmetered activities occurring in the system, and has well validated data that gives a value substantially higher or lower than the default volume, then the auditor should enter their own volume. However the default approach is recommended for most water utilities.<br><br>Note that a value of zero is not permitted, since all water utilities have some volume of water in this component occurring in their system. |
| **Units and Conversions** | The user may develop an audit based on one of three unit selections:<br>1) Million Gallons (US)<br>2) Megalitres (Thousand Cubic Metres)<br>3) Acre-feet<br>Once this selection has been made in the instructions sheet, all calculations are made on the basis of the chosen units. Should the user wish to make additional conversions, a unit converter is provided below (use drop down menus to select units from the yellow unit boxes):<br><br>Enter Units: 1 — Convert From… **Million Gallons (US)** = **Converts to…..** **3.06888329** **Acre-feet**<br>(conversion factor = 3.06888328973723) |
| **Use of Option Buttons** | To use the default percent value choose this button<br>To enter a value choose this button and enter the value in the cell to the right<br>  <br>**NOTE:** For Unbilled Unmetered Consumption, Unauthorized Consumption and Systematic Data Handling Errors, a recommended default value can be applied by selecting the Percent option. The default values are based on fixed percentages of Water Supplied or Billed Authorized Consumption and |
| **Variable production cost (Applied to Real Losses)** Find | The cost to produce and supply the next unit of water (e.g., $/million gallons). This cost is determined by calculating the summed unit costs for ground and surface water treatment and all power used for pumping from the source to the customer. It may also include other miscellaneous unit costs that apply to the production of drinking water. It should also include the unit cost of bulk water purchased as an import if applicable.<br><br>It is common to apply this unit cost to the volume of Real Losses. However, if water resources are strained and the ability to meet future drinking water demands is in question, then the water auditor can be justified in applying the Customer Retail Rate to the Real Loss volume, rather than applying the Variable Production Cost.<br><br>The Free Water Audit Software applies the Variable Production costs to Real Losses by default. However, the auditor has the option on the Reporting Worksheet to select the Customer Retail Cost as the basis for the Real Loss cost evaluation if the auditor determines that this is warranted. |
| **Volume from own sources** Find | The volume of water withdrawn (abstracted) from water resources (rivers, lakes, streams, wells, etc) controlled by the water utility, and then treated for potable water distribution. Most water audits are compiled for utility retail water distribution systems, so this volume should reflect the amount of treated drinking water that entered the distribution system. Often the volume of water measured at the effluent of the treatment works is slightly less than the volume measured at the raw water source, since some of the water is used in the treatment process. Thus, it is useful if flows are metered at the effluent of the treatment works. If metering exists only at the raw water source, an adjustment for water used in the treatment process should be included to account for water consumed in treatment operations such as filter backwashing, basin flushing and cleaning, etc. If the audit is conducted for a wholesale water agency that sells untreated water, then this quantity reflects the measure of the raw water, typically metered at the source. |

| Item Name | Description |
|---|---|
| **Volume from own sources: Master meter and supply error** Find | An estimate or measure of the degree of inaccuracy that exists in the master (production) meters measuring the annual Volume from own Sources, and any error in the data trail that exists to collect, store and report the summary production data. This adjustment is a weighted average number that represents the collective error for all master meters for all days of the audit year and any errors identified in the data trail. Meter error can occur in different ways. A meter or meters may be inaccurate by under-registering flow (did not capture all the flow), or by over-registering flow (overstated the actual flow). Data error can occur due to data gaps caused by temporary outages of the meter or related instrumentation. All water utilities encounter some degree of inaccuracy in master meters and data errors in archival systems are common; thus a value of zero should not be entered. Enter a negative percentage or value for metered data under-registration; or, enter a positive percentage or value for metered data over-registration. |
| **Water exported** Find | The Water Exported volume is the bulk water conveyed and sold by the water utility to neighboring water systems that exists outside of their service area. Typically this water is metered at the custody transfer point of interconnection between the two water utilities. Usually the meter(s) are owned by the water utility that is selling the water: i.e. the exporter. If the water utility who is compiling the annual water audit sells bulk water in this manner, they are an exporter of water.<br><br>Note: The Water Exported volume is sold to wholesale customers who are typically charged a wholesale rate that is different than retail rates charged to the retail customers existing within the service area. Many state regulatory agencies require that the Water Exported volume be reported to them as a quantity separate and distinct from the retail customer billed consumption. For these reasons - and others - the Water Exported volume is always quantified separately from Billed Authorized Consumption in the standard water audit. **Be certain not to "double-count" this quantity by including it in both the Water Exported box and the Billed Metered Consumption box of the water audit Reporting Worksheet. This volume should be included only in the Water Exported box.** |
| **Water exported: Master meter and** Find | An estimate or measure of the volume in which the Water Exported volume is incorrect. This adjustment is a weighted average that represents the collective error for all of the metered and archived exported flow for all days of the audit year. Meter error can occur in different ways. A meter may be inaccurate by under-registering flow (did not capture all the flow), or by over-registering flow (overstated the actual flow). Error in the metered, archived data can also occur due to data gaps caused by temporary outages of the meter or related instrumentation. All water utilities encounter some degree of error in their metered data, particularly if meters are aged and infrequently tested. Occasional errors also occur in the archived data. Thus, a value of zero should not be entered. Enter a negative percentage or value for metered data under-registration; or enter a positive percentage or value for metered data over-registration. If regular meter accuracy testing is conducted on the meter(s) - which is usually conducted by the water utility selling the water - then the results of this testing can be used to help quantify the meter error adjustment. Corrections to data gaps or other errors found in the archived data should also be included as a portion of this meter error adjustment. |
| **Water imported** Find | The Water Imported volume is the bulk water purchased to become part of the Water Supplied volume. Typically this is water purchased from a neighboring water utility or regional water authority, and is metered at the custody transfer point of interconnection between the two water utilities. Usually the meter(s) are owned by the water supplier selling the water to the utility conducting the water audit. The water supplier selling the bulk water usually charges the receiving utility based upon a wholesale water rate. |
| **Water imported: Master meter and supply error** Find | An estimate or measure of the volume in which the Water Imported volume is incorrect. This adjustment is a weighted average that represents the collective error for all of the metered and archived imported flow for all days of the audit year. Meter error can occur in different ways. A meter may be inaccurate by under-registering flow (did not capture all the flow), or by over-registering flow (overstated the actual flow). Error in the metered, archived data can also occur due to data gaps caused by temporary outages of the meter or related instrumentation. All water utilities encounter some level of meter inaccuracy, particularly if meters are aged and infrequently tested. Occasional errors also occur in the archived metered data. Thus, a value of zero should not be entered. Enter a negative percentage or value for metered data under-registration; or, enter a positive percentage or value for metered data over-registration. If regular meter accuracy testing is conducted on the meter(s) - which is usually conducted by the water utility selling the water - then the results of this testing can be used to help quantify the meter error adjustment. |
| **WATER LOSSES** Find | = apparent losses + real losses<br><br>Water Losses are the difference between Water Supplied and Authorized Consumption. Water losses can be considered as a total volume for the whole system, or for partial systems such as transmission systems, pressure zones or district metered areas (DMA); if one of these configurations are the basis of the water audit. |

# AWWA Free Water Audit Software:
## Determining Water Loss Standing

WAS v5.0

American Water Works Association.
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**Water Audit Report for:** City of Fullerton (CA3010010)
**Reporting Year:** 2020 | 1/2020 - 12/2020
**Data Validity Score:** 77

## Water Loss Control Planning Guide

| Functional Focus Area | Water Audit Data Validity Level / Score | | | | |
|---|---|---|---|---|---|
| | **Level I** (0-25) | **Level II** (26-50) | **Level III** (51-70) | **Level IV** (71-90) | **Level V** (91-100) |
| Audit Data Collection | Launch auditing and loss control team; address production metering deficiencies | Analyze business process for customer metering and billing functions and water supply operations. Identify data gaps. | Establish/revise policies and procedures for data collection | Refine data collection practices and establish as routine business process | Annual water audit is a reliable gauge of year-to-year water efficiency standing |
| Short-term loss control | Research information on leak detection programs. Begin flowcharting analysis of customer billing system | Conduct loss assessment investigations on a sample portion of the system: customer meter testing, leak survey, unauthorized consumption, etc. | Establish ongoing mechanisms for customer meter accuracy testing, active leakage control and infrastructure monitoring | Refine, enhance or expand ongoing programs based upon economic justification | Stay abreast of improvements in metering, meter reading, billing, leakage management and infrastructure rehabilitation |
| Long-term loss control | | Begin to assess long-term needs requiring large expenditure: customer meter replacement, water main replacement program, new customer billing system or Automatic Meter Reading (AMR) system. | Begin to assemble economic business case for long-term needs based upon improved data becoming available through the water audit process. | Conduct detailed planning, budgeting and launch of comprehensive improvements for metering, billing or infrastructure management | Continue incremental improvements in short-term and long-term loss control interventions |
| Target-setting | | | Establish long-term apparent and real loss reduction goals (+10 year horizon) | Establish mid-range (5 year horizon) apparent and real loss reduction goals | Evaluate and refine loss control goals on a yearly basis |
| Benchmarking | | | Preliminary Comparisons - can begin to rely upon the Infrastructure Leakage Index (ILI) for performance comparisons for real losses (see below table) | Performance Benchmarking - ILI is meaningful in comparing real loss standing | Identify Best Practices/ Best in class - the ILI is very reliable as a real loss performance indicator for best in class service |

*For validity scores of 50 or below, the shaded blocks should not be focus areas until better data validity is achieved.*

Once data have been entered into the Reporting Worksheet, the performance indicators are automatically calculated. How does a water utility operator know how well his or her system is performing? The AWWA Water Loss Control Committee provided the following table to assist water utilities is gauging an approximate Infrastructure Leakage Index (ILI) that is appropriate for their water system and local conditions. The lower the amount of leakage and real losses that exist in the system, then the lower the ILI value will be.

**Note:** this table offers an approximate guideline for leakage reduction target-setting. The best means of setting such targets include performing an economic assessment of various loss control methods. However, this table is useful if such an assessment is not possible.

## General Guidelines for Setting a Target ILI
## (without doing a full economic analysis of leakage control options)

| Target ILI Range | Financial Considerations | Operational Considerations | Water Resources Considerations |
|---|---|---|---|
| **1.0 - 3.0** | Water resources are costly to develop or purchase; ability to increase revenues via water rates is greatly limited because of regulation or low ratepayer affordability. | Operating with system leakage above this level would require expansion of existing infrastructure and/or additional water resources to meet the demand. | Available resources are greatly limited and are very difficult and/or environmentally unsound to develop. |
| **>3.0 -5.0** | Water resources can be developed or purchased at reasonable expense; periodic water rate increases can be feasibly imposed and are tolerated by the customer population. | Existing water supply infrastructure capability is sufficient to meet long-term demand as long as reasonable leakage management controls are in place. | Water resources are believed to be sufficient to meet long-term needs, but demand management interventions (leakage management, water conservation) are included in the long-term planning. |
| **>5.0 - 8.0** | Cost to purchase or obtain/treat water is low, as are rates charged to customers. | Superior reliability, capacity and integrity of the water supply infrastructure make it relatively immune to supply shortages. | Water resources are plentiful, reliable, and easily extracted. |
| **Greater than 8.0** | Although operational and financial considerations may allow a long-term ILI greater than 8.0, such a level of leakage is not an effective utilization of water as a resource. Setting a target level greater than 8.0 - other than as an incremental goal to a smaller long-term target - is discouraged. | | |
| **Less than 1.0** | If the calculated Infrastructure Leakage Index (ILI) value for your system is 1.0 or less, two possibilities exist. a) you are maintaining your leakage at low levels in a class with the top worldwide performers in leakage control. b) A portion of your data may be flawed, causing your losses to be greatly understated. This is likely if you calculate a low ILI value but do not employ extensive leakage control practices in your operations. In such cases it is beneficial to validate the data by performing field measurements to confirm the accuracy of production and customer meters, or to identify any other potential sources of error in the data. | | |

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**Example 1a**: Million Gallons: | **Example 1b**: Million Gallons: | **Example 2a**: Megalitres: | **Example 2b**: Megalitres:

# Example Audit 1a:

## AWWA Free Water Audit Software: Reporting Worksheet

WAS v5.0
American Water Works Association.
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? Click to access definition
+ Click to add a comment

**Water Audit Report for:** City of Asheville (01-11-010)
**Reporting Year:** 2013 | 7/2012 - 6/2013

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: MILLION GALLONS (US) 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 Error Adjustments

**WATER SUPPLIED**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Volume from own sources: | 7 | 7,352.880 | MG/Yr | 3 | | | 285.450 | MG/Yr |
| Water imported: | n/a | 0.000 | MG/Yr | | | | | MG/Yr |
| Water exported: | n/a | 0.000 | MG/Yr | | | | | MG/Yr |

Enter negative % or value for under-registration
Enter positive % or value for over-registration

**WATER SUPPLIED:** 7,067.430 MG/Yr

**AUTHORIZED CONSUMPTION**

Click here: ? for help using option buttons below

| | | | | Pcnt: | Value: | |
|---|---|---|---|---|---|---|
| Billed metered: | 8 | 4,782.250 | MG/Yr | | | |
| Billed unmetered: | n/a | 0.000 | MG/Yr | | | |
| Unbilled metered: | 7 | 27.757 | MG/Yr | | | |
| Unbilled unmetered: | 8 | 157.790 | MG/Yr | | 157.790 | MG/Yr |

Unbilled Unmetered volume entered is greater than the recommended default value

Use buttons to select percentage of water supplied **OR** value

**AUTHORIZED CONSUMPTION:** 4,967.797 MG/Yr

**WATER LOSSES (Water Supplied - Authorized Consumption)** 2,099.633 MG/Yr

**Apparent Losses**

| | | | Pcnt: | Value: | |
|---|---|---|---|---|---|
| Unauthorized consumption: | | 17.669 | MG/Yr | 0.25% | | MG/Yr |

Default option selected for unauthorized consumption - a grading of 5 is applied but not displayed

| | | | | | | |
|---|---|---|---|---|---|---|
| Customer metering inaccuracies: | 7 | 111.220 | MG/Yr | 2.26% | | MG/Yr |
| Systematic data handling errors: | 5 | 11.956 | MG/Yr | 0.25% | | MG/Yr |

Default option selected for Systematic data handling errors - a grading of 5 is applied but not displayed

**Apparent Losses:** 140.844 MG/Yr

**Real Losses (Current Annual Real Losses or CARL)**

**Real Losses = Water Losses - Apparent Losses:** 1,958.789 MG/Yr

**WATER LOSSES:** 2,099.633 MG/Yr

**NON-REVENUE WATER**

**NON-REVENUE WATER:** 2,285.180 MG/Yr

= Water Losses + Unbilled Metered + Unbilled Unmetered

**SYSTEM DATA**

| | | | |
|---|---|---|---|
| Length of mains: | 4 | 1,236.5 | miles |
| Number of active AND inactive service connections: | 7 | 55,256 | |
| Service connection density: | | 45 | 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: 4 | 145.3 psi

**COST DATA**

| | | | |
|---|---|---|---|
| Total annual cost of operating water system: | 10 | $33,630,676 | $/Year |
| Customer retail unit cost (applied to Apparent Losses): | 10 | $3.22 | $/100 cubic feet (ccf) |
| Variable production cost (applied to Real Losses): | 6 | $335.94 | $/Million gallons |

☐ 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: Variable production cost (applied to Real Losses)
3: Unauthorized consumption

Example Audit 1b:

**AWWA Free Water Audit Software:**
**System Attributes and Performance Indicators**

WAS v5.0

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| | |
|---|---|
| Water Audit Report for: | City of Asheville (01-11-010) |
| Reporting Year: | 2013 / 7/2012 - 6/2013 |

***** YOUR WATER AUDIT DATA VALIDITY SCORE IS: 72 out of 100 *****

**System Attributes:**

| | | | |
|---|---|---|---|
| | Apparent Losses: | 140.844 | MG/Yr |
| + | Real Losses: | 1,958.789 | MG/Yr |
| = | **Water Losses:** | **2,099.633** | MG/Yr |
| ? | Unavoidable Annual Real Losses (UARL): | 794.34 | MG/Yr |
| | Annual cost of Apparent Losses: | $606,265 | |
| | Annual cost of Real Losses: | $658,036 | 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: | 32.3% | |
| | Non-revenue water as percent by cost of operating system: | 3.9% | Real Losses valued at Variable Production Cost |
| Operational Efficiency: | Apparent Losses per service connection per day: | 6.98 | gallons/connection/day |
| | Real Losses per service connection per day: | 97.12 | gallons/connection/day |
| | Real Losses per length of main per day*: | N/A | |
| | Real Losses per service connection per day per psi pressure: | 0.67 | gallons/connection/day/psi |
| | From Above, Real Losses = Current Annual Real Losses (CARL): | 1,958.79 | million gallons/year |
| | ? Infrastructure Leakage Index (ILI) [CARL/UARL]: | 2.47 | |

* This performance indicator applies for systems with a low service connection density of less than 32 service connections/mile of pipeline

# Example Audit 2a:

## AWWA Free Water Audit Software: Reporting Worksheet

WAS v5.0

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? Click to access definition
+ Click to add a comment

**Water Audit Report for:** The City of Calgary
**Reporting Year:** 2013 | 1/2013 - 12/2013

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: MEGALITRES (THOUSAND CUBIC METRES) 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 Error Adjustments

**WATER SUPPLIED**

| | Grade | Volume | | Grade | Pcnt: | Value: | |
|---|---|---|---|---|---|---|---|
| Volume from own sources: | 7 | 174,324.000 | ML/Yr | 7 | 1.00% | | ML/Yr |
| Water imported: | n/a | 0.000 | ML/Yr | | | | ML/Yr |
| Water exported: | 7 | 8,190.131 | ML/Yr | 7 | 1.00% | | ML/Yr |

Enter negative % or value for under-registration
Enter positive % or value for over-registration

**WATER SUPPLIED:** 164,488.979 ML/Yr

**AUTHORIZED CONSUMPTION**

Click here: ? for help using option buttons below

| | Grade | Volume | | Pcnt: | Value: | |
|---|---|---|---|---|---|---|
| Billed metered: | 6 | 125,111.268 | ML/Yr | | | |
| Billed unmetered: | 8 | 3,503.386 | ML/Yr | | | |
| Unbilled metered: | 7 | 166.157 | ML/Yr | | | |
| Unbilled unmetered: | 6 | 1,444.000 | ML/Yr | | 1,444.000 | ML/Yr |

Use buttons to select percentage of water supplied **OR** value

**AUTHORIZED CONSUMPTION:** 130,224.811 ML/Yr

**WATER LOSSES (Water Supplied - Authorized Consumption)** 34,264.168 ML/Yr

**Apparent Losses**

| | Grade | Volume | | Pcnt: | Value: | |
|---|---|---|---|---|---|---|
| Unauthorized consumption: | | 411.222 | ML/Yr | 0.25% | | ML/Yr |
| Customer metering inaccuracies: | 6 | 1,265.429 | ML/Yr | 1.00% | | ML/Yr |
| Systematic data handling errors: | | 312.778 | ML/Yr | 0.25% | | ML/Yr |

Default option selected for unauthorized consumption - a grading of 5 is applied but not displayed

Default option selected for Systematic data handling errors - a grading of 5 is applied but not displayed

**Apparent Losses:** 1,989.429 ML/Yr

**Real Losses (Current Annual Real Losses or CARL)**

**Real Losses = Water Losses - Apparent Losses:** 32,274.739 ML/Yr

**WATER LOSSES:** 34,264.168 ML/Yr

**NON-REVENUE WATER**

**NON-REVENUE WATER:** 35,874.325 ML/Yr

= Water Losses + Unbilled Metered + Unbilled Unmetered

**SYSTEM DATA**

| | Grade | Volume | |
|---|---|---|---|
| Length of mains: | 8 | 4,945.0 | kilometers |
| Number of active AND inactive service connections: | 8 | 312,075 | |
| Service connection density: | | 63 | conn./km main |
| Are customer meters typically located at the curbstop or property line? | | No | |
| Average length of customer service line: | 8 | 12.0 | metres (length of service line, beyond the property boundary, that is the responsibility of the utility) |
| Average operating pressure: | 8 | 50.8 | metres (head) |

**COST DATA**

| | Grade | Volume | |
|---|---|---|---|
| Total annual cost of operating water system: | 9 | $169,973,759 | $/Year |
| Customer retail unit cost (applied to Apparent Losses): | 9 | $2.35 | $/1000 litres |
| Variable production cost (applied to Real Losses): | 9 | $73.54 | $/Megalitre |

☑ 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: Billed metered
3: Customer metering inaccuracies

## Example Audit 2b:

**AWWA Free Water Audit Software:**
**System Attributes and Performance Indicators**

WAS v5.0

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**Water Audit Report for:** The City of Calgary
**Reporting Year:** 2013 | 1/2013 - 12/2013

*** YOUR WATER AUDIT DATA VALIDITY SCORE IS: 72 out of 100 ***

**System Attributes:**

| | | | |
|---|---|---|---|
| | Apparent Losses: | 1,989.429 | ML/Yr |
| + | Real Losses: | 32,274.739 | ML/Yr |
| = | **Water Losses:** | **34,264.168** | ML/Yr |
| ? | Unavoidable Annual Real Losses (UARL): | 8,015.57 | ML/Yr |
| | Annual cost of Apparent Losses: | $4,675,159 | |
| | Annual cost of Real Losses: | $75,845,637 | Valued at **Customer Retail Unit Cost** |

Return to Reporting Worksheet to change this assumpiton

**Performance Indicators:**

| | | | |
|---|---|---|---|
| Financial: | Non-revenue water as percent by volume of Water Supplied: | 21.8% | |
| | Non-revenue water as percent by cost of operating system: | 49.6% | Real Losses valued at Customer Retail Unit Cost |
| Operational Efficiency: | Apparent Losses per service connection per day: | 17.47 | litres/connection/day |
| | Real Losses per service connection per day: | 283.34 | litres/connection/day |
| | Real Losses per length of main per day*: | N/A | |
| | Real Losses per service connection per day per meter (head) pressure: | 5.58 | litres/connection/day/m |
| | From Above, Real Losses = Current Annual Real Losses (CARL): | 32,274.74 | ML/year |
| ? | Infrastructure Leakage Index (ILI) [CARL/UARL]: | 4.03 | |

* This performance indicator applies for systems with a low service connection density of less than 20 service connections/kilometre of pipeline

## Acknowledgements

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AWWA Water Audit Software Version 5.0 Developed by the Water Loss Control Committee of the American Water Works Association August, 2014

This software is intended to serve as a basic tool to compile a preliminary, or "top-down", water audit. It is recommended that users also refer to the current edition of the AWWA M36 Publication, Water Audits and Loss Control Programs, for detailed guidance on compiling a comprehensive, or "bottom-up", water audit using the same water audit methodology.

*DEVELOPED BY:*

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*Reinhard Sturm Water Systems Optimization, Inc.*
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*REFERENCES:*

- *Alegre, H., Hirner, W., Baptista, J. and Parena, R. Performance Indicators for Water Supply Services. IWA Publishing 'Manual of Best Practice' Series, 2000. ISBN 1 900222 272*
- *Kunkel, G. et al, 2003. Water Loss Control Committee Report: Applying Worldwide Best Management Practices in Water Loss Control. Journal AWWA, 95:8:65*
- *AWWA Water Audits and Loss Control Programs, M36 Publication, 3rd Edition, 2009*
- *Service Connection Diagrams courtesy of Ronnie McKenzie, WRP Pty Ltd.*

*VERSION HISTORY:*

| Version: | Release Date: | Number of Worksheets: | Key Features and Developments |
|---|---|---|---|
| v1 | 2005/ 2006 | 5 | The AWWA Water Audit Software was piloted in 2005 (v1.0 beta). The early versions (1.x) of the software restricted data entry to units of Million Gallons per year. For each entry into the audit, users identified whether the input was measured or estimated. |
| v2 | 2006 | 5 | The most significant enhancement in v2 of the software was to allow the user to choose the volumetric units to be used in the audit, Million Gallons or Thousand Cubic Metres (megalitres) per year. Two financial performance indicators were added to provide feedback to the user on the cost of Real and Apparent losses. |
| v3 | 2007 | 7 | In v3, the option to report volumetric units in acre-feet was added. Another new feature in v3 was the inclusion of default values for two water audit components (unbilled unmetered and unauthorized consumption). v3 also included two examples of completed audits in units of million gallons and Megalitres. Several checks were added into v3 to provide instant feedback to the user on common data entry problems, in order to help the user complete an accurate water audit. |
| v4 - v4.2 | 2010 | 10 | v4 (and versions 4.x) of the software included a new approach to data grading. The simple "estimated" or "measured" approach was replaced with a more granular scale (typically 1-10) that reflected descriptions of utility practices and served to describe the confidence and accuracy of the input data. Each input value had a corresponding scale fully described in the Grading Matrix tab. The Grading Matrix also showed the actions required to move to a higher grading score. Grading descriptions were available on the Reporting Worksheet via a pop-up box next to each water audit input. A water audit data validity score is generated (max = 100) and priority areas for attention (to improve audit accuracy) are identified, once a user completes the requied data grading. A service connection diagram was also added to help users understand the impact of customer service line configurations on water losses and how this information should be entered into the water audit software. An acknoweldgements section was also added. Minor bug fixes resulted in the release of versions 4.1 and 4.2. A French language version was also made available for v4.2. |
| v5 | 2014 | 12 | In v5, changes were made to the way Water Supplied information is entered into software, with each major component having a corresponding Master Meter Error Adjustment entry (and data grading requirement). This required changes to the data validity score calculation; v5 of the software uses a weighting system that is, in part, proportional to the volume of input components. The Grading Matrix was updated to reflect the new audit inputs and also to include clarifications and additions to the scale descriptions. The appearance of the software was updated in v5 to make the software more user-friendly and several new features were added to provide more feedback to the user. Notably, a dashboard tab has been added to provide more visual feedback on the water audit results and associated costs of Non-Revenue Water. A comments sheet was added to allow the user to track notes, comments and to cite sources used. |

# AWWA Free Water Audit Software v5.0

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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: | Gar Huang |
| Email Address: | garh@ci.fullerton.ca.us |
| Telephone \| Ext.: | 714-738-6895 |
| Name of City / Utility: | City of Fullerton |
| City/Town/Municipality: | Fullerton |
| State / Province: | California (CA) |
| Country: | USA |
| Year: | 2021 Calendar Year |
| Audit Preparation Date: | 7/10/2022 |
| Volume Reporting Units: | Acre-feet |
| PWSID / Other ID: | CA3010010 |

**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

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? Click to access definition
+ Click to add a comment

**Water Audit Report for:** City of Fullerton (CA3010010)
**Reporting Year:** 2021 | 1/2021 - 12/2021

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

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Volume from own sources: | + ? | 5 | 17,437.338 | acre-ft/yr | + ? | 3 | -2.375 | acre-ft/yr |
| Water imported: | + ? | 7 | 6,473.824 | acre-ft/yr | + ? | 5 | | acre-ft/yr |
| Water exported: | + ? | | | acre-ft/yr | + ? | | | acre-ft/yr |
| **WATER SUPPLIED:** | | | **23,913.538** | acre-ft/yr | | | | |

Pcnt: Value:

Enter negative % or value for under-registration
Enter positive % or value for over-registration

### AUTHORIZED CONSUMPTION

Click here: ? for help using option buttons below

| | | | | | Pcnt: | Value: | |
|---|---|---|---|---|---|---|---|
| Billed metered: | + ? | 7 | 23,113.362 | acre-ft/yr | | | |
| Billed unmetered: | + ? | | 0.000 | acre-ft/yr | | | |
| Unbilled metered: | + ? | | 0.000 | acre-ft/yr | | | |
| Unbilled unmetered: | + ? | 5 | 59.784 | acre-ft/yr | | 59.784 | acre-ft/yr |
| **AUTHORIZED CONSUMPTION:** | ? | | **23,173.145** | acre-ft/yr | | | |

Use buttons to select percentage of water supplied **OR** value

### WATER LOSSES (Water Supplied - Authorized Consumption)

**740.392** acre-ft/yr

**Apparent Losses**

| | | | | | Pcnt: | Value: | |
|---|---|---|---|---|---|---|---|
| Unauthorized consumption: | + ? | | 59.784 | 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 | 351.980 | acre-ft/yr | 1.50% | | acre-ft/yr |
| Systematic data handling errors: | + ? | | 57.783 | 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:** ? **469.547** acre-ft/yr

**Real Losses (Current Annual Real Losses or CARL)**

**Real Losses = Water Losses - Apparent Losses:** ? **270.845** acre-ft/yr

**WATER LOSSES:** **740.392** acre-ft/yr

### NON-REVENUE WATER

**NON-REVENUE WATER:** ? **800.176** acre-ft/yr

= Water Losses + Unbilled Metered + Unbilled Unmetered

### SYSTEM DATA

| | | | | |
|---|---|---|---|---|
| Length of mains: | + ? | 9 | 431.8 | miles |
| Number of active AND inactive service connections: | + ? | 10 | 32,048 | |
| Service connection density: | ? | | 74 | 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 | 78.4 | psi |

### COST DATA

| | | | | | |
|---|---|---|---|---|---|
| Total annual cost of operating water system: | + ? | 10 | $31,098,331 | $/Year | |
| Customer retail unit cost (applied to Apparent Losses): | + ? | 10 | $2.47 | $/100 cubic feet (ccf) | |
| Variable production cost (applied to Real Losses): | + ? | 5 | $542.86 | $/acre-ft | ☐ Use Customer Retail Unit Cost to value real losses |

### WATER AUDIT DATA VALIDITY SCORE:

***** YOUR SCORE IS: 65 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

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**Water Audit Report for:** City of Fullerton (CA3010010)
**Reporting Year:** 2021 | 1/2021 - 12/2021

***** YOUR WATER AUDIT DATA VALIDITY SCORE IS: 65 out of 100 *****

**System Attributes:**

| | | | |
|---|---|---|---|
| | *Apparent Losses:* | *469.547* | *acre-ft/yr* |
| + | *Real Losses:* | *270.845* | *acre-ft/yr* |
| = | **Water Losses:** | **740.392** | *acre-ft/yr* |
| ? | *Unavoidable Annual Real Losses (UARL):* | *627.31* | *acre-ft/yr* |
| | *Annual cost of Apparent Losses:* | *$505,006* | |
| | *Annual cost of Real Losses:* | *$147,031* | *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:* | *3.3%* | |
| | *Non-revenue water as percent by cost of operating system:* | *2.2%* | *Real Losses valued at Variable Production Cost* |
| Operational Efficiency: | *Apparent Losses per service connection per day:* | *13.08* | *gallons/connection/day* |
| | *Real Losses per service connection per day:* | *7.54* | *gallons/connection/day* |
| | *Real Losses per length of main per day*:* | *N/A* | |
| | *Real Losses per service connection per day per psi pressure:* | *0.10* | *gallons/connection/day/psi* |
| | *From Above, Real Losses = Current Annual Real Losses (CARL):* | *270.84* | *acre-feet/year* |
| ? | *Infrastructure Leakage Index (ILI) [CARL/UARL]:* | *0.43* | |

** 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

WAS

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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: | |
| Water imported: master meter error adjustment: | |
| Water exported: | |
| Water exported: master meter error adjustment: | |
| Billed metered: | |
| Billed unmetered: | |
| Unbilled metered: | |

| Audit Item | Comment |
|---|---|
| Unbilled unmetered: | |
| Unauthorized consumption: | |
| Customer metering inaccuracies: | |
| Systematic data handling errors: | |
| Length of mains: | |
| Number of active AND inactive service connections: | |
| Average length of customer service line: | |
| Average operating pressure: | |
| Total annual cost of operating water system: | |
| Customer retail unit cost (applied to Apparent Losses): | |
| Variable production cost (applied to Real Losses): | |

| Audit Item | Comment |
| --- | --- |

| Audit Item | Comment |
| --- | --- |

| Audit Item | Comment |
| --- | --- |

| Audit Item | Comment |
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| Audit Item | Comment |
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| Audit Item | Comment |
| --- | --- |
| | |

7

# AWWA Free Water Audit Software: Water Balance

WAS v5.0

American Water Works Association.

| | |
|---|---|
| Water Audit Report for: | City of Fullerton (CA3010010) |
| Reporting Year: | 2021 — 1/2021 - 12/2021 |
| Data Validity Score: | 65 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Own Sources (Adjusted for known errors) 17,439.713 | System Input 23,913.538 | Water Exported 0.000 | | | Billed Water Exported | Revenue Water 0.000 |
| | | Water Supplied 23,913.538 | Authorized Consumption 23,173.145 | Billed Authorized Consumption 23,113.362 | Billed Metered Consumption (water exported is removed) 23,113.362 | Revenue Water 23,113.362 |
| | | | | | Billed Unmetered Consumption 0.000 | |
| | | | | Unbilled Authorized Consumption 59.784 | Unbilled Metered Consumption 0.000 | Non-Revenue Water (NRW) 800.176 |
| | | | | | Unbilled Unmetered Consumption 59.784 | |
| | | | Water Losses 740.392 | Apparent Losses 469.547 | Unauthorized Consumption 59.784 | |
| | | | | | Customer Metering Inaccuracies 351.980 | |
| | | | | | Systematic Data Handling Errors 57.783 | |
| Water Imported 6,473.824 | | | | Real Losses 270.845 | 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

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The graphic below is a visual representation of the Water Balance with bar heights propotional to the volume of the audit components

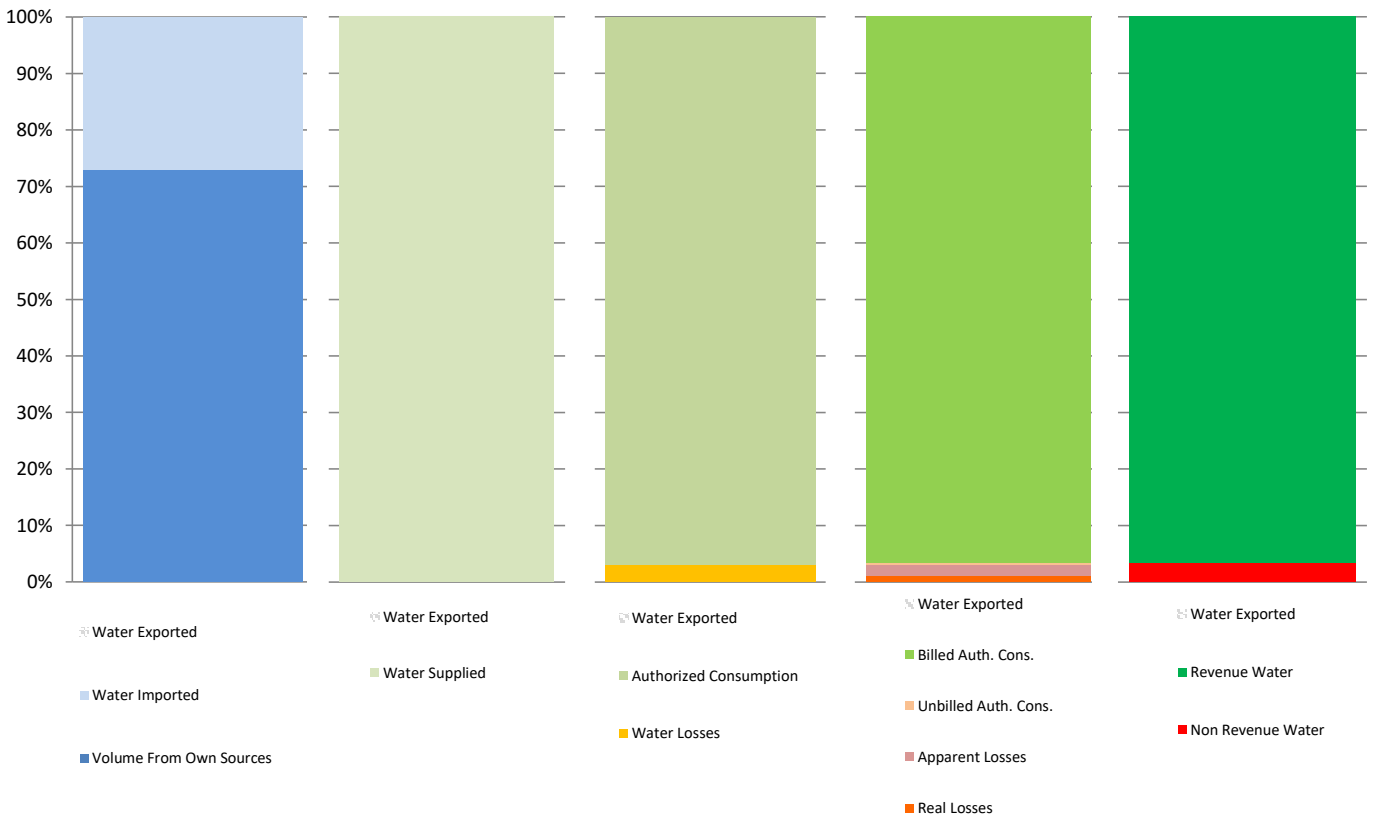
**Water Audit Report for:** City of Fullerton (CA3010010)

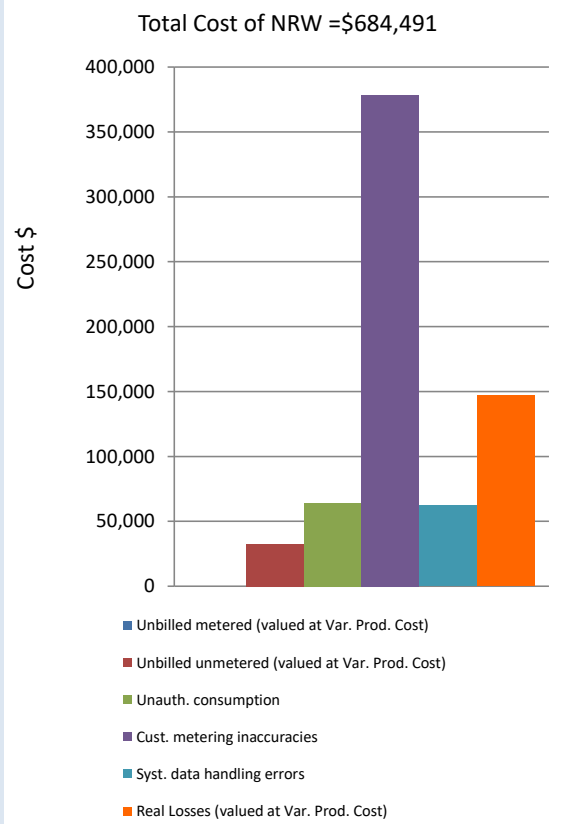
**Reporting Year:** 2021 | 1/2021 - 12/2021

**Data Validity Score:** 65

Show me the VOLUME of Non-Revenue Water

Show me the COST of Non-Revenue Water



# AWWA Free Water Audit Software: Grading Matrix

WAS 5.0

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The grading assigned to each audit component and the corresponding recommended improvements and actions are highlighted in yellow. Audit accuracy is likely to be improved by prioritizing those items shown in red

| Grading >>> | n/a | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **WATER SUPPLIED** | | | | | | | | | | | |
| **Volume from own sources:** | Select this grading only if the water utility purchases/imports all of its water resources (i.e. has no sources of its own) | Less than 25% of water production sources are metered, remaining sources are estimated. No regular meter accuracy testing or electronic calibration conducted. | 25% - 50% of treated water production sources are metered; other sources estimated. No regular meter accuracy testing or electronic calibration conducted. | Conditions between 2 and 4 | 50% - 75% of treated water production sources are metered, other sources estimated. Occasional meter accuracy testing or electronic calibration conducted. | Conditions between 4 and 6 | At least 75% of treated water production sources are metered, or at least 90% of the source flow is derived from metered sources. Meter accuracy testing and/or electronic calibration of related instrumentation is conducted annually. Less than 25% of tested meters are found outside of +/- 6% accuracy. | Conditions between 6 and 8 | 100% of treated water production sources are metered, meter accuracy testing and electronic calibration of related instrumentation is conducted annually, less than 10% of meters are found outside of +/- 6% accuracy | Conditions between 8 and 10 | 100% of treated water production sources are metered, meter accuracy testing and electronic calibration of related instrumentation is conducted semi-annually, with less than 10% found outside of +/- 3% accuracy. Procedures are reviewed by a third party knowledgeable in the M36 methodology. |
| Improvements to attain higher data grading for "Volume from own Sources" component: | | to qualify for 2: Organize and launch efforts to collect data for determining volume from own sources | to qualify for 4: Locate all water production sources on maps and in the field, launch meter accuracy testing for existing meters, begin to install meters on unmetered water production sources and replace any obsolete/defective meters. | | to qualify for 6: Formalize annual meter accuracy testing for all source meters; specify the frequency of testing. Complete installation of meters on unmetered water production sources and complete replacement of all obsolete/defective meters. | | to qualify for 8: Conduct annual meter accuracy testing and calibration of related instrumentation on all meter installations on a regular basis. Complete project to install new, or replace defective existing, meters so that entire production meter population is metered. Repair or replace meters outside of +/- 6% accuracy. | | to qualify for 10: Maintain annual meter accuracy testing and calibration of related instrumentation for all meter installations. Repair or replace meters outside of +/- 3% accuracy. Investigate new meter technology; pilot one or more replacements with innovative meters in attempt to further improve meter accuracy. | | to maintain 10: Standardize meter accuracy test frequency to semi-annual, or more frequent, for all meters. Repair or replace meters outside of +/- 3% accuracy. Continually investigate/pilot improving metering technology. |
| Volume from own sources master meter and supply error adjustment: | Select n/a only if the water utility fails to have meters on its sources of supply | Inventory information on meters and paper records of measured volumes exist but are incomplete and/or in a very crude condition; data error cannot be determined | No automatic datalogging of production volumes; daily readings are scribed on paper records without any accountability controls. Flows are not balanced across the water distribution system: tank/storage elevation changes are not employed in calculating the "Volume from own sources" component and archived flow data is adjusted only when grossly evident data error occurs. | Conditions between 2 and 4 | Production meter data is logged automatically in electronic format and reviewed at least on a monthly basis with necessary corrections implemented. "Volume from own sources" tabulations include estimate of daily changes in tanks/storage facilities. Meter data is adjusted when gross data errors occur, or occasional meter testing deems this necessary. | Conditions between 4 and 6 | Hourly production meter data logged automatically & reviewed on at least a weekly basis. Data is adjusted to correct gross error when meter/instrumentation equipment malfunction is detected; and/or error is confirmed by meter accuracy testing. Tank/storage facility elevation changes are automatically used in calculating a balanced "Volume from own sources" component, and data gaps in the archived data are corrected on at least a weekly basis. | Conditions between 6 and 8 | Continuous production meter data is logged automatically & reviewed each business day. Data is adjusted to correct gross error from detected meter/instrumentation equipment malfunction and/or results of meter accuracy testing. Tank/storage facility elevation changes are automatically used in "Volume from own sources" tabulations and data gaps in the archived data are corrected on a daily basis. | Conditions between 8 and 10 | Computerized system (SCADA or similar) automatically balances flows from all sources and storages; results are reviewed each business day. Tight accountability controls ensure that all data gaps that occur in the archived flow data are quickly detected and corrected. Regular calibrations between SCADA and sources meters ensures minimal data transfer error. |
| Improvements to attain higher data grading for "Master meter and supply error adjustment" component: | | to qualify for 2: Develop a plan to restructure recordkeeping system to capture all flow data; set a procedure to review flow data on a daily basis to detect input errors. Obtain more reliable information about existing meters by conducting field inspections of meters and related instrumentation, and obtaining manufacturer literature. | to qualify for 4: Install automatic datalogging equipment on production meters. Complete installation of level instrumentation at all tanks/storage facilities and include tank level data in automatic calculation routine in a computerized system. Construct a computerized listing or spreadsheet to archive input volumes, tank/storage volume changes and import/export flows in order to determine the composite "Water Supplied" volume for the distribution system. Set a procedure to review this data on a monthly basis to detect gross anomalies and data gaps. | | to qualify for 6: Refine computerized data collection and archive to include hourly production meter data that is reviewed at least on a weekly basis to detect specific data anomalies and gaps. Use daily net storage change to balance flows in calculating "Water Supplied" volume. Necessary corrections to data errors are implemented on a weekly basis. | | to qualify for 8: Ensure that all flow data is collected and archived on at least an hourly basis. All data is reviewed and detected errors corrected each business day. Tank/storage levels variations are employed in calculating balanced "Water Supplied" component. Adjust production meter data for gross error and inaccuracy confirmed by testing. | | to qualify for 10: Link all production and tank/storage facility elevation change data to a Supervisory Control & Data Acquisition (SCADA) System, or similar computerized monitoring/control system, and establish automatic flow balancing algorithm and regularly calibrate between SCADA and source meters. Data is reviewed and corrected each business day. | | to maintain 10: Monitor meter innovations for development of more accurate and less expensive flowmeters. Continue to replace or repair meters as they perform outside of desired accuracy limits. Stay abreast of new and more accurate water level instruments to better record tank/storage levels and archive the variations in storage volume. Keep current with SCADA and data management systems to ensure that archived data is well-managed and error free. |
| Water Imported: | Select n/a if the water utility's supply is exclusively from its own water resources (no bulk purchased/ imported water) | Less than 25% of imported water sources are metered, remaining sources are estimated. No regular meter accuracy testing. | 25% - 50% of imported water sources are metered; other sources estimated. No regular meter accuracy testing. | Conditions between 2 and 4 | 50% - 75% of imported water sources are metered, other sources estimated. Occasional meter accuracy testing conducted. | Conditions between 4 and 6 | At least 75% of imported water sources are metered, meter accuracy testing and/or electronic calibration of related instrumentation is conducted annually for all meter installations. Less than 25% of tested meters are found outside of +/- 6% accuracy. | Conditions between 6 and 8 | 100% of imported water sources are metered, meter accuracy testing and electronic calibration of related instrumentation is conducted annually, less than 10% of meters are found outside of +/- 6% accuracy | Conditions between 8 and 10 | 100% of imported water sources are metered, meter accuracy testing and electronic calibration of related instrumentation is conducted semi-annually for all meter installations, with less than 10% of accuracy tests found outside of +/- 3% accuracy. |

| Grading >>> | n/a | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Improvements to attain higher data grading for "Water Imported Volume" component:<br><br>(*Note: usually the water supplier selling the water - "the Exporter" - to the utility being audited is responsible to maintain the metering installation measuring the imported volume. The utility should coordinate carefully with the Exporter to ensure that adequate meter upkeep takes place and an accurate measure of the Water Imported volume is quantified.* ) | | to qualify for 2:<br>Review bulk water purchase agreements with partner suppliers; confirm requirements for use and maintenance of accurate metering. Identify needs for new or replacement meters with goal to meter all imported water sources. | To qualify for 4:<br>Locate all imported water sources on maps and in the field, launch meter accuracy testing for existing meters, begin to install meters on unmetered imported water interconnections and replace obsolete/defective meters. | | to qualify for 6:<br>Formalize annual meter accuracy testing for all imported water meters, planning for both regular meter accuracy testing and calibration of the related instrumentation. Continue installation of meters on unmetered imported water interconnections and replacement of obsolete/defective meters. | | to qualify for 8:<br>Complete project to install new, or replace defective, meters on all imported water interconnections. Maintain annual meter accuracy testing for all imported water meters and conduct calibration of related instrumentation at least annually. Repair or replace meters outside of +/- 6% accuracy. | | to qualify for 10:<br>Conduct meter accuracy testing for all meters on a semi-annual basis, along with calibration of all related instrumentation. Repair or replace meters outside of +/- 3% accuracy. Investigate new meter technology; pilot one or more replacements with innovative meters in attempt to improve meter accuracy. | | to maintain 10:<br>Standardize meter accuracy test frequency to semi-annual, or more frequent, for all meters. Continue to conduct calibration of related instrumentation on a semi-annual basis. Repair or replace meters outside of +/- 3% accuracy. Continually investigate/pilot improving metering technology. |
| Water imported master meter and supply error adjustment: | Select n/a if the Imported water supply is unmetered, with Imported water quantities estimated on the billing invoices sent by the Exporter to the purchasing Utility. | Inventory information on imported meters and paper records of measured volumes exist but are incomplete and/or in a very crude condition; data error cannot be determined Written agreement(s) with water Exporter(s) are missing or written in vague language concerning meter management and testing. | No automatic datalogging of imported supply volumes; daily readings are scribed on paper records without any accountability controls to confirm data accuracy and the absence of errors and data gaps in recorded volumes. Written agreement requires meter accuracy testing but is vague on the details of how and who conducts the testing. | Conditions between 2 and 4 | Imported supply metered flow data is logged automatically in electronic format and reviewed at least on a monthly basis by the Exporter with necessary corrections implemented. Meter data is adjusted by the Exporter when gross data errors are detected. A coherent data trail exists for this process to protect both the selling and the purchasing Utility. Written agreement exists and clearly states requirements and roles for meter accuracy testing and data management. | Conditions between 4 and 6 | Hourly Imported supply metered data is logged automatically & reviewed on at least a weekly basis by the Exporter. Data is adjusted to correct gross error when meter/instrumentation equipment malfunction is detected; and to correct for error confirmed by meter accuracy testing. Any data gaps in the archived data are detected and corrected during the weekly review. A coherent data trail exists for this process to protect both the selling and the purchasing Utility. | Conditions between 6 and 8 | Continuous Imported supply metered flow data is logged automatically & reviewed each business day by the Exporter. Data is adjusted to correct gross error from detected meter/instrumentation equipment malfunction and/or results of meter accuracy testing. Any data errors/gaps are detected and corrected on a daily basis. A data trail exists for the process to protect both the selling and the purchasing Utility. | Conditions between 8 and 10 | Computerized system (SCADA or similar) automatically records data which is reviewed each business day by the Exporter. Tight accountability controls ensure that all error/data gaps that occur in the archived flow data are quickly detected and corrected. A reliable data trail exists and contract provisions for meter testing and data management are reviewed by the selling and purchasing Utility at least once every five years. |
| Improvements to attain higher data grading for "Water imported master meter and supply error adjustment" component: | | to qualify for 2:<br>Develop a plan to restructure recordkeeping system to capture all flow data; set a procedure to review flow data on a daily basis to detect input errors. Obtain more reliable information about existing meters by conducting field inspections of meters and related instrumentation, and obtaining manufacturer literature. Review the written agreement between the selling and purchasing Utility. | to qualify for 4:<br>Install automatic datalogging equipment on Imported supply meters. Set a procedure to review this data on a monthly basis to detect gross anomalies and data gaps. Launch discussions with the Exporters to jointly review terms of the written agreements regarding meter accuracy testing and data management; revise the terms as necessary. | | to qualify for 6:<br>Refine computerized data collection and archive to include hourly Imported supply metered flow data that is reviewed at least on a weekly basis to detect specific data anomalies and gaps. Make necessary corrections to errors/data errors on a weekly basis. | | to qualify for 8:<br>Ensure that all Imported supply metered flow data is collected and archived on at least an hourly basis. All data is reviewed and errors/data gaps are corrected each business day. | | to qualify for 10:<br>Conduct accountability checks to confirm that all Imported supply metered data is reviewed and corrected each business day by the Exporter. Results of all meter accuracy tests and data corrections should be available for sharing between the Exporter and the purchasing Utility. Establish a schedule for a regular review and updating of the contractual language in the written agreement between the selling and the purchasing Utility; at least every five years. | | to maintain 10:<br>Monitor meter innovations for development of more accurate and less expensive flowmeters; work with the Exporter to help identify meter replacement needs. Keep communication lines with Exporters open and maintain productive relations. Keep the written agreement current with clear and explicit language that meets the ongoing needs of all parties. |
| Water Exported: | Select n/a if the water utility sells no bulk water to neighboring water utilities (no exported water sales) | Less than 25% of exported water sources are metered, remaining sources are estimated. No regular meter accuracy testing. | 25% - 50% of exported water sources are metered; other sources estimated. No regular meter accuracy testing. | Conditions between 2 and 4 | 50% - 75% of exported water sources are metered, other sources estimated. Occasional meter accuracy testing conducted. | Conditions between 4 and 6 | At least 75% of exported water sources are metered, meter accuracy testing and/or electronic calibration conducted annually. Less than 25% of tested meters are found outside of +/- 6% accuracy. | Conditions between 6 and 8 | 100% of exported water sources are metered, meter accuracy testing and electronic calibration of related instrumentation is conducted annually, less than 10% of meters are found outside of +/- 6% accuracy | Conditions between 8 and 10 | 100% of exported water sources are metered, meter accuracy testing and electronic calibration of related instrumentation is conducted semi-annually for all meter installations, with less than 10% of accuracy tests found outside of +/- 3% accuracy. |
| Improvements to attain higher data grading for "Water Exported Volume" component:<br><br>(*Note: usually, if the water utility being audited sells (Exports) water to a neighboring purchasing Utility, it is the responsibility of the utility exporting the water to maintain the metering installation measuring the Exported volume. The utility exporting the water should ensure that adequate meter upkeep takes place and an accurate measure of the Water Exported volume is quantified.* ) | | to qualify for 2:<br>Review bulk water sales agreements with purchasing utilities; confirm requirements for use & upkeep of accurate metering. Identify needs to install new, or replace defective meters as needed. | To qualify for 4:<br>Locate all exported water sources on maps and in field, launch meter accuracy testing for existing meters, begin to install meters on unmetered exported water interconnections and replace obsolete/defective meters | | to qualify for 6:<br>Formalize annual meter accuracy testing for all exported water meters. Continue installation of meters on unmetered exported water interconnections and replacement of obsolete/defective meters. | | to qualify for 8:<br>Complete project to install new, or replace defective, meters on all exported water interconnections. Maintain annual meter accuracy testing for all exported water meters. Repair or replace meters outside of +/- 6% accuracy. | | to qualify for 10:<br>Maintain annual meter accuracy testing for all meters. Repair or replace meters outside of +/- 3% accuracy. Investigate new meter technology; pilot one or more replacements with innovative meters in attempt to improve meter accuracy. | | to maintain 10:<br>Standardize meter accuracy test frequency to semi-annual, or more frequent, for all meters. Repair or replace meters outside of +/- 3% accuracy. Continually investigate/pilot improving metering technology. |

| Grading >>> | n/a | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Water exported master meter and supply error adjustment: | Select n/a only if the water utility fails to have meters on its exported supply interconnections. | Inventory information on exported meters and paper records of measured volumes exist but are incomplete and/or in a very crude condition; data error cannot be determined Written agreement(s) with the utility purchasing the water are missing or written in vague language concerning meter management and testing. | No automatic datalogging of exported supply volumes; daily readings are scribed on paper records without any accountability controls to confirm data accuracy and the absence of errors and data gaps in recorded volumes. Written agreement requires meter accuracy testing but is vague on the details of how and who conducts the testing. | Conditions between 2 and 4 | Exported metered flow data is logged automatically in electronic format and reviewed at least on a monthly basis, with necessary corrections implemented. Meter data is adjusted by the utility selling (exporting) the water when gross data errors are detected. A coherent data trail exists for this process to protect both the utility exporting the water and the purchasing Utility. Written agreement exists and clearly states requirements and roles for meter accuracy testing and data management. | Conditions between 4 and 6 | Hourly exported supply metered data is logged automatically & reviewed on at least a weekly basis by the utility selling the water. Data is adjusted to correct gross error when meter/instrumentation equipment malfunction is detected; and to correct for error found by meter accuracy testing. Any data gaps in the archived data are detected and corrected during the weekly review. A coherent data trail exists for this process to protect both the selling (exporting) utility and the purchasing Utility. | Conditions between 6 and 8 | Continuous exported supply metered flow data is logged automatically & reviewed each business day by the utility selling (exporting) the water. Data is adjusted to correct gross error from detected meter/instrumentation equipment malfunction and any error confirmed by meter accuracy testing. Any data errors/gaps are detected and corrected on a daily basis. A data trail exists for the process to protect both the selling (exporting) Utility and the purchasing Utility. | Conditions between 8 and 10 | Computerized system (SCADA or similar) automatically records data which is reviewed each business day by the utility selling (exporting) the water. Tight accountability controls ensure that all error/data gaps that occur in the archived flow data are quickly detected and corrected. A reliable data trail exists and contract provisions for meter testing and data management are reviewed by the selling Utility and purchasing Utility at least once every five years. |
| Improvements to attain higher data grading for "Water exported master meter and supply error adjustment" component: | | to qualify for 2: Develop a plan to restructure recordkeeping system to capture all flow data; set a procedure to review flow data on a daily basis to detect input errors. Obtain more reliable information about existing meters by conducting field inspections of meters and related instrumentation, and obtaining manufacturer literature. Review the written agreement between the utility selling (exporting) the water and the purchasing Utility. | to qualify for 4: Install automatic datalogging equipment on exported supply meters. Set a procedure to review this data on a monthly basis to detect gross anomalies and data gaps. Launch discussions with the purchasing utilities to jointly review terms of the written agreements regarding meter accuracy testing and data management; revise the terms as necessary. | | to qualify for 6: Refine computerized data collection and archive to include hourly exported supply metered flow data that is reviewed at least on a weekly basis to detect specific data anomalies and gaps. Make necessary corrections to errors/data errors on a weekly basis. | | to qualify for 8: Ensure that all exported metered flow data is collected and archived on at least an hourly basis. All data is reviewed and errors/data gaps are corrected each business day. | | to qualify for 10: Conduct accountability checks to confirm that all exported metered flow data is reviewed and corrected each business day by the utility selling the water. Results of all meter accuracy tests and data corrections should be available for sharing between the utility and the purchasing Utility. Establish a schedule for a regular review and updating of the contractual language in the written agreements with the purchasing utilities; at least every five years. | | to maintain 10: Monitor meter innovations for development of more accurate and less expensive flowmeters; work with the purchasing utilities to help identify meter replacement needs. Keep communication lines with the purchasing utilities open and maintain productive relations. Keep the written agreement current with clear and explicit language that meets the ongoing needs of all parties. |
| **AUTHORIZED CONSUMPTION** | | | | | | | | | | | |
| Billed metered: | n/a (not applicable). Select n/a only if the entire customer population is not metered and is billed for water service on a flat or fixed rate basis. In such a case the volume entered must be zero. | Less than 50% of customers with volume-based billings from meter readings; flat or fixed rate billing exists for the majority of the customer population | At least 50% of customers with volume-based billing from meter reads; flat rate billing for others. Manual meter reading is conducted, with less than 50% meter read success rate, remaining accounts' consumption is estimated. Limited meter records, no regular meter testing or replacement. Billing data maintained on paper records, with no auditing. | Conditions between 2 and 4 | At least 75% of customers with volume-based, billing from meter reads; flat or fixed rate billing for remaining accounts. Manual meter reading is conducted with at least 50% meter read success rate; consumption for accounts with failed reads is estimated. Purchase records verify age of customer meters; only very limited meter accuracy testing is conducted. Customer meters are replaced only upon complete failure. Computerized billing records exist, but only sporadic internal auditing conducted. | Conditions between 4 and 6 | At least 90% of customers with volume-based billing from meter reads; consumption for remaining accounts is estimated. Manual customer meter reading gives at least 80% customer meter reading success rate; consumption for accounts with failed reads is estimated. Good customer meter records eixst, but only limited meter accuracy testing is conducted. Regular replacement is conducted for the oldest meters. Computerized billing records exist with annual auditing of summary statistics conducting by utility personnel. | Conditions between 6 and 8 | At least 97% of customers exist with volume-based billing from meter reads. At least 90% customer meter reading success rate; or at least 80% read success rate with planning and budgeting for trials of Automatic Meter Reading (AMR) or Advanced Metering Infrastructure (AMI) in one or more pilot areas. Good customer meter records. Regular meter accuracy testing guides replacement of statistically significant number of meters each year. Routine auditing of computerized billing records for global and detailed statistics occurs annually by utility personnel, and is verified by third party at least once every five years. | Conditions between 8 and 10 | At least 99% of customers exist with volume-based billing from meter reads. At least 95% customer meter reading success rate; or minimum 80% meter reading success rate, with Automatic Meter Reading (AMR) or Advanced Metering Infrastructure (AMI) trials underway. Statistically significant customer meter testing and replacement program in place on a continuous basis. Computerized billing with routine, detailed auditing, including field investigation of representative sample of accounts undertaken annually by utility personnel. Audit is conducted by third party auditors at least once every three years. |
| Improvements to attain higher data grading for "Billed Metered Consumption" component: | If n/a is selected because the customer meter population is unmetered, consider establishing a new policy to meter the customer population and employ water rates based upon metered volumes. | to qualify for 2: Conduct investigations or trials of customer meters to select appropriate meter models. Budget funding for meter installations. Investigate volume based water rate structures. | to qualify for 4: Purchase and install meters on unmetered accounts. Implement policies to improve meter reading success. Catalog meter information during meter read visits to identify age/model of existing meters. Test a minimal number of meters for accuracy. Install computerized billing system. | | to qualify for 6: Purchase and install meters on unmetered accounts. Eliminate flat fee billing and establish appropriate water rate structure based upon measured consumption. Continue to achieve verifiable success in removing manual meter reading barriers. Expand meter accuracy testing. Launch regular meter replacement program. Launch a program of annual auditing of global billing statistics by utility personnel. | | to qualify for 8: Purchase and install meters on unmetered accounts. If customer meter reading success rate is less than 97%, assess cost-effectiveness of Automatic Meter Reading (AMR) or Advanced Metering Infrastructure (AMI) system for portion or entire system; or otherwise achieve ongoing improvements in manual meter reading success rate to 97% or higher. Refine meter accuracy testing program. Set meter replacement goals based upon accuracy test results. Implement annual auditing of detailed billing records by utility personnel and implement third party auditing at least once every five years. | | to qualify for 10: Purchase and install meters on unmetered accounts. Launch Automatic Meter Reading (AMR) or Advanced Metering Infrastructure (AMI) system trials if manual meter reading success rate of at least 99% is not achieved within a five-year program. Continue meter accuracy testing program. Conduct planning and budgeting for large scale meter replacement based upon meter life cycle analysis using cumulative flow target. Continue annual detailed billing data auditing by utility personnel and conduct third party auditing at least once every three years. | | to maintain 10: Continue annual internal billing data auditing, and third party auditing at least every three years. Continue customer meter accuracy testing to ensure that accurate customer meter readings are obtained and entered as the basis for volume based billing. Stay abreast of improvements in Automatic Meter Reading (AMR) and Advanced Metering Infrastructure (AMI) and information management. Plan and budget for justified upgrades in metering, meter reading and billing data management to maintain very high accuracy in customer metering and billing. |

| Grading >>> | n/a | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Billed unmetered: | Select n/a if it is the policy of the water utility to meter all customer connections and it has been confirmed by detailed auditing that all customers do indeed have a water meter; i.e. no intentionally unmetered accounts exist | Water utility policy does not require customer metering; flat or fixed fee billing is employed. No data is collected on customer consumption. The only estimates of customer population consumption available are derived from data estimation methods using average fixture count multiplied by number of connections, or similar approach. | Water utility policy does not require customer metering; flat or fixed fee billing is employed. Some metered accounts exist in parts of the system (pilot areas or District Metered Areas) with consumption read periodically or recorded on portable dataloggers over one, three, or seven day periods. Data from these sample meters are used to infer consumption for the total customer population. Site specific estimation methods are used for unusual buildings/water uses. | Conditions between 2 and 4 | Water utility policy does require metering and volume based billing in general. However, a liberal amount of exemptions and a lack of clearly written and communicated procedures result in up to 20% of billed accounts believed to be unmetered by exemption; or the water utility is in transition to becoming fully metered, and a large number of customers remain unmetered. A rough estimate of the annual consumption for all unmetered accounts is included in the annual water audit, with no inspection of individual unmetered accounts. | Conditions between 4 and 6 | Water utility policy does require metering and volume based billing but established exemptions exist for a portion of accounts such as municipal buildings. As many as 15% of billed accounts are unmetered due to this exemption or meter installation difficulties. Only a group estimate of annual consumption for all unmetered accounts is included in the annual water audit, with no inspection of individual unmetered accounts. | Conditions between 6 and 8 | Water utility policy does require metering and volume based billing for all customer accounts. However, less than 5% of billed accounts remain unmetered because meter installation is hindered by unusual circumstances. The goal is to minimize the number of unmetered accounts. Reliable estimates of consumption are obtained for these unmetered accounts via site specific estimation methods. | Conditions between 8 and 10 | Water utility policy does require metering and volume based billing for all customer accounts. Less than 2% of billed accounts are unmetered and exist because meter installation is hindered by unusual circumstances. The goal exists to minimize the number of unmetered accounts to the extent that is economical. Reliable estimates of consumption are obtained at these accounts via site specific estimation methods. |
| Improvements to attain higher data grading for "Billed Unmetered Consumption" component: | | to qualify for 2: Conduct research and evaluate cost/benefit of a new water utility policy to require metering of the customer population; thereby greatly reducing or eliminating unmetered accounts. Conduct pilot metering project by installing water meters in small sample of customer accounts and periodically reading the meters or datalogging the water consumption over one, three, or seven day periods. | to qualify for 4: Implement a new water utility policy requiring customer metering. Launch or expand pilot metering study to include several different meter types, which will provide data for economic assessment of full scale metering options. Assess sites with access difficulties to devise means to obtain water consumption volumes. Begin customer meter installation. | | to qualify for 6: Refine policy and procedures to improve customer metering participation for all but solidly exempt accounts. Assign staff resources to review billing records to identify errant unmetered properties. Specify metering needs and funding requirements to install sufficient meters to significant reduce the number of unmetered accounts | | to qualify for 8: Push to install customer meters on a full scale basis. Refine metering policy and procedures to ensure that all accounts, including municipal properties, are designated for meters. Plan special efforts to address "hard-to-access" accounts. Implement procedures to obtain a reliable consumption estimate for the remaining few unmetered accounts awaiting meter installation. | | to qualify for 10: Continue customer meter installation throughout the service area, with a goal to minimize unmetered accounts. Sustain the effort to investigate accounts with access difficulties, and devise means to install water meters or otherwise measure water consumption. | | to maintain 10: Continue to refine estimation methods for unmetered consumption and explore means to establish metering, for as many billed remaining unmetered accounts as is economically feasible. |
| Unbilled metered: | select n/a if all billing-exempt consumption is unmetered. | Billing practices exempt certain accounts, such as municipal buildings, but written policies do not exist; and a reliable count of unbilled metered accounts is unavailable. Meter upkeep and meter reading on these accounts is rare and not considered a priority. Due to poor recordkeeping and lack of auditing, water consumption for all such accounts is purely guesstimated. | Billing practices exempt certain accounts, such as municipal buildings, but only scattered, dated written directives exist to justify this practice. A reliable count of unbilled metered accounts is unavailable. Sporadic meter replacement and meter reading occurs on an as-needed basis. The total annual water consumption for all unbilled, metered accounts is estimated based upon approximating the number of accounts and assigning consumption from actively billed accounts of same meter size. | Conditions between 2 and 4 | Dated written procedures permit billing exemption for specific accounts, such as municipal properties, but are unclear regarding certain other types of accounts. Meter reading is given low priority and is sporadic. Consumption is quantified from meter readings where available. The total number of unbilled, unmetered accounts must be estimated along with consumption volumes. | Conditions between 4 and 6 | Written policies regarding billing exemptions exist but adherence in practice is questionable. Metering and meter reading for municipal buildings is reliable but sporadic for other unbilled metered accounts. Periodic auditing of such accounts is conducted. Water consumption is quantified directly from meter readings where available, but the majority of the consumption is estimated. | Conditions between 6 and 8 | Written policy identifies the types of accounts granted a billing exemption. Customer meter management and meter reading are considered secondary priorities, but meter reading is conducted at least annually to obtain consumption volumes for the annual water audit. High level auditing of billing records ensures that a reliable census of such accounts exists. | Conditions between 8 and 10 | Clearly written policy identifies the types of accounts given a billing exemption, with emphasis on keeping such accounts to a minimum. Customer meter management and meter reading for these accounts is given proper priority and is reliably conducted. Regular auditing confirms this. Total water consumption for these accounts is taken from reliable readings from accurate meters. |
| Improvements to attain higher data grading for "Unbilled Metered Consumption" component: | | to qualify for 2: Reassess the water utility's policy allowing certain accounts to be granted a billing exemption. Draft an outline of a new written policy for billing exemptions, with clear justification as to why any accounts should be exempt from billing, and with the intention to keep the number of such accounts to a minimum. | to qualify for 4: Review historic written directives and policy documents allowing certain accounts to be billing-exempt. Draft an outline of a written policy for billing exemptions, identify criteria that grants an exemption, with a goal of keeping this number of accounts to a minimum. Consider increasing the priority of reading meters on unbilled accounts at least annually. | | to qualify for 6: Draft a new written policy regarding billing exemptions based upon consensus criteria allowing this occurrence. Assign resources to audit meter records and billing records to obtain census of unbilled metered accounts. Gradually include a greater number of these metered accounts to the routes for regular meter reading. | | to qualify for 8: Communicate billing exemption policy throughout the organization and implement procedures that ensure proper account management. Conduct inspections of accounts confirmed in unbilled metered status and verify that accurate meters exist and are scheduled for routine meter readings. Gradually increase the number of unbilled metered accounts that are included in regular meter reading routes. | | to qualify for 10: Ensure that meter management (meter accuracy testing, meter replacement) and meter reading activities for unbilled accounts are accorded the same priority as billed accounts. Establish ongoing annual auditing process to ensure that water consumption is reliably collected and provided to the annual water audit process. | | to maintain 10: Reassess the utility's philosophy in allowing any water uses to go "unbilled". It is possible to meter and bill all accounts, even if the fee charged for water consumption is discounted or waived. Metering and billing all accounts ensures that water consumption is tracked and water waste from plumbing leaks is detected and minimized. |
| Unbilled unmetered: | | Extent of unbilled, unmetered consumption is unknown due to unclear policies and poor recordkeeping. Total consumption is quantified based upon a purely subjective estimate. | Clear extent of unbilled, unmetered consumption is unknown, but a number of events are randomly documented each year, confirming existence of such consumption, but without sufficient documentation to quantify an accurate estimate of the annual volume consumed. | Conditions between 2 and 4 | Extent of unbilled, unmetered consumption is partially known, and procedures exist to document certain events such as miscellaneous fire hydrant uses. Formulae is used to quantify the consumption from such events (time running multiplied by typical flowrate, multiplied by number of events). | Default value of 1.25% of system input volume is employed | Coherent policies exist for some forms of unbilled, unmetered consumption but others await closer evaluation. Reasonable recordkeeping for the managed uses exists and allows for annual volumes to be quantified by inference, but unsupervised uses are guesstimated. | Conditions between 6 and 8 | Clear policies and good recordkeeping exist for some uses (ex: water used in periodic testing of unmetered fire connections), but other uses (ex: miscellaneous uses of fire hydrants) have limited oversight. Total consumption is a mix of well quantified use such as from formulae (time running multiplied by typical flow, multiplied by number of events) or temporary meters, and relatively subjective estimates of less regulated use. | Conditions between 8 and 10 | Clear policies exist to identify permitted use of water in unbilled, unmetered fashion, with the intention of minimizing this type of consumption. Good records document each occurrence and consumption is quantified via formulae (time running multiplied by typical flow, multiplied by number of events) or use of temporary meters. |

| Grading >>> | n/a | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
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| Improvements to attain higher data grading for "Unbilled Unmetered Consumption" component: | | to qualify for 5: Utilize the accepted default value of 1.25% of the volume of water supplied as an expedient means to gain a reasonable quantification of this use. to qualify for 2: Establish a policy regarding what water uses should be allowed to remain as unbilled and unmetered. Consider tracking a small sample of one such use (ex: fire hydrant flushings). | to qualify for 5: Utilize accepted default value of 1.25% of the volume of water supplied as an expedient means to gain a reasonable quantification of this use. to qualify for 4: Evaluate the documentation of events that have been observed. Meet with user groups (ex: for fire hydrants - fire departments, contractors to ascertain their need and/or volume requirements for water from fire hydrants). | | to qualify for 5: Utilize accepted default value of 1.25% of the volume of water supplied as an expedient means to gain a reasonable quantification of all such use. This is particularly appropriate for water utilities who are in the early stages of the water auditing process, and should focus on other components since the volume of unbilled, umetered consumption is usually a relatively small quatity component, and other larger-quantity components should take priority. | to qualify for 6 or greater: Finalize policy and begin to conduct field checks to better establish and quantify such usage. Proceed if top-down audit exists and/or a great volume of such use is suspected. | to qualify for 8: Assess water utility policy and procedures for various unmetered usages. For example, ensure that a policy exists and permits are issued for use of fire hydrants by persons outside of the utility. Create written procedures for use and documentation of fire hydrants by water utility personnel. Use same approach for other types of unbilled, unmetered water usage. | | to qualify for 10: Refine written procedures to ensure that all uses of unbilled, unmetered water are overseen by a structured permitting process managed by water utility personnel. Reassess policy to determine if some of these uses have value in being converted to billed and/or metered status. | | to maintain 10: Continue to refine policy and procedures with intention of reducing the number of allowable uses of water in unbilled and unmetered fashion. Any uses that can feasibly become billed and metered should be converted eventually. |
| **APPARENT LOSSES** | | | | | | | | | | | |
| Unauthorized consumption: | | Extent of unauthorized consumption is unknown due to unclear policies and poor recordkeeping. Total unauthorized consumption is guesstimated. | Unauthorized consumption is a known occurrence, but its extent is a mystery. There are no requirements to document observed events, but periodic field reports capture some of these occurrences. Total unauthorized consumption is approximated from this limited data. | conditions between 2 and 4 | Procedures exist to document some unauthorized consumption such as observed unauthorized fire hydrant openings. Use formulae to quantify this consumption (time running multiplied typical flowrate, multiplied by number of events). | Default value of 0.25% of volume of water supplied is employed | Coherent policies exist for some forms of unauthorized consumption (more than simply fire hydrant misuse) but others await closer evaluation. Reasonable surveillance and recordkeeping exist for occurrences that fall under the policy. Volumes quantified by inference from these records. | Conditions between 6 and 8 | Clear policies and good auditable recordkeeping exist for certain events (ex: tampering with water meters, illegal bypasses of customer meters); but other occurrences have limited oversight. Total consumption is a combination of volumes from formulae (time x typical flow) and subjective estimates of unconfirmed consumption. | Conditions between 8 and 10 | Clear policies exist to identify all known unauthorized uses of water. Staff and procedures exist to provide enforcement of policies and detect violations. Each occurrence is recorded and quantified via formulae (estimated time running multiplied by typical flow) or similar methods. All records and calculations should exist in a form that can be audited by a third party. |
| Improvements to attain higher data grading for "Unauthorized Consumption" component: | | to qualify for 5: Use accepted default of 0.25% of volume of water supplied. to qualify for 2: Review utility policy regarding what water uses are considered unauthorized, and consider tracking a small sample of one such occurrence (ex: unauthorized fire hydrant openings) | to qualify for 5: Use accepted default of 0.25% of system input volume to qualify for 4: Review utility policy regarding what water uses are considered unauthorized, and consider tracking a small sample of one such occurrence (ex: unauthorized fire hydrant openings) | | to qualify for 5: Utilize accepted default value of 0.25% of volume of water supplied as an expedient means to gain a reasonable quantification of all such use. This is particularly appropriate for water utilities who are in the early stages of the water auditing process. | to qualify for 6 or greater: Finalize policy updates to clearly identify the types of water consumption that are authorized from those usages that fall outside of this policy and are, therefore, unauthorized. Begin to conduct regular field checks. Proceed if the top-down audit already exists and/or a great volume of such use is suspected. | to quality for 8: Assess water utility policies to ensure that all known occurrences of unauthorized consumption are outlawed, and that appropriate penalties are prescribed. Create written procedures for detection and documentation of various occurrences of unauthorized consumption as they are uncovered. | | to qualify for 10: Refine written procedures and assign staff to seek out likely occurrences of unauthorized consumption. Explore new locking devices, monitors and other technologies designed to detect and thwart unauthorized consumption. | | to maintain 10: Continue to refine policy and procedures to eliminate any loopholes that allow or tacitly encourage unauthorized consumption. Continue to be vigilant in detection, documentation and enforcement efforts. |
| **Customer metering inaccuracies:** | select n/a only if the entire customer population is unmetered. In such a case the volume entered must be zero. | Customer meters exist, but with unorganized paper records on meters; no meter accuracy testing or meter replacement program for any size of retail meter. Metering workflow is driven chaotically with no proactive management. Loss volume due to aggregate meter inaccuracy is guesstimated. | Poor recordkeeping and meter oversight is recognized by water utility management who has allotted staff and funding resources to organize improved recordkeeping and start meter accuracy testing. Existing paper records gathered and organized to provide cursory disposition of meter population. Customer meters are tested for accuracy only upon customer request. | Conditions between 2 and 4 | Reliable recordkeeping exists; meter information is improving as meters are replaced. Meter accuracy testing is conducted annually for a small number of meters (more than just customer requests, but less than 1% of inventory). A limited number of the oldest meters are replaced each year. Inaccuracy volume is largely an estimate, but refined based upon limited testing data. | Conditions between 4 and 6 | A reliable electronic recordkeeping system for meters exists. The meter population includes a mix of new high performing meters and dated meters with suspect accuracy. Routine, but limited, meter accuracy testing and meter replacement occur. Inaccuracy volume is quantified using a mix of reliable and less certain data. | Conditions between 6 and 8 | Ongoing meter replacement and accuracy testing result in highly accurate customer meter population. Testing is conducted on samples of meters of varying age and accumulated volume of throughput to determine optimum replacement time for various types of meters. | Ongoing meter replacement and accuracy testing result in highly accurate customer meter population. Statistically significant number of meters are tested in audit year. This testing is conducted on samples of meters of varying age and accumulated volume of throughput to determine optimum replacement time for these meters. | Good records of all active customer meters exist and include as a minimum: meter number, account number/location, type, size and manufacturer. Ongoing meter replacement occurs according to a targeted and justified basis. Regular meter accuracy testing gives a reliable measure of composite inaccuracy volume for the customer meter population. New metering technology is embraced to keep overall accuracy improving. Procedures are reviewed by a third party knowledgeable in the M36 methodology. |

| Grading >>> | n/a | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
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| Improvements to attain higher data grading for "Customer meter inaccuracy volume" component: | If n/a is selected because the customer meter population is unmetered, consider establishing a new policy to meter the customer population and employ water rates based upon metered volumes. | to qualify for 2: Gather available meter purchase records. Conduct testing on a small number of meters believed to be the most inaccurate. Review staffing needs of the metering group and budget for necessary resources to better organize meter management. | to qualify for 4: Implement a reliable record keeping system for customer meter histories, preferably using electronic methods typically linked to, or part of, the Customer Billing System or Customer Information System. Expand meter accuracy testing to a larger group of meters. | | to qualify for 6: Standardize the procedures for meter recordkeeping within an electronic information system. Accelerate meter accuracy testing and meter replacements guided by testing results. | | to qualify for 8: Expand annual meter accuracy testing to evaluate a statistically significant number of meter makes/models. Expand meter replacement program to replace statistically significant number of poor performing meters each year. | | to qualify for 9: Continue efforts to manage meter population with reliable recordkeeping. Test a statistically significant number of meters each year and analyze test results in an ongoing manner to serve as a basis for a target meter replacement strategy based upon accumulated volume throughput. | to qualify for 10: Continue efforts to manage meter population with reliable recordkeeping, meter testing and replacement. Evaluate new meter types and install one or more types in 5-10 customer accounts each year in order to pilot improving metering technology. | to maintain 10: Increase the number of meters tested and replaced as justified by meter accuracy test data. Continually monitor development of new metering technology and Advanced Metering Infrastructure (AMI) to grasp opportunities for greater accuracy in metering of water flow and management of customer consumption data. |
| Systematic Data Handling Errors: | Note: all water utilities incur some amount of this error. Even in water utilities with unmetered customer populations and fixed rate billing, errors occur in annual billing tabulations. Enter a positive value for the volume and select a grading. | Policies and procedures for activation of new customer water billing accounts are vague and lack accountability. Billing data is maintained on paper records which are not well organized. No auditing is conducted to confirm billing data handling efficiency. An unknown number of customers escape routine billing due to lack of billing process oversight. | Policy and procedures for activation of new customer accounts and oversight of billing records exist but need refinement. Billing data is maintained on paper records or insufficiently capable electronic database. Only periodic unstructured auditing work is conducted to confirm billing data handling efficiency. The volume of unbilled water due to billing lapses is a guess. | Conditions between 2 and 4 | Policy and procedures for new account activation and oversight of billing operations exist but needs refinement. Periodic, limited internal audits conducted and confirm with approximate accuracy the consumption volumes lost to billing lapses. | Conditions between 4 and 6 | Policy and procedures for new account activation and oversight of billing operations is adequate and reviewed periodically. Computerized billing system is in use with basic reporting available. Any effect of billing adjustments on measured consumption volumes is well understood. Internal checks of billing data error conducted annually. Reasonably accurate quantification of consumption volume lost to billing lapses is obtained. | Conditions between 6 and 8 | New account activation and billing operations policy and procedures are reviewed at least biannually. Computerized billing system includes an array of reports to confirm billing data and system functionality. Checks are conducted routinely to flag and explain zero consumption accounts. Annual internal checks conducted with third party audit conducted at least once every five years. Accountability checks flag billing lapses. Consumption lost to billing lapses is well quantified and reducing year-by-year. | Conditions between 8 and 10 | Sound written policy and procedures exist for new account activation and oversight of customer billing operations. Robust computerized billing system gives high functionality and reporting capabilities which are utilized, analyzed and the results reported each billing cycle. Assessment of policy and data handling errors are conducted internally and audited by third party at least once every three years, ensuring consumption lost to billing lapses is minimized and detected as it occurs. |
| Improvements to attain higher data grading for "Systematic Data Handling Error volume" component: | | to qualify for 2: Draft written policy and procedures for activating new water billing accounts and oversight of billing operations. Investigate and budget for computerized customer billing system. Conduct initial audit of billing records by flow-charting the basic business processes of the customer account/billing function. | to qualify for 4: Finalize written policy and procedures for activation of new billing acocunts and overall billing operations management. Implement a computerized customer billing system. Conduct initial audit of billing records as part of this process. | | to qualify for 6: Refine new account activation and billing operations procedures and ensure consistency with the utility policy regarding billing, and minimize opportunity for missed billings. Upgrade or replace customer billing system for needed functionality - ensure that billing adjustments don't corrupt the value of consumption volumes. Procedurize internal annual audit process. | | to qualify for 8: Formalize regular review of new account activation process and general billing practices. Enhance reporting capability of computerized billing system. Formalize regular auditing process to reveal scope of data handling error. Plan for periodic third party audit to occur at least once every five years. | | to qualify for 10: Close policy/procedure loopholes that allow some customer accounts to go unbilled, or data handling errors to exist. Ensure that billing system reports are utilized, analyzed and reported every billing cycle. Ensure that internal and third party audits are conducted at least once every three years. | | to maintain 10: Stay abreast of customer information management developments and innovations. Monitor developments of Advanced Metering Infrastructure (AMI) and integrate technology to ensure that customer endpoint information is well-monitored and errors/lapses are at an economic minimum. |
| **SYSTEM DATA** | | | | | | | | | | | |
| Length of mains: | | Poorly assembled and maintained paper as-built records of existing water main installations makes accurate determination of system pipe length impossible. Length of mains is guesstimated. | Paper records in poor or uncertain condition (no annual tracking of installations & abandonments). Poor procedures to ensure that new water mains installed by developers are accurately documented. | Conditions between 2 and 4 | Sound written policy and procedures exist for documenting new water main installations, but gaps in management result in a uncertain degree of error in tabulation of mains length. | Conditions between 4 and 6 | Sound written policy and procedures exist for permitting and commissioning new water mains. Highly accurate paper records with regular field validation; or electronic records and asset management system in good condition. Includes system backup. | Conditions between 6 and 8 | Sound written policy and procedures exist for permitting and commissioning new water mains. Electronic recordkeeping such as a Geographical Information System (GIS) and asset management system are used to store and manage data. | Conditions between 8 and 10 | Sound written policy exists for managing water mains extensions and replacements. Geographic Information System (GIS) data and asset management database agree and random field validation proves truth of databases. Records of annual field validation should be available for review. |
| Improvements to attain higher data grading for "Length of Water Mains" component: | | to qualify for 2: Assign personnel to inventory current as-built records and compare with customer billing system records and highway plans in order to verify poorly documented pipelines. Assemble policy documents regarding permitting and documentation of water main installations by the utility and building developers; identify gaps in procedures that result in poor documentation of new water main installations. | to qualify for 4: Complete inventory of paper records of water main installations for several years prior to audit year. Review policy and procedures for commissioning and documenting new water main installation. | | to qualify for 6: Finalize updates/improvements to written policy and procedures for permitting/commissioning new main installations. Confirm inventory of records for five years prior to audit year; correct any errors or omissions. | | to qualify for 8: Launch random field checks of limited number of locations. Convert to electronic database such as a Geographic Information System (GIS) with backup as justified. Develop written policy and procedures. | | to qualify for 10: Link Geographic Information System (GIS) and asset management databases, conduct field verification of data. Record field verification information at least annually. | | to maintain 10: Continue with standardization and random field validation to improve the completeness and accuracy of the system. |

| Grading >>> | n/a | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
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| Number of active AND inactive service connections: | | Vague permitting (of new service connections) policy and poor paper recordkeeping of customer connections/billings result in suspect determination of the number of service connections, which may be 10-15% in error from actual count. | General permitting policy exists but paper records, procedural gaps, and weak oversight result in questionable total for number of connections, which may vary 5-10% of actual count. | Conditions between 2 and 4 | Written account activation policy and procedures exist, but with some gaps in performance and oversight. Computerized information management system is being brought online to replace dated paper recordkeeping system. Reasonably accurate tracking of service connection installations & abandonments; but count can be up to 5% in error from actual total. | Conditions between 4 and 6 | Written new account activation and overall billing policies and procedures are adequate and reviewed periodically. Computerized information management system is in use with annual installations & abandonments totaled. Very limited field verifications and audits. Error in count of number of service connections is believed to be no more than 3%. | Conditions between 6 and 8 | Policies and procedures for new account activation and overall billing operations are written, well-structured and reviewed at least biannually. Well-managed computerized information management system exists and routine, periodic field checks and internal system audits are conducted. Counts of connections are no more than 2% in error. | Conditions between 8 and 10 | Sound written policy and well managed and audited procedures ensure reliable management of service connection population. Computerized information management system, Customer Billing System, and Geographic Information System (GIS) information agree; field validation proves truth of databases. Count of connections recorded as being in error is less than 1% of the entire population. |
| Improvements to attain higher data grading for "Number of Active and Inactive Service Connections" component: | **Note: The number of Service Connections does not include fire hydrant leads/lines connecting the hydrant to the water main** | to qualify for 2: Draft new policy and procedures for new account activation and overall billing operations. Research and collect paper records of installations & abandonments for several years prior to audit year. | to qualify for 4: Refine policy and procedures for new account activation and overall billing operations. Research computerized recordkeeping system (Customer Information System or Customer Billing System) to improve documentation format for service connections. | | to qualify for 6: Refine procedures to ensure consistency with new account activation and overall billing policy to establish new service connections or decommission existing connections. Improve process to include all totals for at least five years prior to audit year. | | to qualify for 8: Formalize regular review of new account activation and overall billing operations policies and procedures. Launch random field checks of limited number of locations. Develop reports and auditing mechanisms for computerized information management system. | | to qualify for 10: Close any procedural loopholes that allow installations to go undocumented. Link computerized information management system with Geographic Information System (GIS) and formalize field inspection and information system auditing processes. Documentation of new or decommissioned service connections encounters several levels of checks and balances. | | to maintain 10: Continue with standardization and random field validation to improve knowledge of system. |
| Average length of customer service line: | Note: if customer water meters are located outside of the customer building next to the curb stop or boundary separating utility/customer responsibility, then the auditor should answer "Yes" to the question on the Reporting Worksheet asking about this. If the answer is Yes, the grading description listed under the Grading of 10(a) will be followed, with a value of zero automatically entered at a Grading of 10. See the Service Connection Diagram worksheet for a visual presentation of this distance. | Gradings 1-9 apply if customer properties are unmetered, if customer meters exist and are located inside the customer building premises, or if the water utility owns and is responsible for the entire service connection piping from the water main to the customer building. In any of these cases the average distance between the curb stop or boundary separating utility/customer responsibility for service connection piping, and the typical first point of use (ex: faucet) or the customer meter must be quantified. Gradings of 1-9 are used to grade the validity of the means to quantify this value. (See the "Service Connection Diagram" worksheet) | | | | | | | | | Either of two conditions can be met for a grading of 10: a) Customer water meters exist outside of customer buildings next to the curb stop or boundary separating utility/customer responsibility for service connection piping. If so, answer "Yes" to the question on the Reporting Working asking about this condition. A value of zero and a Grading of 10 are automatically entered in the Reporting Worksheet . b). Meters exist inside customer buildings, or properties are unmetered. In either case, answer "No" to the Reporting Worksheet question on meter location, and enter a distance determined by the auditor. For a Grading of 10 this value must be a very reliable number from a Geographic Information System (GIS) and confirmed by a statistically valid number of field checks. |
| | | Vague policy exists to define the delineation of water utility ownership and customer ownership of the service connection piping. Curb stops are perceived as the breakpoint but these have not been well-maintained or documented. Most are buried or obscured. Their location varies widely from site-to-site, and estimating this distance is arbitrary due to the unknown location of many curb stops. | Policy requires that the curb stop serves as the delineation point between water utility ownership and customer ownership of the service connection piping. The piping from the water main to the curb stop is the property of the water utility; and the piping from the curb stop to the customer building is owned by the customer. Curb stop locations are not well documented and the average distance is based upon a limited number of locations measured in the field. | Conditions between 2 and 4 | Good policy requires that the curb stop serves as the delineation point between water utility ownership and customer ownership of the service connection piping. Curb stops are generally installed as needed and are reasonably documented. Their location varies widely from site-to-site, and an estimate of this distance is hindered by the availability of paper records of limited accuracy. | Conditions between 4 and 6 | Clear written policy exists to define utility/customer responsibility for service connection piping. Accurate, well-maintained paper or basic electronic recordkeeping system exists. Periodic field checks confirm piping lengths for a sample of customer properties. | Conditions between 6 and 8 | Clearly worded policy standardizes the location of curb stops and meters, which are inspected upon installation. Accurate and well maintained electronic records exist with periodic field checks to confirm locations of service lines, curb stops and customer meter pits. An accurate number of customer properties from the customer billing system allows for reliable averaging of this length. | Conditions between 8 and 10 | |
| Improvements to attain higher data grading for "Average Length of Customer Service Line" component: | | to qualify for 2: Research and collect paper records of service line installations. Inspect several sites in the field using pipe locators to locate curb stops. Obtain the length of this small sample of connections in this manner. | to qualify for 4: Formalize and communicate policy delineating utility/customer responsibilities for service connection piping. Assess accuracy of paper records by field inspection of a small sample of service connections using pipe locators as needed. Research the potential migration to a computerized information management system to store service connection data. | | to qualify for 6: Establish coherent procedures to ensure that policy for curb stop, meter installation and documentation is followed. Gain consensus within the water utility for the establishment of a computerized information management system. | | to qualify for 8: Implement an electronic means of recordkeeping, typically via a customer information system, customer billing system, or Geographic Information System (GIS). Standardize the process to conduct field checks of a limited number of locations. | | to qualify for 10: Link customer information management system and Geographic Information System (GIS), standardize process for field verification of data. | | to maintain 10: Continue with standardization and random field validation to improve knowledge of service connection configurations and customer meter locations. |
| Average operating pressure: | | Available records are poorly assembled and maintained paper records of supply pump characteristics and water distribution system operating conditions. Average pressure is guesstimated based upon this information and ground elevations from crude topographical maps. Widely varying distribution system pressures due to undulating terrain, high system head loss and weak/erratic pressure controls further compromise the validity of the average pressure calculation. | Limited telemetry monitoring of scattered pumping station and water storage tank sites provides some static pressure data, which is recorded in handwritten logbooks. Pressure data is gathered at individual sites only when low pressure complaints arise. Average pressure is determined by averaging relatively crude data, and is affected by significant variation in ground elevations, system head loss and gaps in pressure controls in the distribution system. | Conditions between 2 and 4 | Effective pressure controls separate different pressure zones; moderate pressure variation across the system, occasional open boundary valves are discovered that breech pressure zones. Basic telemetry monitoring of the distribution system logs pressure data electronically. Pressure data gathered by gauges or dataloggers at fire hydrants or buildings when low pressure complaints arise, and during fire flow tests and system flushing. Reliable topographical data exists. Average pressure is calculated using this mix of data. | Conditions between 4 and 6 | Reliable pressure controls separate distinct pressure zones; only very occasional open boundary valves are encountered that breech pressure zones. Well-covered telemetry monitoring of the distribution system (not just pumping at source treatment plants or wells) logs extensive pressure data electronically. Pressure gathered by gauges/dataloggers at fire hydrants and buildings when low pressure complaints arise, and during fire flow tests and system flushing. Average pressure is determined by using this mix of reliable data. | Conditions between 6 and 8 | Well-managed, discrete pressure zones exist with generally predictable pressure fluctuations. A current full-scale SCADA System or similar realtime monitoring system exists to monitor the water distribution system and collect data, including real time pressure readings at representative sites across the system. The average system pressure is determined from reliable monitoring system data. | Conditions between 8 and 10 | Well-managed pressure districts/zones, SCADA System and hydraulic model exist to give very precise pressure data across the water distribution system. Average system pressure is reliably calculated from extensive, reliable, and cross-checked data. Calculations are reported on an annual basis as a minimum. |

| Grading >>> | n/a | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Improvements to attain higher data grading for "Average Operating Pressure" component: | | to qualify for 2: Employ pressure gauging and/or datalogging equipment to obtain pressure measurements from fire hydrants. Locate accurate topographical maps of service area in order to confirm ground elevations. Research pump data sheets to find pump pressure/flow characteristics | to qualify for 4: Formalize a procedure to use pressure gauging/datalogging equipment to gather pressure data during various system events such as low pressure complaints, or operational testing. Gather pump pressure and flow data at different flow regimes. Identify faulty pressure controls (pressure reducing valves, altitude valves, partially open boundary valves) and plan to properly configure pressure zones. Make all pressure data from these efforts available to generate system-wide average pressure. | | to qualify for 6: Expand the use of pressure gauging/datalogging equipment to gather scattered pressure data at a representative set of sites, based upon pressure zones or areas. Utilize pump pressure and flow data to determine supply head entering each pressure zone or district. Correct any faulty pressure controls (pressure reducing valves, altitude valves, partially open boundary valves) to ensure properly configured pressure zones. Use expanded pressure dataset from these activities to generate system-wide average pressure. | | to qualify for 8: Install a Supervisory Control and Data Acquisition (SCADA) System, or similar realtime monitoring system, to monitor system parameters and control operations. Set regular calibration schedule for instrumentation to insure data accuracy. Obtain accurate topographical data and utilize pressure data gathered from field surveys to provide extensive, reliable data for pressure averaging. | | to qualify for 10: Annually, obtain a system-wide average pressure value from the hydraulic model of the distribution system that has been calibrated via field measurements in the water distribution system and confirmed in comparisons with SCADA System data. | | to maintain 10: Continue to refine the hydraulic model of the distribution system and consider linking it with SCADA System for real-time pressure data calibration, and averaging. |

| Grading >>> | n/a | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **COST DATA** | | | | | | | | | | | |
| Total annual cost of operating water system: | | Incomplete paper records and lack of financial accounting documentation on many operating functions makes calculation of water system operating costs a pure guesstimate | Reasonably maintained, but incomplete, paper or electronic accounting provides data to estimate the major portion of water system operating costs. | Conditions between 2 and 4 | Electronic, industry-standard cost accounting system in place. However, gaps in data are known to exist, periodic internal reviews are conducted but not a structured financial audit. | Conditions between 4 and 6 | Reliable electronic, industry-standard cost accounting system in place, with all pertinent water system operating costs tracked. Data audited periodically by utility personnel, but not a Certified Public Accountant (CPA). | Conditions between 6 and 8 | Reliable electronic, industry-standard cost accounting system in place, with all pertinent water system operating costs tracked. Data audited at least annually by utility personnel, and at least once every three years by third-party CPA. | Conditions between 8 and 10 | Reliable electronic, industry-standard cost accounting system in place, with all pertinent water system operating costs tracked. Data audited annually by utility personnel and annually also by third-party CPA. |
| Improvements to attain higher data grading for "Total Annual Cost of Operating the Water System" component: | | to qualify for 2: Gather available records, institute new financial accounting procedures to regularly collect and audit basic cost data of most important operations functions. | to qualify for 4: Implement an electronic cost accounting system, structured according to accounting standards for water utilities | | to qualify for 6: Establish process for periodic internal audit of water system operating costs; identify cost data gaps and institute procedures for tracking these outstanding costs. | | to qualify for 8: Standardize the process to conduct routine financial audit on an annual basis. Arrange for CPA audit of financial records at least once every three years. | | to qualify for 10: Standardize the process to conduct a third-party financial audit by a CPA on an annual basis. | | to maintain 10: Maintain program, stay abreast of expenses subject to erratic cost changes and long-term cost trend, and budget/track costs proactively |
| Customer retail unit cost (applied to Apparent Losses): | Customer population unmetered, and/or only a fixed fee is charged for consumption. | Antiquated, cumbersome water rate structure is used, with periodic historic amendments that were poorly documented and implemented; resulting in classes of customers being billed inconsistent charges. The actual composite billing rate likely differs significantly from the published water rate structure, but a lack of auditing leaves the degree of error indeterminate. | Dated, cumbersome water rate structure, not always employed consistently in actual billing operations. The actual composite billing rate is known to differ from the published water rate structure, and a reasonably accurate estimate of the degree of error is determined, allowing a composite billing rate to be quantified. | Conditions between 2 and 4 | Straight-forward water rate structure in use, but not updated in several years. Billing operations reliably employ the rate structure. The composite billing rate is derived from a single customer class such as residential customer accounts, neglecting the effect of different rates from varying customer classes. | Conditions between 4 and 6 | Clearly written, up-to-date water rate structure is in force and is applied reliably in billing operations. Composite customer rate is determined using a weighted average residential rate using volumes of water in each rate block. | Conditions between 6 and 8 | Effective water rate structure is in force and is applied reliably in billing operations. Composite customer rate is determined using a weighted average composite consumption rate, which includes residential, commercial, industrial, institutional (CII), and any other distinct customer classes within the water rate structure. | Conditions between 8 and 10 | Current, effective water rate structure is in force and applied reliably in billing operations. The rate structure and calculations of composite rate - which includes residential, commercial, industrial, institutional (CII), and other distinct customer classes - are reviewed by a third party knowledgeable in the M36 methodology at least once every five years. |
| Improvements to attain higher data grading for "Customer Retail Unit Cost" component: | | to qualify for 2: Formalize the process to implement water rates, including a secure documentation procedure. Create a current, formal water rate document and gain approval from all stakeholders. | to qualify for 4: Review the water rate structure and update/formalize as needed. Assess billing operations to ensure that actual billing operations incorporate the established water rate structure. | | to qualify for 6: Evaluate volume of water used in each usage block by residential users. Multiply volumes by full rate structure. | Launch effort to fully meter the customer population and charge rates based upon water volumes | to qualify for 8: Evaluate volume of water used in each usage block by all classifications of users. Multiply volumes by full rate structure. | | to qualify for 10: Conduct a periodic third-party audit of water used in each usage block by all classifications of users. Multiply volumes by full rate structure. | | to maintain 10: Keep water rate structure current in addressing the water utility's revenue needs. Update the calculation of the customer unit rate as new rate components, customer classes, or other components are modified. |
| **Variable production cost (applied to Real Losses):** | Note: if the water utility purchases/imports its entire water supply, then enter the unit purchase cost of the bulk water supply in the Reporting Worksheet with a grading of 10 | Incomplete paper records and lack of documentation on primary operating functions (electric power and treatment costs most importantly) makes calculation of variable production costs a pure guesstimate | Reasonably maintained, but incomplete, paper or electronic accounting provides data to roughly estimate the basic operations costs (pumping power costs and treatment costs) and calculate a unit variable production cost. | Conditions between 2 and 4 | Electronic, industry-standard cost accounting system in place. Electric power and treatment costs are reliably tracked and allow accurate weighted calculation of unit variable production costs based on these two inputs and water imported purchase costs (if applicable). All costs are audited internally on a periodic basis. | Conditions between 4 and 6 | Reliable electronic, industry-standard cost accounting system in place, with all pertinent water system operating costs tracked. Pertinent additional costs beyond power, treatment and water imported purchase costs (if applicable) such as liability, residuals management, wear and tear on equipment, impending expansion of supply, are included in the unit variable production cost, as applicable. The data is audited at least annually by utility personnel. | Conditions between 6 and 8 | Reliable electronic, industry-standard cost accounting system in place, with all pertinent primary and secondary variable production and water imported purchase (if applicable) costs tracked. The data is audited at least annually by utility personnel, and at least once every three years by a third-party knowledgeable in the M36 methodology. | Conditions between 8 and 10 | Either of two conditions can be met to obtain a grading of 10: 1) Third party CPA audit of all pertinent primary and secondary variable production and water imported purchase (if applicable) costs on an annual basis. or: 2) Water supply is entirely purchased as bulk water imported, and the unit purchase cost - including all applicable marginal supply costs - serves as the variable production cost. If all applicable marginal supply costs are not included in this figure, a grade of 10 should not be selected. |
| Improvements to attain higher data grading for "Variable Production Cost" component: | | to qualify for 2: Gather available records, institute new procedures to regularly collect and audit basic cost data and most important operations functions. | to qualify for 4: Implement an electronic cost accounting system, structured according to accounting standards for water utilities | | to qualify for 6: Formalize process for regular internal audits of production costs. Assess whether additional costs (liability, residuals management, equipment wear, impending infrastructure expansion) should be included to calculate a more representative variable production cost. | | to qualify for 8: Formalize the accounting process to include direct cost components (power, treatment) as well as indirect cost components (liability, residuals management, etc.) Arrange to conduct audits by a knowledgable third-party at least once every three years. | | to qualify for 10: Standardize the process to conduct a third-party financial audit by a CPA on an annual basis. | | to maintain 10: Maintain program, stay abreast of expenses subject to erratic cost changes and budget/track costs proactively |

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**Average Length of Customer Service Line**

The three figures shown on this worksheet display the assignment of the Average Length of Customer Service Line, Lp, for the three most common piping configurations.

**Figure 1** shows the configuration of the water meter outside of the customer building next to the curb stop valve. In this configuration Lp = 0 since the distance between the curb stop and the customer metering point is essentially zero.

**Figure 2** shows the configuration of the customer water meter located inside the customer building, where Lp is the distance from the curb stop to the water meter.

**Figure 3** shows the configuration of an unmetered customer building , where Lp is the distance from the curb stop to the first point of customer water consumption, or, more simply, the building line.

In any water system the Lp will vary notably in a community of different structures, therefore the average Lp value is used and this should be approximated or calculated if a sample of service line measurements has been gathered.

Click for more information

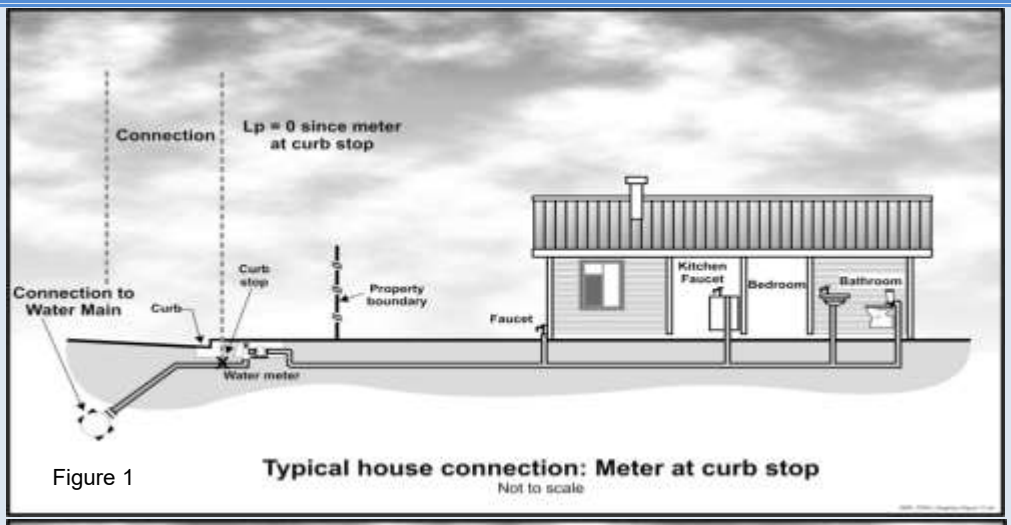


Figure 1 Typical house connection: Meter at curb stop
Not to scale

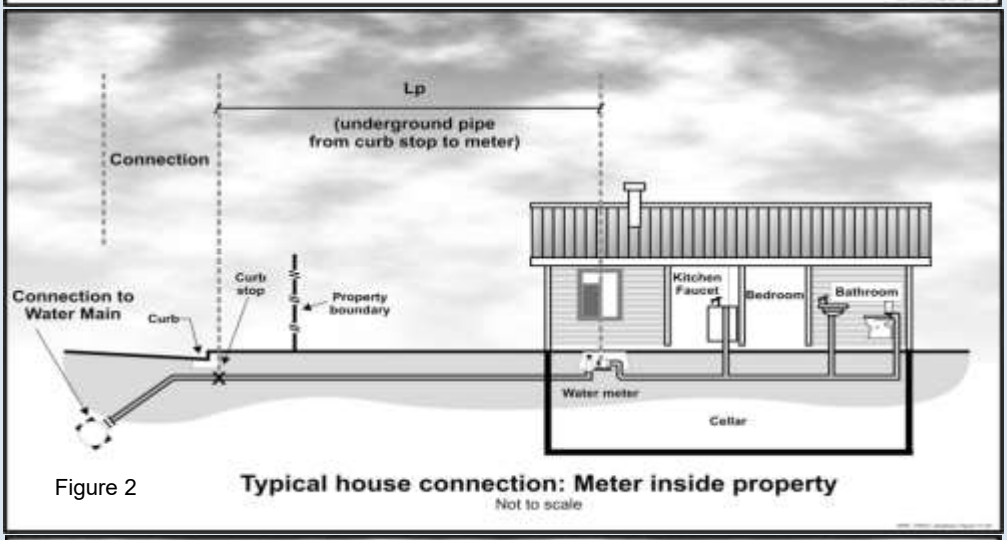


Figure 2 Typical house connection: Meter inside property
Not to scale

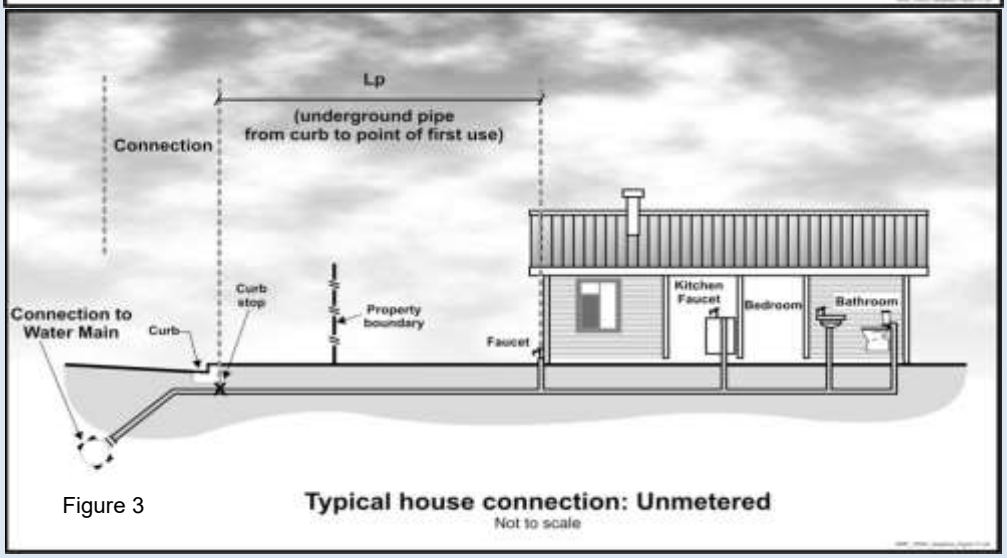


Figure 3 Typical house connection: Unmetered
Not to scale

# AWWA Free Water Audit Software: Definitions

WAS v5.0

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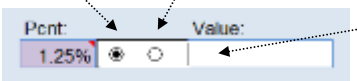
| Item Name | Description |
|---|---|
| **Apparent Losses**<br>Find | = unauthorized consumption + customer metering inaccuracies + systematic data handling errors<br><br>Apparent Losses include all types of inaccuracies associated with customer metering (worn meters as well as improperly sized meters or wrong type of meter for the water usage profile) as well as systematic data handling errors (meter reading, billing, archiving and reporting), plus unauthorized consumption (theft or illegal use).<br>NOTE: Over-estimation of Apparent Losses results in under-estimation of Real Losses. Under-estimation of Apparent Losses results in over-estimation of Real Losses. |
| **AUTHORIZED CONSUMPTION**<br>Find | = billed water exported + billed metered + billed unmetered + unbilled metered + unbilled unmetered consumption<br><br>The volume of metered and/or unmetered water taken by registered customers, the water utility's own uses, and uses of others who are implicitly or explicitly authorized to do so by the water utility; for residential, commercial, industrial and public-minded purposes.<br><br>Typical retail customers' consumption is tabulated usually from established customer accounts as billed metered consumption, or - for unmetered customers - billed unmetered consumption. These types of consumption, along with billed water exported, provide revenue potential for the water utility. **Be certain to tabulate the water exported volume as a separate component and do not "double-count" it by including in the billed metered consumption component as well as the water exported component.**<br><br>Unbilled authorized consumption occurs typically in non-account uses, including water for fire fighting and training, flushing of water mains and sewers, street cleaning, watering of municipal gardens, public fountains, or similar public-minded uses. Occasionally these uses may be metered and billed (or charged a flat fee), but usually they are unmetered and unbilled. In the latter case, the water auditor may use a default value to estimate this quantity, or implement procedures for the reliable quantification of these uses. This starts with documenting usage events as they occur and estimating the amount of water used in each event. (See Unbilled unmetered consumption) |
| View Service Connection Diagram<br>**Average length of customer service line**<br>Find | This is the average length of customer service line, Lp, that is owned and maintained by the customer; from the point of ownership transfer to the customer water meter, or building line (if unmetered). The quantity is one of the data inputs for the calculation of Unavoidable Annual Real Losses (UARL), which serves as the denominator of the performance indicator: Infrastructure Leakage Index (ILI). The value of Lp is multiplied by the number of customer service connections to obtain a total length of customer owned piping in the system. The purpose of this parameter is to account for the unmetered service line infrastructure that is the responsibility of the customer for arranging repairs of leaks that occur on their lines. In many cases leak repairs arranged by customers take longer to be executed than leak repairs arranged by the water utility on utility-maintained piping. Leaks run longer - and lose more water - on customer-owned service piping, than utility owned piping.<br><br>If the customer water meter exists near the ownership transfer point (usually the curb stop located between the water main and the customer premises) this distance is zero because the meter and transfer point are the same. This is the often encountered configuration of customer water meters located in an underground meter box or "pit" outside of the customer's building. The Free Water Audit Software asks a "Yes/No" question about the meter at this location. If the auditor selects "Yes" then this distance is set to zero and the data grading score for this component is set to 10.<br><br>If water meters are typically located inside the customer premise/building, or properties are unmetered, it is up to the water auditor to estimate a system-wide average Lp length based upon the various customer land parcel sizes and building locations in the service area. Lp will be a shorter length in areas of high density housing, and a longer length in areas of low density housing and varied commercial and industrial buildings. General parcel demographics should be employed to obtain a composite average Lp length for the entire system.<br><br>Refer to the "Service Connection Diagram" worksheet for a depiction of the service line/metering configurations that typically exist in water utilities. This worksheet gives guidance on the determination of the Average Length, Lp, for each configuration. |
| **Average operating pressure**<br>Find | This is the average pressure in the distribution system that is the subject of the water audit. Many water utilities have a calibrated hydraulic model of their water distribution system. For these utilities, the hydraulic model can be utilized to obtain a very accurate quantity of average pressure. In the absence of a hydraulic model, the average pressure may be approximated by obtaining readings of static water pressure from a representative sample of fire hydrants or other system access points evenly located across the system. A weighted average of the pressure can be assembled; but be sure to take into account the elevation of the fire hydrants, which typically exist several feet higher than the level of buried water pipelines. If the water utility is compiling the water audit for the first time, the average pressure can be approximated, but with a low data grading. In subsequent years of auditing, effort should be made to improve the accuracy of the average pressure quantity. This will then qualify the value for a higher data grading. |
| **Billed Authorized Consumption** | All consumption that is billed and authorized by the utility. This may include both metered and unmetered consumption. See "Authorized Consumption" for more information. |
| **Billed metered consumption**<br>Find | All metered consumption which is billed to retail customers, including all groups of customers such as domestic, commercial, industrial or institutional. **It does NOT include water supplied to neighboring utilities (water exported) which is metered and billed. Be sure to subtract any consumption for exported water sales that may be included in these billing roles. Water supplied as exports to neighboring water utilities should be included only in the Water Exported component.** The metered consumption data can be taken directly from billing records for the water audit period. The accuracy of yearly metered consumption data can be refined by including an adjustment to account for customer meter reading lag time since not all customer meters are read on the same day of the meter reading period. However additional analysis is necessary to determine the lag time adjustment value, which may or may not be significant. |
| **Billed unmetered consumption**<br>Find | All billed consumption which is calculated based on estimates or norms from water usage sites that have been determined by utility policy to be left unmetered. This is typically a very small component in systems that maintain a policy to meter their customer population. However, this quantity can be the key consumption component in utilities that have not adopted a universal metering policy. **This component should NOT include any water that is supplied to neighboring utilities (water exported) which is unmetered but billed. Water supplied as exports to neighboring water utilities should be included only in the Water Exported component.** |

| Item Name | Description |
|---|---|
| **Customer metering inaccuracies**<br>Find | Apparent water losses caused by the collective under-registration of customer water meters. Many customer water meters gradually wear as large cumulative volumes of water are passed through them over time. This causes the meters to under-register the flow of water. This occurrence is common with smaller residential meters of sizes 5/8-inch and 3/4 inch after they have registered very large cumulative volumes of water, which generally occurs only after periods of years. For meters sized 1-inch and larger - typical of multi-unit residential, commercial and industrial accounts - meter under-registration can occur from wear or from the improper application of the meter; i.e. installing the wrong type of meter or the wrong size of meter, for the flow pattern (profile) of the consumer. For instance, many larger meters have reduced accuracy at low flows. If an oversized meter is installed, most of the time the routine flow will occur in the low flow range of the meter, and a significant portion of it may not be registered. It is important to properly select and install all meters, but particularly large customer meters, size 1-inch and larger.<br><br>The auditor has two options for entering data for this component of the audit. The auditor can enter a percentage under-registration (typically an estimated value), this will apply the selected percentage to the two categories of metered consumption to determine the volume of water not recorded due to customer meter inaccuracy. Note that this percentage is a composite average inaccuracy for <u>all</u> customer meters in the entire meter population. The percentage will be multiplied by the sum of the volumes in the Billed Metered and Unbilled Metered components. Alternatively, if the auditor has substantial data from meter testing activities, he or she can calculate their own loss volumes, and this volume may be entered directly.<br><br>Note that a value of zero will be accepted but an alert will appear asking if the customer population is unmetered. Since all metered systems have some degree of inaccuracy, a positive value should be entered. A value of zero in this component is valid only if the water utility does not meter its customer population. |
| **Customer retail unit cost**<br>Find | The Customer Retail Unit Cost represents the charge that customers pay for water service. This unit cost is applied routinely to the components of Apparent Loss, since these losses represent water reaching customers but not (fully) paid for. Since most water utilities have a rate structure that includes a variety of different costs based upon class of customer, a weighted average of individual costs and number of customer accounts in each class can be calculated to determine a single composite cost that should be entered into this cell. Finally, the weighted average cost should also include additional charges for sewer, storm water or biosolids processing, <u>but only if</u> these charges are based upon the volume of potable water consumed.<br><br>For water utilities in regions with limited water resources and a questionable ability to meet the drinking water demands in the future, the Customer Retail Unit Cost might also be applied to value the Real Losses; instead of applying the Variable Production Cost to Real Losses. In this way, it is assumed that every unit volume of leakage reduced by leakage management activities will be sold to a customer.<br><br>Note: the Free Water Audit Software allows the user to select the units that are charged to customers (either $/1,000 gallons, $/hundred cubic feet, or $/1,000 litres) and automatically converts these units to the units that appear in the "WATER SUPPLIED" box. The monetary units are United States dollars, $. |
| **Infrastructure Leakage Index (ILI)**<br>Find | The ratio of the Current Annual Real Losses (Real Losses) to the Unavoidable Annual Real Losses (UARL). The ILI is a highly effective performance indicator for comparing (benchmarking) the performance of utilities in operational management of real losses. |
| **Length of mains**<br>Find | Length of all pipelines (except service connections) in the system starting from the point of system input metering (for example at the outlet of the treatment plant). It is also recommended to include in this measure the total length of fire hydrant lead pipe. Hydrant lead pipe is the pipe branching from the water main to the fire hydrant. Fire hydrant leads are typically of a sufficiently large size that is more representative of a pipeline than a service connection. The average length of hydrant leads across the entire system can be assumed if not known, and multiplied by the number of fire hydrants in the system, which can also be assumed if not known. This value can then be added to the total pipeline length. Total length of mains can therefore be calculated as:<br><br>Length of Mains, miles = (total pipeline length, miles) + [ {(average fire hydrant lead length, ft) x (number of fire hydrants)} / 5,280 ft/mile ]<br>or<br>Length of Mains, kilometres = (total pipeline length, kilometres) + [ {(average fire hydrant lead length, metres) x (number of fire hydrants)} / 1,000 metres/kilometre ] |
| **NON-REVENUE WATER**<br>Find | = Apparent Losses + Real Losses + Unbilled Metered Consumption + Unbilled Unmetered Consumption. This is water which does not provide revenue potential to the utility. |
| **Number of <u>active AND inactive</u> service connections**<br>Find | Number of customer service connections, extending from the water main to supply water to a customer. Please note that this includes the actual number of distinct piping connections, including fire connections, whether active or inactive. This may differ substantially from the number of customers (or number of accounts). **Note: this number does not include the pipeline leads to fire hydrants - the total length of piping supplying fire hyrants should be included in the "Length of mains" parameter.** |
| **Real Losses**<br>Find | Physical water losses from the pressurized system (water mains and customer service connections) and the utility's storage tanks, up to the point of customer consumption. In metered systems this is the customer meter, in unmetered situations this is the first point of consumption (stop tap/tap) within the property. The annual volume lost through all types of leaks, breaks and overflows depends on frequencies, flow rates, and average duration of individual leaks, breaks and overflows. |
| **Revenue Water** | Those components of System Input Volume that are billed and have the potential to produce revenue. |
| **Service Connection Density**<br>Find | =number of customer service connections / length of mains |

| Item Name | Description |
|---|---|
| **Systematic data handling errors**<br>Find | Apparent losses caused by accounting omissions, errant computer programming, gaps in policy, procedure, and permitting/activation of new accounts; and any type of data lapse that results in under-stated customer water consumption in summary billing reports.<br><br>**Systematic Data Handling Errors result in a direct loss of revenue potential. Water utilities can find "lost" revenue by keying on this component.**<br><br>Utilities typically measure water consumption registered by water meters at customer premises. The meter should be read routinely (ex: monthly) and the data transferred to the Customer Billing System, which generates and sends a bill to the customer. Data Transfer Errors result in the consumption value being less than the actual consumption, creating an apparent loss. Such error might occur from illegible and mis-recorded hand-written readings compiled by meter readers, inputting an incorrect meter register unit conversion factor in the automatic meter reading equipment, or a variety of similar errors.<br><br>Apparent losses also occur from Data Analysis Errors in the archival and data reporting processes of the Customer Billing System. Inaccurate estimates used for accounts that fail to produce a meter reading are a common source of error. Billing adjustments may award customers a rightful monetary credit, but do so by creating a negative value of consumption, thus under-stating the actual consumption. Account activation lapses may allow new buildings to use water for months without meter readings and billing. Poor permitting and construction inspection practices can result in a new building lacking a billing account, a water meter and meter reading; i.e., the customer is unknown to the utility's billing system.<br><br>Close auditing of the permitting, metering, meter reading, billing and reporting processes of the water consumption data trail can uncover data management gaps that create volumes of systematic data handling error. Utilities should routinely analyze customer billing records to detect data anomalies and quantify these losses. For example, a billing account that registers zero consumption for two or more billing cycles should be checked to explain why usage has seemingly halted. Given the revenue loss impacts of these losses, water utilities are well-justified in providing continuous oversight and timely correction of data transfer errors & data handling errors.<br><br>If the water auditor has not yet gathered detailed data or assessment of systematic data handling error, it is recommended that the auditor apply the default value of 0.25% of the the Billed Authorized Consumption volume. However, if the auditor has investigated the billing system and its controls, and has well validated data that indicates the volume from systematic data handling error is substantially higher or lower than that generated by the default value, then the auditor should enter a quantity that was derived from the utility investigations and select an appropriate grading. Note: negative values are not allowed for this audit component. If the auditor enters zero for this component then a grading of 1 will be automatically assigned. |
| **Total annual cost of operating the water system**<br>Find | These costs include those for operations, maintenance and any annually incurred costs for long-term upkeep of the drinking water supply and distribution system. It should include the costs of day-to-day upkeep and long-term financing such as repayment of capital bonds for infrastructure expansion or improvement. Typical costs include employee salaries and benefits, materials, equipment, insurance, fees, administrative costs and all other costs that exist to sustain the drinking water supply. Depending upon water utility accounting procedures or regulatory agency requirements, it may be appropriate to include depreciation in the total of this cost. This cost should not include any costs to operate wastewater, biosolids or other systems outside of drinking water. |
| **Unauthorized consumption**<br>Find | Includes water illegally withdrawn from fire hydrants, illegal connections, bypasses to customer consumption meters, or tampering with metering or meter reading equipment; as well as any other ways to receive water while thwarting the water utility's ability to collect revenue for the water. Unauthorized consumption results in uncaptured revenue and creates an error that understates customer consumption. In most water utilities this volume is low and, if the water auditor has not yet gathered detailed data for these loss occurrences, it is recommended that the auditor apply a default value of 0.25% of the volume of water supplied. However, if the auditor has investigated unauthorized occurrences, and has well validated data that indicates the volume from unauthorized consumption is substantially higher or lower than that generated by the default value, then the auditor should enter a quantity that was derived from the utility investigations. Note that a value of zero will not be accepted since all water utilities have some volume of unauthorized consumption occurring in their system.<br><br>Note: if the auditor selects the default value for unauthorized consumption, a data grading of 5 is automatically assigned, but not displayed on the Reporting Worksheet. |
| **Unavoidable Annual Real Losses (UARL)**<br>Find | UARL (gallons)=(5.41Lm + 0.15Nc + 7.5Lc) xP,<br>or<br>UARL (litres)=(18.0Lm + 0.8Nc + 25.0Lc) xP<br><br>where:<br>Lm = length of mains (miles or kilometres)<br>Nc = number of customer service connections<br>Lp = the average distance of customer service connection piping (feet or metres)<br>(see the Worksheet "Service Connection Diagram" for guidance on deterring the value of Lp)<br>Lc = total length of customer service connection piping (miles or km)<br>Lc = Nc X Lp (miles or kilometres)<br>P = Pressure (psi or metres)<br><br>The UARL is a theoretical reference value representing the technical low limit of leakage that could be achieved if all of today's best technology could be successfully applied. It is a key variable in the calculation of the Infrastructure Leakage Index (ILI). Striving to reduce system leakage to a level close to the UARL is usually not needed unless the water supply is unusually expensive, scarce or both.<br><br>NOTE: The UARL calculation has not yet been proven as fully valid for very small, or low pressure water distribution systems. If,<br>in gallons:<br>(Lm x 32) + Nc < 3000 or<br>P <35psi<br>in litres:<br>(Lm x 20) + Nc < 3000 or<br>P < 25m<br>then the calculated UARL value may not be valid. The software does not display a value of UARL or ILI if either of these conditions is true. |

| Item Name | Description |
|---|---|
| **Unbilled Authorized Consumption** | All consumption that is unbilled, but still authorized by the utility. This includes Unbilled Metered Consumption + Unbilled Unmetered Consumption. See "Authorized Consumption" for more information. For Unbilled Unmetered Consumption, the Free Water Audit Software provides the auditor the option to select a default value if they have not audited unmetered activities in detail. The default calculates a volume that is 1.25% of the Water Supplied volume. If the auditor has carefully audited the various unbilled, unmetered, authorized uses of water, and has established reliable estimates of this collective volume, then he or she may enter the volume directly for this component, and not use the default value. |
| **Unbilled metered consumption**<br>Find | Metered consumption which is authorized by the water utility, but, for any reason, is deemed by utility policy to be unbilled. This might for example include metered water consumed by the utility itself in treatment or distribution operations, or metered water provided to civic institutions free of charge. **It does not include water supplied to neighboring utilities (water exported) which may be metered but not billed.** |
| **Unbilled unmetered consumption**<br>Find | Any kind of Authorized Consumption which is neither billed or metered. This component typically includes water used in activities such as fire fighting, flushing of water mains and sewers, street cleaning, fire flow tests conducted by the water utility, etc. In most water utilities it is a small component which is very often substantially overestimated. **It does NOT include water supplied to neighboring utilities (water exported) which is unmetered and unbilled – an unlikely case.** This component has many sub-components of water use which are often tedious to identify and quantify. Because of this, and the fact that it is usually a small portion of the water supplied, it is recommended that the auditor apply the default value, which is 1.25% of the Water Supplied volume. Select the default percentage to enter this value.<br><br>If the water utility has carefully audited the unbilled, unmetered activities occurring in the system, and has well validated data that gives a value substantially higher or lower than the default volume, then the auditor should enter their own volume. However the default approach is recommended for most water utilities.<br><br>Note that a value of zero is not permitted, since all water utilities have some volume of water in this component occurring in their system. |
| **Units and Conversions** | The user may develop an audit based on one of three unit selections:<br>1) Million Gallons (US)<br>2) Megalitres (Thousand Cubic Metres)<br>3) Acre-feet<br>Once this selection has been made in the instructions sheet, all calculations are made on the basis of the chosen units. Should the user wish to make additional conversions, a unit converter is provided below (use drop down menus to select units from the yellow unit boxes):<br><br>Enter Units: 1 — Convert From… Million Gallons (US) = **Converts to…..** 3.06888329 Acre-feet<br>(conversion factor = 3.06888328973723) |
| **Use of Option Buttons** | To use the default percent value choose this button<br>To enter a value choose this button and enter the value in the cell to the right<br>  <br><br>**NOTE:** For Unbilled Unmetered Consumption, Unauthorized Consumption and Systematic Data Handling Errors, a recommended default value can be applied by selecting the Percent option. The default values are based on fixed percentages of Water Supplied or Billed Aut horized Consumption and are recommended for use in this audit unless the auditor has well validated data for their system. Default values are sho wn by purple cells, as shown in the example above.<br><br>If a default value is selected, the user does not need to grade the item; a grading value of 5 is automatically applied (howe ver, this grade will not be displayed). |
| **Variable production cost (applied to Real Losses)**<br>Find | The cost to produce and supply the next unit of water (e.g., $/million gallons). This cost is determined by calculating the summed unit costs for ground and surface water treatment and all power used for pumping from the source to the customer. It may also include other miscellaneous unit costs that apply to the production of drinking water. It should also include the unit cost of bulk water purchased as an import if applicable.<br><br>It is common to apply this unit cost to the volume of Real Losses. However, if water resources are strained and the ability to meet future drinking water demands is in question, then the water auditor can be justified in applying the Customer Retail Rate to the Real Loss volume, rather than applying the Variable Production Cost.<br><br>The Free Water Audit Software applies the Variable Production costs to Real Losses by default. However, the auditor has the option on the Reporting Worksheet to select the Customer Retail Cost as the basis for the Real Loss cost evaluation if the auditor determines that this is warranted. |
| **Volume from own sources**<br>Find | The volume of water withdrawn (abstracted) from water resources (rivers, lakes, streams, wells, etc) controlled by the water utility, and then treated for potable water distribution. Most water audits are compiled for utility retail water distribution systems, so this volume should reflect the amount of treated drinking water that entered the distribution system. Often the volume of water measured at the effluent of the treatment works is slightly less than the volume measured at the raw water source, since some of the water is used in the treatment process. Thus, it is useful if flows are metered at the effluent of the treatment works. If metering exists only at the raw water source, an adjustment for water used in the treatment process should be included to account for water consumed in treatment operations such as filter backwashing, basin flushing and cleaning, etc. If the audit is conducted for a wholesale water agency that sells untreated water, then this quantity reflects the measure of the raw water, typically metered at the source. |

| Item Name | Description |
|---|---|
| **Volume from own sources: Master meter and supply error adjustment** Find | An estimate or measure of the degree of inaccuracy that exists in the master (production) meters measuring the annual Volume from own Sources, and any error in the data trail that exists to collect, store and report the summary production data. This adjustment is a weighted average number that represents the collective error for all master meters for all days of the audit year and any errors identified in the data trail. Meter error can occur in different ways. A meter or meters may be inaccurate by under-registering flow (did not capture all the flow), or by over-registering flow (overstated the actual flow). Data error can occur due to data gaps caused by temporary outages of the meter or related instrumentation. All water utilities encounter some degree of inaccuracy in master meters and data errors in archival systems are common; thus a value of zero should not be entered. Enter a negative percentage or value for metered data under-registration; or, enter a positive percentage or value for metered data over-registration. |
| **Water exported** Find | The Water Exported volume is the bulk water conveyed and sold by the water utility to neighboring water systems that exists outside of their service area. Typically this water is metered at the custody transfer point of interconnection between the two water utilities. Usually the meter(s) are owned by the water utility that is selling the water: i.e. the exporter. If the water utility who is compiling the annual water audit sells bulk water in this manner, they are an exporter of water.<br><br>Note: The Water Exported volume is sold to wholesale customers who are typically charged a wholesale rate that is different than retail rates charged to the retail customers existing within the service area. Many state regulatory agencies require that the Water Exported volume be reported to them as a quantity separate and distinct from the retail customer billed consumption. For these reasons - and others - the Water Exported volume is always quantified separately from Billed Authorized Consumption in the standard water audit. **Be certain not to "double-count" this quantity by including it in both the Water Exported box and the Billed Metered Consumption box of the water audit Reporting Worksheet. This volume should be included only in the Water Exported box.** |
| **Water exported: Master meter and supply error adjustment** Find | An estimate or measure of the volume in which the Water Exported volume is incorrect. This adjustment is a weighted average that represents the collective error for all of the metered and archived exported flow for all days of the audit year. Meter error can occur in different ways. A meter may be inaccurate by under-registering flow (did not capture all the flow), or by over-registering flow (overstated the actual flow). Error in the metered, archived data can also occur due to data gaps caused by temporary outages of the meter or related instrumentation. All water utilities encounter some degree of error in their metered data, particularly if meters are aged and infrequently tested. Occasional errors also occur in the archived data. Thus, a value of zero should not be entered. Enter a negative percentage or value for metered data under-registration; or enter a positive percentage or value for metered data over-registration. If regular meter accuracy testing is conducted on the meter(s) - which is usually conducted by the water utility selling the water - then the results of this testing can be used to help quantify the meter error adjustment. Corrections to data gaps or other errors found in the archived data should also be included as a portion of this meter error adjustment. |
| **Water imported** Find | The Water Imported volume is the bulk water purchased to become part of the Water Supplied volume. Typically this is water purchased from a neighboring water utility or regional water authority, and is metered at the custody transfer point of interconnection between the two water utilities. Usually the meter(s) are owned by the water supplier selling the water to the utility conducting the water audit. The water supplier selling the bulk water usually charges the receiving utility based upon a wholesale water rate. |
| **Water imported: Master meter and supply error adjustment** Find | An estimate or measure of the volume in which the Water Imported volume is incorrect. This adjustment is a weighted average that represents the collective error for all of the metered and archived imported flow for all days of the audit year. Meter error can occur in different ways. A meter may be inaccurate by under-registering flow (did not capture all the flow), or by over-registering flow (overstated the actual flow). Error in the metered, archived data can also occur due to data gaps caused by temporary outages of the meter or related instrumentation. All water utilities encounter some level of meter inaccuracy, particularly if meters are aged and infrequently tested. Occasional errors also occur in the archived metered data. Thus, a value of zero should not be entered. Enter a negative percentage or value for metered data under-registration; or, enter a positive percentage or value for metered data over-registration. If regular meter accuracy testing is conducted on the meter(s) - which is usually conducted by the water utility selling the water - then the results of this testing can be used to help quantify the meter error adjustment. |
| **WATER LOSSES** Find | = apparent losses + real losses<br><br>Water Losses are the difference between Water Supplied and Authorized Consumption. Water losses can be considered as a total volume for the whole system, or for partial systems such as transmission systems, pressure zones or district metered areas (DMA); if one of these configurations are the basis of the water audit. |

# AWWA Free Water Audit Software:
## Determining Water Loss Standing

WAS v5.0

American Water Works Association.
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**Water Audit Report for:** City of Fullerton (CA3010010)
**Reporting Year:** 2021 | 1/2021 - 12/2021
**Data Validity Score:** 65

## Water Loss Control Planning Guide

| Functional Focus Area | Water Audit Data Validity Level / Score | | | | |
|---|---|---|---|---|---|
| | **Level I** (0-25) | **Level II** (26-50) | **Level III** (51-70) | **Level IV** (71-90) | **Level V** (91-100) |
| Audit Data Collection | Launch auditing and loss control team; address production metering deficiencies | Analyze business process for customer metering and billing functions and water supply operations. Identify data gaps. | Establish/revise policies and procedures for data collection | Refine data collection practices and establish as routine business process | Annual water audit is a reliable gauge of year-to-year water efficiency standing |
| Short-term loss control | Research information on leak detection programs. Begin flowcharting analysis of customer billing system | Conduct loss assessment investigations on a sample portion of the system: customer meter testing, leak survey, unauthorized consumption, etc. | Establish ongoing mechanisms for customer meter accuracy testing, active leakage control and infrastructure monitoring | Refine, enhance or expand ongoing programs based upon economic justification | Stay abreast of improvements in metering, meter reading, billing, leakage management and infrastructure rehabilitation |
| Long-term loss control | | Begin to assess long-term needs requiring large expenditure: customer meter replacement, water main replacement program, new customer billing system or Automatic Meter Reading (AMR) system. | Begin to assemble economic business case for long-term needs based upon improved data becoming available through the water audit process. | Conduct detailed planning, budgeting and launch of comprehensive improvements for metering, billing or infrastructure management | Continue incremental improvements in short-term and long-term loss control interventions |
| Target-setting | | | Establish long-term apparent and real loss reduction goals (+10 year horizon) | Establish mid-range (5 year horizon) apparent and real loss reduction goals | Evaluate and refine loss control goals on a yearly basis |
| Benchmarking | | | Preliminary Comparisons - can begin to rely upon the Infrastructure Leakage Index (ILI) for performance comparisons for real losses (see below table) | Performance Benchmarking - ILI is meaningful in comparing real loss standing | Identify Best Practices/ Best in class - the ILI is very reliable as a real loss performance indicator for best in class service |

*For validity scores of 50 or below, the shaded blocks should not be focus areas until better data validity is achieved.*

Once data have been entered into the Reporting Worksheet, the performance indicators are automatically calculated. How does a water utility operator know how well his or her system is performing? The AWWA Water Loss Control Committee provided the following table to assist water utilities is gauging an approximate Infrastructure Leakage Index (ILI) that is appropriate for their water system and local conditions. The lower the amount of leakage and real losses that exist in the system, then the lower the ILI value will be.

**Note:** this table offers an approximate guideline for leakage reduction target-setting. The best means of setting such targets include performing an economic assessment of various loss control methods. However, this table is useful if such an assessment is not possible.

## General Guidelines for Setting a Target ILI
## (without doing a full economic analysis of leakage control options)

| Target ILI Range | Financial Considerations | Operational Considerations | Water Resources Considerations |
|---|---|---|---|
| **1.0 - 3.0** | Water resources are costly to develop or purchase; ability to increase revenues via water rates is greatly limited because of regulation or low ratepayer affordability. | Operating with system leakage above this level would require expansion of existing infrastructure and/or additional water resources to meet the demand. | Available resources are greatly limited and are very difficult and/or environmentally unsound to develop. |
| **>3.0 -5.0** | Water resources can be developed or purchased at reasonable expense; periodic water rate increases can be feasibly imposed and are tolerated by the customer population. | Existing water supply infrastructure capability is sufficient to meet long-term demand as long as reasonable leakage management controls are in place. | Water resources are believed to be sufficient to meet long-term needs, but demand management interventions (leakage management, water conservation) are included in the long-term planning. |
| **>5.0 - 8.0** | Cost to purchase or obtain/treat water is low, as are rates charged to customers. | Superior reliability, capacity and integrity of the water supply infrastructure make it relatively immune to supply shortages. | Water resources are plentiful, reliable, and easily extracted. |
| **Greater than 8.0** | Although operational and financial considerations may allow a long-term ILI greater than 8.0, such a level of leakage is not an effective utilization of water as a resource. Setting a target level greater than 8.0 - other than as an incremental goal to a smaller long-term target - is discouraged. | | |
| **Less than 1.0** | If the calculated Infrastructure Leakage Index (ILI) value for your system is 1.0 or less, two possibilities exist. a) you are maintaining your leakage at low levels in a class with the top worldwide performers in leakage control. b) A portion of your data may be flawed, causing your losses to be greatly understated. This is likely if you calculate a low ILI value but do not employ extensive leakage control practices in your operations. In such cases it is beneficial to validate the data by performing field measurements to confirm the accuracy of production and customer meters, or to identify any other potential sources of error in the data. | | |

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**Example 1a**: Million Gallons: | **Example 1b**: Million Gallons: Performance Indicators | **Example 2a**: Megalitres: Reporting Worksheet | **Example 2b**: Megalitres: Reporting Worksheet

# Example Audit 1a:

## AWWA Free Water Audit Software: Reporting Worksheet

WAS v5.0

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? Click to access definition
+ Click to add a comment

**Water Audit Report for:** City of Asheville (01-11-010)
**Reporting Year:** 2013 | 7/2012 - 6/2013

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: MILLION GALLONS (US) 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 Error Adjustments

### WATER SUPPLIED

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Pcnt: | | Value: | |
| Volume from own sources: | + ? | 7 | 7,352.880 | MG/Yr | + ? 3 | | | 285.450 | MG/Yr |
| Water imported: | + ? | n/a | 0.000 | MG/Yr | + ? | | | | MG/Yr |
| Water exported: | + ? | n/a | 0.000 | MG/Yr | + ? | | | | MG/Yr |
| **WATER SUPPLIED:** | | | 7,067.430 | MG/Yr | | | | | |

Enter negative % or value for under-registration
Enter positive % or value for over-registration

### AUTHORIZED CONSUMPTION

Click here: ? for help using option buttons below

| | | | | | Pcnt: | | Value: | |
|---|---|---|---|---|---|---|---|---|
| Billed metered: | + ? | 8 | 4,782.250 | MG/Yr | | | | |
| Billed unmetered: | + ? | n/a | 0.000 | MG/Yr | | | | |
| Unbilled metered: | + ? | 7 | 27.757 | MG/Yr | | | | |
| Unbilled unmetered: | + ? | 8 | 157.790 | MG/Yr | | | 157.790 | MG/Yr |
| **AUTHORIZED CONSUMPTION:** | ? | | 4,967.797 | MG/Yr | | | | |

Unbilled Unmetered volume entered is greater than the recommended default value

Use buttons to select percentage of water supplied **OR** value

### WATER LOSSES (Water Supplied - Authorized Consumption)

2,099.633 MG/Yr

**Apparent Losses**

| | | | | | Pcnt: | | Value: | |
|---|---|---|---|---|---|---|---|---|
| Unauthorized consumption: | + ? | | 17.669 | MG/Yr | 0.25% | | | MG/Yr |
| Customer metering inaccuracies: | + ? | 7 | 111.220 | MG/Yr | 2.26% | | | MG/Yr |
| Systematic data handling errors: | + ? | 5 | 11.956 | MG/Yr | 0.25% | | | MG/Yr |

**Default option selected for unauthorized consumption - a grading of 5 is applied but not displayed**

**Default option selected for Systematic data handling errors - a grading of 5 is applied but not displayed**

**Apparent Losses:** ? 140.844 MG/Yr

**Real Losses (Current Annual Real Losses or CARL)**

**Real Losses = Water Losses - Apparent Losses:** ? 1,958.789 MG/Yr

**WATER LOSSES:** 2,099.633 MG/Yr

### NON-REVENUE WATER

**NON-REVENUE WATER:** ? 2,285.180 MG/Yr

= Water Losses + Unbilled Metered + Unbilled Unmetered

### SYSTEM DATA

| | | | | |
|---|---|---|---|---|
| Length of mains: | + ? | 4 | 1,236.5 | miles |
| Number of active AND inactive service connections: | + ? | 7 | 55,256 | |
| Service connection density: | ? | | 45 | 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 operating pressure: | + ? | 4 | 145.3 | psi |

**Average length of customer service line has been set to zero and a data grading score of 10 has been applied**

### COST DATA

| | | | | |
|---|---|---|---|---|
| Total annual cost of operating water system: | + ? | 10 | $33,630,676 | $/Year |
| Customer retail unit cost (applied to Apparent Losses): | + ? | 10 | $3.22 | $/100 cubic feet (ccf) |
| Variable production cost (applied to Real Losses): | + ? | 6 | $335.94 | $/Million gallons |

☐ 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: Variable production cost (applied to Real Losses)
3: Unauthorized consumption

## Example Audit 1b:

**AWWA Free Water Audit Software:**
**System Attributes and Performance Indicators**

WAS v5.0

American Water Works Association.
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**Water Audit Report for:** City of Asheville (01-11-010)
**Reporting Year:** 2013 | 7/2012 - 6/2013

***** YOUR WATER AUDIT DATA VALIDITY SCORE IS: 72 out of 100 *****

**System Attributes:**

| | | | |
|---|---|---|---|
| | *Apparent Losses:* | *140.844* | *MG/Yr* |
| + | *Real Losses:* | *1,958.789* | *MG/Yr* |
| = | **Water Losses:** | **2,099.633** | *MG/Yr* |
| ? | *Unavoidable Annual Real Losses (UARL):* | *794.34* | *MG/Yr* |
| | *Annual cost of Apparent Losses:* | *$606,265* | |
| | *Annual cost of Real Losses:* | *$658,036* | *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:* | *32.3%* | |
| | *Non-revenue water as percent by cost of operating system:* | *3.9%* | *Real Losses valued at Variable Production Cost* |
| Operational Efficiency: | *Apparent Losses per service connection per day:* | *6.98* | *gallons/connection/day* |
| | *Real Losses per service connection per day:* | *97.12* | *gallons/connection/day* |
| | *Real Losses per length of main per day*:* | *N/A* | |
| | *Real Losses per service connection per day per psi pressure:* | *0.67* | *gallons/connection/day/psi* |
| | *From Above, Real Losses = Current Annual Real Losses (CARL):* | *1,958.79* | *million gallons/year* |
| ? | *Infrastructure Leakage Index (ILI) [CARL/UARL]:* | *2.47* | |

** This performance indicator applies for systems with a low service connection density of less than 32 service connections/mile of pipeline*

# Example Audit 2a:

## AWWA Free Water Audit Software: Reporting Worksheet

WAS v5.0

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? Click to access definition

+ Click to add a comment

**Water Audit Report for:** The City of Calgary

**Reporting Year:** 2013 | 1/2013 - 12/2013

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: MEGALITRES (THOUSAND CUBIC METRES) 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 Error Adjustments

### WATER SUPPLIED

| | | | | | Pcnt: | Value: | |
|---|---|---|---|---|---|---|---|
| Volume from own sources: | 7 | 174,324.000 | ML/Yr | 7 | 1.00% | | ML/Yr |
| Water imported: | n/a | 0.000 | ML/Yr | | | | ML/Yr |
| Water exported: | 7 | 8,190.131 | ML/Yr | 7 | 1.00% | | ML/Yr |
| **WATER SUPPLIED:** | | **164,488.979** | ML/Yr | | | | |

Enter negative % or value for under-registration
Enter positive % or value for over-registration

### AUTHORIZED CONSUMPTION

Click here: ? for help using option buttons below

| | | | | Pcnt: | Value: | |
|---|---|---|---|---|---|---|
| Billed metered: | 6 | 125,111.268 | ML/Yr | | | |
| Billed unmetered: | 8 | 3,503.386 | ML/Yr | | | |
| Unbilled metered: | 7 | 166.157 | ML/Yr | | | |
| Unbilled unmetered: | 6 | 1,444.000 | ML/Yr | | 1,444.000 | ML/Yr |
| **AUTHORIZED CONSUMPTION:** | | **130,224.811** | ML/Yr | | | |

Use buttons to select percentage of water supplied **OR** value

### WATER LOSSES (Water Supplied - Authorized Consumption)

**34,264.168** ML/Yr

**Apparent Losses**

| | | | | Pcnt: | Value: | |
|---|---|---|---|---|---|---|
| Unauthorized consumption: | | 411.222 | ML/Yr | 0.25% | | ML/Yr |

**Default option selected for unauthorized consumption - a grading of 5 is applied but not displayed**

| | | | | | | |
|---|---|---|---|---|---|---|
| Customer metering inaccuracies: | 6 | 1,265.429 | ML/Yr | 1.00% | | ML/Yr |
| Systematic data handling errors: | | 312.778 | ML/Yr | 0.25% | | ML/Yr |

**Default option selected for Systematic data handling errors - a grading of 5 is applied but not displayed**

**Apparent Losses:** **1,989.429** ML/Yr

**Real Losses (Current Annual Real Losses or CARL)**

**Real Losses = Water Losses - Apparent Losses:** **32,274.739** ML/Yr

**WATER LOSSES:** **34,264.168** ML/Yr

### NON-REVENUE WATER

**NON-REVENUE WATER:** **35,874.325** ML/Yr

= Water Losses + Unbilled Metered + Unbilled Unmetered

### SYSTEM DATA

| | | | |
|---|---|---|---|
| Length of mains: | 8 | 4,945.0 | kilometers |
| Number of active AND inactive service connections: | 8 | 312,075 | |
| Service connection density: | | 63 | conn./km main |
| Are customer meters typically located at the curbstop or property line? | | No | |
| Average length of customer service line: | 8 | 12.0 | metres (length of service line, beyond the property boundary, that is the responsibility of the utility) |
| Average operating pressure: | 8 | 50.8 | metres (head) |

### COST DATA

| | | | |
|---|---|---|---|
| Total annual cost of operating water system: | 9 | $169,973,759 | $/Year |
| Customer retail unit cost (applied to Apparent Losses): | 9 | $2.35 | $/1000 litres |
| Variable production cost (applied to Real Losses): | 9 | $73.54 | $/Megalitre |

☑ 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: Billed metered

3: Customer metering inaccuracies

## Example Audit 2b:

**AWWA Free Water Audit Software:**
**System Attributes and Performance Indicators**

WAS v5.0

American Water Works Association.
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**Water Audit Report for:** The City of Calgary
**Reporting Year:** 2013 | 1/2013 - 12/2013

***** YOUR WATER AUDIT DATA VALIDITY SCORE IS: 72 out of 100 *****

**System Attributes:**

| | | | |
|---|---|---|---|
| | *Apparent Losses:* | *1,989.429* | *ML/Yr* |
| + | *Real Losses:* | *32,274.739* | *ML/Yr* |
| = | **Water Losses:** | **34,264.168** | *ML/Yr* |
| ? | *Unavoidable Annual Real Losses (UARL):* | *8,015.57* | *ML/Yr* |
| | *Annual cost of Apparent Losses:* | *$4,675,159* | |
| | *Annual cost of Real Losses:* | *$75,845,637* | *Valued at* **Customer Retail Unit Cost** |

*Return to Reporting Worksheet to change this assumpiton*

**Performance Indicators:**

| | | | |
|---|---|---|---|
| Financial: | *Non-revenue water as percent by volume of Water Supplied:* | *21.8%* | |
| | *Non-revenue water as percent by cost of operating system:* | *49.6%* | *Real Losses valued at Customer Retail Unit Cost* |
| Operational Efficiency: | *Apparent Losses per service connection per day:* | *17.47* | *litres/connection/day* |
| | *Real Losses per service connection per day:* | *283.34* | *litres/connection/day* |
| | *Real Losses per length of main per day*:* | *N/A* | |
| | *Real Losses per service connection per day per meter (head) pressure:* | *5.58* | *litres/connection/day/m* |
| | *From Above, Real Losses = Current Annual Real Losses (CARL):* | *32,274.74* | *ML/year* |
| ? | *Infrastructure Leakage Index (ILI) [CARL/UARL]:* | *4.03* | |

** This performance indicator applies for systems with a low service connection density of less than 20 service connections/kilometre of pipeline*

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AWWA Water Audit Software Version 5.0 Developed by the Water Loss Control Committee of the American Water Works Association August, 2014

This software is intended to serve as a basic tool to compile a preliminary, or "top-down", water audit. It is recommended that users also refer to the current edition of the AWWA M36 Publication, Water Audits and Loss Control Programs, for detailed guidance on compiling a comprehensive, or "bottom-up", water audit using the same water audit methodology.

*DEVELOPED BY:*

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*REFERENCES:*

*- Alegre, H., Hirner, W., Baptista, J. and Parena, R. Performance Indicators for Water Supply Services. IWA Publishing 'Manual of Best Practice' Series, 2000. ISBN 1 900222 272*

*- Kunkel, G. et al, 2003. Water Loss Control Committee Report: Applying Worldwide Best Management Practices in Water Loss Control. Journal AWWA, 95:8:65*

*- AWWA Water Audits and Loss Control Programs, M36 Publication, 3rd Edition, 2009*

*- Service Connection Diagrams courtesy of Ronnie McKenzie, WRP Pty Ltd.*

*VERSION HISTORY:*

| Version: | Release Date: | Number of Worksheets: | Key Features and Developments |
|---|---|---|---|
| v1 | 2005/ 2006 | 5 | The AWWA Water Audit Software was piloted in 2005 (v1.0 beta). The early versions (1.x) of the software restricted data entry to units of Million Gallons per year. For each entry into the audit, users identified whether the input was measured or estimated. |
| v2 | 2006 | 5 | The most significant enhancement in v2 of the software was to allow the user to choose the volumetric units to be used in the audit, Million Gallons or Thousand Cubic Metres (megalitres) per year. Two financial performance indicators were added to provide feedback to the user on the cost of Real and Apparent losses. |
| v3 | 2007 | 7 | In v3, the option to report volumetric units in acre-feet was added. Another new feature in v3 was the inclusion of default values for two water audit components (unbilled unmetered and unauthorized consumption). v3 also included two examples of completed audits in units of million gallons and Megalitres. Several checks were added into v3 to provide instant feedback to the user on common data entry problems, in order to help the user complete an accurate water audit. |
| v4 - v4.2 | 2010 | 10 | v4 (and versions 4.x) of the software included a new approach to data grading. The simple "estimated" or "measured" approach was replaced with a more granular scale (typically 1-10) that reflected descriptions of utility practices and served to describe the confidence and accuracy of the input data. Each input value had a corresponding scale fully described in the Grading Matrix tab. The Grading Matrix also showed the actions required to move to a higher grading score. Grading descriptions were available on the Reporting Worksheet via a pop-up box next to each water audit input. A water audit data validity score is generated (max = 100) and priority areas for attention (to improve audit accuracy) are identified, once a user completes the requied data grading. A service connection diagram was also added to help users understand the impact of customer service line configurations on water losses and how this information should be entered into the water audit software. An acknoweldgements section was also added. Minor bug fixes resulted in the release of versions 4.1 and 4.2. A French language version was also made available for v4.2. |
| v5 | 2014 | 12 | In v5, changes were made to the way Water Supplied information is entered into software, with each major component having a corresponding Master Meter Error Adjustment entry (and data grading requirement). This required changes to the data validity score calculation; v5 of the software uses a weighting system that is, in part, proportional to the volume of input components. The Grading Matrix was updated to reflect the new audit inputs and also to include clarifications and additions to the scale descriptions. The appearance of the software was updated in v5 to make the software more user-friendly and several new features were added to provide more feedback to the user. Notably, a dashboard tab has been added to provide more visual feedback on the water audit results and associated costs of Non-Revenue Water. A comments sheet was added to allow the user to track notes, comments and to cite sources used. |

# AWWA Free Water Audit Software v6.0

FWAS v6.0

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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 targeting loss reduction levels. This tool contains several separate worksheets. Sheets can be accessed using the tabs at the bottom of the screen, or by clicking the TOC links below.

## Table of Contents (TOC)


**Start Page** The current sheet. Enter contact information and basic audit details.

**Worksheet** Enter the required data on this worksheet to calculate the water balance and data grading.

**Interactive Data Grading** Answer questions about operational practices for each audit input, and the data validity grades will automatically populate.

**Dashboard** Review NRW components, performance indicators and graphical outputs to evaluate the results of the audit.

**Notes** Enter notes to explain how values were calculated, document data sources, and related information about data management practices.

**Blank Sheet** By popular demand! A blank sheet. The world is your canvas.

**Water Balance** The values entered in the Worksheet automatically populate the Water Balance.

**Loss Control Planning** Use this sheet to interpret the results of the audit validity score and performance indicators.

**Definitions** Use this sheet to understand the terms used in the audit process.

**Service Connection Diagram** Diagrams depicting possible customer service connection line configurations.

**Acknowledge-ments** Acknowledgements for development of the AWWA Free Water Audit Software v6.0.


**AWWA Web Resources for Water Loss Control**

https://www.awwa.org/Resources-Tools/Resource-Topics/Water-Loss-Control

Items referenced in the Free Water Audit Software v6.0 on the web:

- Data Grading Matrix v6.0
- Example Water Audit v6.0
- Water Audit Compiler v6.0
- AWWA Reports on Performance Indicators
- M36 Manual

## Enter Basic Information

| | |
|---|---|
| Name of Utility: | City of Fullerton |
| Name of Contact Person: | Gar Huang |
| Email: | garh@ci.fullerton.ca.us |
| Telephone \| Ext.: | 714-738-6895 |
| City/Town/Municipality: | Fullerton |
| State / Province: | California (CA) |
| Country: | USA |
| Audit Preparation Date: | Aug 30 2023 |
| Audit Year: | 2022 |
| Audit Year Label: | Calendar (Fiscal, Calendar, etc) |
| Audit Period Start Date: | Jan 01 2022 |
| Audit Period End Date: | Dec 31 2022 |
| Volume Reporting Units: | Acre-feet |
| Water System Structure: | Retail |
| Water Type: | Potable Water |
| System ID Number: | CA3010010 |
| Validator Name/ID: | Rachel Davis |
| Validator Email: | rdavis@mwdoc.com |
| Estimated Total Population Served by Water Utility: | 141,874 |

## Key of Input Acronyms

*In order of appearance in the Worksheet*

| | |
|---|---|
| **VOS** | Volume from Own Sources |
| **VOSEA** | VOS Error Adjustment |
| **WI** | Water Imported |
| **WIEA** | WI Error Adjustment |
| **WE** | Water Exported |
| **WEEA** | WE Error Adjustment |
| **BMAC** | Billed Metered Authorized Consumption |
| **BUAC** | Billed Unmetered Authorized Consumption |
| **UMAC** | Unbilled Metered Authorized Consumption |
| **UUAC** | Unbilled Unmetered Authorized Consumption |
| **SDHE** | Systematic Data Handling Errors |
| **CMI** | Customer Metering Inaccuracies |
| **UC** | Unauthorized Consumption |
| **Lm** | Length of mains |
| **Nc** | Number of service connections |
| **Lp** | Average length of (private) customer service line |
| **AOP** | Average Operating Pressure |
| **CRUC** | Customer Retail Unit Charge |
| **VPC** | Variable Production Cost |

**Color Key** User input | Calculated | Optional default

## Guidance for the Worksheet

Choosing to enter unit of **percent** or **volume** (applies to VOSEA, WIEA, WEEA, CMI) choose entry option:

| | | |
|---|---|---|
| 1.00% | percent | *or* |
| | volume | 25.000 |

Choosing to enter **default** or **custom input** (applies to UUAC, SDHE, UC) choose entry option:

| | | |
|---|---|---|
| 0.25% | default | *or* |
| | custom | 75.000 |

## Guidance for the Interactive Data Grading

Use acronym buttons in IDG header to navigate among inputs. Acronym Key above. White = needs answers, orange = complete, clear = not required. Example below.

After clicking an acronym button, answer all visible questions in the order they're presented, choosing best-fit answer

Grade will populate when all visible questions are complete for an input **7**

The limiting criteria will be labeled along the right. If only 1 limiting criterion is shown, improving on that criterion will achieve a higher data grade. If multiple limiting criteria are shown, improving on *each* limiting criterion is necessary to achieve a higher data grade. A complete inventory of data grading criteria is available in the Data Grading Matrix v6.0 (see web resources) Limiting

If you have questions or comments regarding this software please contact us at: wlc@awwa.org

# AWWA Free Water Audit Software: Worksheet

FWAS v6.0

American Water Works Association.
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**Water Audit Report for:** City of Fullerton
**Audit Year:** 2022 | Jan 01 2022 - Dec 31 2022 | Calendar

Click 'n' to add notes
Click 'g' to determine data validity grade

To edit water system info: go to start page

To access definitions, click the input name

All volumes to be entered as: ACRE-FEET PER YEAR

Water Supplied Error Adjustments

## WATER SUPPLIED

choose entry option:

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VOS | Volume from Own Sources: | n | g | 6 | 17,184.550 | Acre-ft/Yr | n | g | 10 | volume | 41.938 | acre-ft/yr | under-registration | VOSEA |
| WI | Water Imported: | n | g | 6 | 5,771.890 | Acre-ft/Yr | n | g | | percent | | | | WIEA |
| WE | Water Exported: | n | g | n/a | 0.000 | Acre-ft/Yr | | | | | | | | WEEA |
| | WATER SUPPLIED: | | | | 22,998.378 | Acre-ft/Yr | | | | | | | | |

## AUTHORIZED CONSUMPTION

choose entry option:

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| BMAC | Billed Metered: | n | g | 8 | 21,723.244 | Acre-ft/Yr | | |
| BUAC | Billed Unmetered: | n | g | n/a | 0.000 | Acre-ft/Yr | | |
| UMAC | Unbilled Metered: | n | g | n/a | 0.000 | Acre-ft/Yr | | |
| UUAC | Unbilled Unmetered: | n | g | 3 | 54.308 | Acre-ft/Yr | 0.25% | default |

Default option selected for Unbilled Unmetered, with automatic data grading of 3

AUTHORIZED CONSUMPTION: 21,777.552 Acre-ft/Yr

## WATER LOSSES

1,220.826 Acre-ft/Yr

### Apparent Losses

Default option selected for Systematic Data Handling Errors, with automatic data grading of 3

choose entry option:

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| SDHE | Systematic Data Handling Errors: | n | g | 3 | 54.308 | Acre-ft/Yr | 0.25% | default | |
| CMI | Customer Metering Inaccuracies: | n | g | 6 | 330.811 | Acre-ft/Yr | 1.50% | percent | under-registration |
| UC | Unauthorized Consumption: | n | g | 3 | 54.308 | Acre-ft/Yr | 0.25% | default | |

Default option selected for Unauthorized Consumption, with automatic data grading of 3

Apparent Losses: 439.427 Acre-ft/Yr

### Real Losses

Real Losses: 781.399 Acre-ft/Yr

WATER LOSSES: 1,220.826 Acre-ft/Yr

## NON-REVENUE WATER

NON-REVENUE WATER: 1,275.134 Acre-ft/Yr

## SYSTEM DATA

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Lm | Length of mains: | n | g | 10 | 431.7 | miles | (including fire hydrant lead lengths) |
| Nc | Number of service connections: | n | g | 10 | 32,082 | | (active *and* inactive) |
| | Service connection density: | | | | 74 | conn./mile main | |

Are customer meters typically located at the curbstop/property line? Yes

| | | | | | |
|---|---|---|---|---|---|
| Lp | | n | g | 10 | |

Average length of customer service line has been set to zero and a data grading of 10 has been applied

| | | | | | | |
|---|---|---|---|---|---|---|
| AOP | Average Operating Pressure: | n | g | 6 | 78.4 | psi |

## COST DATA

| | | | | | | |
|---|---|---|---|---|---|---|
| CRUC | Customer Retail Unit Charge: | n | g | 7 | $2.90 | $/100 cubic feet (ccf) |
| VPC | Variable Production Cost: | n | g | 8 | $782.02 | $/acre-ft |

Total Annual Operating Cost: $41,753,410 $/yr (optional input)

## WATER AUDIT DATA VALIDITY TIER:

***** The Water Audit Data Validity Score is in Tier III (51-70). See Dashboard tab for additional outputs. *****

go to dashboard

A weighted scale for the components of supply, consumption and water loss is included in the calculation of the Water Audit Data Validity Score

**PRIORITY AREAS FOR ATTENTION TO IMPROVE DATA VALIDITY:**

*Based on the information provided, audit reliability can be most improved by addressing the following components:*

1: Volume from Own Sources (VOS)
2: Water Imported (WI)
3: Billed Metered (BMAC)

**KEY PERFORMANCE INDICATOR TARGETS:**

*OPTIONAL: If targets exist for the operational performance indicators, they can be input below:*

| | | |
|---|---|---|
| Unit Total Losses: | | gal/conn/day |
| Unit Apparent Losses: | | gal/conn/day |
| Unit Real Losses[A]: | | gal/conn/day |
| Unit Real Losses[B]: | | gal/mile/day |

*If entered above by user, targets will display on KPI gauges (see Dashboard)*

2022

WIEA

White = incomplete
Orange = complete
Use acronyms for navigation

Limiting criteria (see Start Page for details)

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go to input

## Volume from Own Sources (VOS) - Data Grading Criteria

go to notes

| vos | Criteria Question | Select Best-Fit Answers to All Visible Questions | |
|---|---|---|---|
| vos.0 | Did the water utility supply any water from its own sources during the audit year? | Yes | |
| vos.1 | What percent of own supply volume is metered? | >99% | |
| | **For questions 2-10 below: Choose the answer that applies for those meters that measure >90% of the finished water volume.**<br>**In-situ flow accuracy testing** = a test process that confirms the flow measuring accuracy of the primary device (the flowmeter), in its installed location, using an independent reference volume.<br>**Electronic calibration** = a process that checks for error in the metering secondary device(s) and/or the tertiary device(s).<br>**Secondary device** can include conversion to mA, meter transmitter or similar instrumentation.<br>**Tertiary device** can include SCADA, historian or other computerized archival system. | | |
| vos.2 | What is the frequency of electronic calibration? | Not applicable due to no electronic signal output (i.e. to SCADA) | |
| vos.3 | | | |
| vos.4 | | | |
| vos.5 | What is the frequency of in-situ flow accuracy testing? | Annually | |
| vos.6 | Is the most recent in-situ flow accuracy testing documentation available for review? | Yes | |
| vos.7 | What are the total volume-weighted average results of in-situ flow accuracy testing (during or closest to audit year)? | At or within ±3% | |
| vos.8 | Have testing and calibration procedures been closely scrutinized for compliance with procedures described in the AWWA M36 and/or M33 Manual(s)? | No | |
| vos.9 | Which best describes the frequency of finished water meter readings? | Daily | |
| vos.10 | Which best describes the frequency of data review for anomalies/errors? These can include numbers that are outside of typical patterns, and zero or 'null' values that may reflect a gap in data recording. | Once per month | Limiting |
| | **FINAL DATA GRADE FOR THIS AUDIT INPUT:** | **6** | |

go to input

## Volume from Own Sources Error Adjustment (VOSEA) - Data Grading Criteria

go to notes

| vosea | Criteria Question | Select Best-Fit Answers to All Visible Questions |
|---|---|---|
| vosea.1 | Are tank levels monitored automatically & recorded daily? | Yes |
| vosea.2 | Are daily changes of stored water volumes in distribution system tanks included in the tabulation of the daily "Volume from Own Sources" quantity? | Yes |
| vosea.3 | Is the annual net distribution storage change included in either the VOS input or the VOSEA input? | Yes |
| vosea.4 | Are the flow accuracy test and/or electronic calibration results included in the VOSEA input in the water audit? | Yes, results are analyzed and incorporated |
| | **FINAL DATA GRADE FOR THIS AUDIT INPUT:** | **10** |

go to input

## Water Imported (WI) - Data Grading Criteria

go to notes

| wi | Criteria Question | Select Best-Fit Answers to All Visible Questions | |
|---|---|---|---|
| wi.0 | Did the water utility import any water during the audit year? | Yes | |
| wi.1 | What percent of water imported is metered? | >99% | |
| | **For questions 2-10 below: Choose the answer that applies for those meters that measure >90% of the water imported volume.**<br>**In-situ flow accuracy testing** = a test process that confirms the flow measuring accuracy of the primary device (the flowmeter), in its installed location, using an independent reference volume.<br>**Electronic calibration** = a process that checks for error in the metering secondary device(s) and/or the tertiary device(s).<br>**Secondary device** can include conversion to mA, meter transmitter or similar instrumentation.<br>**Tertiary device** can include SCADA, historian or other computerized archival system. | | |
| wi.2 | What is the frequency of electronic calibration? | At least semi-annually | |
| wi.3 | What level of data transfer errors are checked as part of the electronic calibration process? | Data transfer errors are checked at secondary device(s), but not to tertiary device(s) | |
| wi.4 | Is the most recent electronic calibration documentation available? | Yes | |
| wi.5 | What is the frequency of in-situ flow accuracy testing? | None, or Not within last 5 years | |
| wi.6 | | | |
| wi.7 | | | |
| wi.8 | Have testing and calibration procedures been closely scrutinized for compliance with procedures described in the AWWA M36 and/or M33 Manual(s)? | No | |
| wi.9 | Which best describes the frequency of meter readings (data collection frequency as opposed to billing frequency)? | Continuous | |
| wi.10 | What is the frequency of data review & correction by Exporting or Importing Utility for data gaps and/or anomalies? These can include numbers that are outside of typical patterns, and zero or 'null' values that may reflect a gap in data recording. | Once per month | Limiting |
| | **FINAL DATA GRADE FOR THIS AUDIT INPUT:** | **6** | |

go to input

## Water Imported Error Adjustment (WIEA) - Data Grading Criteria

go to notes

| wiea | Criteria Question | Select Best-Fit Answers to All Visible Questions |
|---|---|---|
| wiea.1 | Is an agreement in place between Exporting and Importing Utility for the purchase of water? | |
| wiea.2 | Are meter accuracy testing or electronic calibration requirements stipulated in the water purchase agreement? | |
| wiea.3 | Are flow accuracy test and/or electronic calibration results used to inform the error adjustment input in the water audit? | |
| wiea.4 | Who has access to the import meter readings including current and archived data? | |

**FINAL DATA GRADE FOR THIS AUDIT INPUT:**

go to input

## Water Exported (WE) - Data Grading Criteria

go to notes

| we | Criteria Question | Select Best-Fit Answers to All Visible Questions |
|---|---|---|
| we.0 | Did the water utility export any water during the audit year? | No |
| we.1 | | |

**For questions 2-10 below: Choose the answer that applies for those meters that measure >90% of the water exported volume.**
**In-situ flow accuracy testing** = a test process that confirms the flow measuring accuracy of the primary device (the flowmeter), in its installed location, using an independent reference volume.
**Electronic calibration** = a process that checks for error in the metering secondary device(s) and/or the tertiary device(s).
**Secondary device** can include conversion to mA, meter transmitter or similar instrumentation.
**Tertiary device** can include SCADA, historian or other computerized archival system.

| | | |
|---|---|---|
| we.2 | | |
| we.3 | | |
| we.4 | | |
| we.5 | | |
| we.6 | | |
| we.7 | | |
| we.8 | | |
| we.9 | | |
| we.10 | | |
| | **FINAL DATA GRADE FOR THIS AUDIT INPUT:** | **n/a** |

go to input

## Water Exported Error Adjustment (WEEA) - Data Grading Criteria

go to notes

| weea | Criteria Question | Select Best-Fit Answers to All Visible Questions |
|---|---|---|
| weea.1 | | |
| weea.2 | | |
| weea.3 | | |
| weea.4 | | |
| | FINAL DATA GRADE FOR THIS AUDIT INPUT: | n/a |

go to input

## Billed Metered Authorized Consumption (BMAC) - Data Grading Criteria

go to notes

| bmac | Criteria Question | Select Best-Fit Answers to All Visible Questions | |
|---|---|---|---|
| bmac.0 | Were any customers metered in the audit year? | Yes | |
| bmac.1 | For billed metered accounts, what % of bills are estimated in a typical billing cycle? | 5% or less | |
| bmac.2 | How often does the utility read its customer meters?<br>For systems with multiple read frequencies, select the reading frequency that describes the majority of your customers. | Bi-Monthly | Limiting |
| bmac.3 | Is the BMAC volume pro-rated to represent consumption occuring exactly during the audit period? | Yes | |
| bmac.4 | How frequently does internal review by utility staff of the BMAC volumes occur? | Every billing cycle | |
| bmac.5 | What level of detail is examined in the internal review of BMAC volumes? | Totals grouped by use type or customer class and specific accounts flagged for anomalous consumption | |
| bmac.6 | When was the most recent billing data review by someone who is independent of the utility billing process? | Within last 3 years | |
| bmac.7 | What level of detail was examined in the review by someone who is independent of the utility billing process? | Full billing database query and analysis of raw data to verify the summary consumption volumes | |
| | **FINAL DATA GRADE FOR THIS AUDIT INPUT:** | **8** | |

go to input

## Billed Unmetered Authorized Consumption (BUAC) - Data Grading Criteria

go to notes

| buac | Criteria Question | Select Best-Fit Answers to All Visible Questions |
|---|---|---|
| buac.0 | Was there any billed consumption on unmetered accounts in the audit year? | No |
| buac.1 | | |
| buac.2 | | |
| buac.3 | | |
| | **FINAL DATA GRADE FOR THIS AUDIT INPUT:** | **n/a** |

go to input

## Unbilled Metered Authorized Consumption (UMAC) - Data Grading Criteria

go to notes

| umac | Criteria Question | Select Best-Fit Answers to All Visible Questions |
|---|---|---|
| umac.0 | Did the water utility have any unbilled-metered consumption in the audit year? | No |
| umac.1 | | |
| umac.2 | | |
| umac.3 | | |
| umac.4 | | |
| | FINAL DATA GRADE FOR THIS AUDIT INPUT: | n/a |

go to input

## Unbilled Unmetered Authorized Consumption (UUAC) - Data Grading Criteria

go to notes

This Data Grading Criteria is hidden when the 'default' input is used on the Worksheet

| | |
|---|---|
| **FINAL DATA GRADE FOR THIS AUDIT INPUT:** | **3** |

go to input

## Systematic Data Handling Error (SDHE) - Data Grading Criteria

go to notes

This Data Grading Criteria is hidden when the 'default' input is used on the Worksheet

| | |
|---|---|
| **FINAL DATA GRADE FOR THIS AUDIT INPUT:** | **3** |

go to input

## Customer Metering Inaccuracies (CMI) - Data Grading Criteria

go to notes

| cmi | Criteria Question | Select Best-Fit Answers to All Visible Questions | |
|---|---|---|---|
| cmi.0 | Was there any metered customer usage during the audit period? | Yes | |
| cmi.1 | Do you test meters reactively (when triggered by customer complaint or billing/consumption flag)? | Reactive testing conducted | |
| cmi.2 | For small size customer meters, which best describes the frequency of proactive testing (effort beyond when triggered by customer complaint or billing/consumption flags)? | Recurring, within two years of the audit period | |
| cmi.3 | Which best describes what meters are included in the proactive small size customer meter testing activities? | Testing targeted to subsets of meters ie oldest meters | |
| cmi.4 | For mid and large size customer meters, which best describes the frequency of the proactive testing program? | Ongoing, conducted annually | |
| cmi.5 | Which best describes what meters are included in the proactive mid- and large customer meter testing activities? | Proactive - all large meters are on a testing schedule | |
| cmi.6 | Which best describes how the input was derived? | Meter accuracy test results or manufacturer specs are referenced but not analyzed and used directly in calculation | Limiting |
| cmi.7 | Has the input derivation been reviewed by someone with expert knowledge in the M36 methodology? | Yes | |
| cmi.8 | To what extent does meter replacement occur and for which meters? | Annual proactive replacement of subset of meters (i.e. by age or throughput) | |
| cmi.9 | Which best describes the reliability of meter installation records? | Records are kept for meter installations, but data is missing for installation date, type, size, or manufacturer | |
| | **FINAL DATA GRADE FOR THIS AUDIT INPUT:** | **6** | |

go to input

## Unauthorized Consumption (UC) - Data Grading Criteria

go to notes

This Data Grading Criteria is hidden when the 'default' input is used on the Worksheet

| | |
|---|---|
| **FINAL DATA GRADE FOR THIS AUDIT INPUT:** | **3** |

go to input

## Length of Mains (Lm) - Data Grading Criteria

go to notes

| Lm | Criteria Question | Select Best-Fit Answers to All Visible Questions |
|---|---|---|
| Lm.1 | How was the input derived? | Derived directly from Mains inventory (GIS, ledger, etc) |
| Lm.2 | Are hydrant laterals included in the input derivation? | Yes |
| Lm.3 | Which best describes how the Mains inventory (GIS, ledger, etc) is kept up to date? | Additions or subtractions are updated in the mains inventory (GIS, ledger, etc), at least annually |
| Lm.4 | Which best describes how the Mains inventory (GIS, ledger, etc) is field validated to confirm field conditions match the inventory? | Field validation is accomplished (i.e. in daily operations or specific validation projects) |
| | **FINAL DATA GRADE FOR THIS AUDIT INPUT:** | **10** |

go to input

## Number of Service Connections (Nc) - Data Grading Criteria

go to notes

| Nc | Criteria Question | Select Best-Fit Answers to All Visible Questions |
|---|---|---|
| Nc.1 | How was the input derived? | Extracted from Services inventory (GIS, billing system, etc) |
| Nc.2 | What is the count of services based on? | Premise based, i.e. service connection count, location ID count |
| Nc.3 | Are inactive (but still pressurized) service lines included in the input? These may be metered or unmetered. | Yes |
| Nc.4 | Which best describes how the inventory of service connections (GIS, billing system, etc) is kept up to date? | Additions or subtractions are updated in the service line inventory (GIS, billing system, etc), at least annually |
| Nc.5 | Which best describes how the inventory of service connections (GIS, billing system, etc) is field validated to confirm field conditions match the inventory? | Field validation is accomplished for the entire system (i.e. in daily operations or specific validation projects) |
| | **FINAL DATA GRADE FOR THIS AUDIT INPUT:** | **10** |

go to input

## Average Length of (Private) Customer Service Line (Lp) - Data Grading Criteria

go to notes

| Lp | Criteria Question | Select Best-Fit Answers to All Visible Questions |
|---|---|---|
| Lp.0 | Are customer meters typically located at the curbstop or property line? | Yes |
| Lp.1 | | |
| Lp.2 | | |
| Lp.3 | | |
| Lp.4 | | |
| | **FINAL DATA GRADE FOR THIS AUDIT INPUT:** | **10** |

go to input

## Average Operating Pressure (AOP) - Data Grading Criteria

go to notes

| aop | Criteria Question | Select Best-Fit Answers to All Visible Questions | |
|---|---|---|---|
| aop.1 | Which best describes checks on the boundary integrity for the system's pressure zone(s)? | Normally-closed boundary valves between zones have never been confirmed to be fully closed | Limiting |
| aop.2 | Which best describes how one-time pressure readings (i.e. from hydrants) are collected? | Collected only if there are low pressure complaints, or new development requests | |
| aop.3 | Which best describes where continuous pressure data (via temporary data loggers or permanent telemetry) is collected? | At zone boundary conditions only (i.e. supply entry points, PRVs, booster stations) | |
| aop.4 | Which best describes how continuous pressure data is collected? | Year-round data collection via permanent monitoring | |
| aop.5 | How was the input derived? | Derived from hydraulic model, where model has not been field calibrated in the last 5 years | |
| | **FINAL DATA GRADE FOR THIS AUDIT INPUT:** | **6** | |

go to input

## Customer Retail Unit Charge (CRUC) - Data Grading Criteria

go to notes

| cruc | Criteria Question | Select Best-Fit Answers to All Visible Questions | |
|---|---|---|---|
| cruc.0 | Was any metered consumption billed on a volumetric basis in the audit period? | Yes | |
| cruc.1 | Which best describes the use and reliability of the current rate structure? | Customer bill calculations have been checked to confirm the rate structure is correctly implemented | |
| cruc.2 | Choose the option that best describes how the input was derived | A volume-weighted average of all rates was calculated | |
| cruc.3 | Is there any additional volumetric revenue the utility receives that depends on water meter readings, such as sewer? | Yes, but this has not been incorporated into the volume-weighted average calculation | Limiting |
| cruc.4 | Has the input derivation been reviewed by someone with expert knowledge in the M36 methodology? | Yes | |
| | **FINAL DATA GRADE FOR THIS AUDIT INPUT:** | **7** | |

go to input

## Variable Production Cost (VPC) - Data Grading Criteria

go to notes

| vpc | Criteria Question | Select Best-Fit Answers to All Visible Questions | |
|---|---|---|---|
| vpc.1 | Choose the option that best describes how the input was derived | Multiple sources of water exist, and a volume-weighted average was calculated for all sources | |
| vpc.2 | Choose the option that best describes which short-run marginal costs have been included in the input, using the definitions below for reference. Short-run marginal costs can include the following:<br>- chemicals + power for treatment, typically applicable if the utility is producing/treating water<br>- power for distribution, typically applicable if pumps exist in the distribution network<br>- water acquisition costs, typically applicable if the utility is purchasing water or incurs any extraction costs for withdrawing from a source<br>Some short-run marginal costs may not be applicable. The auditor should analyze the system characteristics to determine which costs are applicable for inclusion in the VPC input derivation. See also the latest AWWA M36 Manual for further guidance. | All applicable short-run marginal costs are included | |
| vpc.3 | Choose the option that best describes which long-run marginal costs have been included in the input, using the definitions below for reference. Long-run marginal costs can include the following:<br>- water treatment residuals management, typically applicable if solids are produced from water treatment process<br>- accelerated wear & tear on dynamic equipment, typically applicable if pumps exist for treatment and/or distribution, or any other equipment exists that wears out as a function of use instead of time (i.e. filter media, chemical dosing pumps, uv disinfection bulbs, etc)<br>- payouts for damage claims from main and service line breaks, typically applicable if damage claims are paid by the utility<br>- accelerated expansion of supply capacity, typically applicable if the utility is at or nearing supply capacity, or scarecity costs in water scarce areas<br>- full cost pricing that includes all lifecycle costs and externalities (internalized or not)<br>Some long-run marginal costs may not be applicable. The auditor should analyze the system characteristics to determine which costs are applicable for inclusion in the VPC input derivation. See also the latest AWWA M36 Manual for further guidance. | Long-run marginal costs have not been evaluated for applicability, and are not included | Limiting |
| vpc.4 | Has the input derivation been reviewed by someone with expert knowledge in the M36 methodology? | Yes | |
| | **FINAL DATA GRADE FOR THIS AUDIT INPUT:** | **8** | |

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# AWWA Free Water Audit Software: Dashboard

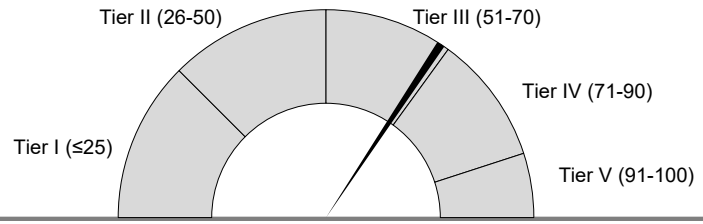
go to worksheet | go to grading | go to references

**Water Audit Report for: City of Fullerton** **Audit Year: 2022 Calendar** **Jan 01 2022 - Dec 31 2022**

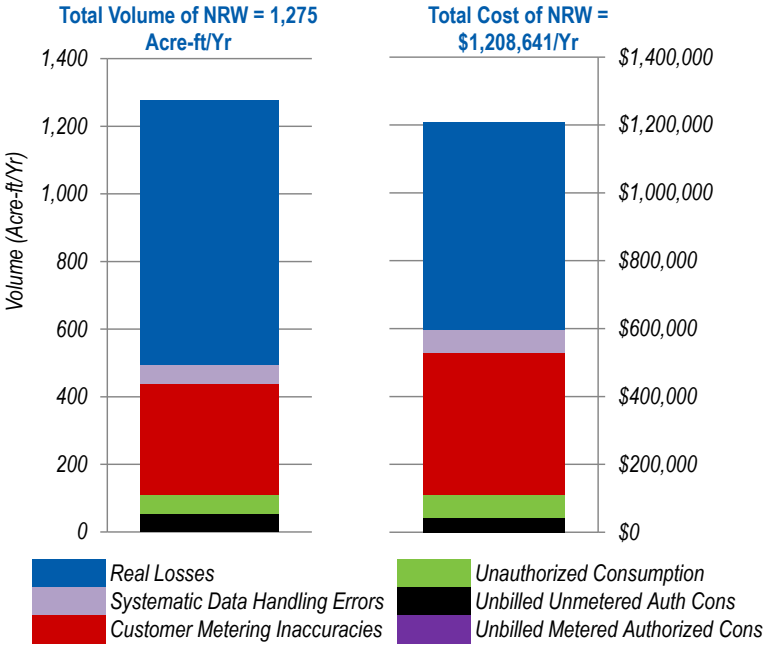
## Data Validity

**Data Validity Score:** 68 **Data Validity Tier:** Tier III (51-70)

See Loss Control Planning for Tier Details




## NRW Components Summary

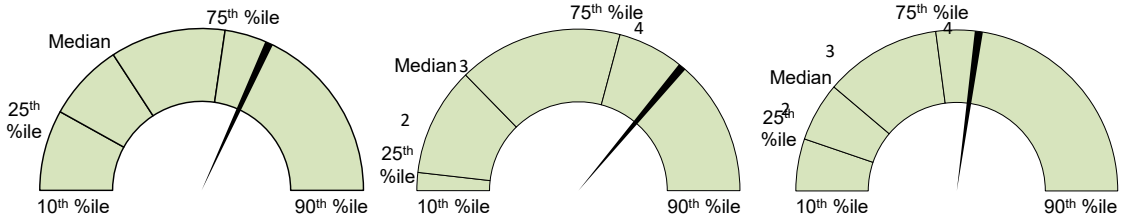



| | Volume Acre-ft/Yr | Value $/Yr | Basis of Valuation |
|---|---|---|---|
| *Apparent Losses* | 439.4 | $555,102 | *CRUC* |
| *Real Losses* | 781.4 | $611,070 | *VPC* |
| *Unbilled Authorized Cons* | 54.3 | $42,470 | *VPC* |
| *Non-Revenue Water* | 1,275.1 | $1,208,641 | *Blended* |

## Key Performance Indicators

Actual KPI result — Target (see Worksheet)

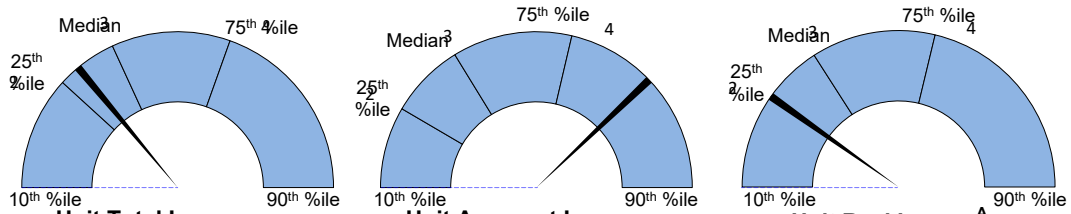
gauge %iles per validated industry ranges[2]




**Total Loss Cost Rate** 36.35 $/conn/year

**Apparent Loss Cost Rate** 17.30 $/conn/year

**Real Loss Cost Rate** 19.05 $/conn/year



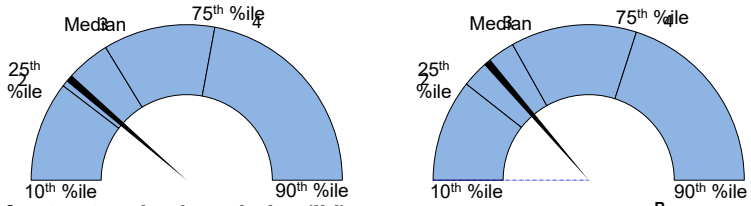

**Unit Total Losses** 34.0 gal/conn/day

**Unit Apparent Losses** 12.2 gal/conn/day

**Unit Real Losses**[A] 21.7 gal/conn/day

Average Operating Pressure
78.4 psi

90th %ile
75th %ile
Median
25th %ile
10th %ile




**Infrastructure Leakage Index (ILI)** 1.2 dimensionless

**Unit Real Losses**[B] 1,616 gal/mile/day

See UARL definition for additional guidance on the ILI

(UARL) Unavoidable Annual Real Losses 627.7 Acre-ft/Yr 17.5 gal/conn/day

### Guidance Information for Key Performance

- The eight indicators shown are the recommended suite per the AWWA Water Loss Control Committee 2020 Position on KPIs[1].
- A suite of KPIs is necessary, as no single KPI can holistically communicate water loss performance for a given water system.
- See Table 1 below for Uses and Limitations for each KPI, excerpted from the AWWA Water Loss Control Committee Report (2020)[1], with naming conventions updated.
- Percentiles (%iles) shown on KPI gauges come from Level 1 validated data in the AWWA WLCC Reference Water Audit Dataset (2020)[2].
- KPI %iles shown above are not segregated by cohorts. Limited KPI data by cohorts may be found in WRF 4695 Guidance Manual, Appendix B (2019)[5].
- Actual KPI results that fall below 10th %ile or above 90th %ile do not necessarily imply error, but should be viewed with scrutiny.
- Percentiles not intended to imply targets. Targets may be input by user for operational KPIs, if desired, on Worksheet.
- See UARL and ILI in Definitions tab for discussion of size and pressure limitations.
- Systems that fall on the extreme ends of size or connection density should use caution when interpreting Unit Losses KPIs.

## Table 1

Source: AWWA Water Loss Control Committee Report (2020)[1], with naming conventions updated

## 2020 AWWA Water Audit Method – Water Audit Outputs and Key Performance Indicators: Uses and Limitations

| Type | Indicator | Description | Suitable Purposes | | | | | Uses and Limitations | Principal Users |
|---|---|---|---|---|---|---|---|---|---|
| | | | Assessment | Bench-Marking | Target-Setting | Planning | Tracking | | |
| **Attribute** | Apparent Loss Volume | Calculated by Free Water Audit Software | ✓ | | | | ✓ | Assess loss level | Utility, Regulators |
| | Apparent Loss Cost | Calculated by Free Water Audit Software | ✓ | | | | ✓ | Assess cost loss level | Utility, Regulators |
| | Real Loss Volume | Calculated by Free Water Audit Software | ✓ | | | | ✓ | Assess loss level | Utility, Regulators |
| | Real Loss Cost | Calculated by Free Water Audit Software | ✓ | | | | ✓ | Assess loss cost level | Utility, Regulators |
| | Unavoidable Annual Real Loss (UARL) | Calculated by Free Water Audit Software | ✓ | | | | ✓ | Reveal theoretical technical low level of leakage | Utility, Regulators |
| **Volume** | Unit Apparent Losses (vol/conn/day) | Strong and understandable indicator for multiple users. | ✓ | ✓ | ✓ | ✓ | ✓ | Used for performance tracking and target-setting | Utility, Regulators |
| | Unit Real Losses[A] (vol/conn/day) | Strong and understandable indicator for multiple users. | ✓ | ✓ | ✓ | ✓ | ✓ | Used for performance tracking and target-setting | Utility, Regulators, Policy Makers |
| | Unit Real Losses[B] (vol/pipeline length/ day) | Strong and understandable indicator for use by utilities with low connection density. | ✓ | ✓ | ✓ | ✓ | ✓ | Data collection and assessment of systems with "low" connection density | Utility, Regulators, Policy Makers |
| | Unit Total Losses (vol/conn/day) **New KPI** | Strong and understandable indicator, suitable for high-level performance measurement. | ✓ | | | | ✓ | High level indicator for trending analysis. Not appropriate for target-setting or benchmarking | Utilities, Customers |
| | Infrastructure Leakage Index (ILI) | Robust, specialized ratio KPI; can be influenced by pressure and connection density. | ✓ | ✓ | | | ✓ | Benchmarking after pressure management is implemented | Utilities |
| **Value** | Apparent Loss Cost Rate (value/conn/year) **New KPI** | Indicators with sufficient technical rigor. Provide the unit financial value of each type of loss, which is useful for planning and assessment of cost efficiency of water loss reduction and control interventions and programs. | ✓ | | | ✓ | ✓ | Data collection and assessment on AWWA indicators or contextual parameters to use in conjunction with Loss Cost Rates | Utilities, Regulators, Customers |
| | Real Loss Cost Rate (value/conn/year) **New KPI** | | ✓ | | | ✓ | ✓ | | Utilities, Regulators, Customers |
| **Validity** | Data Validity Tier (DVT) | Strong indicator of water loss audit data quality, if data has been validated. Tier provides guidance on priority areas of activity. | ✓ | ✓ | | ✓ | ✓ | Assess caliber of data inputs of the water audit | Regulators, Utilities |

# AWWA Free Water Audit Software: User Notes

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**Water Audit Report for:** City of Fullerton
**Audit Year:** 2022

Calendar
Jan 01 2022 - Dec 31 2022

| General Notes: | |
|---|---|

| | | Audit Item | Notes on Input Derivation | Notes on Data Validity Grading |
|---|---|---|---|---|
| go to worksheet | go to grading | Volume from Own Sources (VOS) | | |
| go to worksheet | go to grading | Volume from Own Sources Error Adjustment (VOSEA) | | |
| go to worksheet | go to grading | Water Imported (WI) | | |
| go to worksheet | go to grading | Water Imported Error Adjustment (WIEA) | | |
| go to worksheet | go to grading | Water Exported (WE) | | |

| | | Audit Item | Notes on Input Derivation | Notes on Data Validity Grading |
|---|---|---|---|---|
| go to worksheet | go to grading | Water Exported Error Adjustment (WEIA) | | |
| go to worksheet | go to grading | Billed Metered Authorized Consumption (BMAC) | | |
| go to worksheet | go to grading | Billed Unmetered Authorized Consumption (BUAC) | | |
| go to worksheet | go to grading | Unbilled Metered Authorized Consumption (UMAC) | | |
| go to worksheet | go to grading | Unbilled Unmetered Authorized Consumption (UUAC) | | |
| go to worksheet | go to grading | Systematic Data Handling Errors (SDHE) | | |
| go to worksheet | go to grading | Customer Metering Inaccuracies (CMI) | | |

| | | Audit Item | Notes on Input Derivation | Notes on Data Validity Grading |
|---|---|---|---|---|
| go to worksheet | go to grading | Unauthorized Consumption (UC) | | |
| go to worksheet | go to grading | Length of Mains (Lm) | | |
| go to worksheet | go to grading | Number of Service Connections (Nc) | | |
| go to worksheet | go to grading | Average Length of (private) Customer Service Line (Lp) | | |
| go to worksheet | go to grading | Average Operating Pressure (AOP) | | |
| go to worksheet | go to grading | Customer Retail Unit Charge (CRUC) | | |
| go to worksheet | go to grading | Variable Production Cost (VPC) | | |

Hello, I am a blank sheet, at your service.

3%

2.9%

# AWWA Free Water Audit Software
## Water Balance

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**Water Audit Report for:** City of Fullerton
**Audit Year:** 2022 — Jan 01 2022 - Dec 31 2022
**Data Validity Tier:** Tier III (51-70)

| | | | | | | |
|---|---|---|---|---|---|---|
| Volume from Own Sources (VOS) (corrected for known errors) 17,226.488 | System Input Volume 22,998.378 | Water Exported (WE) (corrected for known errors) 0.000 | Billed Water Exported | | | Revenue Water (Exported) 0.000 |
| | | Water Supplied 22,998.378 | Authorized Consumption 21,777.552 | Billed Authorized Consumption 21,723.244 | Billed Metered Consumption (BMAC) (water exported is removed) 21,723.244 | Revenue Water 21,723.244 |
| | | | | | Billed Unmetered Consumption (BUAC) 0.000 | |
| | | | | Unbilled Authorized Consumption 54.308 | Unbilled Metered Consumption (UMAC) 0.000 | Non-Revenue Water (NRW) 1,275.134 |
| | | | | | Unbilled Unmetered Consumption (UUAC) 54.308 | |
| | | | Water Losses 1,220.826 | Apparent Losses 439.427 | Systematic Data Handling Errors (SDHE) 54.308 | |
| | | | | | Customer Metering Inaccuracies (CMI) 330.811 | |
| | | | | | Unauthorized Consumption (UC) 54.308 | |
| Water Imported (WI) (corrected for known errors) 5,771.890 | | | | Real Losses 781.399 | 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: Determining Water Loss Standing

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**Water Audit Report for:** City of Fullerton
**Audit Year:** 2022 | Jan 01 2022 - Dec 31 2022
**Data Validity Tier:** Tier III (51-70)

## Water Loss Control Planning Guide

| | Water Audit Data Validity Tier (Score Range) | | | | |
|---|---|---|---|---|---|
| **Functional Focus Area** | **Tier I (1-25)** | **Tier II (26-50)** | **Tier III (51-70)** | **Tier IV (71-90)** | **Tier V (91-100)** |
| Audit Data Collection | Launch auditing and loss control team; address supply metering deficiencies | Analyze business process for customer metering and billing functions and water supply operations; Identify data gaps; improve supply metering | Establish/revise policies and procedures for data collection | Refine data collection practices and establish as routine business process | Annual water audit is a reliable gauge of year-to-year water efficiency standing |
| Short-term loss control | Research information on leak detection programs; Begin flowcharting analysis of customer billing system | Conduct loss assessment investigations on a sample portion of the system: customer meter testing, leak survey, unauthorized consumption, etc | Establish ongoing mechanisms for customer meter accuracy testing, active leakage control and infrastructure monitoring | Refine, enhance or expand ongoing programs based upon economic justification | Stay abreast of improvements in metering, meter reading, billing, leakage management and infrastructure rehabilitation |
| Long-term loss control | | Begin to assess long-term needs requiring large expenditure: customer meter replacement, water main replacement program, new customer billing system or AMR/AMI system | Begin to assemble economic business case for long-term needs based upon improved data becoming available through the water audit process | Conduct detailed planning, budgeting and launch of comprehensive improvements for metering, billing or infrastructure management | Continue incremental improvements in short-term and long-term loss control interventions |
| Target-setting | | | Establish long-term apparent and real loss reduction goals (+10 year horizon) | Establish mid-range (5 year horizon) apparent and real loss reduction goals | Evaluate and refine loss control goals on a yearly basis |
| Benchmarking | | | Preliminary Comparisons - can begin to rely upon with PIs for performance comparisons for real losses | Performance Benchmarking with PIs is meaningful in comparing real loss standing | Identify Best Practices/ Best in class; PIs are very reliable as real loss performance indicators for best in class service |

*For validity scores of 50 or below, the shaded blocks should not be focus areas until better data validity is achieved.*

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| Item Name | Description |
|---|---|
| **Apparent Losses**<br>Find | = systematic data handling errors + customer metering inaccuracies + unauthorized consumption<br><br>Apparent Losses include all types of inaccuracies associated with customer metering (worn meters as well as improperly sized meters or wrong type of meter for the water usage profile) as well as systematic data handling errors (meter reading, billing, archiving and reporting), plus unauthorized consumption (theft or illegal use).<br>NOTE: Over-estimation of Apparent Losses results in under-estimation of Real Losses. Under-estimation of Apparent Losses results in over-estimation of Real Losses. |
| **AUTHORIZED CONSUMPTION**<br>Find | = billed metered + billed unmetered + unbilled metered + unbilled unmetered consumption<br><br>The volume of metered and/or unmetered water taken by registered customers, the water utility's own uses, and uses of others who are implicitly or explicitly authorized to do so by the water utility; for residential, commercial, industrial and public-minded purposes.<br><br>Typical retail customers' consumption is tabulated usually from established customer accounts as billed metered consumption, or - for unmetered customers - billed unmetered consumption. These types of consumption, along with billed water exported, provide revenue potential for the water utility. Typically a lag will exist between timing for reading of supply meters and reading of customer meters. A lag-time correction should typically be calculated to account for this. **Be certain to tabulate the water exported volume as a separate component and do not "double-count" it by including in the billed metered consumption component as well as the water exported component.**<br><br>Unbilled authorized consumption occurs typically in non-account uses, including water for fire fighting and training, flushing of water mains and sewers, street cleaning, watering of municipal gardens, public fountains, or similar public-minded uses. Occasionally these uses may be metered and billed (or charged a flat fee), but usually they are unmetered and unbilled. In the latter case, the water auditor may use a default value to estimate this quantity, or implement procedures for the reliable quantification of these uses. This starts with documenting usage events as they occur and estimating the amount of water used in each event. (See Unbilled Unmetered Authorized Consumption) |
| View Service Connection Diagram<br><br>**Average Length of (private) Customer Service Line (Lp)**<br><br>Find | This is the average length of underground customer service line, Lp, that is owned and maintained by the customer; from the point of ownership transfer to the customer water meter, or building line (if unmetered). The quantity is one of the data inputs for the calculation of Unavoidable Annual Real Losses (UARL), which serves as the denominator of the performance indicator: Infrastructure Leakage Index (ILI). The value of Lp is multiplied by the number of customer service connections to obtain a total length of customer owned piping in the system. The purpose of this parameter is to account for the unmetered service line infrastructure that is the responsibility of the customer for arranging repairs of leaks that occur on their lines. In many cases leak repairs arranged by customers take longer to be executed than leak repairs arranged by the water utility on utility-maintained piping. Leaks run longer - and lose more water - on customer-owned service piping, than utility owned piping.<br><br>If the customer water meter exists near the ownership transfer point (usually the curb stop located between the water main and the customer premises) this distance is zero because the meter and transfer point are the same. This is the often encountered configuration of customer water meters located in an underground meter box or "pit" outside of the customer's building. The Free Water Audit Software asks a "Yes/No" question about the meter at this location. If the auditor selects "Yes" then this distance is set to zero and the data grading score for this component is set to 10.<br><br>If water meters are typically located inside the customer premise/building, or properties are unmetered, it is up to the water auditor to estimate a system-wide average Lp length based upon the various customer land parcel sizes and building locations in the service area. Lp will be a shorter length in areas of high density housing, and a longer length in areas of low density housing and varied commercial and industrial buildings. General parcel demographics should be employed to obtain a total Lp length (Lc) and subsequently a weighted average Lp length for the entire system.<br><br>Refer to the "Service Connection Diagram" worksheet for a depiction of the service line/metering configurations that typically exist in water utilities. This worksheet gives guidance on the determination of the Average Length, Lp, for each configuration. |
| **Average Operating Pressure (AOP)**<br><br>Find | This is the average pressure in the distribution system that is the subject of the water audit. If the water utility is compiling the water audit for the first time, the average pressure can be approximated, but with a low data grading. In subsequent years of auditing, effort should be made to improve the accuracy of the average pressure quantity. This will then qualify the value for a higher data grading.<br><br>In the absence of a hydraulic model, the average pressure may be approximated by obtaining readings of static water pressure from a representative sample of fire hydrants or other system access points evenly located across the system. A weighted average of the pressure can be assembled; but be sure to take into account the elevation of the fire hydrants, which typically exist several feet higher than the level of buried water pipelines.<br><br>If your water utility has an up-to-date and calibrated hydraulic model of the water distribution system, it can be utilized to obtain a very accurate quantity of average pressure. However using the average pressure of all “nodes” in the system model is not necessarily the most accurate way to calculate the average operating pressure. This is especially true if there are significant pressure differences throughout the system, and the “nodes” are not evenly distributed throughout the distribution system. The most accurate calculation is to obtain the average pressure that each pipe segment experiences. The way to do this is to calculate the pressure at each end of the pipe. Then calculate the average of those two values and multiply this average value by the length of that pipe. This must be calculated for all pipe segments in the model. Finally calculate the sum of all of these values and and divide by the total pipe length. This effectively calculates a weighted average of pressure over the total pipe length. For low density systems (<32 connections/mile), average mains pressures at the service connection or curb stop may have greater influence and should be considered. |
| **Billed Authorized Consumption** | All consumption that is billed and authorized by the utility. This may include both metered and unmetered consumption. See "Authorized Consumption" for more information. |

| Item Name | Description |
|---|---|
| **Billed Metered Authorized Consumption (BMAC)** Find | All metered consumption which is billed to retail customers, including all groups of customers such as domestic, commercial, industrial or institutional. **It does NOT include water supplied to neighboring utilities (water exported) which is metered and billed. Be sure to subtract any consumption for exported water sales that may be included in these billing roles. Water supplied as exports to neighboring water utilities should be included only in the Water Exported component.** The metered consumption data can be taken directly from billing records for the water audit period. The accuracy of yearly metered consumption data can be refined by including an adjustment to account for customer meter reading lag time since not all customer meters are read on the same day of the meter reading period. However additional analysis is necessary to determine the lag time adjustment value, which may or may not be significant. |
| **Billed Unmetered Authorized Consumption (BUAC)** Find | All billed consumption which is calculated based on estimates or norms from water usage sites that have been determined by utility policy to be left unmetered. This is typically a very small component in systems that maintain a policy to meter their customer population. However, this quantity can be the key consumption component in utilities that have not adopted a universal metering policy. **This component should NOT include any water that is supplied to neighboring utilities (water exported) which is unmetered but billed. Water supplied as exports to neighboring water utilities should be included only in the Water Exported component.** |
| **Customer Metering Inaccuracies (CMI)** Find | Apparent water losses caused by the collective under-registration of customer water meters. Many customer water meters gradually wear as large cumulative volumes of water are passed through them over time. This causes the meters to under-register the flow of water. This occurrence is common with smaller residential meters of sizes 5/8-inch and 3/4 inch after they have registered very large cumulative volumes of water, which generally occurs only after periods of years. For meters sized 1-inch and larger - typical of multi-unit residential, commercial, institutional and industrial accounts - meter under-registration can occur from wear or from the improper application of the meter; i.e. installing the wrong type of meter or the wrong size of meter, for the flow pattern (profile) of the consumer. For instance, many larger meters have reduced accuracy at low flows. If an oversized meter is installed, most of the time the routine flow will occur in the low flow range of the meter, and a significant portion of it may not be registered. It is important to properly select and install all meters, but particularly large customer meters, size 1-inch and larger.<br><br>The auditor has two options for entering data for this component of the audit. The auditor can enter a percentage under-registration (typically an estimated value), this will apply the selected percentage to the two categories of metered consumption to determine the volume of water not recorded due to customer meter inaccuracy. Note that this percentage is a composite average inaccuracy for all customer meters in the entire meter population. The percentage will be multiplied by the sum of the volumes in the Billed Metered and Unbilled Metered components. Alternatively, if the auditor has substantial data from meter testing activities, he or she can calculate their own loss volumes, and this volume may be entered directly.<br><br>Note that a value of zero will be accepted but is not recommended, as all metered systems tend to have some degree of inaccuracy. A positive value should be entered. A value of zero in this component is generally valid only if the water utility does not meter its customer population.<br><br>The formula for caculating a volume of CMI from a percentage input is as follows: CMI volume = (BMAC+UMAC)/(1-CMI%)-(BMAC+UMAC) |
| **Customer Retail Unit Charge (CRUC)** Find | The Customer Retail Unit Charge represents the volumetric portion of the total charges that customers pay for water service. The CRUC does not include fixed charges. This unit charge cost is applied routinely to the components of Apparent Loss, since these losses represent water reaching customers but not (fully) paid for. Since most water utilities have a rate structure that includes a variety of different charges costs based upon class of customer, a volume-weighted average of water sold at each unique rate should be calculated to determine a single composite charge that should be entered into this cell. Finally, the weighted average charge should also include additional charges for sewer, storm water or biosolids processing, but only if these charges are based upon the volume of potable water consumed.<br><br>For water utilities in regions with limited water resources and a questionable ability to meet the drinking water demands in the future, the Customer Retail Unit Charge Cost might also be applied to value the Real Losses; instead of applying the Variable Production Cost to Real Losses. In this way, it is assumed that every unit volume of leakage reduced by leakage management activities will be sold to a customer.<br><br>Note: the Free Water Audit Software allows the user to select the units that are charged to customers (either $/1,000 gallons, $/hundred cubic feet, or $/1,000 litres) and automatically converts these units for purpose of calculating Apparent Loss valuations. The monetary units are United States dollars, $. |
| **Infrastructure Leakage Index (ILI)** Find | The ratio of the Current Annual Real Losses (Real Losses) to the Unavoidable Annual Real Losses (UARL). This performance indicator is dimensionless.<br><br>**NOTES ON THE UARL AND ILI:**<br>1. This Free Water Audit Software version 6 presents the calculated UARL and ILI for systems of all sizes and all pressures. Some published research is now available on predicting how UARL is likely to be modified when modeling low leakage limits in systems that are very small (< 3000 conn), or have very low average pressures, or have very high pressures (aka boundary cases). Inherent over- or under- estimation of UARL volume may exist in these boundary cases, as they operate at or near the limits of the UARL model assumptions. More widespread application and understanding of system specific corrections to the UARL model in these boundary cases is now likely to occur, but are not included in the FWAS at the time of this publication. Caution is advised when using the standard UARL modeled value (and subsequently the ILI) for boundary cases. In boundary cases, the ILI may still be considered a general Performance Indicator, but not used as an absolute performance measurement or for benchmark comparisons.<br><br>2. The UARL term is based on average operating pressure in a given audit year, and a utility's current pressure conditions may not be optimized. Thus, ILI should always be interpreted with some measure of pressure, and only used for tracking progress if all justifiable pressure management has already been completed. |

| Item Name | Description |
|---|---|
| **Length of Mains (Lm)**<br>Find | Length of all pipelines (except service connections) in the system starting from the point of system input metering (for example at the outlet of the treatment plant). It is also recommended to include in this measure the total length of fire hydrant lead pipe. Hydrant lead pipe is the pipe branching from the water main to the fire hydrant. Fire hydrant leads are typically of a sufficiently large size that is more representative of a pipeline than a service connection. The average length of hydrant leads across the entire system can be assumed if not known, and multiplied by the number of fire hydrants in the system, which can also be assumed if not known. This value can then be added to the total pipeline length. Total length of mains can therefore be calculated as:<br><br>Length of Mains, miles = (total pipeline length, miles) + [ {(average fire hydrant lead length, ft) x (number of fire hydrants)} / 5,280 ft/mile ]<br>or<br>Length of Mains, kilometres = (total pipeline length, kilometres) + [ {(average fire hydrant lead length, metres) x (number of fire hydrants)} / 1,000 metres/kilometre ] |
| **NON-REVENUE WATER**<br>Find | = Apparent Losses + Real Losses + Unbilled Metered Consumption + Unbilled Unmetered Consumption. This is water which does not provide revenue potential to the utility. |
| **Number of Service Connections (Nc)**<br>Find | Number of customer service connections, extending from the water main to supply water to a customer. This includes the actual number of pressurized piping connections, including fire connections, **whether active or inactive**. This may differ substantially from the number of customers (or number of accounts).<br>**Note: this number does not include the pipeline leads to fire hydrants. The total length of piping supplying fire hydrants should be <u>included</u> in the "Length of mains" input, and <u>excluded</u> from the Number of service connections input.** |
| **Real Losses**<br>Find | Physical water losses from the pressurized system (water mains and customer service connections) and the utility's storage tanks, up to the point of customer consumption. In metered systems this is the customer meter, in unmetered situations this is the first point of consumption (stop tap/tap) within the property. The annual volume lost through all types of leaks, breaks and overflows depends on frequencies, flow rates, and average duration of individual leaks, breaks and overflows. |
| **Revenue Water** | Those components of System Input Volume that are billed and have the potential to produce revenue. |
| **Service Connection Density**<br>Find | =number of customer service connections / length of mains |
| **Systematic Data Handling Errors (SDHE)**<br>Find | Apparent losses caused by accounting omissions, errant computer programming, gaps in policy, procedure, and permitting/activation of new accounts; and any type of data lapse that results in under-stated customer water consumption in summary billing reports. **Systematic Data Handling Errors occur as a customer consumption volume and can result in a direct loss of revenue potential. Water utilities can find "lost" revenue by keying on this component.**<br><br>Utilities typically measure water consumption volumes registered by water meters at customer premises. The meter should be read routinely (ex: monthly) and the data transferred to the Customer Billing System, which generates and sends a bill to the customer. Data Transfer Errors result in the registered consumption volume value being less than the actual consumption volume, creating an apparent loss. Such error might occur from illegible and mis-recorded hand-written readings compiled by meter readers, inputting an incorrect meter register unit conversion factor in the automatic meter reading equipment, or a variety of similar errors.<br><br>Apparent losses also occur from Data Analysis Errors in the archival and data reporting processes of the Customer Billing System. Inaccurate estimates used for accounts that fail to produce a meter reading are a common source of error. Billing adjustments may award customers a rightful monetary credit, but do so by creating a negative value of consumption volume, thus under-stating the actual consumption. Account activation lapses may allow new buildings to begin using water for months without meter readings and billing. Poor permitting and construction inspection practices can result in a new building water service commencing without a billing account, a water meter and meter reading; i.e., the customer is unknown to the utility's billing system. Close auditing of the permitting, metering, meter reading, billing and reporting processes of the water consumption data trail can uncover data management gaps that create volumes of systematic data handling error. Utilities should routinely analyze customer billing records to detect data anomalies and quantify these losses. For example, a billing account that registers zero consumption for two or more billing cycles should be checked to explain why usage has seemingly halted. Given the revenue loss impacts of these losses, water utilities are well-justified in providing continuous oversight and timely correction of data transfer errors & data handling errors.<br><br>If the water auditor has not yet gathered detailed data or assessment of systematic data handling error, it is recommended that the auditor apply the default value of 0.25% of the Billed Authorized Consumption volume. However, if the auditor has investigated the billing system and its controls, and has well validated data that indicates the volume from systematic data handling error is substantially higher or lower than that generated by the default value, then the auditor should enter a quantity that was derived from the utility investigations and select an appropriate grading. Negative or zero values are not allowed for this audit component.<br><br>Note: occasionally billed consumption volumes for a customer account may be over-stated due to issues of double-counting an account or applying an over-stated meter multiplier. The possibility of such occurrences should be explored in the data validation process, particularly if billed authorized consumption volumes for the year, or for any sub-group of customers (by classification or meter size), appears to be inordinately high. It is recommended to correct any such errors in the billed consumption total for the year, rather than consider these volumes part of Systematic Data Handling Error. |
| **Total annual operating cost (optional input)**<br>Find | *This input has been made optional, as it is no longer used in calculating a Performance Indicator. Auditors are welcome to continue to track this input as desired.* These costs include those for operations, maintenance and any annually incurred costs for long-term upkeep of the drinking water supply and distribution system. It should include the costs of day-to-day upkeep and long-term financing such as repayment of capital bonds for infrastructure expansion or improvement. Typical costs include employee salaries and benefits, materials, equipment, insurance, fees, administrative costs and all other costs that exist to sustain the drinking water supply. Depending upon water utility accounting procedures or regulatory agency requirements, it may be appropriate to include depreciation in the total of this cost. This cost should not include any costs to operate wastewater, biosolids or other systems outside of drinking water. |

| Item Name | Description |
|---|---|
| **Unauthorized Consumption (UC)**<br>Find | Includes water illegally withdrawn from fire hydrants, illegal connections, bypasses to customer consumption meters, or tampering with metering or meter reading equipment; as well as any other ways to receive water while thwarting the water utility's ability to collect revenue for the water. Unauthorized consumption results in uncaptured revenue and creates an error that understates customer consumption. In most water utilities this volume is low and, if the water auditor has not yet gathered detailed data for these loss occurrences, it is recommended to use the default value of 0.25% of the Billed Authorized Consumption volume. However, if the auditor has investigated unauthorized occurrences, and has well validated data that indicates the volume from unauthorized consumption is substantially higher or lower than that generated by the default value, then the auditor should enter a quantity that was derived from the utility investigations. Note that a value of zero will not be accepted since all water utilities tend to have some volume of unauthorized consumption occurring in their system. |
| **Unavoidable Annual Real Losses (UARL)**<br>Find | The UARL is a theoretical reference value representing the technical low limit of leakage for well managed systems in good condition, with aggressive active leakage control. It is a key variable in the calculation of the Infrastructure Leakage Index (ILI).<br><br>UARL (gallons) = (5.41Lm + 0.15Nc + 7.5Lc) x P x 365 d/year,<br>or<br>UARL (litres) = (18.0Lm + 0.8Nc + 25.0Lc) x P x 365 d/year<br><br>where:<br>Lm = length of mains (miles or kilometres)<br>Nc = number of customer service connections<br>Lp = the average length of customer service connection piping (feet or metres)<br>(see the Worksheet "Service Connection Diagram" for guidance on deterring the value of Lp)<br>Lc = total length of customer service connection piping (miles or km)<br>Lc = Nc X Lp (miles or kilometres)<br>P = Average operating pressure (psi or metres) (see Average Operating Pressure definition)<br><br>**NOTES ON THE UARL AND ILI:**<br>1. This Free Water Audit Software version 6 presents the calculated UARL and ILI for systems of all sizes and all pressures. Some published research is now available on predicting how UARL is likely to be modified when modeling low leakage limits in systems that are very small (< 3000 conn), or have very low average pressures, or have very high pressures (aka boundary cases). Inherent over- or under- estimation of UARL volume may exist in these boundary cases, as they operate at or near the limits of the UARL model assumptions. More widespread application and understanding of system specific corrections to the UARL model in these boundary cases is now likely to occur, but are not included in the FWAS at the time of this publication. Caution is advised when using the standard UARL modeled value (and subsequently the ILI) for boundary cases. In boundary cases, the ILI may still be considered a general Performance Indicator, but not used as an absolute performance measurement or for benchmark comparisons.<br>2. The UARL term is based on average operating pressure in a given audit year, and a utility's current pressure conditions may not be optimized. Thus, ILI should always be interpreted with some measure of pressure, and only used for tracking progress if all justifiable pressure management has already been completed. |
| **Unbilled Authorized Consumption** | All consumption that is unbilled, but still authorized by the utility. This includes Unbilled Metered Authorized Consumption (UMAC) + Unbilled Unmetered Authorized Consumption (UUAC). See "Authorized Consumption" for more information. |
| **Unbilled Metered Authorized Consumption (UMAC)**<br>Find | Metered consumption which is authorized by the water utility, but, for any reason, is deemed by utility policy to be unbilled. This might for example include metered water consumed by the utility itself in treatment or distribution operations, or metered water provided to civic institutions free of charge. **It does not include water supplied to neighboring utilities (water exported) which may be metered but not billed.** |
| **Unbilled Unmetered Authorized Consumption (UUAC)**<br>Find | Any kind of Authorized Consumption which is neither billed nor metered. This component typically includes water used in activities such as fire fighting, flushing of water mains and sewers, street cleaning, fire flow tests conducted by the water utility, etc. In most water utilities it is a small component.<br><br>This component does NOT include water supplied to neighboring utilities (water exported) which is unmetered and unbilled – an unlikely case. Also, if any potable water used at a water treatment plant is tapped from a location upstream of the meter(s) used to determine the Volume from Own Sources in the audit, this is outside of the boundary of the audit and should therefore not be included as part of Unbilled, Unmetered Authorized Consumption.<br><br>This component has many sub-components of water use which may not yet be quantified. The default is 0.25% of the Billed Authorized Consumption volume (BMAC + BUAC), and is recommended for temporary use if customized estimates are not yet available, with recommendation to begin tracking and estimating these volumes for the next audit.<br><br>Note that a value of zero is not permitted, since all water utilities likely have some volume of water in this component occurring in their system. |
| **Units and Conversions** | The user may develop an audit based on one of three unit selections:<br>1) Million Gallons (US)<br>2) Megalitres (Thousand Cubic Metres)<br>3) Acre-feet<br>Once this selection has been made in the instructions sheet, all calculations are made on the basis of the chosen units. Should the user wish to make additional conversions, a unit converter is provided below (use drop down menus to select units): |

| Item Name | Description |
|---|---|
| | Enter Units: Convert From… / Converts to….. <br> 100 Million Gallons (US) = 306.888329 Acre-feet <br> (conversion factor = 3.0689) |
| **Variable Production Cost (VPC) (applied to Real Losses)** <br> Find | The cost to produce and supply the next unit of water (e.g., $/million gallons). This cost can include both short-run and long-run marginal costs. See the VPC data grading questions on IDG tab for examples of short-run and long-run marginal costs that may be included. <br><br> It is common to apply the VPC unit cost to the volume of Real Losses. However, if water resources are strained and the ability to meet future drinking water demands is in question, then the water auditor may be justified in applying the Customer Retail Unit Charge to the Real Loss volume, rather than applying the Variable Production Cost. |
| **Volume from Own Sources (VOS)** <br> Find | The volume of water withdrawn (abstracted) from water resources (rivers, lakes, streams, wells, etc) controlled by the water utility, and then treated for potable water distribution. Most water audits are compiled for utility retail water distribution systems, so this volume should reflect the amount of treated drinking water that entered the distribution system. Often the volume of water measured as treated effluent of the treatment works is slightly less than the volume measured at the raw water source, since some of the water is used in the treatment process. Thus, it is useful if flows are metered at the effluent of the treatment works. Water treatment plants are also often supplied potable drinking water and therefore are a "customer" of the water utility. If the service connection line serving the water treatment plant is downstream of treated water effluent flowmeters, this water should be metered and billed as billed authorized consumption. In this case, this volume of water does not enter into any calculations for Volume from Own Sources. If the service connection line suppling potable water to the treatment plant is upstream of treated water effluent flowmeters, then this water is considered "process" water and included with calculations accounting for process water use. <br> If metering exists only at the raw water source, an adjustment for water used in the treatment process should be included to account for water consumed in treatment operations such as filter backwashing, basin flushing and cleaning, plant potable water consumption (if the supply is drawn upstream of effluent flowmetering.) and similar uses. If the audit is conducted for a wholesale water agency that sells untreated water, then this quantity reflects the measure of the raw water, typically metered at the source. |
| **Volume from own sources: error adjustment** <br> Find | An estimate or measure of the degree of inaccuracy that exists in the master (production) meters measuring the annual Volume from own Sources, and any error in the data trail that exists to collect, store and report the summary production data. This adjustment is a weighted average number that represents the collective error for all master meters for all days of the audit year and any errors identified in the data trail. Meter error can occur in different ways. A meter or meters may be inaccurate by under-registering flow (did not capture all the flow), or by over-registering flow (overstated the actual flow). Data error can occur due to data gaps caused by temporary outages of the meter or related instrumentation. All water utilities encounter some degree of inaccuracy in master meters and data errors in archival systems are common. Enter a positive percentage or volume, then select 'under-registration' or 'over-registration' from the drop-down immediately adjacent. **See Water Supplied Error Adjustments definition for guidance on how to calculate this input.** |
| **Water Exported (WE)** <br> Find | The Water Exported volume is the bulk water conveyed or sold by the water utility to neighboring water systems that exists outside of their service area. Typically this water is metered at the custody transfer point of interconnection between the two water utilities. Usually the meter(s) are owned by the water utility that is selling or transfering the water: i.e. the exporter. If the water utility who is compiling the annual water audit sells or transfers bulk water in this manner, they are an exporter of water. <br><br> Note: The Water Exported volume is typically sold to wholesale customers who are charged a wholesale rate that is different than retail rates charged to the retail customers existing within the service area. Many state regulatory agencies require that the Water Exported volume be reported to them as a quantity separate and distinct from the retail customer billed consumption. For these reasons - and others - the Water Exported volume is always quantified separately from Billed Authorized Consumption in the standard water audit. **Be certain not to "double-count" this quantity by including it in both the Water Exported box and the Billed Metered Consumption box of the water audit Worksheet. This volume should be included only in the Water Exported box.** |
| **Water Exported: Error Adjustment (WEEA)** <br> Find | An estimate or measure of the volume by which the Water Exported volume is incorrect. This adjustment is a weighted average that represents the collective error for all of the metered and archived exported flow for all days of the audit year. Meter error can occur in different ways. A meter may be inaccurate by under-registering flow (did not capture all the flow), or by over-registering flow (overstated the actual flow). Error in the metered, archived data can also occur due to data gaps caused by temporary outages of the meter or related instrumentation. All water utilities encounter some degree of error in their metered data, particularly if meters are aged and infrequently tested. Occasional errors also occur in the archived data. Enter a positive percentage or volume, then select 'under-registration' or 'over-registration' from the drop-down immediately adjacent. If regular meter accuracy testing is conducted on the meter(s) - which is usually conducted by the water utility selling the water - then the results of this testing can be used to help quantify the meter error adjustment. Corrections to data gaps or other errors found in the archived data should also be included as a portion of this meter error adjustment. **See Water Supplied Error Adjustments definition for guidance on how to calculate this input.** |
| **Water Imported (WI)** <br> Find | The Water Imported volume is the bulk water purchased to become part of the Water Supplied volume. Typically this is water purchased from a neighboring water utility or regional water wholesale supplier, and is metered at the custody transfer point of interconnection between the two water utilities. Usually the meter(s) are owned by the water supplier selling the water to the utility conducting the water audit. The water supplier selling the bulk water usually charges the receiving utility based upon a wholesale water rate. |

| Item Name | Description |
|---|---|
| **Water Imported: Error Adjustment (WIEA)**<br><br>Find | An estimate or measure of the volume by which the Water Imported volume is incorrect. This adjustment is a weighted average that represents the collective error for all of the metered and archived imported flow for all days of the audit year. Meter error can occur in different ways. A meter may be inaccurate by under-registering flow (did not capture all the flow), or by over-registering flow (overstated the actual flow). Error in the metered, archived data can also occur due to data gaps caused by temporary outages of the meter or related instrumentation. All water utilities encounter some level of meter inaccuracy, particularly if meters are aged and infrequently tested. Occasional errors also occur in the archived metered data. Enter a positive percentage or volume, then select 'under-registration' or 'over-registration' from the drop-down immediately adjacent. If regular meter accuracy testing is conducted on the meter(s) - which is usually conducted by the water utility selling the water - then the results of this testing can be used to help quantify the meter error adjustment. **See Water Supplied Error Adjustments definition for guidance on how to calculate this input.** |
| **Water Supplied Error Adjustments**<br>Find | **Disclaimer**: The guidance provided below should be considered general, representing a typical approach to determining Error Adjustment. Supply metering setups, metering technologies, instrumentation, data recording/archival, and data management systems can vary significantly from one water utility to the next. Inherent margins of error will also vary among different testing and calibration methods and the measurement systems being tested. Other factors that may be important include, but are not limited to, frequency of testing and calibration practices, data communication outages in the audit period, tested flowrates versus typical operating flowrates, and test durations. All of these factors must be considered when assessing Error Adjustment for the Water Supplied inputs. Each specific situation should be carefully analyzed to determine the most appropriate approach for determining the Error Adjustment to input, if any.<br><br>**General**: For the Water Supplied inputs, there are three typical sources of error that may warrant an Error Adjustment on the Worksheet.<br>1. **Meter error:** measurement inaccuracy in the meter(s) used to derive the input volume, typically identified through in-situ flow accuracy testing. Applicable for VOS, WI and WE. If no such testing has been performed, adjustment for meter error is not typically recommended.<br>2. **Data transfer error**: inaccuracy in archived volumes, typically due to gaps in data, programming errors impacting unit conversions, and/or programming errors impacting totalization of measured volumes over the audit period. Applicable for VOS, WI and WE. These errors are typically identified through electronic calibration to verify data transfer at the secondary device (i.e. conversion to mA, meter transmitter or similar instrumentation) and/or the tertiary device (i.e. SCADA, historian or other computerized archival system).<br>3. **Net distribution storage change**: The difference between end of audit period and beginning of audit period for total finished water stored, downstream of the system input meter(s). Typically applicable for VOS or WI. This volume is typically derived by comparing distribution storage tank water levels at end and beginning of the water audit period and using approximate tank geometry to convert levels to volumes.<br><br>**Derivation Guidance**:<br>If an Error Adjustment input is being calculated as a volume, each source of error (described above) may be separately calculated, with careful consideration of under- vs over-registration, then added together to determine the composite volume to input. The composite input should be entered on the Worksheet as a positive number, then under- or over-registration selected on the adjacent dropdown.<br>If an Error Adjustment input is being calculated as a percent, some very general guidance for calculating each error source (described above) is provided below. The auditor is again cautioned that each specific water supply setup needs to be evaluated closely as noted in the Disclaimer. Refer to the latest AWWA M36 Manual for additional discussion and guidance on this matter.<br><br>1. Meter error: If in-situ flow accuracy testing has been performed, and inherent testing method error is understood, first the *meter accuracy %* may be determined as follows:<br>*meter accuracy % = System input meter(s) volume / Reference volume*<br><br>Then, the *meter error %* may be determined as follows: □<br>*meter error % = meter accuracy % - 100%*<br><br>2. Data transfer error: If electronic calibration at the secondary (i.e. conversion to mA, meter transmitter or similar instrumentation) and/or tertiary (i.e. SCADA, historian or other computerized archival system) devices has been performed, first the *data transfer accuracy %* may be determined as follows:<br>*data transfer accuracy % = Tertiary device volume / Reference volume (typically at Secondary device)*<br><br>Then, the *data transfer error %* may be determined as follows:□<br>*data transfer error % = data transfer accuracy % - 100%*<br><br>If no error is identified, or if electronic calibration has not been performed, or if no secondary or tertiary devices exist, a *data transfer error %* adjustment is not typically recommended.<br><br>3. Net distribution storage change. If meter error and/or data transfer error are being calculated as a %, it is recommended to make the adjustment for net distribution storage change as a volume adjustment, directly in the VOS or WI input, as applicable.<br><br>The final step is to add *meter error %* and *data transfer error %:*<br>*Error Adjustment % = meter accuracy % + data transfer error %*<br><br>If the total Error Adjustment % calculates out as a negative number, it represents an under-registration. Vice versa, if positive. The composite input should be entered on the Worksheet as a positive number, then under- or over-registration selected on the adjacent dropdown. □ |
| **WATER LOSSES**<br><br>Find | = apparent losses + real losses<br>= water supplied - authorized consumption<br><br>Water Losses are the difference between Water Supplied and Authorized Consumption. Water losses can be considered as a total volume for the whole system, or for partial systems such as transmission systems, pressure zones or district metered areas (DMA), if one of these configurations are the basis of the water audit. |

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**Average Length of Customer Service Line**

The three figures shown on this worksheet display the assignment of the Average Length of Customer Service Line, Lp, for the three most common piping configurations.

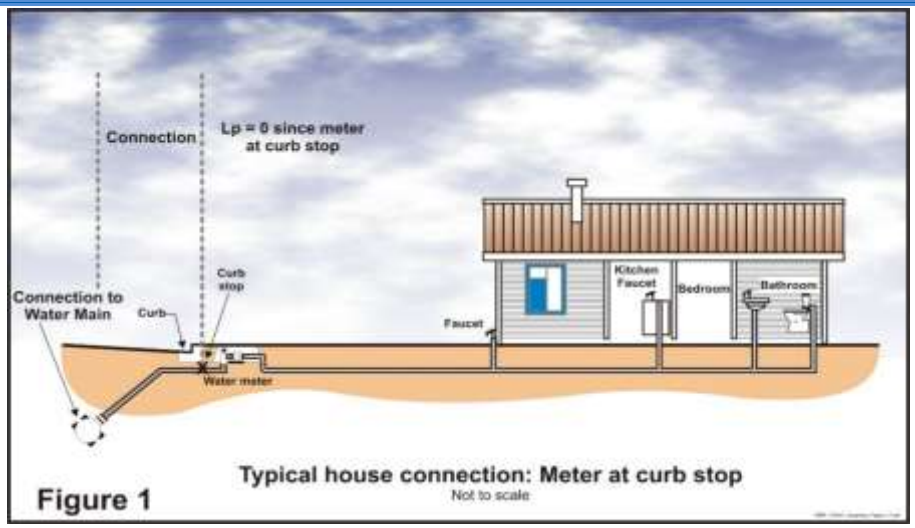
**Figure 1** shows the configuration of the water meter outside of the customer building next to the curb stop valve. In this configuration Lp = 0 since the distance between the curb stop and the customer metering point is essentially zero.

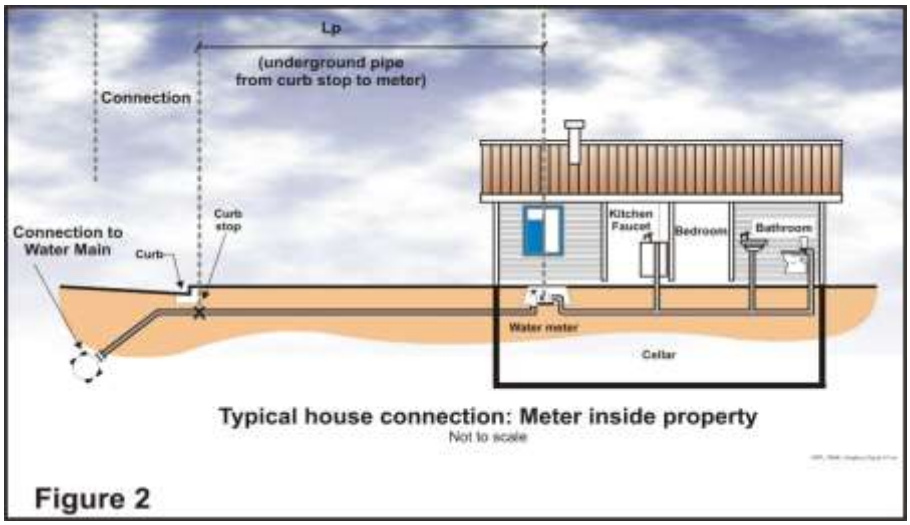
**Figure 2** shows the configuration of the customer water meter located inside the customer building, where Lp is the distance from the curb stop to the water meter.

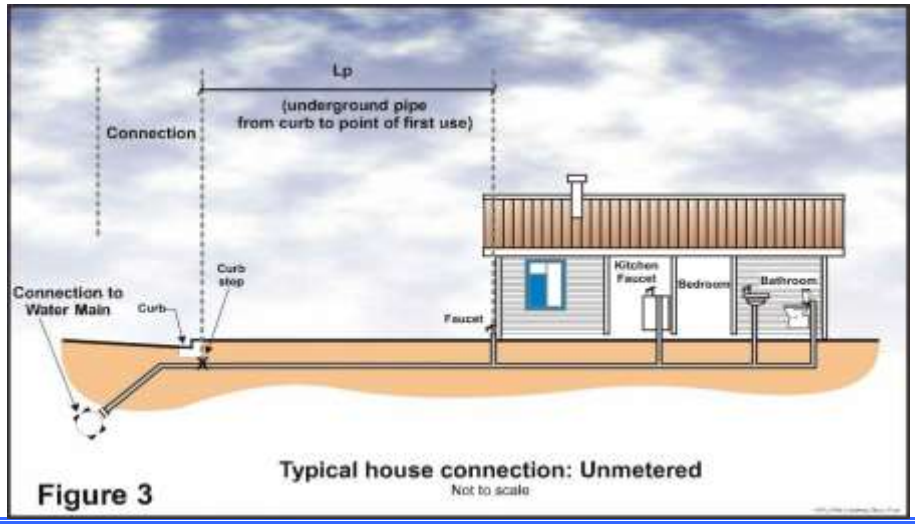
**Figure 3** shows the configuration of an unmetered customer building , where Lp is the distance from the curb stop to the first point of customer water consumption, or, more simply, the building line.

In any water system the Lp will vary notably in a community of different structures, therefore the average Lp value is used and this should be approximated or calculated if a sample of service line measurements has been gathered.

Click for more information



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American Water Works Association
Dedicated to the World's Most Important Resource®

**AWWA Free Water Audit Software - Version 6.0**
developed by the
Water Loss Control Committee of the American Water Works Association
December 2020

World Water Loss Day
4th December

This software is intended to serve as a basic tool to compile a preliminary, or "top-down", water audit. It is recommended that users also refer to the current edition of the AWWA M36 Publication, Water Audits and Loss Control Programs, for detailed guidance on compiling a comprehensive, or "bottom-up", water audit using the same water audit methodology.

*DEVELOPED BY:*

| | | |
|---|---|---|
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| David Sayers | | Black & Veatch |
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A special thanks to those members of the AWWA Water Loss Control Committee and other water industry stakeholders who assisted in the review and testing of this software.

*REFERENCES:*

1. Kunkel, G., G. Trachtman, A. Wyatt, and W. Jernigan. *Water Loss Control Committee Report: Key Performance Indicators for Non-Revenue Water—AWWA's 2020 Position*. 2020. Journal AWWA. https://awwa.onlinelibrary.wiley.com/doi/full/10.1002/awwa.1428
2. Kunkel, G. et al. *AWWA WLCC Reference Water Audit Dataset*. 2020. AWWA. Denver, CO.
3. *AWWA Water Audits and Loss Control Programs, M36 Publication.* 5th Edition, (forthcoming) 2021. AWWA. Denver, CO.
4. Trachtman G., A. Wyatt, et al. 2019. *Assessment of Performance Indicator for Non-Revenue Water Target Setting and Progress Tracking*. AWWA. Denver, CO.
5. Trachtman G., A. Wyatt, et al. 2019. *WRF 4695: Guidance on Implementing an Effective Water Loss Control Plan*. Water Research Foundation. Denver, CO.
6. Lambert, A. 2020. *Low ILIs and Small Systems.* Llandudno, UK. https://leakssuitelibrary.com
7. *Good Practices on Leakage Management, Main Report*. EU Reference Document. European Commission, Luxembourg. 2015.
   https://circabc.europa.eu/sd/a/1ddfba34-e1ce-4888-b031-6c559cb28e47/Good%20Practices%20on%20Leakage%20Management%20-%20Main%20Report_Final.pdf
   https://circabc.europa.eu/sd/a/ec13ae01-7800-4114-8d72-98827b509e18/Good%20Practices%20on%20Leakage%20Management%20-%20Case%20Study%20document._Final.pdf
8. Service Connection Diagrams courtesy of Ronnie McKenzie, WRP Pty Ltd.
9. Sturm, R., W. Jernigan, C. Stief, and D. Blackwell. *Level 1 Water Audit Validation Guidance Manual*. 2nd Edition, (forthcoming) 2021. Project #5057. Denver: Water Research Foundation.

*VERSION HISTORY:*

| Version: | Release Date: | Number of Worksheets: | Key Features and Developments |
|---|---|---|---|
| v1 | 2005/ 2006 | 5 | The AWWA Water Audit Software was piloted in 2005 (v1.0 beta). The early versions (1.x) of the software restricted data entry to units of Million Gallons per year. For each entry into the audit, users identified whether the input was measured or estimated. |
| v2 | 2006 | 5 | The most significant enhancement in v2 of the software was to allow the user to choose the volumetric units to be used in the audit, Million Gallons or Thousand Cubic Metres (megalitres) per year. Two financial performance indicators were added to provide feedback to the user on the cost of Real and Apparent losses. |
| v3 | 2007 | 7 | In v3, the option to report volumetric units in acre-feet was added. Another new feature in v3 was the inclusion of default values for two water audit components (unbilled unmetered and unauthorized consumption). v3 also included two examples of completed audits in units of million gallons and Megalitres. Several checks were added into v3 to provide instant feedback to the user on common data entry problems, in order to help the user complete an accurate water audit. |
| v4 - v4.2 | 2010 | 10 | v4 (and versions 4.x) of the software included a new approach to data grading. The simple "estimated" or "measured" approach was replaced with a more granular scale (typically 1-10) that reflected descriptions of utility practices and served to describe the confidence and accuracy of the input data. Each input value had a corresponding scale fully described in the Grading Matrix tab. The Grading Matrix also showed the actions required to move to a higher grading score. Grading descriptions were available on the Reporting Worksheet via a pop-up box next to each water audit input. A water audit data validity score is generated (max = 100) and priority areas for attention (to improve audit accuracy) are identified, once a user completes the requied data grading. A service connection diagram was also added to help users understand the impact of customer service line configurations on water losses and how this information should be entered into the water audit software. An acknoweldgements section was also added. Minor bug fixes resulted in the release of versions 4.1 and 4.2. A French language version was also made available for v4.2. |
| v5 | 2014 | 12 | In v5, changes were made to the way Water Supplied information is entered into software, with each major component having a corresponding Master Meter Error Adjustment entry (and data grading requirement). This required changes to the data validity score calculation; v5 of the software uses a weighting system that is, in part, proportional to the volume of input components. The Grading Matrix was updated to reflect the new audit inputs and also to include clarifications and additions to the scale descriptions. The appearance of the software was updated in v5 to make the software more user-friendly and several new features were added to provide more feedback to the user. Notably, a dashboard tab has been added to provide more visual feedback on the water audit results and associated costs of Non-Revenue Water. A comments sheet was added to allow the user to track notes, comments and to cite sources used. |
| v6 | 2020 | 11 | v6 brings an overhaul to the user interface for data grading, now presented as a series of questions on the Interactive Data Grading (IDG) tab for each input that, when answered (by selecting best-fit answer from a dropdown menu), automically determines the data grade for the given input. This provides transparency to the data practices selected and which specifically are limiting, removes subjectivity in data grade assignments, and provides clarity on candidate next steps for data validity improvements. IDG tab includes navigation buttons across top banner for ease of movement between inputs, and color signals for completion. The Worksheet (fka Reporting Worksheet) includes overt designation of error adjustment as "under" or "over" for the 3 Water Supplied inputs, as well as Customer Metering Inaccuracies. This makes the convention consistent, transparent, and reduces chance of user error. A Blank Sheet has been added allowing the user to, as desired, perform supplemental calculations or capture additional relevant information. The Dashboard has been overhauled to include Data Validity, NRW Components and Key Performance Indicators (KPIs). KPIs are presented in gauge format, depicting the specific KPI result against the range of results from Level 1 validated data in North America (see Web Resources, Start Page). Percentage-based indicators (% of supply, % of cost) removed as these indicators were deemed unreliable and sunset by the AWWA Water Loss Control Committee, subsequent to research and reporting from its NRW Performance Indicators Task Force. |

If you have questions or comments regarding the software please contact us via email at: wlc@awwa.org

# AWWA Free Water Audit Software v6.0

FWAS v6.0

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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 targeting loss reduction levels. This tool contains several separate worksheets. Sheets can be accessed using the tabs at the bottom of the screen, or by clicking the TOC links below.

## Table of Contents (TOC)


**Start Page** The current sheet. Enter contact information and basic audit details.

**Worksheet** Enter the required data on this worksheet to calculate the water balance and data grading.

**Interactive Data Grading** Answer questions about operational practices for each audit input, and the data validity grades will automatically populate.

**Dashboard** Review NRW components, performance indicators and graphical outputs to evaluate the results of the audit.

**Notes** Enter notes to explain how values were calculated, document data sources, and related information about data management practices.

**Blank Sheet** By popular demand! A blank sheet. The world is your canvas.

**Water Balance** The values entered in the Worksheet automatically populate the Water Balance.

**Loss Control Planning** Use this sheet to interpret the results of the audit validity score and performance indicators.

**Definitions** Use this sheet to understand the terms used in the audit process.

**Service Connection Diagram** Diagrams depicting possible customer service connection line configurations.

**Acknowledge-ments** Acknowledgements for development of the AWWA Free Water Audit Software v6.0.


**AWWA Web Resources for Water Loss Control**

https://www.awwa.org/Resources-Tools/Resource-Topics/Water-Loss-Control

Items referenced in the Free Water Audit Software v6.0 on the web:

- Data Grading Matrix v6.0
- Example Water Audit v6.0
- Water Audit Compiler v6.0
- AWWA Reports on Performance Indicators
- M36 Manual

## Enter Basic Information

| | |
|---|---|
| Name of Utility: | City of Fullerton |
| Name of Contact Person: | Gar Huang |
| Email: | garh@ci.fullerton.ca.us |
| Telephone \| Ext.: | 714-738-6895 |
| City/Town/Municipality: | Fullerton |
| State / Province: | California (CA) |
| Country: | USA |
| Audit Preparation Date: | Sep 03 2024 |
| Audit Year: | 2023 |
| Audit Year Label: | Calendar (Fiscal, Calendar, etc) |
| Audit Period Start Date: | Jan 01 2023 |
| Audit Period End Date: | Dec 31 2023 |
| Volume Reporting Units: | Acre-feet |
| Water System Structure: | Retail |
| Water Type: | Potable Water |
| System ID Number: | CA3010010 |
| Validator Name/ID: | Rachel Davis |
| Validator Email: | rdavis@mwdoc.com |
| Estimated Total Population Served by Water Utility: | 139,250 |

## Key of Input Acronyms

*In order of appearance in the Worksheet*

| | |
|---|---|
| **VOS** | Volume from Own Sources |
| **VOSEA** | VOS Error Adjustment |
| **WI** | Water Imported |
| **WIEA** | WI Error Adjustment |
| **WE** | Water Exported |
| **WEEA** | WE Error Adjustment |
| **BMAC** | Billed Metered Authorized Consumption |
| **BUAC** | Billed Unmetered Authorized Consumption |
| **UMAC** | Unbilled Metered Authorized Consumption |
| **UUAC** | Unbilled Unmetered Authorized Consumption |
| **SDHE** | Systematic Data Handling Errors |
| **CMI** | Customer Metering Inaccuracies |
| **UC** | Unauthorized Consumption |
| **Lm** | Length of mains |
| **Nc** | Number of service connections |
| **Lp** | Average length of (private) customer service line |
| **AOP** | Average Operating Pressure |
| **CRUC** | Customer Retail Unit Charge |
| **VPC** | Variable Production Cost |

**Color Key** User input | Calculated | Optional default

## Guidance for the Worksheet

Choosing to enter unit of **percent** or **volume** (applies to VOSEA, WIEA, WEEA, CMI) choose entry option:

| | | |
|---|---|---|
| 1.00% | percent | *or* |
| | volume | 25.000 |

Choosing to enter **default** or **custom input** (applies to UUAC, SDHE, UC) choose entry option:

| | | |
|---|---|---|
| 0.25% | default | *or* |
| | custom | 75.000 |

## Guidance for the Interactive Data Grading

Use acronym buttons in IDG header to navigate among inputs. Acronym Key above. White = needs answers, orange = complete, clear = not required. Example below.

After clicking an acronym button, answer all visible questions in the order they're presented, choosing best-fit answer

Grade will populate when all visible questions are complete for an input **7**

The limiting criteria will be labeled along the right. If only 1 limiting criterion is shown, improving on that criterion will achieve a higher data grade. If multiple limiting criteria are shown, improving on *each* limiting criterion is necessary to achieve a higher data grade. A complete inventory of data grading criteria is available in the Data Grading Matrix v6.0 (see web resources) Limiting

If you have questions or comments regarding this software please contact us at: wlc@awwa.org

# AWWA Free Water Audit Software: Worksheet

FWAS v6.0

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**Water Audit Report for:** City of Fullerton
**Audit Year:** 2023 | Jan 01 2023 - Dec 31 2023 | Calendar

Click 'n' to add notes
Click 'g' to determine data validity grade

To edit water system info: go to start page

To access definitions, click the input name

All volumes to be entered as: ACRE-FEET PER YEAR

Water Supplied Error Adjustments

## WATER SUPPLIED

choose entry option:

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VOS | Volume from Own Sources: | n | g | 8 | 15,116.468 | Acre-ft/Yr | n | g | 8 | volume | 24.011 | acre-ft/yr | over-registration | VOSEA |
| WI | Water Imported: | n | g | 6 | 5,006.982 | Acre-ft/Yr | n | g | 7 | percent | | | | WIEA |
| WE | Water Exported: | n | g | n/a | 0.000 | Acre-ft/Yr | | | | | | | | WEEA |
| | WATER SUPPLIED: | | | | 20,099.439 | Acre-ft/Yr | | | | | | | | |

## AUTHORIZED CONSUMPTION

choose entry option:

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| BMAC | Billed Metered: | n | g | 8 | 19,139.250 | Acre-ft/Yr | | |
| BUAC | Billed Unmetered: | n | g | n/a | 0.000 | Acre-ft/Yr | | |
| UMAC | Unbilled Metered: | n | g | n/a | 0.000 | Acre-ft/Yr | | |
| UUAC | Unbilled Unmetered: | n | g | 3 | 47.848 | Acre-ft/Yr | 0.25% | default |

Default option selected for Unbilled Unmetered, with automatic data grading of 3

AUTHORIZED CONSUMPTION: 19,187.098 Acre-ft/Yr

## WATER LOSSES

912.341 Acre-ft/Yr

### Apparent Losses

Default option selected for Systematic Data Handling Errors, with automatic data grading of 3

choose entry option:

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SDHE | Systematic Data Handling Errors: | n | g | 3 | 47.848 | Acre-ft/Yr | 0.25% | default | | | |
| CMI | Customer Metering Inaccuracies: | n | g | 7 | 303.644 | Acre-ft/Yr | | volume | 303.644 | acre-ft/yr | under-registration |
| UC | Unauthorized Consumption: | n | g | 3 | 47.848 | Acre-ft/Yr | 0.25% | default | | | |

Default option selected for Unauthorized Consumption, with automatic data grading of 3

Apparent Losses: 399.340 Acre-ft/Yr

### Real Losses

Real Losses: 513.001 Acre-ft/Yr

WATER LOSSES: 912.341 Acre-ft/Yr

## NON-REVENUE WATER

NON-REVENUE WATER: 960.189 Acre-ft/Yr

## SYSTEM DATA

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Lm | Length of mains: | n | g | 10 | 434.7 | miles | (including fire hydrant lead lengths) |
| Nc | Number of service connections: | n | g | 10 | 32,116 | | (active *and* inactive) |
| | Service connection density: | | | | 74 | conn./mile main | |

Are customer meters typically located at the curbstop/property line? Yes

Lp n g 10

Average length of customer service line has been set to zero and a data grading of 10 has been applied

AOP Average Operating Pressure: n g 6 76.8 psi

## COST DATA

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| CRUC | Customer Retail Unit Charge: | n | g | 7 | $3.06 | $/100 cubic feet (ccf) | Total Annual Operating Cost | |
| VPC | Variable Production Cost: | n | g | 8 | $865.10 | $/acre-ft | $36,793,034 | $/yr (optional input) |

## WATER AUDIT DATA VALIDITY TIER:

***** The Water Audit Data Validity Score is in Tier IV (71-90). See Dashboard tab for additional outputs. *****

go to dashboard

A weighted scale for the components of supply, consumption and water loss is included in the calculation of the Water Audit Data Validity Score

**PRIORITY AREAS FOR ATTENTION TO IMPROVE DATA VALIDITY:**

*Based on the information provided, audit reliability can be most improved by addressing the following components:*

1: Volume from Own Sources (VOS)
2: Water Imported (WI)
3: Billed Metered (BMAC)

**KEY PERFORMANCE INDICATOR TARGETS:**

*OPTIONAL: If targets exist for the operational performance indicators, they can be input below:*

| | | |
|---|---|---|
| Unit Total Losses: | 20.1 | gal/conn/day |
| Unit Apparent Losses: | 15.6 | gal/conn/day |
| Unit Real Losses[A]: | 14.5 | gal/conn/day |
| Unit Real Losses[B]: | | gal/mile/day |

*If entered above by user, targets will display on KPI gauges (see Dashboard)*

2023

White = incomplete
Orange = complete
Use acronyms for navigation

Limiting criteria (see Start Page for details)

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go to input

## Volume from Own Sources (VOS) - Data Grading Criteria

go to notes

| vos | Criteria Question | Select Best-Fit Answers to All Visible Questions | |
|---|---|---|---|
| vos.0 | Did the water utility supply any water from its own sources during the audit year? | Yes | |
| vos.1 | What percent of own supply volume is metered? | >99% | |
| | **For questions 2-10 below: Choose the answer that applies for those meters that measure >90% of the finished water volume.**<br>**In-situ flow accuracy testing** = a test process that confirms the flow measuring accuracy of the primary device (the flowmeter), in its installed location, using an independent reference volume.<br>**Electronic calibration** = a process that checks for error in the metering secondary device(s) and/or the tertiary device(s).<br>**Secondary device** can include conversion to mA, meter transmitter or similar instrumentation.<br>**Tertiary device** can include SCADA, historian or other computerized archival system. | | |
| vos.2 | What is the frequency of electronic calibration? | Not applicable due to no electronic signal output (i.e. to SCADA) | |
| vos.3 | | | |
| vos.4 | | | |
| vos.5 | What is the frequency of in-situ flow accuracy testing? | Annually | |
| vos.6 | Is the most recent in-situ flow accuracy testing documentation available for review? | Yes | |
| vos.7 | What are the total volume-weighted average results of in-situ flow accuracy testing (during or closest to audit year)? | At or within ±3% | |
| vos.8 | Have testing and calibration procedures been closely scrutinized for compliance with procedures described in the AWWA M36 and/or M33 Manual(s)? | No | |
| vos.9 | Which best describes the frequency of finished water meter readings? | Daily | |
| vos.10 | Which best describes the frequency of data review for anomalies/errors? These can include numbers that are outside of typical patterns, and zero or 'null' values that may reflect a gap in data recording. | More frequently than monthly, but not every day | Limiting |
| | **FINAL DATA GRADE FOR THIS AUDIT INPUT:** | **8** | |

go to input

## Volume from Own Sources Error Adjustment (VOSEA) - Data Grading Criteria

go to notes

| vosea | Criteria Question | Select Best-Fit Answers to All Visible Questions | |
|---|---|---|---|
| vosea.1 | Are tank levels monitored automatically & recorded daily? | Yes | |
| vosea.2 | Are daily changes of stored water volumes in distribution system tanks included in the tabulation of the daily "Volume from Own Sources" quantity? | No | Limiting |
| vosea.3 | Is the annual net distribution storage change included in either the VOS input or the VOSEA input? | Yes | |
| vosea.4 | Are the flow accuracy test and/or electronic calibration results included in the VOSEA input in the water audit? | Yes, results are analyzed and incorporated | |
| | **FINAL DATA GRADE FOR THIS AUDIT INPUT:** | **8** | |

go to input

## Water Imported (WI) - Data Grading Criteria

go to notes

| wi | Criteria Question | Select Best-Fit Answers to All Visible Questions | |
|---|---|---|---|
| wi.0 | Did the water utility import any water during the audit year? | Yes | |
| wi.1 | What percent of water imported is metered? | >99% | |
| | **For questions 2-10 below: Choose the answer that applies for those meters that measure >90% of the water imported volume.**<br>**In-situ flow accuracy testing** = a test process that confirms the flow measuring accuracy of the primary device (the flowmeter), in its installed location, using an independent reference volume.<br>**Electronic calibration** = a process that checks for error in the metering secondary device(s) and/or the tertiary device(s).<br>**Secondary device** can include conversion to mA, meter transmitter or similar instrumentation.<br>**Tertiary device** can include SCADA, historian or other computerized archival system. | | |
| wi.2 | What is the frequency of electronic calibration? | At least semi-annually | |
| wi.3 | What level of data transfer errors are checked as part of the electronic calibration process? | Data transfer errors are checked at secondary device(s), but not to tertiary device(s) | |
| wi.4 | Is the most recent electronic calibration documentation available? | Yes | |
| wi.5 | What is the frequency of in-situ flow accuracy testing? | None, or Not within last 5 years | |
| wi.6 | | | |
| wi.7 | | | |
| wi.8 | Have testing and calibration procedures been closely scrutinized for compliance with procedures described in the AWWA M36 and/or M33 Manual(s)? | No | |
| wi.9 | Which best describes the frequency of meter readings (data collection frequency as opposed to billing frequency)? | Continuous | |
| wi.10 | What is the frequency of data review & correction by Exporting or Importing Utility for data gaps and/or anomalies? These can include numbers that are outside of typical patterns, and zero or 'null' values that may reflect a gap in data recording. | Once per month | Limiting |
| | **FINAL DATA GRADE FOR THIS AUDIT INPUT:** | **6** | |

go to input

## Water Imported Error Adjustment (WIEA) - Data Grading Criteria

go to notes

| wiea | Criteria Question | Select Best-Fit Answers to All Visible Questions | |
|---|---|---|---|
| wiea.1 | Is an agreement in place between Exporting and Importing Utility for the purchase of water? | Yes, written | |
| wiea.2 | Are meter accuracy testing or electronic calibration requirements stipulated in the water purchase agreement? | Yes, and stipulated frequency as annual | |
| wiea.3 | Are flow accuracy test and/or electronic calibration results used to inform the error adjustment input in the water audit? | Yes, results are analyzed and a 'no-adjustment' was determined | |
| wiea.4 | Who has access to the import meter readings including current and archived data? | Exporting Utility only | Limiting |
| | **FINAL DATA GRADE FOR THIS AUDIT INPUT:** | **7** | |

go to input

## Water Exported (WE) - Data Grading Criteria

go to notes

| we | Criteria Question | Select Best-Fit Answers to All Visible Questions |
|---|---|---|
| we.0 | Did the water utility export any water during the audit year? | No |
| we.1 | | |

**For questions 2-10 below: Choose the answer that applies for those meters that measure >90% of the water exported volume.**
**In-situ flow accuracy testing** = a test process that confirms the flow measuring accuracy of the primary device (the flowmeter), in its installed location, using an independent reference volume.
**Electronic calibration** = a process that checks for error in the metering secondary device(s) and/or the tertiary device(s).
**Secondary device** can include conversion to mA, meter transmitter or similar instrumentation.
**Tertiary device** can include SCADA, historian or other computerized archival system.

| | | |
|---|---|---|
| we.2 | | |
| we.3 | | |
| we.4 | | |
| we.5 | | |
| we.6 | | |
| we.7 | | |
| we.8 | | |
| we.9 | | |
| we.10 | | |
| | **FINAL DATA GRADE FOR THIS AUDIT INPUT:** | **n/a** |

go to input

## Water Exported Error Adjustment (WEEA) - Data Grading Criteria

go to notes

| weea | Criteria Question | Select Best-Fit Answers to All Visible Questions |
|---|---|---|
| weea.1 | | |
| weea.2 | | |
| weea.3 | | |
| weea.4 | | |
| | FINAL DATA GRADE FOR THIS AUDIT INPUT: | n/a |

go to input

## Billed Metered Authorized Consumption (BMAC) - Data Grading Criteria

go to notes

| bmac | Criteria Question | Select Best-Fit Answers to All Visible Questions | |
|---|---|---|---|
| bmac.0 | Were any customers metered in the audit year? | Yes | |
| bmac.1 | For billed metered accounts, what % of bills are estimated in a typical billing cycle? | 5% or less | |
| bmac.2 | How often does the utility read its customer meters?<br>For systems with multiple read frequencies, select the reading frequency that describes the majority of your customers. | Bi-Monthly | Limiting |
| bmac.3 | Is the BMAC volume pro-rated to represent consumption occuring exactly during the audit period? | Yes | |
| bmac.4 | How frequently does internal review by utility staff of the BMAC volumes occur? | Every billing cycle | |
| bmac.5 | What level of detail is examined in the internal review of BMAC volumes? | Totals grouped by use type or customer class and specific accounts flagged for anomalous consumption | |
| bmac.6 | When was the most recent billing data review by someone who is independent of the utility billing process? | Within last 3 years | |
| bmac.7 | What level of detail was examined in the review by someone who is independent of the utility billing process? | Full billing database query and analysis of raw data to verify the summary consumption volumes | |
| | **FINAL DATA GRADE FOR THIS AUDIT INPUT:** | **8** | |

go to input

## Billed Unmetered Authorized Consumption (BUAC) - Data Grading Criteria

go to notes

| buac | Criteria Question | Select Best-Fit Answers to All Visible Questions |
|---|---|---|
| buac.0 | Was there any billed consumption on unmetered accounts in the audit year? | No |
| buac.1 | | |
| buac.2 | | |
| buac.3 | | |
| | **FINAL DATA GRADE FOR THIS AUDIT INPUT:** | **n/a** |

go to input

## Unbilled Metered Authorized Consumption (UMAC) - Data Grading Criteria

go to notes

| umac | Criteria Question | Select Best-Fit Answers to All Visible Questions |
|---|---|---|
| umac.0 | Did the water utility have any unbilled-metered consumption in the audit year? | No |
| umac.1 | | |
| umac.2 | | |
| umac.3 | | |
| umac.4 | | |
| | FINAL DATA GRADE FOR THIS AUDIT INPUT: | n/a |

go to input

## Unbilled Unmetered Authorized Consumption (UUAC) - Data Grading Criteria

go to notes

This Data Grading Criteria is hidden when the 'default' input is used on the Worksheet

| | |
|---|---|
| **FINAL DATA GRADE FOR THIS AUDIT INPUT:** | **3** |

go to input

## Systematic Data Handling Error (SDHE) - Data Grading Criteria

go to notes

This Data Grading Criteria is hidden when the 'default' input is used on the Worksheet

| | |
|---|---|
| **FINAL DATA GRADE FOR THIS AUDIT INPUT:** | **3** |

go to input

## Customer Metering Inaccuracies (CMI) - Data Grading Criteria

go to notes

| cmi | Criteria Question | Select Best-Fit Answers to All Visible Questions | |
|---|---|---|---|
| cmi.0 | Was there any metered customer usage during the audit period? | Yes | |
| cmi.1 | Do you test meters reactively (when triggered by customer complaint or billing/consumption flag)? | Reactive testing conducted | |
| cmi.2 | For small size customer meters, which best describes the frequency of proactive testing (effort beyond when triggered by customer complaint or billing/consumption flags)? | Ongoing, conducted annually | |
| cmi.3 | Which best describes what meters are included in the proactive small size customer meter testing activities? | Testing targeted to subsets of meters ie oldest meters | Limiting |
| cmi.4 | For mid and large size customer meters, which best describes the frequency of the proactive testing program? | Ongoing, conducted annually | |
| cmi.5 | Which best describes what meters are included in the proactive mid- and large customer meter testing activities? | Proactive - all large meters are on a testing schedule | |
| cmi.6 | Which best describes how the input was derived? | Calculated based on most recent meter accuracy tests, but not comprehensive of all meter performance | |
| cmi.7 | Has the input derivation been reviewed by someone with expert knowledge in the M36 methodology? | Yes | |
| cmi.8 | To what extent does meter replacement occur and for which meters? | Annual proactive replacement of subset of meters (i.e. by age or throughput) | |
| cmi.9 | Which best describes the reliability of meter installation records? | Records are kept for meter installations, but data is missing for installation date, type, size, or manufacturer | |
| | **FINAL DATA GRADE FOR THIS AUDIT INPUT:** | **7** | |

go to input

## Unauthorized Consumption (UC) - Data Grading Criteria

go to notes

This Data Grading Criteria is hidden when the 'default' input is used on the Worksheet

| | |
|---|---|
| **FINAL DATA GRADE FOR THIS AUDIT INPUT:** | **3** |

go to input

## Length of Mains (Lm) - Data Grading Criteria

go to notes

| Lm | Criteria Question | Select Best-Fit Answers to All Visible Questions |
|---|---|---|
| Lm.1 | How was the input derived? | Derived directly from Mains inventory (GIS, ledger, etc) |
| Lm.2 | Are hydrant laterals included in the input derivation? | Yes |
| Lm.3 | Which best describes how the Mains inventory (GIS, ledger, etc) is kept up to date? | Additions or subtractions are updated in the mains inventory (GIS, ledger, etc), at least annually |
| Lm.4 | Which best describes how the Mains inventory (GIS, ledger, etc) is field validated to confirm field conditions match the inventory? | Field validation is accomplished (i.e. in daily operations or specific validation projects) |
| | **FINAL DATA GRADE FOR THIS AUDIT INPUT:** | **10** |

go to input

## Number of Service Connections (Nc) - Data Grading Criteria

go to notes

| Nc | Criteria Question | Select Best-Fit Answers to All Visible Questions |
|---|---|---|
| Nc.1 | How was the input derived? | Extracted from Services inventory (GIS, billing system, etc) |
| Nc.2 | What is the count of services based on? | Premise based, i.e. service connection count, location ID count |
| Nc.3 | Are inactive (but still pressurized) service lines included in the input? These may be metered or unmetered. | Yes |
| Nc.4 | Which best describes how the inventory of service connections (GIS, billing system, etc) is kept up to date? | Additions or subtractions are updated in the service line inventory (GIS, billing system, etc), at least annually |
| Nc.5 | Which best describes how the inventory of service connections (GIS, billing system, etc) is field validated to confirm field conditions match the inventory? | Field validation is accomplished for the entire system (i.e. in daily operations or specific validation projects) |
| | **FINAL DATA GRADE FOR THIS AUDIT INPUT:** | **10** |

go to input

## Average Length of (Private) Customer Service Line (Lp) - Data Grading Criteria

go to notes

| Lp | Criteria Question | Select Best-Fit Answers to All Visible Questions |
|---|---|---|
| Lp.0 | Are customer meters typically located at the curbstop or property line? | Yes |
| Lp.1 | | |
| Lp.2 | | |
| Lp.3 | | |
| Lp.4 | | |
| | **FINAL DATA GRADE FOR THIS AUDIT INPUT:** | **10** |

go to input

## Average Operating Pressure (AOP) - Data Grading Criteria

go to notes

| aop | Criteria Question | Select Best-Fit Answers to All Visible Questions | |
|---|---|---|---|
| aop.1 | Which best describes checks on the boundary integrity for the system's pressure zone(s)? | Normally-closed boundary valves between zones have never been confirmed to be fully closed | Limiting |
| aop.2 | Which best describes how one-time pressure readings (i.e. from hydrants) are collected? | Collected only if there are low pressure complaints, or new development requests | |
| aop.3 | Which best describes where continuous pressure data (via temporary data loggers or permanent telemetry) is collected? | At zone boundary conditions only (i.e. supply entry points, PRVs, booster stations) | |
| aop.4 | Which best describes how continuous pressure data is collected? | Year-round data collection via permanent monitoring | |
| aop.5 | How was the input derived? | Derived from hydraulic model, where model has been field calibrated in the last 5 years | |
| | **FINAL DATA GRADE FOR THIS AUDIT INPUT:** | **6** | |

go to input

## Customer Retail Unit Charge (CRUC) - Data Grading Criteria

go to notes

| cruc | Criteria Question | Select Best-Fit Answers to All Visible Questions | |
|---|---|---|---|
| cruc.0 | Was any metered consumption billed on a volumetric basis in the audit period? | Yes | |
| cruc.1 | Which best describes the use and reliability of the current rate structure? | Customer bill calculations have been checked to confirm the rate structure is correctly implemented | |
| cruc.2 | Choose the option that best describes how the input was derived | A volume-weighted average of all rates was calculated | |
| cruc.3 | Is there any additional volumetric revenue the utility receives that depends on water meter readings, such as sewer? | Yes, but this has not been incorporated into the volume-weighted average calculation | Limiting |
| cruc.4 | Has the input derivation been reviewed by someone with expert knowledge in the M36 methodology? | Yes | |
| | **FINAL DATA GRADE FOR THIS AUDIT INPUT:** | **7** | |

go to input

## Variable Production Cost (VPC) - Data Grading Criteria

go to notes

| vpc | Criteria Question | Select Best-Fit Answers to All Visible Questions | |
|---|---|---|---|
| vpc.1 | Choose the option that best describes how the input was derived | Multiple sources of water exist, and a volume-weighted average was calculated for all sources | |
| vpc.2 | Choose the option that best describes which short-run marginal costs have been included in the input, using the definitions below for reference. Short-run marginal costs can include the following:<br>- chemicals + power for treatment, typically applicable if the utility is producing/treating water<br>- power for distribution, typically applicable if pumps exist in the distribution network<br>- water acquisition costs, typically applicable if the utility is purchasing water or incurs any extraction costs for withdrawing from a source<br>Some short-run marginal costs may not be applicable. The auditor should analyze the system characteristics to determine which costs are applicable for inclusion in the VPC input derivation. See also the latest AWWA M36 Manual for further guidance. | All applicable short-run marginal costs are included | |
| vpc.3 | Choose the option that best describes which long-run marginal costs have been included in the input, using the definitions below for reference. Long-run marginal costs can include the following:<br>- water treatment residuals management, typically applicable if solids are produced from water treatment process<br>- accelerated wear & tear on dynamic equipment, typically applicable if pumps exist for treatment and/or distribution, or any other equipment exists that wears out as a function of use instead of time (i.e. filter media, chemical dosing pumps, uv disinfection bulbs, etc)<br>- payouts for damage claims from main and service line breaks, typically applicable if damage claims are paid by the utility<br>- accelerated expansion of supply capacity, typically applicable if the utility is at or nearing supply capacity, or scarecity costs in water scarce areas<br>- full cost pricing that includes all lifecycle costs and externalities (internalized or not)<br>Some long-run marginal costs may not be applicable. The auditor should analyze the system characteristics to determine which costs are applicable for inclusion in the VPC input derivation. See also the latest AWWA M36 Manual for further guidance. | Long-run marginal costs have not been evaluated for applicability, and are not included | Limiting |
| vpc.4 | Has the input derivation been reviewed by someone with expert knowledge in the M36 methodology? | Yes | |
| | **FINAL DATA GRADE FOR THIS AUDIT INPUT:** | **8** | |

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# AWWA Free Water Audit Software: Dashboard

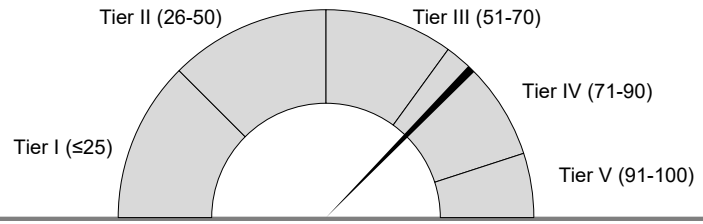
go to worksheet | go to grading | go to references

**Water Audit Report for: City of Fullerton** **Audit Year: 2023 Calendar** **Jan 01 2023 - Dec 31 2023**

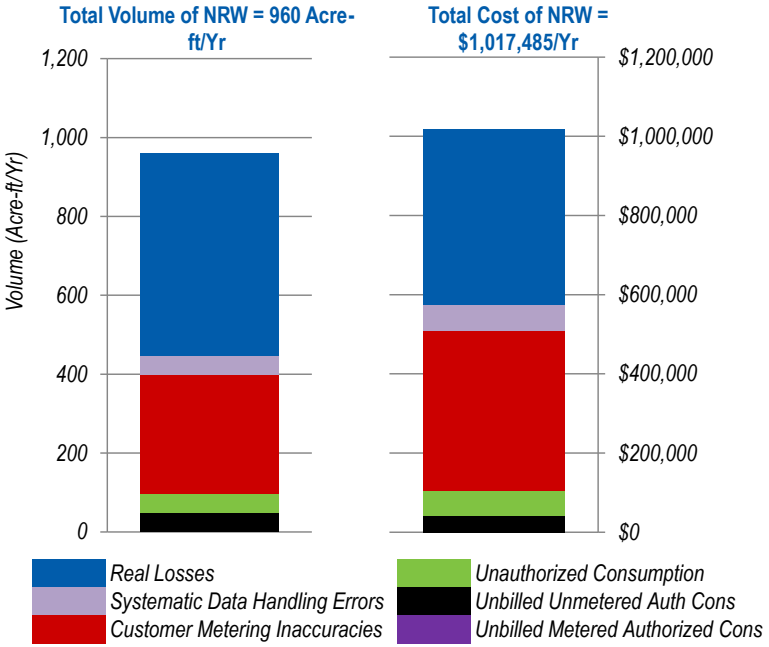
## Data Validity

**Data Validity Score:** 74 **Data Validity Tier:** Tier IV (71-90)

See Loss Control Planning for Tier Details




## NRW Components Summary

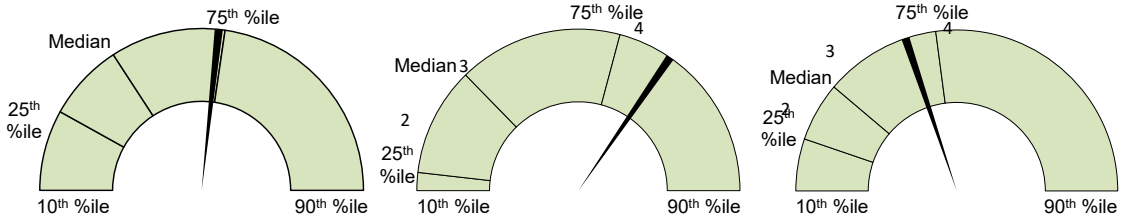



| | Volume Acre-ft/Yr | Value $/Yr | Basis of Valuation |
|---|---|---|---|
| *Apparent Losses* | 399.3 | $532,295 | *CRUC* |
| *Real Losses* | 513.0 | $443,797 | *VPC* |
| *Unbilled Authorized Cons* | 47.8 | $41,393 | *VPC* |
| *Non-Revenue Water* | 960.2 | $1,017,485 | *Blended* |

## Key Performance Indicators

Actual KPI result — Target (see Worksheet)

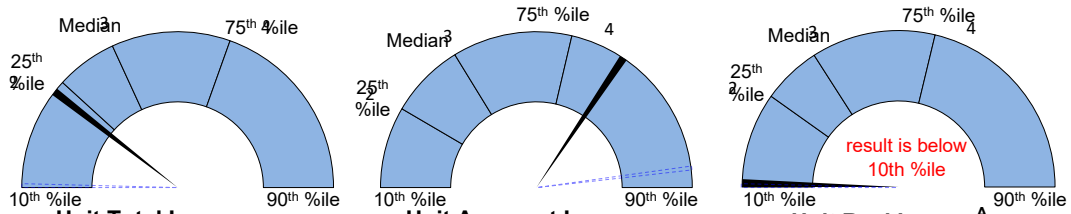
gauge %iles per validated industry ranges[2]




**Total Loss Cost Rate** 30.39 $/conn/year

**Apparent Loss Cost Rate** 16.57 $/conn/year

**Real Loss Cost Rate** 13.82 $/conn/year



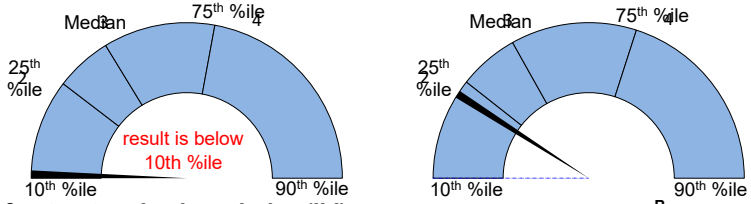

**Unit Total Losses** 25.4 gal/conn/day

**Unit Apparent Losses** 11.1 gal/conn/day

**Unit Real Losses**[A] 14.3 gal/conn/day

Average Operating Pressure 76.8 psi

90th %ile
75th %ile
Median
25th %ile
10th %ile




**Infrastructure Leakage Index (ILI)** 0.8 dimensionless

**Unit Real Losses**[B] 1,054 gal/mile/day

See UARL definition for additional guidance on the ILI

(UARL) Unavoidable Annual Real Losses 616.7 Acre-ft/Yr 17.1 gal/conn/day

### Guidance Information for Key Performance

- The eight indicators shown are the recommended suite per the AWWA Water Loss Control Committee 2020 Position on KPIs[1].
- A suite of KPIs is necessary, as no single KPI can holistically communicate water loss performance for a given water system.
- See Table 1 below for Uses and Limitations for each KPI, excerpted from the AWWA Water Loss Control Committee Report (2020)[1], with naming conventions updated.
- Percentiles (%iles) shown on KPI gauges come from Level 1 validated data in the AWWA WLCC Reference Water Audit Dataset (2020)[2].
- KPI %iles shown above are not segregated by cohorts. Limited KPI data by cohorts may be found in WRF 4695 Guidance Manual, Appendix B (2019)[5].
- Actual KPI results that fall below 10th %ile or above 90th %ile do not necessarily imply error, but should be viewed with scrutiny.
- Percentiles not intended to imply targets. Targets may be input by user for operational KPIs, if desired, on Worksheet.
- See UARL and ILI in Definitions tab for discussion of size and pressure limitations.
- Systems that fall on the extreme ends of size or connection density should use caution when interpreting Unit Losses KPIs.

## Table 1

Source: AWWA Water Loss Control Committee Report (2020)[1], with naming conventions updated

## 2020 AWWA Water Audit Method – Water Audit Outputs and Key Performance Indicators: Uses and Limitations

| Type | Indicator | Description | Suitable Purposes | | | | | Uses and Limitations | Principal Users |
|---|---|---|---|---|---|---|---|---|---|
| | | | Assessment | Bench-Marking | Target-Setting | Planning | Tracking | | |
| **Attribute** | Apparent Loss Volume | Calculated by Free Water Audit Software | ✓ | | | | ✓ | Assess loss level | Utility, Regulators |
| | Apparent Loss Cost | Calculated by Free Water Audit Software | ✓ | | | | ✓ | Assess cost loss level | Utility, Regulators |
| | Real Loss Volume | Calculated by Free Water Audit Software | ✓ | | | | ✓ | Assess loss level | Utility, Regulators |
| | Real Loss Cost | Calculated by Free Water Audit Software | ✓ | | | | ✓ | Assess loss cost level | Utility, Regulators |
| | Unavoidable Annual Real Loss (UARL) | Calculated by Free Water Audit Software | ✓ | | | | ✓ | Reveal theoretical technical low level of leakage | Utility, Regulators |
| **Volume** | Unit Apparent Losses (vol/conn/day) | Strong and understandable indicator for multiple users. | ✓ | ✓ | ✓ | ✓ | ✓ | Used for performance tracking and target-setting | Utility, Regulators |
| | Unit Real Losses[A] (vol/conn/day) | Strong and understandable indicator for multiple users. | ✓ | ✓ | ✓ | ✓ | ✓ | Used for performance tracking and target-setting | Utility, Regulators, Policy Makers |
| | Unit Real Losses[B] (vol/pipeline length/ day) | Strong and understandable indicator for use by utilities with low connection density. | ✓ | ✓ | ✓ | ✓ | ✓ | Data collection and assessment of systems with "low" connection density | Utility, Regulators, Policy Makers |
| | Unit Total Losses (vol/conn/day) **New KPI** | Strong and understandable indicator, suitable for high-level performance measurement. | ✓ | | | | ✓ | High level indicator for trending analysis. Not appropriate for target-setting or benchmarking | Utilities, Customers |
| | Infrastructure Leakage Index (ILI) | Robust, specialized ratio KPI; can be influenced by pressure and connection density. | ✓ | ✓ | | | ✓ | Benchmarking after pressure management is implemented | Utilities |
| **Value** | Apparent Loss Cost Rate (value/conn/year) **New KPI** | Indicators with sufficient technical rigor. Provide the unit financial value of each type of loss, which is useful for planning and assessment of cost efficiency of water loss reduction and control interventions and programs. | ✓ | | | ✓ | ✓ | Data collection and assessment on AWWA indicators or contextual parameters to use in conjunction with Loss Cost Rates | Utilities, Regulators, Customers |
| | Real Loss Cost Rate (value/conn/year) **New KPI** | | ✓ | | | ✓ | ✓ | | Utilities, Regulators, Customers |
| **Validity** | Data Validity Tier (DVT) | Strong indicator of water loss audit data quality, if data has been validated. Tier provides guidance on priority areas of activity. | ✓ | ✓ | | ✓ | ✓ | Assess caliber of data inputs of the water audit | Regulators, Utilities |

# AWWA Free Water Audit Software: User Notes

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**Water Audit Report for:** City of Fullerton
**Audit Year:** 2023

Calendar
Jan 01 2023 - Dec 31 2023

| General Notes: | |
|---|---|

| | | Audit Item | Notes on Input Derivation | Notes on Data Validity Grading |
|---|---|---|---|---|
| go to worksheet | go to grading | Volume from Own Sources (VOS) | | |
| go to worksheet | go to grading | Volume from Own Sources Error Adjustment (VOSEA) | | |
| go to worksheet | go to grading | Water Imported (WI) | | |
| go to worksheet | go to grading | Water Imported Error Adjustment (WIEA) | | |
| go to worksheet | go to grading | Water Exported (WE) | | |

| | | Audit Item | Notes on Input Derivation | Notes on Data Validity Grading |
|---|---|---|---|---|
| go to worksheet | go to grading | Water Exported Error Adjustment (WEIA) | | |
| go to worksheet | go to grading | Billed Metered Authorized Consumption (BMAC) | | |
| go to worksheet | go to grading | Billed Unmetered Authorized Consumption (BUAC) | | |
| go to worksheet | go to grading | Unbilled Metered Authorized Consumption (UMAC) | | |
| go to worksheet | go to grading | Unbilled Unmetered Authorized Consumption (UUAC) | | |
| go to worksheet | go to grading | Systematic Data Handling Errors (SDHE) | | |
| go to worksheet | go to grading | Customer Metering Inaccuracies (CMI) | | |

| | | Audit Item | Notes on Input Derivation | Notes on Data Validity Grading |
|---|---|---|---|---|
| go to worksheet | go to grading | Unauthorized Consumption (UC) | | |
| go to worksheet | go to grading | Length of Mains (Lm) | | |
| go to worksheet | go to grading | Number of Service Connections (Nc) | | |
| go to worksheet | go to grading | Average Length of (private) Customer Service Line (Lp) | | |
| go to worksheet | go to grading | Average Operating Pressure (AOP) | | |
| go to worksheet | go to grading | Customer Retail Unit Charge (CRUC) | | |
| go to worksheet | go to grading | Variable Production Cost (VPC) | | |

Hello, I am a blank sheet, at your service.

2.8%

# AWWA Free Water Audit Software
## Water Balance

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**Water Audit Report for:** City of Fullerton
**Audit Year:** 2023 — Jan 01 2023 - Dec 31 2023
**Data Validity Tier:** Tier IV (71-90)

| | | | | | | |
|---|---|---|---|---|---|---|
| Volume from Own Sources (VOS) (corrected for known errors) *15,092.457* | System Input Volume *20,099.439* | Water Exported (WE) (corrected for known errors) *0.000* | Billed Water Exported | | | Revenue Water (Exported) 0.000 |
| | | Water Supplied *20,099.439* | Authorized Consumption *19,187.098* | Billed Authorized Consumption *19,139.250* | Billed Metered Consumption (BMAC) (water exported is removed) *19,139.250* | Revenue Water 19,139.250 |
| | | | | | Billed Unmetered Consumption (BUAC) *0.000* | |
| | | | | Unbilled Authorized Consumption *47.848* | Unbilled Metered Consumption (UMAC) *0.000* | Non-Revenue Water (NRW) 960.189 |
| | | | | | Unbilled Unmetered Consumption (UUAC) *47.848* | |
| | | | Water Losses *912.341* | Apparent Losses *399.340* | Systematic Data Handling Errors (SDHE) *47.848* | |
| | | | | | Customer Metering Inaccuracies (CMI) *303.644* | |
| | | | | | Unauthorized Consumption (UC) *47.848* | |
| Water Imported (WI) (corrected for known errors) *5,006.982* | | | | Real Losses *513.001* | 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: Determining Water Loss Standing

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**Water Audit Report for:** City of Fullerton
**Audit Year:** 2023 | Jan 01 2023 - Dec 31 2023
**Data Validity Tier:** Tier IV (71-90)

## Water Loss Control Planning Guide

| | Water Audit Data Validity Tier (Score Range) | | | | |
|---|---|---|---|---|---|
| **Functional Focus Area** | **Tier I (1-25)** | **Tier II (26-50)** | **Tier III (51-70)** | **Tier IV (71-90)** | **Tier V (91-100)** |
| Audit Data Collection | Launch auditing and loss control team; address supply metering deficiencies | Analyze business process for customer metering and billing functions and water supply operations; Identify data gaps; improve supply metering | Establish/revise policies and procedures for data collection | Refine data collection practices and establish as routine business process | Annual water audit is a reliable gauge of year-to-year water efficiency standing |
| Short-term loss control | Research information on leak detection programs; Begin flowcharting analysis of customer billing system | Conduct loss assessment investigations on a sample portion of the system: customer meter testing, leak survey, unauthorized consumption, etc | Establish ongoing mechanisms for customer meter accuracy testing, active leakage control and infrastructure monitoring | Refine, enhance or expand ongoing programs based upon economic justification | Stay abreast of improvements in metering, meter reading, billing, leakage management and infrastructure rehabilitation |
| Long-term loss control | | Begin to assess long-term needs requiring large expenditure: customer meter replacement, water main replacement program, new customer billing system or AMR/AMI system | Begin to assemble economic business case for long-term needs based upon improved data becoming available through the water audit process | Conduct detailed planning, budgeting and launch of comprehensive improvements for metering, billing or infrastructure management | Continue incremental improvements in short-term and long-term loss control interventions |
| Target-setting | | | Establish long-term apparent and real loss reduction goals (+10 year horizon) | Establish mid-range (5 year horizon) apparent and real loss reduction goals | Evaluate and refine loss control goals on a yearly basis |
| Benchmarking | | | Preliminary Comparisons - can begin to rely upon with PIs for performance comparisons for real losses | Performance Benchmarking with PIs is meaningful in comparing real loss standing | Identify Best Practices/ Best in class; PIs are very reliable as real loss performance indicators for best in class service |

*For validity scores of 50 or below, the shaded blocks should not be focus areas until better data validity is achieved.*

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| Item Name | Description |
|---|---|
| **Apparent Losses**<br>Find | = systematic data handling errors + customer metering inaccuracies + unauthorized consumption<br><br>Apparent Losses include all types of inaccuracies associated with customer metering (worn meters as well as improperly sized meters or wrong type of meter for the water usage profile) as well as systematic data handling errors (meter reading, billing, archiving and reporting), plus unauthorized consumption (theft or illegal use).<br>NOTE: Over-estimation of Apparent Losses results in under-estimation of Real Losses. Under-estimation of Apparent Losses results in over-estimation of Real Losses. |
| **AUTHORIZED CONSUMPTION**<br>Find | = billed metered + billed unmetered + unbilled metered + unbilled unmetered consumption<br><br>The volume of metered and/or unmetered water taken by registered customers, the water utility's own uses, and uses of others who are implicitly or explicitly authorized to do so by the water utility; for residential, commercial, industrial and public-minded purposes.<br><br>Typical retail customers' consumption is tabulated usually from established customer accounts as billed metered consumption, or - for unmetered customers - billed unmetered consumption. These types of consumption, along with billed water exported, provide revenue potential for the water utility. Typically a lag will exist between timing for reading of supply meters and reading of customer meters. A lag-time correction should typically be calculated to account for this. **Be certain to tabulate the water exported volume as a separate component and do not "double-count" it by including in the billed metered consumption component as well as the water exported component.**<br><br>Unbilled authorized consumption occurs typically in non-account uses, including water for fire fighting and training, flushing of water mains and sewers, street cleaning, watering of municipal gardens, public fountains, or similar public-minded uses. Occasionally these uses may be metered and billed (or charged a flat fee), but usually they are unmetered and unbilled. In the latter case, the water auditor may use a default value to estimate this quantity, or implement procedures for the reliable quantification of these uses. This starts with documenting usage events as they occur and estimating the amount of water used in each event. (See Unbilled Unmetered Authorized Consumption) |
| View Service Connection Diagram<br><br>**Average Length of (private) Customer Service Line (Lp)**<br><br>Find | This is the average length of underground customer service line, Lp, that is owned and maintained by the customer; from the point of ownership transfer to the customer water meter, or building line (if unmetered). The quantity is one of the data inputs for the calculation of Unavoidable Annual Real Losses (UARL), which serves as the denominator of the performance indicator: Infrastructure Leakage Index (ILI). The value of Lp is multiplied by the number of customer service connections to obtain a total length of customer owned piping in the system. The purpose of this parameter is to account for the unmetered service line infrastructure that is the responsibility of the customer for arranging repairs of leaks that occur on their lines. In many cases leak repairs arranged by customers take longer to be executed than leak repairs arranged by the water utility on utility-maintained piping. Leaks run longer - and lose more water - on customer-owned service piping, than utility owned piping.<br><br>If the customer water meter exists near the ownership transfer point (usually the curb stop located between the water main and the customer premises) this distance is zero because the meter and transfer point are the same. This is the often encountered configuration of customer water meters located in an underground meter box or "pit" outside of the customer's building. The Free Water Audit Software asks a "Yes/No" question about the meter at this location. If the auditor selects "Yes" then this distance is set to zero and the data grading score for this component is set to 10.<br><br>If water meters are typically located inside the customer premise/building, or properties are unmetered, it is up to the water auditor to estimate a system-wide average Lp length based upon the various customer land parcel sizes and building locations in the service area. Lp will be a shorter length in areas of high density housing, and a longer length in areas of low density housing and varied commercial and industrial buildings. General parcel demographics should be employed to obtain a total Lp length (Lc) and subsequently a weighted average Lp length for the entire system.<br><br>Refer to the "Service Connection Diagram" worksheet for a depiction of the service line/metering configurations that typically exist in water utilities. This worksheet gives guidance on the determination of the Average Length, Lp, for each configuration. |
| **Average Operating Pressure (AOP)**<br><br>Find | This is the average pressure in the distribution system that is the subject of the water audit. If the water utility is compiling the water audit for the first time, the average pressure can be approximated, but with a low data grading. In subsequent years of auditing, effort should be made to improve the accuracy of the average pressure quantity. This will then qualify the value for a higher data grading.<br><br>In the absence of a hydraulic model, the average pressure may be approximated by obtaining readings of static water pressure from a representative sample of fire hydrants or other system access points evenly located across the system. A weighted average of the pressure can be assembled; but be sure to take into account the elevation of the fire hydrants, which typically exist several feet higher than the level of buried water pipelines.<br><br>If your water utility has an up-to-date and calibrated hydraulic model of the water distribution system, it can be utilized to obtain a very accurate quantity of average pressure. However using the average pressure of all “nodes” in the system model is not necessarily the most accurate way to calculate the average operating pressure. This is especially true if there are significant pressure differences throughout the system, and the “nodes” are not evenly distributed throughout the distribution system. The most accurate calculation is to obtain the average pressure that each pipe segment experiences. The way to do this is to calculate the pressure at each end of the pipe. Then calculate the average of those two values and multiply this average value by the length of that pipe. This must be calculated for all pipe segments in the model. Finally calculate the sum of all of these values and and divide by the total pipe length. This effectively calculates a weighted average of pressure over the total pipe length. For low density systems (<32 connections/mile), average mains pressures at the service connection or curb stop may have greater influence and should be considered. |
| **Billed Authorized Consumption** | All consumption that is billed and authorized by the utility. This may include both metered and unmetered consumption. See "Authorized Consumption" for more information. |

| Item Name | Description |
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| **Billed Metered Authorized Consumption (BMAC)** Find | All metered consumption which is billed to retail customers, including all groups of customers such as domestic, commercial, industrial or institutional. **It does NOT include water supplied to neighboring utilities (water exported) which is metered and billed. Be sure to subtract any consumption for exported water sales that may be included in these billing roles. Water supplied as exports to neighboring water utilities should be included only in the Water Exported component.** The metered consumption data can be taken directly from billing records for the water audit period. The accuracy of yearly metered consumption data can be refined by including an adjustment to account for customer meter reading lag time since not all customer meters are read on the same day of the meter reading period. However additional analysis is necessary to determine the lag time adjustment value, which may or may not be significant. |
| **Billed Unmetered Authorized Consumption (BUAC)** Find | All billed consumption which is calculated based on estimates or norms from water usage sites that have been determined by utility policy to be left unmetered. This is typically a very small component in systems that maintain a policy to meter their customer population. However, this quantity can be the key consumption component in utilities that have not adopted a universal metering policy. **This component should NOT include any water that is supplied to neighboring utilities (water exported) which is unmetered but billed. Water supplied as exports to neighboring water utilities should be included only in the Water Exported component.** |
| **Customer Metering Inaccuracies (CMI)** Find | Apparent water losses caused by the collective under-registration of customer water meters. Many customer water meters gradually wear as large cumulative volumes of water are passed through them over time. This causes the meters to under-register the flow of water. This occurrence is common with smaller residential meters of sizes 5/8-inch and 3/4 inch after they have registered very large cumulative volumes of water, which generally occurs only after periods of years. For meters sized 1-inch and larger - typical of multi-unit residential, commercial, institutional and industrial accounts - meter under-registration can occur from wear or from the improper application of the meter; i.e. installing the wrong type of meter or the wrong size of meter, for the flow pattern (profile) of the consumer. For instance, many larger meters have reduced accuracy at low flows. If an oversized meter is installed, most of the time the routine flow will occur in the low flow range of the meter, and a significant portion of it may not be registered. It is important to properly select and install all meters, but particularly large customer meters, size 1-inch and larger.<br><br>The auditor has two options for entering data for this component of the audit. The auditor can enter a percentage under-registration (typically an estimated value), this will apply the selected percentage to the two categories of metered consumption to determine the volume of water not recorded due to customer meter inaccuracy. Note that this percentage is a composite average inaccuracy for all customer meters in the entire meter population. The percentage will be multiplied by the sum of the volumes in the Billed Metered and Unbilled Metered components. Alternatively, if the auditor has substantial data from meter testing activities, he or she can calculate their own loss volumes, and this volume may be entered directly.<br><br>Note that a value of zero will be accepted but is not recommended, as all metered systems tend to have some degree of inaccuracy. A positive value should be entered. A value of zero in this component is generally valid only if the water utility does not meter its customer population.<br><br>The formula for caculating a volume of CMI from a percentage input is as follows: CMI volume = (BMAC+UMAC)/(1-CMI%)-(BMAC+UMAC) |
| **Customer Retail Unit Charge (CRUC)** Find | The Customer Retail Unit Charge represents the volumetric portion of the total charges that customers pay for water service. The CRUC does not include fixed charges. This unit charge cost is applied routinely to the components of Apparent Loss, since these losses represent water reaching customers but not (fully) paid for. Since most water utilities have a rate structure that includes a variety of different charges costs based upon class of customer, a volume-weighted average of water sold at each unique rate should be calculated to determine a single composite charge that should be entered into this cell. Finally, the weighted average charge should also include additional charges for sewer, storm water or biosolids processing, but only if these charges are based upon the volume of potable water consumed.<br><br>For water utilities in regions with limited water resources and a questionable ability to meet the drinking water demands in the future, the Customer Retail Unit Charge Cost might also be applied to value the Real Losses; instead of applying the Variable Production Cost to Real Losses. In this way, it is assumed that every unit volume of leakage reduced by leakage management activities will be sold to a customer.<br><br>Note: the Free Water Audit Software allows the user to select the units that are charged to customers (either $/1,000 gallons, $/hundred cubic feet, or $/1,000 litres) and automatically converts these units for purpose of calculating Apparent Loss valuations. The monetary units are United States dollars, $. |
| **Infrastructure Leakage Index (ILI)** Find | The ratio of the Current Annual Real Losses (Real Losses) to the Unavoidable Annual Real Losses (UARL). This performance indicator is dimensionless.<br><br>**NOTES ON THE UARL AND ILI:**<br>1. This Free Water Audit Software version 6 presents the calculated UARL and ILI for systems of all sizes and all pressures. Some published research is now available on predicting how UARL is likely to be modified when modeling low leakage limits in systems that are very small (< 3000 conn), or have very low average pressures, or have very high pressures (aka boundary cases). Inherent over- or under- estimation of UARL volume may exist in these boundary cases, as they operate at or near the limits of the UARL model assumptions. More widespread application and understanding of system specific corrections to the UARL model in these boundary cases is now likely to occur, but are not included in the FWAS at the time of this publication. Caution is advised when using the standard UARL modeled value (and subsequently the ILI) for boundary cases. In boundary cases, the ILI may still be considered a general Performance Indicator, but not used as an absolute performance measurement or for benchmark comparisons.<br><br>2. The UARL term is based on average operating pressure in a given audit year, and a utility's current pressure conditions may not be optimized. Thus, ILI should always be interpreted with some measure of pressure, and only used for tracking progress if all justifiable pressure management has already been completed. |

| Item Name | Description |
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| **Length of Mains (Lm)**<br>Find | Length of all pipelines (except service connections) in the system starting from the point of system input metering (for example at the outlet of the treatment plant). It is also recommended to include in this measure the total length of fire hydrant lead pipe. Hydrant lead pipe is the pipe branching from the water main to the fire hydrant. Fire hydrant leads are typically of a sufficiently large size that is more representative of a pipeline than a service connection. The average length of hydrant leads across the entire system can be assumed if not known, and multiplied by the number of fire hydrants in the system, which can also be assumed if not known. This value can then be added to the total pipeline length. Total length of mains can therefore be calculated as:<br><br>Length of Mains, miles = (total pipeline length, miles) + [ {(average fire hydrant lead length, ft) x (number of fire hydrants)} / 5,280 ft/mile ]<br>or<br>Length of Mains, kilometres = (total pipeline length, kilometres) + [ {(average fire hydrant lead length, metres) x (number of fire hydrants)} / 1,000 metres/kilometre ] |
| **NON-REVENUE WATER**<br>Find | = Apparent Losses + Real Losses + Unbilled Metered Consumption + Unbilled Unmetered Consumption. This is water which does not provide revenue potential to the utility. |
| **Number of Service Connections (Nc)**<br>Find | Number of customer service connections, extending from the water main to supply water to a customer. This includes the actual number of pressurized piping connections, including fire connections, **whether active or inactive**. This may differ substantially from the number of customers (or number of accounts).<br>**Note: this number does not include the pipeline leads to fire hydrants. The total length of piping supplying fire hydrants should be <u>included</u> in the "Length of mains" input, and <u>excluded</u> from the Number of service connections input.** |
| **Real Losses**<br>Find | Physical water losses from the pressurized system (water mains and customer service connections) and the utility's storage tanks, up to the point of customer consumption. In metered systems this is the customer meter, in unmetered situations this is the first point of consumption (stop tap/tap) within the property. The annual volume lost through all types of leaks, breaks and overflows depends on frequencies, flow rates, and average duration of individual leaks, breaks and overflows. |
| **Revenue Water** | Those components of System Input Volume that are billed and have the potential to produce revenue. |
| **Service Connection Density**<br>Find | =number of customer service connections / length of mains |
| **Systematic Data Handling Errors (SDHE)**<br>Find | Apparent losses caused by accounting omissions, errant computer programming, gaps in policy, procedure, and permitting/activation of new accounts; and any type of data lapse that results in under-stated customer water consumption in summary billing reports. **Systematic Data Handling Errors occur as a customer consumption volume and can result in a direct loss of revenue potential. Water utilities can find "lost" revenue by keying on this component.**<br><br>Utilities typically measure water consumption volumes registered by water meters at customer premises. The meter should be read routinely (ex: monthly) and the data transferred to the Customer Billing System, which generates and sends a bill to the customer. Data Transfer Errors result in the registered consumption volume value being less than the actual consumption volume, creating an apparent loss. Such error might occur from illegible and mis-recorded hand-written readings compiled by meter readers, inputting an incorrect meter register unit conversion factor in the automatic meter reading equipment, or a variety of similar errors.<br><br>Apparent losses also occur from Data Analysis Errors in the archival and data reporting processes of the Customer Billing System. Inaccurate estimates used for accounts that fail to produce a meter reading are a common source of error. Billing adjustments may award customers a rightful monetary credit, but do so by creating a negative value of consumption volume, thus under-stating the actual consumption. Account activation lapses may allow new buildings to begin using water for months without meter readings and billing. Poor permitting and construction inspection practices can result in a new building water service commencing without a billing account, a water meter and meter reading; i.e., the customer is unknown to the utility's billing system. Close auditing of the permitting, metering, meter reading, billing and reporting processes of the water consumption data trail can uncover data management gaps that create volumes of systematic data handling error. Utilities should routinely analyze customer billing records to detect data anomalies and quantify these losses. For example, a billing account that registers zero consumption for two or more billing cycles should be checked to explain why usage has seemingly halted. Given the revenue loss impacts of these losses, water utilities are well-justified in providing continuous oversight and timely correction of data transfer errors & data handling errors.<br><br>If the water auditor has not yet gathered detailed data or assessment of systematic data handling error, it is recommended that the auditor apply the default value of 0.25% of the Billed Authorized Consumption volume. However, if the auditor has investigated the billing system and its controls, and has well validated data that indicates the volume from systematic data handling error is substantially higher or lower than that generated by the default value, then the auditor should enter a quantity that was derived from the utility investigations and select an appropriate grading. Negative or zero values are not allowed for this audit component.<br><br>Note: occasionally billed consumption volumes for a customer account may be over-stated due to issues of double-counting an account or applying an over-stated meter multiplier. The possibility of such occurrences should be explored in the data validation process, particularly if billed authorized consumption volumes for the year, or for any sub-group of customers (by classification or meter size), appears to be inordinately high. It is recommended to correct any such errors in the billed consumption total for the year, rather than consider these volumes part of Systematic Data Handling Error. |
| **Total annual operating cost (optional input)**<br>Find | *This input has been made optional, as it is no longer used in calculating a Performance Indicator. Auditors are welcome to continue to track this input as desired.* These costs include those for operations, maintenance and any annually incurred costs for long-term upkeep of the drinking water supply and distribution system. It should include the costs of day-to-day upkeep and long-term financing such as repayment of capital bonds for infrastructure expansion or improvement. Typical costs include employee salaries and benefits, materials, equipment, insurance, fees, administrative costs and all other costs that exist to sustain the drinking water supply. Depending upon water utility accounting procedures or regulatory agency requirements, it may be appropriate to include depreciation in the total of this cost. This cost should not include any costs to operate wastewater, biosolids or other systems outside of drinking water. |

| Item Name | Description |
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| **Unauthorized Consumption (UC)**<br>Find | Includes water illegally withdrawn from fire hydrants, illegal connections, bypasses to customer consumption meters, or tampering with metering or meter reading equipment; as well as any other ways to receive water while thwarting the water utility's ability to collect revenue for the water. Unauthorized consumption results in uncaptured revenue and creates an error that understates customer consumption. In most water utilities this volume is low and, if the water auditor has not yet gathered detailed data for these loss occurrences, it is recommended to use the default value of 0.25% of the Billed Authorized Consumption volume. However, if the auditor has investigated unauthorized occurrences, and has well validated data that indicates the volume from unauthorized consumption is substantially higher or lower than that generated by the default value, then the auditor should enter a quantity that was derived from the utility investigations. Note that a value of zero will not be accepted since all water utilities tend to have some volume of unauthorized consumption occurring in their system. |
| **Unavoidable Annual Real Losses (UARL)**<br>Find | The UARL is a theoretical reference value representing the technical low limit of leakage for well managed systems in good condition, with aggressive active leakage control. It is a key variable in the calculation of the Infrastructure Leakage Index (ILI).<br><br>UARL (gallons) = (5.41Lm + 0.15Nc + 7.5Lc) x P x 365 d/year,<br>or<br>UARL (litres) = (18.0Lm + 0.8Nc + 25.0Lc) x P x 365 d/year<br><br>where:<br>Lm = length of mains (miles or kilometres)<br>Nc = number of customer service connections<br>Lp = the average length of customer service connection piping (feet or metres)<br>(see the Worksheet "Service Connection Diagram" for guidance on deterring the value of Lp)<br>Lc = total length of customer service connection piping (miles or km)<br>Lc = Nc X Lp (miles or kilometres)<br>P = Average operating pressure (psi or metres) (see Average Operating Pressure definition)<br><br>**NOTES ON THE UARL AND ILI:**<br>1. This Free Water Audit Software version 6 presents the calculated UARL and ILI for systems of all sizes and all pressures. Some published research is now available on predicting how UARL is likely to be modified when modeling low leakage limits in systems that are very small (< 3000 conn), or have very low average pressures, or have very high pressures (aka boundary cases). Inherent over- or under- estimation of UARL volume may exist in these boundary cases, as they operate at or near the limits of the UARL model assumptions. More widespread application and understanding of system specific corrections to the UARL model in these boundary cases is now likely to occur, but are not included in the FWAS at the time of this publication. Caution is advised when using the standard UARL modeled value (and subsequently the ILI) for boundary cases. In boundary cases, the ILI may still be considered a general Performance Indicator, but not used as an absolute performance measurement or for benchmark comparisons.<br>2. The UARL term is based on average operating pressure in a given audit year, and a utility's current pressure conditions may not be optimized. Thus, ILI should always be interpreted with some measure of pressure, and only used for tracking progress if all justifiable pressure management has already been completed. |
| **Unbilled Authorized Consumption** | All consumption that is unbilled, but still authorized by the utility. This includes Unbilled Metered Authorized Consumption (UMAC) + Unbilled Unmetered Authorized Consumption (UUAC). See "Authorized Consumption" for more information. |
| **Unbilled Metered Authorized Consumption (UMAC)**<br>Find | Metered consumption which is authorized by the water utility, but, for any reason, is deemed by utility policy to be unbilled. This might for example include metered water consumed by the utility itself in treatment or distribution operations, or metered water provided to civic institutions free of charge. **It does not include water supplied to neighboring utilities (water exported) which may be metered but not billed.** |
| **Unbilled Unmetered Authorized Consumption (UUAC)**<br>Find | Any kind of Authorized Consumption which is neither billed nor metered. This component typically includes water used in activities such as fire fighting, flushing of water mains and sewers, street cleaning, fire flow tests conducted by the water utility, etc. In most water utilities it is a small component.<br><br>This component does NOT include water supplied to neighboring utilities (water exported) which is unmetered and unbilled – an unlikely case. Also, if any potable water used at a water treatment plant is tapped from a location upstream of the meter(s) used to determine the Volume from Own Sources in the audit, this is outside of the boundary of the audit and should therefore not be included as part of Unbilled, Unmetered Authorized Consumption.<br><br>This component has many sub-components of water use which may not yet be quantified. The default is 0.25% of the Billed Authorized Consumption volume (BMAC + BUAC), and is recommended for temporary use if customized estimates are not yet available, with recommendation to begin tracking and estimating these volumes for the next audit.<br><br>Note that a value of zero is not permitted, since all water utilities likely have some volume of water in this component occurring in their system. |
| **Units and Conversions** | The user may develop an audit based on one of three unit selections:<br>1) Million Gallons (US)<br>2) Megalitres (Thousand Cubic Metres)<br>3) Acre-feet<br>Once this selection has been made in the instructions sheet, all calculations are made on the basis of the chosen units. Should the user wish to make additional conversions, a unit converter is provided below (use drop down menus to select units): |

| Item Name | Description |
|---|---|
| | Enter Units: Convert From… / Converts to….. <br> 100 Million Gallons (US) = 306.888329 Acre-feet <br> (conversion factor = 3.0689) |
| **Variable Production Cost (VPC) (applied to Real Losses)** <br> Find | The cost to produce and supply the next unit of water (e.g., $/million gallons). This cost can include both short-run and long-run marginal costs. See the VPC data grading questions on IDG tab for examples of short-run and long-run marginal costs that may be included. <br><br> It is common to apply the VPC unit cost to the volume of Real Losses. However, if water resources are strained and the ability to meet future drinking water demands is in question, then the water auditor may be justified in applying the Customer Retail Unit Charge to the Real Loss volume, rather than applying the Variable Production Cost. |
| **Volume from Own Sources (VOS)** <br> Find | The volume of water withdrawn (abstracted) from water resources (rivers, lakes, streams, wells, etc) controlled by the water utility, and then treated for potable water distribution. Most water audits are compiled for utility retail water distribution systems, so this volume should reflect the amount of treated drinking water that entered the distribution system. Often the volume of water measured as treated effluent of the treatment works is slightly less than the volume measured at the raw water source, since some of the water is used in the treatment process. Thus, it is useful if flows are metered at the effluent of the treatment works. Water treatment plants are also often supplied potable drinking water and therefore are a "customer" of the water utility. If the service connection line serving the water treatment plant is downstream of treated water effluent flowmeters, this water should be metered and billed as billed authorized consumption. In this case, this volume of water does not enter into any calculations for Volume from Own Sources. If the service connection line suppling potable water to the treatment plant is upstream of treated water effluent flowmeters, then this water is considered "process" water and included with calculations accounting for process water use. <br> If metering exists only at the raw water source, an adjustment for water used in the treatment process should be included to account for water consumed in treatment operations such as filter backwashing, basin flushing and cleaning, plant potable water consumption (if the supply is drawn upstream of effluent flowmetering.) and similar uses. If the audit is conducted for a wholesale water agency that sells untreated water, then this quantity reflects the measure of the raw water, typically metered at the source. |
| **Volume from own sources: error adjustment** <br> Find | An estimate or measure of the degree of inaccuracy that exists in the master (production) meters measuring the annual Volume from own Sources, and any error in the data trail that exists to collect, store and report the summary production data. This adjustment is a weighted average number that represents the collective error for all master meters for all days of the audit year and any errors identified in the data trail. Meter error can occur in different ways. A meter or meters may be inaccurate by under-registering flow (did not capture all the flow), or by over-registering flow (overstated the actual flow). Data error can occur due to data gaps caused by temporary outages of the meter or related instrumentation. All water utilities encounter some degree of inaccuracy in master meters and data errors in archival systems are common. Enter a positive percentage or volume, then select 'under-registration' or 'over-registration' from the drop-down immediately adjacent. **See Water Supplied Error Adjustments definition for guidance on how to calculate this input.** |
| **Water Exported (WE)** <br> Find | The Water Exported volume is the bulk water conveyed or sold by the water utility to neighboring water systems that exists outside of their service area. Typically this water is metered at the custody transfer point of interconnection between the two water utilities. Usually the meter(s) are owned by the water utility that is selling or transfering the water: i.e. the exporter. If the water utility who is compiling the annual water audit sells or transfers bulk water in this manner, they are an exporter of water. <br><br> Note: The Water Exported volume is typically sold to wholesale customers who are charged a wholesale rate that is different than retail rates charged to the retail customers existing within the service area. Many state regulatory agencies require that the Water Exported volume be reported to them as a quantity separate and distinct from the retail customer billed consumption. For these reasons - and others - the Water Exported volume is always quantified separately from Billed Authorized Consumption in the standard water audit. **Be certain not to "double-count" this quantity by including it in both the Water Exported box and the Billed Metered Consumption box of the water audit Worksheet. This volume should be included only in the Water Exported box.** |
| **Water Exported: Error Adjustment (WEEA)** <br> Find | An estimate or measure of the volume by which the Water Exported volume is incorrect. This adjustment is a weighted average that represents the collective error for all of the metered and archived exported flow for all days of the audit year. Meter error can occur in different ways. A meter may be inaccurate by under-registering flow (did not capture all the flow), or by over-registering flow (overstated the actual flow). Error in the metered, archived data can also occur due to data gaps caused by temporary outages of the meter or related instrumentation. All water utilities encounter some degree of error in their metered data, particularly if meters are aged and infrequently tested. Occasional errors also occur in the archived data. Enter a positive percentage or volume, then select 'under-registration' or 'over-registration' from the drop-down immediately adjacent. If regular meter accuracy testing is conducted on the meter(s) - which is usually conducted by the water utility selling the water - then the results of this testing can be used to help quantify the meter error adjustment. Corrections to data gaps or other errors found in the archived data should also be included as a portion of this meter error adjustment. **See Water Supplied Error Adjustments definition for guidance on how to calculate this input.** |
| **Water Imported (WI)** <br> Find | The Water Imported volume is the bulk water purchased to become part of the Water Supplied volume. Typically this is water purchased from a neighboring water utility or regional water wholesale supplier, and is metered at the custody transfer point of interconnection between the two water utilities. Usually the meter(s) are owned by the water supplier selling the water to the utility conducting the water audit. The water supplier selling the bulk water usually charges the receiving utility based upon a wholesale water rate. |

| Item Name | Description |
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| **Water Imported: Error Adjustment (WIEA)**<br><br>Find | An estimate or measure of the volume by which the Water Imported volume is incorrect. This adjustment is a weighted average that represents the collective error for all of the metered and archived imported flow for all days of the audit year. Meter error can occur in different ways. A meter may be inaccurate by under-registering flow (did not capture all the flow), or by over-registering flow (overstated the actual flow). Error in the metered, archived data can also occur due to data gaps caused by temporary outages of the meter or related instrumentation. All water utilities encounter some level of meter inaccuracy, particularly if meters are aged and infrequently tested. Occasional errors also occur in the archived metered data. Enter a positive percentage or volume, then select 'under-registration' or 'over-registration' from the drop-down immediately adjacent. If regular meter accuracy testing is conducted on the meter(s) - which is usually conducted by the water utility selling the water - then the results of this testing can be used to help quantify the meter error adjustment. **See Water Supplied Error Adjustments definition for guidance on how to calculate this input.** |
| **Water Supplied Error Adjustments**<br>Find | **Disclaimer**: The guidance provided below should be considered general, representing a typical approach to determining Error Adjustment. Supply metering setups, metering technologies, instrumentation, data recording/archival, and data management systems can vary significantly from one water utility to the next. Inherent margins of error will also vary among different testing and calibration methods and the measurement systems being tested. Other factors that may be important include, but are not limited to, frequency of testing and calibration practices, data communication outages in the audit period, tested flowrates versus typical operating flowrates, and test durations. All of these factors must be considered when assessing Error Adjustment for the Water Supplied inputs. Each specific situation should be carefully analyzed to determine the most appropriate approach for determining the Error Adjustment to input, if any.<br><br>**General**: For the Water Supplied inputs, there are three typical sources of error that may warrant an Error Adjustment on the Worksheet.<br>1. **Meter error:** measurement inaccuracy in the meter(s) used to derive the input volume, typically identified through in-situ flow accuracy testing. Applicable for VOS, WI and WE. If no such testing has been performed, adjustment for meter error is not typically recommended.<br>2. **Data transfer error**: inaccuracy in archived volumes, typically due to gaps in data, programming errors impacting unit conversions, and/or programming errors impacting totalization of measured volumes over the audit period. Applicable for VOS, WI and WE. These errors are typically identified through electronic calibration to verify data transfer at the secondary device (i.e. conversion to mA, meter transmitter or similar instrumentation) and/or the tertiary device (i.e. SCADA, historian or other computerized archival system).<br>3. **Net distribution storage change**: The difference between end of audit period and beginning of audit period for total finished water stored, downstream of the system input meter(s). Typically applicable for VOS or WI. This volume is typically derived by comparing distribution storage tank water levels at end and beginning of the water audit period and using approximate tank geometry to convert levels to volumes.<br><br>**Derivation Guidance**:<br>If an Error Adjustment input is being calculated as a volume, each source of error (described above) may be separately calculated, with careful consideration of under- vs over-registration, then added together to determine the composite volume to input. The composite input should be entered on the Worksheet as a positive number, then under- or over-registration selected on the adjacent dropdown.<br>If an Error Adjustment input is being calculated as a percent, some very general guidance for calculating each error source (described above) is provided below. The auditor is again cautioned that each specific water supply setup needs to be evaluated closely as noted in the Disclaimer. Refer to the latest AWWA M36 Manual for additional discussion and guidance on this matter.<br><br>1. Meter error: If in-situ flow accuracy testing has been performed, and inherent testing method error is understood, first the *meter accuracy %* may be determined as follows:<br>*meter accuracy % = System input meter(s) volume / Reference volume*<br><br>Then, the *meter error %* may be determined as follows: □<br>*meter error % = meter accuracy % - 100%*<br><br>2. Data transfer error: If electronic calibration at the secondary (i.e. conversion to mA, meter transmitter or similar instrumentation) and/or tertiary (i.e. SCADA, historian or other computerized archival system) devices has been performed, first the *data transfer accuracy %* may be determined as follows:<br>*data transfer accuracy % = Tertiary device volume / Reference volume (typically at Secondary device)*<br><br>Then, the *data transfer error %* may be determined as follows:□<br>*data transfer error % = data transfer accuracy % - 100%*<br><br>If no error is identified, or if electronic calibration has not been performed, or if no secondary or tertiary devices exist, a *data transfer error %* adjustment is not typically recommended.<br><br>3. Net distribution storage change. If meter error and/or data transfer error are being calculated as a %, it is recommended to make the adjustment for net distribution storage change as a volume adjustment, directly in the VOS or WI input, as applicable.<br><br>The final step is to add *meter error %* and *data transfer error %:*<br>*Error Adjustment % = meter accuracy % + data transfer error %*<br><br>If the total Error Adjustment % calculates out as a negative number, it represents an under-registration. Vice versa, if positive. The composite input should be entered on the Worksheet as a positive number, then under- or over-registration selected on the adjacent dropdown. □ |
| **WATER LOSSES**<br><br>Find | = apparent losses + real losses<br>= water supplied - authorized consumption<br><br>Water Losses are the difference between Water Supplied and Authorized Consumption. Water losses can be considered as a total volume for the whole system, or for partial systems such as transmission systems, pressure zones or district metered areas (DMA), if one of these configurations are the basis of the water audit. |

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**Average Length of Customer Service Line**

The three figures shown on this worksheet display the assignment of the Average Length of Customer Service Line, Lp, for the three most common piping configurations.

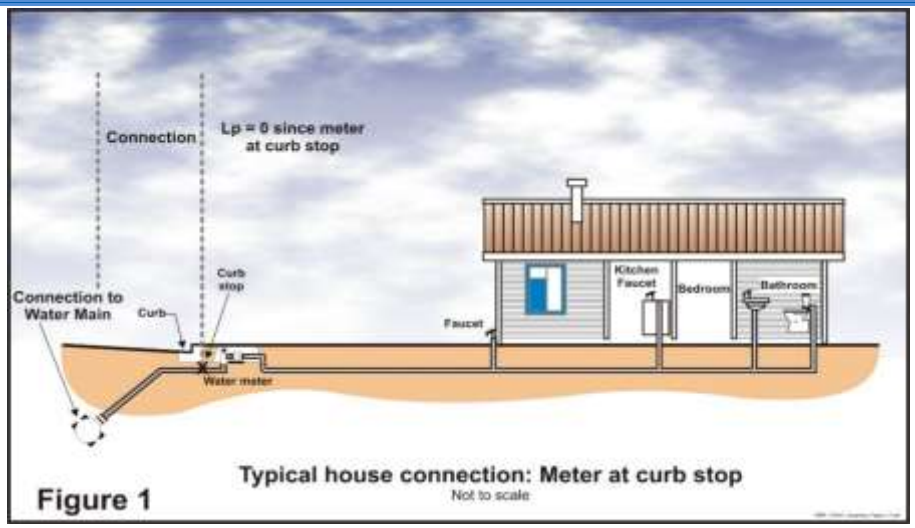
**Figure 1** shows the configuration of the water meter outside of the customer building next to the curb stop valve. In this configuration Lp = 0 since the distance between the curb stop and the customer metering point is essentially zero.

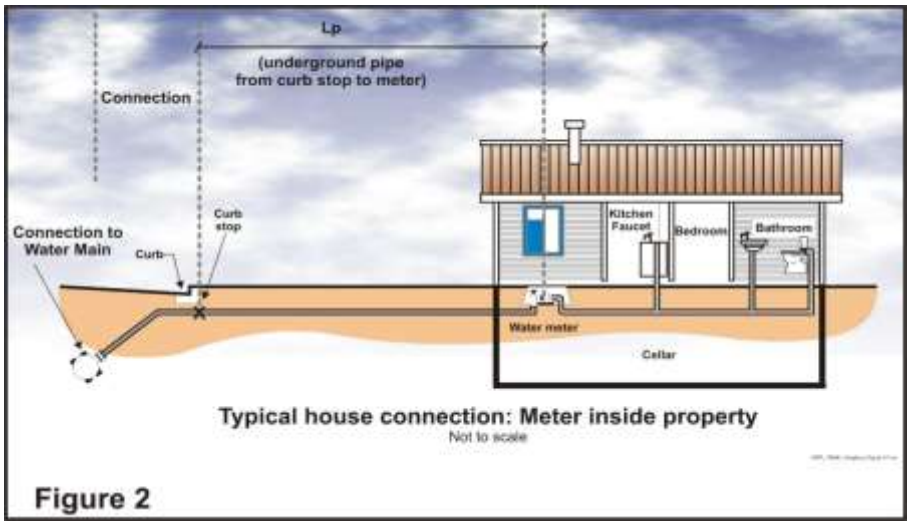
**Figure 2** shows the configuration of the customer water meter located inside the customer building, where Lp is the distance from the curb stop to the water meter.

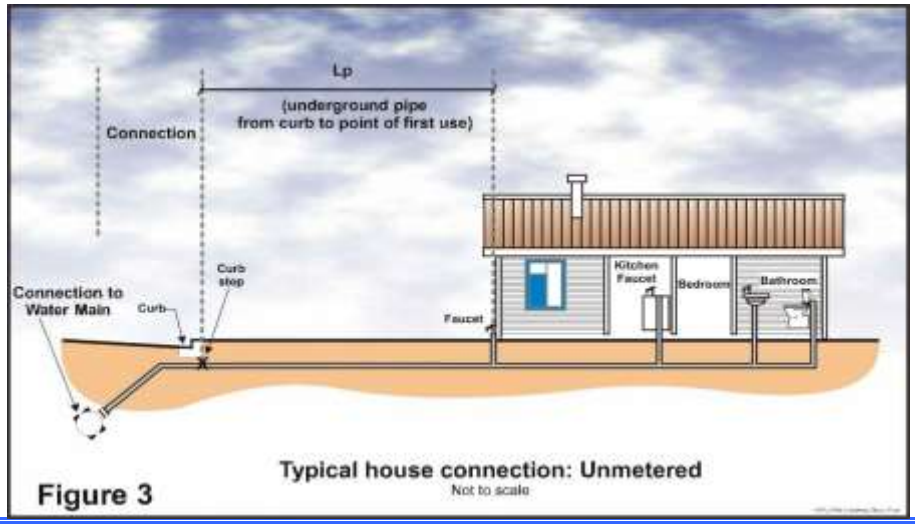
**Figure 3** shows the configuration of an unmetered customer building , where Lp is the distance from the curb stop to the first point of customer water consumption, or, more simply, the building line.

In any water system the Lp will vary notably in a community of different structures, therefore the average Lp value is used and this should be approximated or calculated if a sample of service line measurements has been gathered.

Click for more information



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American Water Works Association
Dedicated to the World's Most Important Resource®

**AWWA Free Water Audit Software - Version 6.0**
developed by the
Water Loss Control Committee of the American Water Works Association
December 2020

World Water Loss Day
4th December

This software is intended to serve as a basic tool to compile a preliminary, or "top-down", water audit. It is recommended that users also refer to the current edition of the AWWA M36 Publication, Water Audits and Loss Control Programs, for detailed guidance on compiling a comprehensive, or "bottom-up", water audit using the same water audit methodology.

*DEVELOPED BY:*

| | | |
|---|---|---|
| Will Jernigan, PE | *Software Chair* | Cavanaugh |
| David Sayers | | Black & Veatch |
| Kate Gasner | | Water Systems Optimization |
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| Andrew Chastain-Howley, PG, MCSM | | Black & Veatch |

A special thanks to those members of the AWWA Water Loss Control Committee and other water industry stakeholders who assisted in the review and testing of this software.

*REFERENCES:*

1. Kunkel, G., G. Trachtman, A. Wyatt, and W. Jernigan. *Water Loss Control Committee Report: Key Performance Indicators for Non-Revenue Water—AWWA's 2020 Position*. 2020. Journal AWWA. https://awwa.onlinelibrary.wiley.com/doi/full/10.1002/awwa.1428
2. Kunkel, G. et al. *AWWA WLCC Reference Water Audit Dataset*. 2020. AWWA. Denver, CO.
3. *AWWA Water Audits and Loss Control Programs, M36 Publication.* 5th Edition, (forthcoming) 2021. AWWA. Denver, CO.
4. Trachtman G., A. Wyatt, et al. 2019. *Assessment of Performance Indicator for Non-Revenue Water Target Setting and Progress Tracking*. AWWA. Denver, CO.
5. Trachtman G., A. Wyatt, et al. 2019. *WRF 4695: Guidance on Implementing an Effective Water Loss Control Plan*. Water Research Foundation. Denver, CO.
6. Lambert, A. 2020. *Low ILIs and Small Systems.* Llandudno, UK. https://leakssuitelibrary.com
7. *Good Practices on Leakage Management, Main Report*. EU Reference Document. European Commission, Luxembourg. 2015.
   https://circabc.europa.eu/sd/a/1ddfba34-e1ce-4888-b031-6c559cb28e47/Good%20Practices%20on%20Leakage%20Management%20-%20Main%20Report_Final.pdf
   https://circabc.europa.eu/sd/a/ec13ae01-7800-4114-8d72-98827b509e18/Good%20Practices%20on%20Leakage%20Management%20-%20Case%20Study%20document._Final.pdf
8. Service Connection Diagrams courtesy of Ronnie McKenzie, WRP Pty Ltd.
9. Sturm, R., W. Jernigan, C. Stief, and D. Blackwell. *Level 1 Water Audit Validation Guidance Manual*. 2nd Edition, (forthcoming) 2021. Project #5057. Denver: Water Research Foundation.

*VERSION HISTORY:*

| Version: | Release Date: | Number of Worksheets: | Key Features and Developments |
|---|---|---|---|
| v1 | 2005/ 2006 | 5 | The AWWA Water Audit Software was piloted in 2005 (v1.0 beta). The early versions (1.x) of the software restricted data entry to units of Million Gallons per year. For each entry into the audit, users identified whether the input was measured or estimated. |
| v2 | 2006 | 5 | The most significant enhancement in v2 of the software was to allow the user to choose the volumetric units to be used in the audit, Million Gallons or Thousand Cubic Metres (megalitres) per year. Two financial performance indicators were added to provide feedback to the user on the cost of Real and Apparent losses. |
| v3 | 2007 | 7 | In v3, the option to report volumetric units in acre-feet was added. Another new feature in v3 was the inclusion of default values for two water audit components (unbilled unmetered and unauthorized consumption). v3 also included two examples of completed audits in units of million gallons and Megalitres. Several checks were added into v3 to provide instant feedback to the user on common data entry problems, in order to help the user complete an accurate water audit. |
| v4 - v4.2 | 2010 | 10 | v4 (and versions 4.x) of the software included a new approach to data grading. The simple "estimated" or "measured" approach was replaced with a more granular scale (typically 1-10) that reflected descriptions of utility practices and served to describe the confidence and accuracy of the input data. Each input value had a corresponding scale fully described in the Grading Matrix tab. The Grading Matrix also showed the actions required to move to a higher grading score. Grading descriptions were available on the Reporting Worksheet via a pop-up box next to each water audit input. A water audit data validity score is generated (max = 100) and priority areas for attention (to improve audit accuracy) are identified, once a user completes the requied data grading. A service connection diagram was also added to help users understand the impact of customer service line configurations on water losses and how this information should be entered into the water audit software. An acknoweldgements section was also added. Minor bug fixes resulted in the release of versions 4.1 and 4.2. A French language version was also made available for v4.2. |
| v5 | 2014 | 12 | In v5, changes were made to the way Water Supplied information is entered into software, with each major component having a corresponding Master Meter Error Adjustment entry (and data grading requirement). This required changes to the data validity score calculation; v5 of the software uses a weighting system that is, in part, proportional to the volume of input components. The Grading Matrix was updated to reflect the new audit inputs and also to include clarifications and additions to the scale descriptions. The appearance of the software was updated in v5 to make the software more user-friendly and several new features were added to provide more feedback to the user. Notably, a dashboard tab has been added to provide more visual feedback on the water audit results and associated costs of Non-Revenue Water. A comments sheet was added to allow the user to track notes, comments and to cite sources used. |
| v6 | 2020 | 11 | v6 brings an overhaul to the user interface for data grading, now presented as a series of questions on the Interactive Data Grading (IDG) tab for each input that, when answered (by selecting best-fit answer from a dropdown menu), automically determines the data grade for the given input. This provides transparency to the data practices selected and which specifically are limiting, removes subjectivity in data grade assignments, and provides clarity on candidate next steps for data validity improvements. IDG tab includes navigation buttons across top banner for ease of movement between inputs, and color signals for completion. The Worksheet (fka Reporting Worksheet) includes overt designation of error adjustment as "under" or "over" for the 3 Water Supplied inputs, as well as Customer Metering Inaccuracies. This makes the convention consistent, transparent, and reduces chance of user error. A Blank Sheet has been added allowing the user to, as desired, perform supplemental calculations or capture additional relevant information. The Dashboard has been overhauled to include Data Validity, NRW Components and Key Performance Indicators (KPIs). KPIs are presented in gauge format, depicting the specific KPI result against the range of results from Level 1 validated data in North America (see Web Resources, Start Page). Percentage-based indicators (% of supply, % of cost) removed as these indicators were deemed unreliable and sunset by the AWWA Water Loss Control Committee, subsequent to research and reporting from its NRW Performance Indicators Task Force. |

If you have questions or comments regarding the software please contact us via email at: wlc@awwa.org

# AWWA Free Water Audit Software v6.0

FWAS v6.0

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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 targeting loss reduction levels. This tool contains several separate worksheets. Sheets can be accessed using the tabs at the bottom of the screen, or by clicking the TOC links below.

## Table of Contents (TOC)


**Start Page** The current sheet. Enter contact information and basic audit details.

**Worksheet** Enter the required data on this worksheet to calculate the water balance and data grading.

**Interactive Data Grading** Answer questions about operational practices for each audit input, and the data validity grades will automatically populate.

**Dashboard** Review NRW components, performance indicators and graphical outputs to evaluate the results of the audit.

**Notes** Enter notes to explain how values were calculated, document data sources, and related information about data management practices.

**Blank Sheet** By popular demand! A blank sheet. The world is your canvas.

**Water Balance** The values entered in the Worksheet automatically populate the Water Balance.

**Loss Control Planning** Use this sheet to interpret the results of the audit validity score and performance indicators.

**Definitions** Use this sheet to understand the terms used in the audit process.

**Service Connection Diagram** Diagrams depicting possible customer service connection line configurations.

**Acknowledge-ments** Acknowledgements for development of the AWWA Free Water Audit Software v6.0.


**AWWA Web Resources for Water Loss Control**

https://www.awwa.org/Resources-Tools/Resource-Topics/Water-Loss-Control

Items referenced in the Free Water Audit Software v6.0 on the web:

- Data Grading Matrix v6.0
- Example Water Audit v6.0
- Water Audit Compiler v6.0
- AWWA Reports on Performance Indicators
- M36 Manual

## Enter Basic Information

| | |
|---|---|
| Name of Utility: | City of Fullerton |
| Name of Contact Person: | Gar Huang |
| Email: | garh@ci.fullerton.ca.us |
| Telephone \| Ext.: | 714-738-6895 |
| City/Town/Municipality: | Fullerton |
| State / Province: | California (CA) |
| Country: | USA |
| Audit Preparation Date: | Jul 01 2025 |
| Audit Year: | 2024 |
| Audit Year Label: | Calendar (Fiscal, Calendar, etc) |
| Audit Period Start Date: | Jan 01 2024 |
| Audit Period End Date: | Dec 31 2024 |
| Volume Reporting Units: | Acre-feet |
| Water System Structure: | Retail |
| Water Type: | Potable Water |
| System ID Number: | CA3010010 |
| Validator Name/ID: | Rachel Davis |
| Validator Email: | rdavis@mwdoc.com |
| Estimated Total Population Served by Water Utility: | 144,000 |

## Key of Input Acronyms

*In order of appearance in the Worksheet*

| | |
|---|---|
| **VOS** | Volume from Own Sources |
| **VOSEA** | VOS Error Adjustment |
| **WI** | Water Imported |
| **WIEA** | WI Error Adjustment |
| **WE** | Water Exported |
| **WEEA** | WE Error Adjustment |
| **BMAC** | Billed Metered Authorized Consumption |
| **BUAC** | Billed Unmetered Authorized Consumption |
| **UMAC** | Unbilled Metered Authorized Consumption |
| **UUAC** | Unbilled Unmetered Authorized Consumption |
| **SDHE** | Systematic Data Handling Errors |
| **CMI** | Customer Metering Inaccuracies |
| **UC** | Unauthorized Consumption |
| **Lm** | Length of mains |
| **Nc** | Number of service connections |
| **Lp** | Average length of (private) customer service line |
| **AOP** | Average Operating Pressure |
| **CRUC** | Customer Retail Unit Charge |
| **VPC** | Variable Production Cost |

**Color Key** User input | Calculated | Optional default

## Guidance for the Worksheet

Choosing to enter unit of **percent** or **volume** (applies to VOSEA, WIEA, WEEA, CMI) choose entry option:

| | | |
|---|---|---|
| 1.00% | percent | *or* |
| | volume | 25.000 |

Choosing to enter **default** or **custom input** (applies to UUAC, SDHE, UC) choose entry option:

| | | |
|---|---|---|
| 0.25% | default | *or* |
| | custom | 75.000 |

## Guidance for the Interactive Data Grading

Use acronym buttons in IDG header to navigate among inputs. Acronym Key above. White = needs answers, orange = complete, clear = not required. Example below.

After clicking an acronym button, answer all visible questions in the order they're presented, choosing best-fit answer

Grade will populate when all visible questions are complete for an input **7**

The limiting criteria will be labeled along the right. If only 1 limiting criterion is shown, improving on that criterion will achieve a higher data grade. If multiple limiting criteria are shown, improving on *each* limiting criterion is necessary to achieve a higher data grade. A complete inventory of data grading criteria is available in the Data Grading Matrix v6.0 (see web resources) Limiting

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# AWWA Free Water Audit Software: Worksheet

FWAS v6.0

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**Water Audit Report for:** City of Fullerton
**Audit Year:** 2024 | Jan 01 2024 - Dec 31 2024 | Calendar

Click 'n' to add notes
Click 'g' to determine data validity grade

To edit water system info: go to start page

To access definitions, click the input name

All volumes to be entered as: ACRE-FEET PER YEAR

Water Supplied Error Adjustments

## WATER SUPPLIED

choose entry option:

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VOS | Volume from Own Sources: | n | g | 6 | 14,855.450 | Acre-ft/Yr | n | g | 8 | volume | 36.860 | acre-ft/yr | under-registration | VOSEA |
| WI | Water Imported: | n | g | 6 | 5,941.124 | Acre-ft/Yr | n | g | 7 | percent | | | | WIEA |
| WE | Water Exported: | n | g | n/a | | Acre-ft/Yr | | | | | | | | WEEA |

WATER SUPPLIED: 20,833.434 Acre-ft/Yr

## AUTHORIZED CONSUMPTION

choose entry option:

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| BMAC | Billed Metered: | n | g | 8 | 20,128.680 | Acre-ft/Yr | | |
| BUAC | Billed Unmetered: | n | g | n/a | | Acre-ft/Yr | | |
| UMAC | Unbilled Metered: | n | g | n/a | | Acre-ft/Yr | | |
| UUAC | Unbilled Unmetered: | n | g | 3 | 50.322 | Acre-ft/Yr | 0.25% | default |

Default option selected for Unbilled Unmetered, with automatic data grading of 3

AUTHORIZED CONSUMPTION: 20,179.002 Acre-ft/Yr

## WATER LOSSES

654.432 Acre-ft/Yr

### Apparent Losses

Default option selected for Systematic Data Handling Errors, with automatic data grading of 3

choose entry option:

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| SDHE | Systematic Data Handling Errors: | n | g | 3 | 50.322 | Acre-ft/Yr | 0.25% | default | | |
| CMI | Customer Metering Inaccuracies: | n | g | 7 | 345.663 | Acre-ft/Yr | volume | 345.663 | acre-ft/yr | under-registration |
| UC | Unauthorized Consumption: | n | g | 3 | 50.322 | Acre-ft/Yr | 0.25% | default | | |

Default option selected for Unauthorized Consumption, with automatic data grading of 3

Apparent Losses: 446.306 Acre-ft/Yr

### Real Losses

Real Losses: 208.126 Acre-ft/Yr

WATER LOSSES: 654.432 Acre-ft/Yr

## NON-REVENUE WATER

NON-REVENUE WATER: 704.754 Acre-ft/Yr

## SYSTEM DATA

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Lm | Length of mains: | n | g | 10 | 434.7 | miles | (including fire hydrant lead lengths) |
| Nc | Number of service connections: | n | g | 10 | 32,138 | | (active *and* inactive) |
| | Service connection density: | | | | 74 | conn./mile main | |

Are customer meters typically located at the curbstop/property line? Yes

Lp n g 10

Average length of customer service line has been set to zero and a data grading of 10 has been applied

AOP Average Operating Pressure: n g 6 76.8 psi

## COST DATA

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| CRUC | Customer Retail Unit Charge: | n | g | 7 | $3.89 | $/100 cubic feet (ccf) | Total Annual Operating Cost | |
| VPC | Variable Production Cost: | n | g | 8 | $946.23 | $/acre-ft | $37,768,285 | $/yr (optional input) |

## WATER AUDIT DATA VALIDITY TIER:

***** The Water Audit Data Validity Score is in Tier III (51-70). See Dashboard tab for additional outputs. *****

go to dashboard

A weighted scale for the components of supply, consumption and water loss is included in the calculation of the Water Audit Data Validity Score

**PRIORITY AREAS FOR ATTENTION TO IMPROVE DATA VALIDITY:**

*Based on the information provided, audit reliability can be most improved by addressing the following components:*

1: Volume from Own Sources (VOS)
2: Water Imported (WI)
3: Billed Metered (BMAC)

**KEY PERFORMANCE INDICATOR TARGETS:**

*OPTIONAL: If targets exist for the operational performance indicators, they can be input below:*

| | | |
|---|---|---|
| Unit Total Losses: | | gal/conn/day |
| Unit Apparent Losses: | | gal/conn/day |
| Unit Real Losses[A]: | | gal/conn/day |
| Unit Real Losses[B]: | | gal/mile/day |

*If entered above by user, targets will display on KPI gauges (see Dashboard)*

2024

White = incomplete
Orange = complete
Use acronyms for navigation

Limiting criteria (see Start Page for details)

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go to input

## Volume from Own Sources (VOS) - Data Grading Criteria

go to notes

| vos | Criteria Question | Select Best-Fit Answers to All Visible Questions | |
|---|---|---|---|
| vos.0 | Did the water utility supply any water from its own sources during the audit year? | Yes | |
| vos.1 | What percent of own supply volume is metered? | >99% | |
| | **For questions 2-10 below: Choose the answer that applies for those meters that measure >90% of the finished water volume.**<br>**In-situ flow accuracy testing** = a test process that confirms the flow measuring accuracy of the primary device (the flowmeter), in its installed location, using an independent reference volume.<br>**Electronic calibration** = a process that checks for error in the metering secondary device(s) and/or the tertiary device(s).<br>**Secondary device** can include conversion to mA, meter transmitter or similar instrumentation.<br>**Tertiary device** can include SCADA, historian or other computerized archival system. | | |
| vos.2 | What is the frequency of electronic calibration? | Not applicable due to no electronic signal output (i.e. to SCADA) | |
| vos.3 | | | |
| vos.4 | | | |
| vos.5 | What is the frequency of in-situ flow accuracy testing? | Annually | |
| vos.6 | Is the most recent in-situ flow accuracy testing documentation available for review? | Yes | |
| vos.7 | What are the total volume-weighted average results of in-situ flow accuracy testing (during or closest to audit year)? | At or within ±3% | |
| vos.8 | Have testing and calibration procedures been closely scrutinized for compliance with procedures described in the AWWA M36 and/or M33 Manual(s)? | No | |
| vos.9 | Which best describes the frequency of finished water meter readings? | Daily | |
| vos.10 | Which best describes the frequency of data review for anomalies/errors? These can include numbers that are outside of typical patterns, and zero or 'null' values that may reflect a gap in data recording. | Once per month | Limiting |
| | **FINAL DATA GRADE FOR THIS AUDIT INPUT:** | **6** | |

go to input

## Volume from Own Sources Error Adjustment (VOSEA) - Data Grading Criteria

go to notes

| vosea | Criteria Question | Select Best-Fit Answers to All Visible Questions | |
|---|---|---|---|
| vosea.1 | Are tank levels monitored automatically & recorded daily? | Yes | |
| vosea.2 | Are daily changes of stored water volumes in distribution system tanks included in the tabulation of the daily "Volume from Own Sources" quantity? | No | Limiting |
| vosea.3 | Is the annual net distribution storage change included in either the VOS input or the VOSEA input? | Yes | |
| vosea.4 | Are the flow accuracy test and/or electronic calibration results included in the VOSEA input in the water audit? | Yes, results are analyzed and incorporated | |
| | **FINAL DATA GRADE FOR THIS AUDIT INPUT:** | **8** | |

go to input

## Water Imported (WI) - Data Grading Criteria

go to notes

| wi | Criteria Question | Select Best-Fit Answers to All Visible Questions | |
|---|---|---|---|
| wi.0 | Did the water utility import any water during the audit year? | Yes | |
| wi.1 | What percent of water imported is metered? | >99% | |
| | **For questions 2-10 below: Choose the answer that applies for those meters that measure >90% of the water imported volume.**<br>**In-situ flow accuracy testing** = a test process that confirms the flow measuring accuracy of the primary device (the flowmeter), in its installed location, using an independent reference volume.<br>**Electronic calibration** = a process that checks for error in the metering secondary device(s) and/or the tertiary device(s).<br>**Secondary device** can include conversion to mA, meter transmitter or similar instrumentation.<br>**Tertiary device** can include SCADA, historian or other computerized archival system. | | |
| wi.2 | What is the frequency of electronic calibration? | At least semi-annually | |
| wi.3 | What level of data transfer errors are checked as part of the electronic calibration process? | Data transfer errors are checked at secondary device(s) AND tertiary device(s) | |
| wi.4 | Is the most recent electronic calibration documentation available? | Yes | |
| wi.5 | What is the frequency of in-situ flow accuracy testing? | None, or Not within last 5 years | |
| wi.6 | | | |
| wi.7 | | | |
| wi.8 | Have testing and calibration procedures been closely scrutinized for compliance with procedures described in the AWWA M36 and/or M33 Manual(s)? | No | |
| wi.9 | Which best describes the frequency of meter readings (data collection frequency as opposed to billing frequency)? | Continuous | |
| wi.10 | What is the frequency of data review & correction by Exporting or Importing Utility for data gaps and/or anomalies? These can include numbers that are outside of typical patterns, and zero or 'null' values that may reflect a gap in data recording. | Once per month | Limiting |
| | **FINAL DATA GRADE FOR THIS AUDIT INPUT:** | **6** | |

go to input

## Water Imported Error Adjustment (WIEA) - Data Grading Criteria

go to notes

| wiea | Criteria Question | Select Best-Fit Answers to All Visible Questions | |
|---|---|---|---|
| wiea.1 | Is an agreement in place between Exporting and Importing Utility for the purchase of water? | Yes, written | |
| wiea.2 | Are meter accuracy testing or electronic calibration requirements stipulated in the water purchase agreement? | Yes, and stipulated frequency as annual | |
| wiea.3 | Are flow accuracy test and/or electronic calibration results used to inform the error adjustment input in the water audit? | Yes, results are analyzed and a 'no-adjustment' was determined | |
| wiea.4 | Who has access to the import meter readings including current and archived data? | Exporting Utility only | Limiting |
| | **FINAL DATA GRADE FOR THIS AUDIT INPUT:** | **7** | |

go to input

## Water Exported (WE) - Data Grading Criteria

go to notes

| we | Criteria Question | Select Best-Fit Answers to All Visible Questions |
|---|---|---|
| we.0 | Did the water utility export any water during the audit year? | No |
| we.1 | | |

**For questions 2-10 below: Choose the answer that applies for those meters that measure >90% of the water exported volume.**
**In-situ flow accuracy testing** = a test process that confirms the flow measuring accuracy of the primary device (the flowmeter), in its installed location, using an independent reference volume.
**Electronic calibration** = a process that checks for error in the metering secondary device(s) and/or the tertiary device(s).
**Secondary device** can include conversion to mA, meter transmitter or similar instrumentation.
**Tertiary device** can include SCADA, historian or other computerized archival system.

| | | |
|---|---|---|
| we.2 | | |
| we.3 | | |
| we.4 | | |
| we.5 | | |
| we.6 | | |
| we.7 | | |
| we.8 | | |
| we.9 | | |
| we.10 | | |
| | **FINAL DATA GRADE FOR THIS AUDIT INPUT:** | **n/a** |

go to input

## Water Exported Error Adjustment (WEEA) - Data Grading Criteria

go to notes

| weea | Criteria Question | Select Best-Fit Answers to All Visible Questions |
|---|---|---|
| weea.1 | | |
| weea.2 | | |
| weea.3 | | |
| weea.4 | | |
| | FINAL DATA GRADE FOR THIS AUDIT INPUT: | n/a |

go to input

## Billed Metered Authorized Consumption (BMAC) - Data Grading Criteria

go to notes

| bmac | Criteria Question | Select Best-Fit Answers to All Visible Questions | |
|---|---|---|---|
| bmac.0 | Were any customers metered in the audit year? | Yes | |
| bmac.1 | For billed metered accounts, what % of bills are estimated in a typical billing cycle? | 5% or less | |
| bmac.2 | How often does the utility read its customer meters?<br>For systems with multiple read frequencies, select the reading frequency that describes the majority of your customers. | Bi-Monthly | Limiting |
| bmac.3 | Is the BMAC volume pro-rated to represent consumption occuring exactly during the audit period? | Yes | |
| bmac.4 | How frequently does internal review by utility staff of the BMAC volumes occur? | Every billing cycle | |
| bmac.5 | What level of detail is examined in the internal review of BMAC volumes? | Totals grouped by use type or customer class and specific accounts flagged for anomalous consumption | |
| bmac.6 | When was the most recent billing data review by someone who is independent of the utility billing process? | Within last 3 years | |
| bmac.7 | What level of detail was examined in the review by someone who is independent of the utility billing process? | Full billing database query and analysis of raw data to verify the summary consumption volumes | |
| | **FINAL DATA GRADE FOR THIS AUDIT INPUT:** | **8** | |

go to input

## Billed Unmetered Authorized Consumption (BUAC) - Data Grading Criteria

go to notes

| buac | Criteria Question | Select Best-Fit Answers to All Visible Questions |
|---|---|---|
| buac.0 | Was there any billed consumption on unmetered accounts in the audit year? | No |
| buac.1 | | |
| buac.2 | | |
| buac.3 | | |
| | **FINAL DATA GRADE FOR THIS AUDIT INPUT:** | **n/a** |

go to input

## Unbilled Metered Authorized Consumption (UMAC) - Data Grading Criteria

go to notes

| umac | Criteria Question | Select Best-Fit Answers to All Visible Questions |
|---|---|---|
| umac.0 | Did the water utility have any unbilled-metered consumption in the audit year? | No |
| umac.1 | | |
| umac.2 | | |
| umac.3 | | |
| umac.4 | | |
| | FINAL DATA GRADE FOR THIS AUDIT INPUT: | n/a |

go to input

## Unbilled Unmetered Authorized Consumption (UUAC) - Data Grading Criteria

go to notes

This Data Grading Criteria is hidden when the 'default' input is used on the Worksheet

| | |
|---|---|
| **FINAL DATA GRADE FOR THIS AUDIT INPUT:** | **3** |

go to input

## Systematic Data Handling Error (SDHE) - Data Grading Criteria

go to notes

This Data Grading Criteria is hidden when the 'default' input is used on the Worksheet

| | |
|---|---|
| **FINAL DATA GRADE FOR THIS AUDIT INPUT:** | **3** |

go to input

## Customer Metering Inaccuracies (CMI) - Data Grading Criteria

go to notes

| cmi | Criteria Question | Select Best-Fit Answers to All Visible Questions | |
|---|---|---|---|
| cmi.0 | Was there any metered customer usage during the audit period? | Yes | |
| cmi.1 | Do you test meters reactively (when triggered by customer complaint or billing/consumption flag)? | Reactive testing conducted | |
| cmi.2 | For small size customer meters, which best describes the frequency of proactive testing (effort beyond when triggered by customer complaint or billing/consumption flags)? | Ongoing, conducted annually | |
| cmi.3 | Which best describes what meters are included in the proactive small size customer meter testing activities? | Testing targeted to subsets of meters ie oldest meters | Limiting |
| cmi.4 | For mid and large size customer meters, which best describes the frequency of the proactive testing program? | Ongoing, conducted annually | |
| cmi.5 | Which best describes what meters are included in the proactive mid- and large customer meter testing activities? | Proactive - all large meters are on a testing schedule | |
| cmi.6 | Which best describes how the input was derived? | Calculated based on most recent meter accuracy tests, but not comprehensive of all meter performance | |
| cmi.7 | Has the input derivation been reviewed by someone with expert knowledge in the M36 methodology? | Yes | |
| cmi.8 | To what extent does meter replacement occur and for which meters? | Annual proactive replacement of subset of meters (i.e. by age or throughput) | |
| cmi.9 | Which best describes the reliability of meter installation records? | Records are kept for meter installations, but data is missing for installation date, type, size, or manufacturer | |
| | **FINAL DATA GRADE FOR THIS AUDIT INPUT:** | **7** | |

go to input

## Unauthorized Consumption (UC) - Data Grading Criteria

go to notes

This Data Grading Criteria is hidden when the 'default' input is used on the Worksheet

| | |
|---|---|
| **FINAL DATA GRADE FOR THIS AUDIT INPUT:** | **3** |

go to input

## Length of Mains (Lm) - Data Grading Criteria

go to notes

| Lm | Criteria Question | Select Best-Fit Answers to All Visible Questions |
|---|---|---|
| Lm.1 | How was the input derived? | Derived directly from Mains inventory (GIS, ledger, etc) |
| Lm.2 | Are hydrant laterals included in the input derivation? | Yes |
| Lm.3 | Which best describes how the Mains inventory (GIS, ledger, etc) is kept up to date? | Additions or subtractions are updated in the mains inventory (GIS, ledger, etc), at least annually |
| Lm.4 | Which best describes how the Mains inventory (GIS, ledger, etc) is field validated to confirm field conditions match the inventory? | Field validation is accomplished (i.e. in daily operations or specific validation projects) |
| | **FINAL DATA GRADE FOR THIS AUDIT INPUT:** | **10** |

go to input

## Number of Service Connections (Nc) - Data Grading Criteria

go to notes

| Nc | Criteria Question | Select Best-Fit Answers to All Visible Questions |
|---|---|---|
| Nc.1 | How was the input derived? | Extracted from Services inventory (GIS, billing system, etc) |
| Nc.2 | What is the count of services based on? | Premise based, i.e. service connection count, location ID count |
| Nc.3 | Are inactive (but still pressurized) service lines included in the input? These may be metered or unmetered. | Yes |
| Nc.4 | Which best describes how the inventory of service connections (GIS, billing system, etc) is kept up to date? | Additions or subtractions are updated in the service line inventory (GIS, billing system, etc), at least annually |
| Nc.5 | Which best describes how the inventory of service connections (GIS, billing system, etc) is field validated to confirm field conditions match the inventory? | Field validation is accomplished for the entire system (i.e. in daily operations or specific validation projects) |
| | **FINAL DATA GRADE FOR THIS AUDIT INPUT:** | **10** |

go to input

## Average Length of (Private) Customer Service Line (Lp) - Data Grading Criteria

go to notes

| Lp | Criteria Question | Select Best-Fit Answers to All Visible Questions |
|---|---|---|
| Lp.0 | Are customer meters typically located at the curbstop or property line? | Yes |
| Lp.1 | | |
| Lp.2 | | |
| Lp.3 | | |
| Lp.4 | | |
| | **FINAL DATA GRADE FOR THIS AUDIT INPUT:** | **10** |

go to input

## Average Operating Pressure (AOP) - Data Grading Criteria

go to notes

| aop | Criteria Question | Select Best-Fit Answers to All Visible Questions | |
|---|---|---|---|
| aop.1 | Which best describes checks on the boundary integrity for the system's pressure zone(s)? | Normally-closed boundary valves between zones have never been confirmed to be fully closed | Limiting |
| aop.2 | Which best describes how one-time pressure readings (i.e. from hydrants) are collected? | Collected only if there are low pressure complaints, or new development requests | |
| aop.3 | Which best describes where continuous pressure data (via temporary data loggers or permanent telemetry) is collected? | At zone boundary conditions only (i.e. supply entry points, PRVs, booster stations) | |
| aop.4 | Which best describes how continuous pressure data is collected? | Year-round data collection via permanent monitoring | |
| aop.5 | How was the input derived? | Derived from hydraulic model, where model has not been field calibrated in the last 5 years | |
| | **FINAL DATA GRADE FOR THIS AUDIT INPUT:** | **6** | |

go to input

## Customer Retail Unit Charge (CRUC) - Data Grading Criteria

go to notes

| cruc | Criteria Question | Select Best-Fit Answers to All Visible Questions | |
|---|---|---|---|
| cruc.0 | Was any metered consumption billed on a volumetric basis in the audit period? | Yes | |
| cruc.1 | Which best describes the use and reliability of the current rate structure? | Customer bill calculations have been checked to confirm the rate structure is correctly implemented | |
| cruc.2 | Choose the option that best describes how the input was derived | A volume-weighted average of all rates was calculated | |
| cruc.3 | Is there any additional volumetric revenue the utility receives that depends on water meter readings, such as sewer? | Yes, but this has not been incorporated into the volume-weighted average calculation | Limiting |
| cruc.4 | Has the input derivation been reviewed by someone with expert knowledge in the M36 methodology? | Yes | |
| | **FINAL DATA GRADE FOR THIS AUDIT INPUT:** | **7** | |

go to input

## Variable Production Cost (VPC) - Data Grading Criteria

go to notes

| vpc | Criteria Question | Select Best-Fit Answers to All Visible Questions | |
|---|---|---|---|
| vpc.1 | Choose the option that best describes how the input was derived | Multiple sources of water exist, and a volume-weighted average was calculated for all sources | |
| vpc.2 | Choose the option that best describes which short-run marginal costs have been included in the input, using the definitions below for reference. Short-run marginal costs can include the following:<br>- chemicals + power for treatment, typically applicable if the utility is producing/treating water<br>- power for distribution, typically applicable if pumps exist in the distribution network<br>- water acquisition costs, typically applicable if the utility is purchasing water or incurs any extraction costs for withdrawing from a source<br>Some short-run marginal costs may not be applicable. The auditor should analyze the system characteristics to determine which costs are applicable for inclusion in the VPC input derivation. See also the latest AWWA M36 Manual for further guidance. | All applicable short-run marginal costs are included | |
| vpc.3 | Choose the option that best describes which long-run marginal costs have been included in the input, using the definitions below for reference. Long-run marginal costs can include the following:<br>- water treatment residuals management, typically applicable if solids are produced from water treatment process<br>- accelerated wear & tear on dynamic equipment, typically applicable if pumps exist for treatment and/or distribution, or any other equipment exists that wears out as a function of use instead of time (i.e. filter media, chemical dosing pumps, uv disinfection bulbs, etc)<br>- payouts for damage claims from main and service line breaks, typically applicable if damage claims are paid by the utility<br>- accelerated expansion of supply capacity, typically applicable if the utility is at or nearing supply capacity, or scarecity costs in water scarce areas<br>- full cost pricing that includes all lifecycle costs and externalities (internalized or not)<br>Some long-run marginal costs may not be applicable. The auditor should analyze the system characteristics to determine which costs are applicable for inclusion in the VPC input derivation. See also the latest AWWA M36 Manual for further guidance. | Long-run marginal costs have not been evaluated for applicability, and are not included | Limiting |
| vpc.4 | Has the input derivation been reviewed by someone with expert knowledge in the M36 methodology? | Yes | |
| | **FINAL DATA GRADE FOR THIS AUDIT INPUT:** | **8** | |

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# AWWA Free Water Audit Software: Dashboard

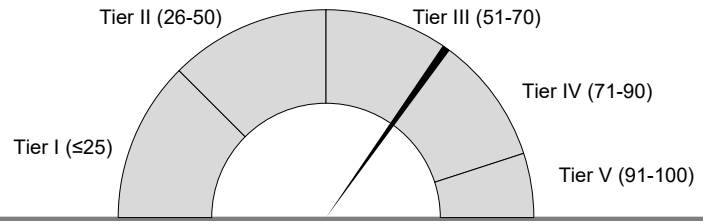
go to worksheet | go to grading | go to references

**Water Audit Report for: City of Fullerton** **Audit Year: 2024 Calendar** **Jan 01 2024 - Dec 31 2024**

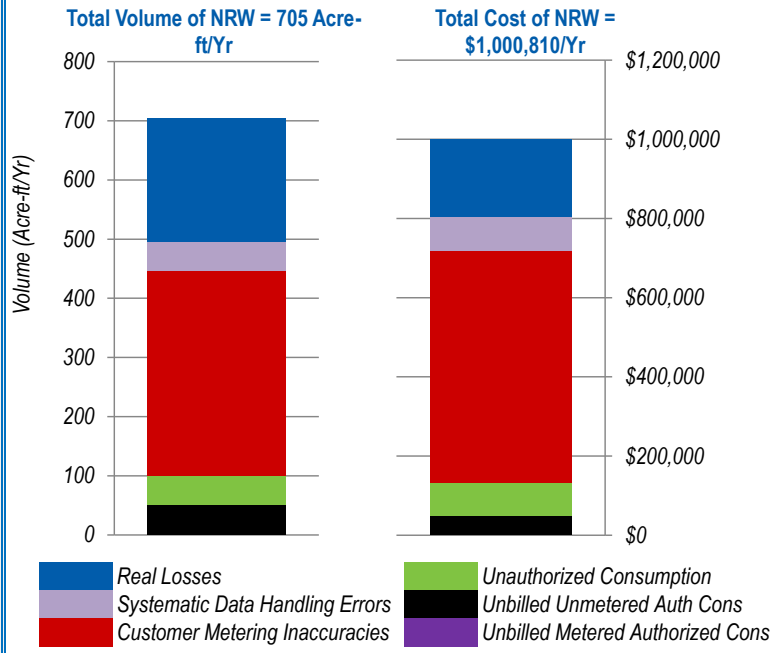
## Data Validity

**Data Validity Score:** 69 **Data Validity Tier:** Tier III (51-70)

See Loss Control Planning for Tier Details




## NRW Components Summary

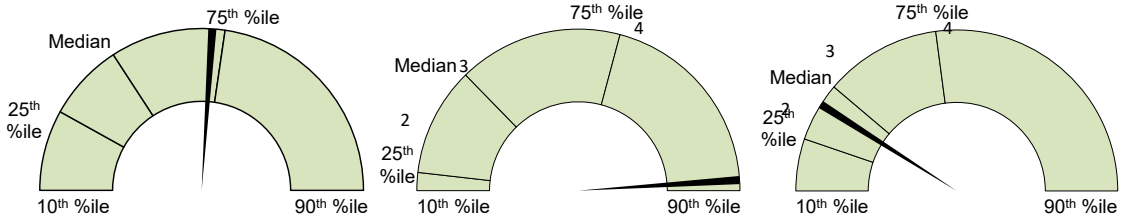



| | Volume Acre-ft/Yr | Value $/Yr | Basis of Valuation |
|---|---|---|---|
| *Apparent Losses* | 446.3 | $756,259 | *CRUC* |
| *Real Losses* | 208.1 | $196,935 | *VPC* |
| *Unbilled Authorized Cons* | 50.3 | $47,616 | *VPC* |
| *Non-Revenue Water* | 704.8 | $1,000,810 | *Blended* |

## Key Performance Indicators

Actual KPI result — Target (see Worksheet)

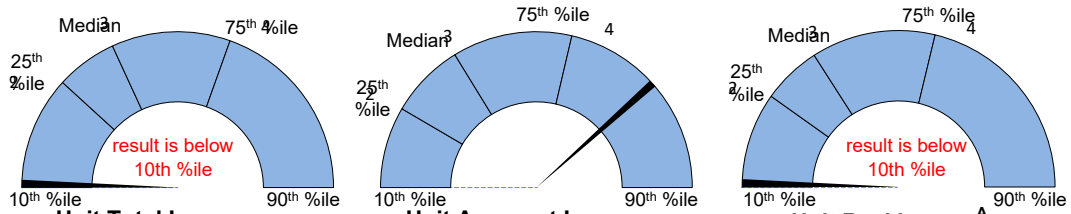
gauge %iles per validated industry ranges[2]




**Total Loss Cost Rate** 29.66 $/conn/year

**Apparent Loss Cost Rate** 23.53 $/conn/year

**Real Loss Cost Rate** 6.13 $/conn/year

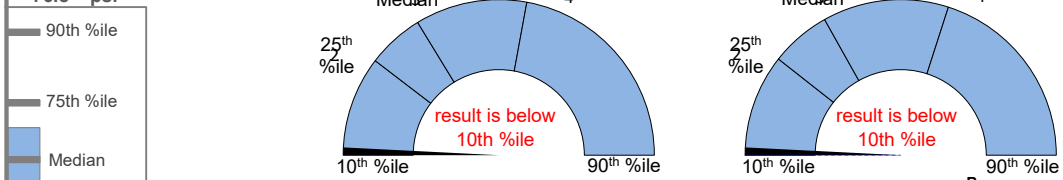



**Unit Total Losses** 18.2 gal/conn/day

**Unit Apparent Losses** 12.4 gal/conn/day

**Unit Real Losses**[A] 5.8 gal/conn/day

Average Operating Pressure 76.8 psi




**Infrastructure Leakage Index (ILI)** 0.3 dimensionless

**Unit Real Losses**[B] 427 gal/mile/day

See UARL definition for additional guidance on the ILI

(UARL) Unavoidable Annual Real Losses 617.0 Acre-ft/Yr 17.1 gal/conn/day

### Guidance Information for Key Performance

- The eight indicators shown are the recommended suite per the AWWA Water Loss Control Committee 2020 Position on KPIs[1].
- A suite of KPIs is necessary, as no single KPI can holistically communicate water loss performance for a given water system.
- See Table 1 below for Uses and Limitations for each KPI, excerpted from the AWWA Water Loss Control Committee Report (2020)[1], with naming conventions updated.
- Percentiles (%iles) shown on KPI gauges come from Level 1 validated data in the AWWA WLCC Reference Water Audit Dataset (2020)[2].
- KPI %iles shown above are not segregated by cohorts. Limited KPI data by cohorts may be found in WRF 4695 Guidance Manual, Appendix B (2019)[5].
- Actual KPI results that fall below 10th %ile or above 90th %ile do not necessarily imply error, but should be viewed with scrutiny.
- Percentiles not intended to imply targets. Targets may be input by user for operational KPIs, if desired, on Worksheet.
- See UARL and ILI in Definitions tab for discussion of size and pressure limitations.
- Systems that fall on the extreme ends of size or connection density should use caution when interpreting Unit Losses KPIs.

## Table 1

Source: AWWA Water Loss Control Committee Report (2020)[1], with naming conventions updated

## 2020 AWWA Water Audit Method – Water Audit Outputs and Key Performance Indicators: Uses and Limitations

| Type | Indicator | Description | Suitable Purposes | | | | | Uses and Limitations | Principal Users |
|---|---|---|---|---|---|---|---|---|---|
| | | | Assessment | Bench-Marking | Target-Setting | Planning | Tracking | | |
| **Attribute** | Apparent Loss Volume | Calculated by Free Water Audit Software | ✓ | | | | ✓ | Assess loss level | Utility, Regulators |
| | Apparent Loss Cost | Calculated by Free Water Audit Software | ✓ | | | | ✓ | Assess cost loss level | Utility, Regulators |
| | Real Loss Volume | Calculated by Free Water Audit Software | ✓ | | | | ✓ | Assess loss level | Utility, Regulators |
| | Real Loss Cost | Calculated by Free Water Audit Software | ✓ | | | | ✓ | Assess loss cost level | Utility, Regulators |
| | Unavoidable Annual Real Loss (UARL) | Calculated by Free Water Audit Software | ✓ | | | | ✓ | Reveal theoretical technical low level of leakage | Utility, Regulators |
| **Volume** | Unit Apparent Losses (vol/conn/day) | Strong and understandable indicator for multiple users. | ✓ | ✓ | ✓ | ✓ | ✓ | Used for performance tracking and target-setting | Utility, Regulators |
| | Unit Real Losses[A] (vol/conn/day) | Strong and understandable indicator for multiple users. | ✓ | ✓ | ✓ | ✓ | ✓ | Used for performance tracking and target-setting | Utility, Regulators, Policy Makers |
| | Unit Real Losses[B] (vol/pipeline length/ day) | Strong and understandable indicator for use by utilities with low connection density. | ✓ | ✓ | ✓ | ✓ | ✓ | Data collection and assessment of systems with "low" connection density | Utility, Regulators, Policy Makers |
| | Unit Total Losses (vol/conn/day) **New KPI** | Strong and understandable indicator, suitable for high-level performance measurement. | ✓ | | | | ✓ | High level indicator for trending analysis. Not appropriate for target-setting or benchmarking | Utilities, Customers |
| | Infrastructure Leakage Index (ILI) | Robust, specialized ratio KPI; can be influenced by pressure and connection density. | ✓ | ✓ | | | ✓ | Benchmarking after pressure management is implemented | Utilities |
| **Value** | Apparent Loss Cost Rate (value/conn/year) **New KPI** | Indicators with sufficient technical rigor. Provide the unit financial value of each type of loss, which is useful for planning and assessment of cost efficiency of water loss reduction and control interventions and programs. | ✓ | | | ✓ | ✓ | Data collection and assessment on AWWA indicators or contextual parameters to use in conjunction with Loss Cost Rates | Utilities, Regulators, Customers |
| | Real Loss Cost Rate (value/conn/year) **New KPI** | | ✓ | | | ✓ | ✓ | | Utilities, Regulators, Customers |
| **Validity** | Data Validity Tier (DVT) | Strong indicator of water loss audit data quality, if data has been validated. Tier provides guidance on priority areas of activity. | ✓ | ✓ | | ✓ | ✓ | Assess caliber of data inputs of the water audit | Regulators, Utilities |

# AWWA Free Water Audit Software: User Notes

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**Water Audit Report for:** City of Fullerton
**Audit Year:** 2024

**Calendar**
**Jan 01 2024 - Dec 31 2024**

| | |
|---|---|
| **General Notes:** | Population estimate pulled from Water Master Plan Update 2025 |

| | | Audit Item | Notes on Input Derivation | Notes on Data Validity Grading |
|---|---|---|---|---|
| go to worksheet | go to grading | **Volume from Own Sources (VOS)** | | |
| go to worksheet | go to grading | **Volume from Own Sources Error Adjustment (VOSEA)** | | |
| go to worksheet | go to grading | **Water Imported (WI)** | | |
| go to worksheet | go to grading | **Water Imported Error Adjustment (WIEA)** | | |
| go to worksheet | go to grading | **Water Exported (WE)** | | |

| | | Audit Item | Notes on Input Derivation | Notes on Data Validity Grading |
|---|---|---|---|---|
| go to worksheet | go to grading | Water Exported Error Adjustment (WEIA) | | |
| go to worksheet | go to grading | Billed Metered Authorized Consumption (BMAC) | | |
| go to worksheet | go to grading | Billed Unmetered Authorized Consumption (BUAC) | | |
| go to worksheet | go to grading | Unbilled Metered Authorized Consumption (UMAC) | | |
| go to worksheet | go to grading | Unbilled Unmetered Authorized Consumption (UUAC) | | |
| go to worksheet | go to grading | Systematic Data Handling Errors (SDHE) | | |
| go to worksheet | go to grading | Customer Metering Inaccuracies (CMI) | | |

| | | Audit Item | Notes on Input Derivation | Notes on Data Validity Grading |
|---|---|---|---|---|
| go to worksheet | go to grading | Unauthorized Consumption (UC) | | |
| go to worksheet | go to grading | Length of Mains (Lm) | | |
| go to worksheet | go to grading | Number of Service Connections (Nc) | | |
| go to worksheet | go to grading | Average Length of (private) Customer Service Line (Lp) | | |
| go to worksheet | go to grading | Average Operating Pressure (AOP) | | |
| go to worksheet | go to grading | Customer Retail Unit Charge (CRUC) | | |
| go to worksheet | go to grading | Variable Production Cost (VPC) | | |

Hello, I am a blank sheet, at your service.

***Non-revenue water as percent of cost of operating system:*** 2.6%

# AWWA Free Water Audit Software
## Water Balance

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**Water Audit Report for:** City of Fullerton
**Audit Year:** 2024 — Jan 01 2024 - Dec 31 2024
**Data Validity Tier:** Tier III (51-70)

| | | | | | | |
|---|---|---|---|---|---|---|
| Volume from Own Sources (VOS) (corrected for known errors) *14,892.310* | System Input Volume *20,833.434* | Water Exported (WE) (corrected for known errors) *0.000* | Billed Water Exported | | | Revenue Water (Exported) 0.000 |
| | | Water Supplied *20,833.434* | Authorized Consumption *20,179.002* | Billed Authorized Consumption *20,128.680* | Billed Metered Consumption (BMAC) (water exported is removed) *20,128.680* | Revenue Water 20,128.680 |
| | | | | | Billed Unmetered Consumption (BUAC) *0.000* | |
| | | | | Unbilled Authorized Consumption *50.322* | Unbilled Metered Consumption (UMAC) *0.000* | Non-Revenue Water (NRW) 704.754 |
| | | | | | Unbilled Unmetered Consumption (UUAC) *50.322* | |
| | | | Water Losses *654.432* | Apparent Losses *446.306* | Systematic Data Handling Errors (SDHE) *50.322* | |
| | | | | | Customer Metering Inaccuracies (CMI) *345.663* | |
| | | | | | Unauthorized Consumption (UC) *50.322* | |
| Water Imported (WI) (corrected for known errors) *5,941.124* | | | | Real Losses *208.126* | 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: Determining Water Loss Standing

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**Water Audit Report for:** City of Fullerton
**Audit Year:** 2024 | Jan 01 2024 - Dec 31 2024
**Data Validity Tier:** Tier III (51-70)

## Water Loss Control Planning Guide

| | Water Audit Data Validity Tier (Score Range) | | | | |
|---|---|---|---|---|---|
| **Functional Focus Area** | **Tier I (1-25)** | **Tier II (26-50)** | **Tier III (51-70)** | **Tier IV (71-90)** | **Tier V (91-100)** |
| Audit Data Collection | Launch auditing and loss control team; address supply metering deficiencies | Analyze business process for customer metering and billing functions and water supply operations; Identify data gaps; improve supply metering | Establish/revise policies and procedures for data collection | Refine data collection practices and establish as routine business process | Annual water audit is a reliable gauge of year-to-year water efficiency standing |
| Short-term loss control | Research information on leak detection programs; Begin flowcharting analysis of customer billing system | Conduct loss assessment investigations on a sample portion of the system: customer meter testing, leak survey, unauthorized consumption, etc | Establish ongoing mechanisms for customer meter accuracy testing, active leakage control and infrastructure monitoring | Refine, enhance or expand ongoing programs based upon economic justification | Stay abreast of improvements in metering, meter reading, billing, leakage management and infrastructure rehabilitation |
| Long-term loss control | | Begin to assess long-term needs requiring large expenditure: customer meter replacement, water main replacement program, new customer billing system or AMR/AMI system | Begin to assemble economic business case for long-term needs based upon improved data becoming available through the water audit process | Conduct detailed planning, budgeting and launch of comprehensive improvements for metering, billing or infrastructure management | Continue incremental improvements in short-term and long-term loss control interventions |
| Target-setting | | | Establish long-term apparent and real loss reduction goals (+10 year horizon) | Establish mid-range (5 year horizon) apparent and real loss reduction goals | Evaluate and refine loss control goals on a yearly basis |
| Benchmarking | | | Preliminary Comparisons - can begin to rely upon with PIs for performance comparisons for real losses | Performance Benchmarking with PIs is meaningful in comparing real loss standing | Identify Best Practices/ Best in class; PIs are very reliable as real loss performance indicators for best in class service |

*For validity scores of 50 or below, the shaded blocks should not be focus areas until better data validity is achieved.*

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| Item Name | Description |
|---|---|
| **Apparent Losses**<br>Find | = systematic data handling errors + customer metering inaccuracies + unauthorized consumption<br><br>Apparent Losses include all types of inaccuracies associated with customer metering (worn meters as well as improperly sized meters or wrong type of meter for the water usage profile) as well as systematic data handling errors (meter reading, billing, archiving and reporting), plus unauthorized consumption (theft or illegal use).<br>NOTE: Over-estimation of Apparent Losses results in under-estimation of Real Losses. Under-estimation of Apparent Losses results in over-estimation of Real Losses. |
| **AUTHORIZED CONSUMPTION**<br>Find | = billed metered + billed unmetered + unbilled metered + unbilled unmetered consumption<br><br>The volume of metered and/or unmetered water taken by registered customers, the water utility's own uses, and uses of others who are implicitly or explicitly authorized to do so by the water utility; for residential, commercial, industrial and public-minded purposes.<br><br>Typical retail customers' consumption is tabulated usually from established customer accounts as billed metered consumption, or - for unmetered customers - billed unmetered consumption. These types of consumption, along with billed water exported, provide revenue potential for the water utility. Typically a lag will exist between timing for reading of supply meters and reading of customer meters. A lag-time correction should typically be calculated to account for this. **Be certain to tabulate the water exported volume as a separate component and do not "double-count" it by including in the billed metered consumption component as well as the water exported component.**<br><br>Unbilled authorized consumption occurs typically in non-account uses, including water for fire fighting and training, flushing of water mains and sewers, street cleaning, watering of municipal gardens, public fountains, or similar public-minded uses. Occasionally these uses may be metered and billed (or charged a flat fee), but usually they are unmetered and unbilled. In the latter case, the water auditor may use a default value to estimate this quantity, or implement procedures for the reliable quantification of these uses. This starts with documenting usage events as they occur and estimating the amount of water used in each event. (See Unbilled Unmetered Authorized Consumption) |
| View Service Connection Diagram<br><br>**Average Length of (private) Customer Service Line (Lp)**<br><br>Find | This is the average length of underground customer service line, Lp, that is owned and maintained by the customer; from the point of ownership transfer to the customer water meter, or building line (if unmetered). The quantity is one of the data inputs for the calculation of Unavoidable Annual Real Losses (UARL), which serves as the denominator of the performance indicator: Infrastructure Leakage Index (ILI). The value of Lp is multiplied by the number of customer service connections to obtain a total length of customer owned piping in the system. The purpose of this parameter is to account for the unmetered service line infrastructure that is the responsibility of the customer for arranging repairs of leaks that occur on their lines. In many cases leak repairs arranged by customers take longer to be executed than leak repairs arranged by the water utility on utility-maintained piping. Leaks run longer - and lose more water - on customer-owned service piping, than utility owned piping.<br><br>If the customer water meter exists near the ownership transfer point (usually the curb stop located between the water main and the customer premises) this distance is zero because the meter and transfer point are the same. This is the often encountered configuration of customer water meters located in an underground meter box or "pit" outside of the customer's building. The Free Water Audit Software asks a "Yes/No" question about the meter at this location. If the auditor selects "Yes" then this distance is set to zero and the data grading score for this component is set to 10.<br><br>If water meters are typically located inside the customer premise/building, or properties are unmetered, it is up to the water auditor to estimate a system-wide average Lp length based upon the various customer land parcel sizes and building locations in the service area. Lp will be a shorter length in areas of high density housing, and a longer length in areas of low density housing and varied commercial and industrial buildings. General parcel demographics should be employed to obtain a total Lp length (Lc) and subsequently a weighted average Lp length for the entire system.<br><br>Refer to the "Service Connection Diagram" worksheet for a depiction of the service line/metering configurations that typically exist in water utilities. This worksheet gives guidance on the determination of the Average Length, Lp, for each configuration. |
| **Average Operating Pressure (AOP)**<br><br>Find | This is the average pressure in the distribution system that is the subject of the water audit. If the water utility is compiling the water audit for the first time, the average pressure can be approximated, but with a low data grading. In subsequent years of auditing, effort should be made to improve the accuracy of the average pressure quantity. This will then qualify the value for a higher data grading.<br><br>In the absence of a hydraulic model, the average pressure may be approximated by obtaining readings of static water pressure from a representative sample of fire hydrants or other system access points evenly located across the system. A weighted average of the pressure can be assembled; but be sure to take into account the elevation of the fire hydrants, which typically exist several feet higher than the level of buried water pipelines.<br><br>If your water utility has an up-to-date and calibrated hydraulic model of the water distribution system, it can be utilized to obtain a very accurate quantity of average pressure. However using the average pressure of all “nodes” in the system model is not necessarily the most accurate way to calculate the average operating pressure. This is especially true if there are significant pressure differences throughout the system, and the “nodes” are not evenly distributed throughout the distribution system. The most accurate calculation is to obtain the average pressure that each pipe segment experiences. The way to do this is to calculate the pressure at each end of the pipe. Then calculate the average of those two values and multiply this average value by the length of that pipe. This must be calculated for all pipe segments in the model. Finally calculate the sum of all of these values and and divide by the total pipe length. This effectively calculates a weighted average of pressure over the total pipe length. For low density systems (<32 connections/mile), average mains pressures at the service connection or curb stop may have greater influence and should be considered. |
| **Billed Authorized Consumption** | All consumption that is billed and authorized by the utility. This may include both metered and unmetered consumption. See "Authorized Consumption" for more information. |

| Item Name | Description |
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| **Billed Metered Authorized Consumption (BMAC)** Find | All metered consumption which is billed to retail customers, including all groups of customers such as domestic, commercial, industrial or institutional. **It does NOT include water supplied to neighboring utilities (water exported) which is metered and billed. Be sure to subtract any consumption for exported water sales that may be included in these billing roles. Water supplied as exports to neighboring water utilities should be included only in the Water Exported component.** The metered consumption data can be taken directly from billing records for the water audit period. The accuracy of yearly metered consumption data can be refined by including an adjustment to account for customer meter reading lag time since not all customer meters are read on the same day of the meter reading period. However additional analysis is necessary to determine the lag time adjustment value, which may or may not be significant. |
| **Billed Unmetered Authorized Consumption (BUAC)** Find | All billed consumption which is calculated based on estimates or norms from water usage sites that have been determined by utility policy to be left unmetered. This is typically a very small component in systems that maintain a policy to meter their customer population. However, this quantity can be the key consumption component in utilities that have not adopted a universal metering policy. **This component should NOT include any water that is supplied to neighboring utilities (water exported) which is unmetered but billed. Water supplied as exports to neighboring water utilities should be included only in the Water Exported component.** |
| **Customer Metering Inaccuracies (CMI)** Find | Apparent water losses caused by the collective under-registration of customer water meters. Many customer water meters gradually wear as large cumulative volumes of water are passed through them over time. This causes the meters to under-register the flow of water. This occurrence is common with smaller residential meters of sizes 5/8-inch and 3/4 inch after they have registered very large cumulative volumes of water, which generally occurs only after periods of years. For meters sized 1-inch and larger - typical of multi-unit residential, commercial, institutional and industrial accounts - meter under-registration can occur from wear or from the improper application of the meter; i.e. installing the wrong type of meter or the wrong size of meter, for the flow pattern (profile) of the consumer. For instance, many larger meters have reduced accuracy at low flows. If an oversized meter is installed, most of the time the routine flow will occur in the low flow range of the meter, and a significant portion of it may not be registered. It is important to properly select and install all meters, but particularly large customer meters, size 1-inch and larger.<br><br>The auditor has two options for entering data for this component of the audit. The auditor can enter a percentage under-registration (typically an estimated value), this will apply the selected percentage to the two categories of metered consumption to determine the volume of water not recorded due to customer meter inaccuracy. Note that this percentage is a composite average inaccuracy for all customer meters in the entire meter population. The percentage will be multiplied by the sum of the volumes in the Billed Metered and Unbilled Metered components. Alternatively, if the auditor has substantial data from meter testing activities, he or she can calculate their own loss volumes, and this volume may be entered directly.<br><br>Note that a value of zero will be accepted but is not recommended, as all metered systems tend to have some degree of inaccuracy. A positive value should be entered. A value of zero in this component is generally valid only if the water utility does not meter its customer population.<br><br>The formula for caculating a volume of CMI from a percentage input is as follows: CMI volume = (BMAC+UMAC)/(1-CMI%)-(BMAC+UMAC) |
| **Customer Retail Unit Charge (CRUC)** Find | The Customer Retail Unit Charge represents the volumetric portion of the total charges that customers pay for water service. The CRUC does not include fixed charges. This unit charge cost is applied routinely to the components of Apparent Loss, since these losses represent water reaching customers but not (fully) paid for. Since most water utilities have a rate structure that includes a variety of different charges costs based upon class of customer, a volume-weighted average of water sold at each unique rate should be calculated to determine a single composite charge that should be entered into this cell. Finally, the weighted average charge should also include additional charges for sewer, storm water or biosolids processing, but only if these charges are based upon the volume of potable water consumed.<br><br>For water utilities in regions with limited water resources and a questionable ability to meet the drinking water demands in the future, the Customer Retail Unit Charge Cost might also be applied to value the Real Losses; instead of applying the Variable Production Cost to Real Losses. In this way, it is assumed that every unit volume of leakage reduced by leakage management activities will be sold to a customer.<br><br>Note: the Free Water Audit Software allows the user to select the units that are charged to customers (either $/1,000 gallons, $/hundred cubic feet, or $/1,000 litres) and automatically converts these units for purpose of calculating Apparent Loss valuations. The monetary units are United States dollars, $. |
| **Infrastructure Leakage Index (ILI)** Find | The ratio of the Current Annual Real Losses (Real Losses) to the Unavoidable Annual Real Losses (UARL). This performance indicator is dimensionless.<br><br>**NOTES ON THE UARL AND ILI:**<br>1. This Free Water Audit Software version 6 presents the calculated UARL and ILI for systems of all sizes and all pressures. Some published research is now available on predicting how UARL is likely to be modified when modeling low leakage limits in systems that are very small (< 3000 conn), or have very low average pressures, or have very high pressures (aka boundary cases). Inherent over- or under- estimation of UARL volume may exist in these boundary cases, as they operate at or near the limits of the UARL model assumptions. More widespread application and understanding of system specific corrections to the UARL model in these boundary cases is now likely to occur, but are not included in the FWAS at the time of this publication. Caution is advised when using the standard UARL modeled value (and subsequently the ILI) for boundary cases. In boundary cases, the ILI may still be considered a general Performance Indicator, but not used as an absolute performance measurement or for benchmark comparisons.<br><br>2. The UARL term is based on average operating pressure in a given audit year, and a utility's current pressure conditions may not be optimized. Thus, ILI should always be interpreted with some measure of pressure, and only used for tracking progress if all justifiable pressure management has already been completed. |

| Item Name | Description |
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| **Length of Mains (Lm)**<br>Find | Length of all pipelines (except service connections) in the system starting from the point of system input metering (for example at the outlet of the treatment plant). It is also recommended to include in this measure the total length of fire hydrant lead pipe. Hydrant lead pipe is the pipe branching from the water main to the fire hydrant. Fire hydrant leads are typically of a sufficiently large size that is more representative of a pipeline than a service connection. The average length of hydrant leads across the entire system can be assumed if not known, and multiplied by the number of fire hydrants in the system, which can also be assumed if not known. This value can then be added to the total pipeline length. Total length of mains can therefore be calculated as:<br><br>Length of Mains, miles = (total pipeline length, miles) + [ {(average fire hydrant lead length, ft) x (number of fire hydrants)} / 5,280 ft/mile ]<br>or<br>Length of Mains, kilometres = (total pipeline length, kilometres) + [ {(average fire hydrant lead length, metres) x (number of fire hydrants)} / 1,000 metres/kilometre ] |
| **NON-REVENUE WATER**<br>Find | = Apparent Losses + Real Losses + Unbilled Metered Consumption + Unbilled Unmetered Consumption. This is water which does not provide revenue potential to the utility. |
| **Number of Service Connections (Nc)**<br>Find | Number of customer service connections, extending from the water main to supply water to a customer. This includes the actual number of pressurized piping connections, including fire connections, **whether active or inactive**. This may differ substantially from the number of customers (or number of accounts).<br>**Note: this number does not include the pipeline leads to fire hydrants. The total length of piping supplying fire hydrants should be <u>included</u> in the "Length of mains" input, and <u>excluded</u> from the Number of service connections input.** |
| **Real Losses**<br>Find | Physical water losses from the pressurized system (water mains and customer service connections) and the utility's storage tanks, up to the point of customer consumption. In metered systems this is the customer meter, in unmetered situations this is the first point of consumption (stop tap/tap) within the property. The annual volume lost through all types of leaks, breaks and overflows depends on frequencies, flow rates, and average duration of individual leaks, breaks and overflows. |
| **Revenue Water** | Those components of System Input Volume that are billed and have the potential to produce revenue. |
| **Service Connection Density**<br>Find | =number of customer service connections / length of mains |
| **Systematic Data Handling Errors (SDHE)**<br>Find | Apparent losses caused by accounting omissions, errant computer programming, gaps in policy, procedure, and permitting/activation of new accounts; and any type of data lapse that results in under-stated customer water consumption in summary billing reports. **Systematic Data Handling Errors occur as a customer consumption volume and can result in a direct loss of revenue potential. Water utilities can find "lost" revenue by keying on this component.**<br><br>Utilities typically measure water consumption volumes registered by water meters at customer premises. The meter should be read routinely (ex: monthly) and the data transferred to the Customer Billing System, which generates and sends a bill to the customer. Data Transfer Errors result in the registered consumption volume value being less than the actual consumption volume, creating an apparent loss. Such error might occur from illegible and mis-recorded hand-written readings compiled by meter readers, inputting an incorrect meter register unit conversion factor in the automatic meter reading equipment, or a variety of similar errors.<br><br>Apparent losses also occur from Data Analysis Errors in the archival and data reporting processes of the Customer Billing System. Inaccurate estimates used for accounts that fail to produce a meter reading are a common source of error. Billing adjustments may award customers a rightful monetary credit, but do so by creating a negative value of consumption volume, thus under-stating the actual consumption. Account activation lapses may allow new buildings to begin using water for months without meter readings and billing. Poor permitting and construction inspection practices can result in a new building water service commencing without a billing account, a water meter and meter reading; i.e., the customer is unknown to the utility's billing system. Close auditing of the permitting, metering, meter reading, billing and reporting processes of the water consumption data trail can uncover data management gaps that create volumes of systematic data handling error. Utilities should routinely analyze customer billing records to detect data anomalies and quantify these losses. For example, a billing account that registers zero consumption for two or more billing cycles should be checked to explain why usage has seemingly halted. Given the revenue loss impacts of these losses, water utilities are well-justified in providing continuous oversight and timely correction of data transfer errors & data handling errors.<br><br>If the water auditor has not yet gathered detailed data or assessment of systematic data handling error, it is recommended that the auditor apply the default value of 0.25% of the Billed Authorized Consumption volume. However, if the auditor has investigated the billing system and its controls, and has well validated data that indicates the volume from systematic data handling error is substantially higher or lower than that generated by the default value, then the auditor should enter a quantity that was derived from the utility investigations and select an appropriate grading. Negative or zero values are not allowed for this audit component.<br><br>Note: occasionally billed consumption volumes for a customer account may be over-stated due to issues of double-counting an account or applying an over-stated meter multiplier. The possibility of such occurrences should be explored in the data validation process, particularly if billed authorized consumption volumes for the year, or for any sub-group of customers (by classification or meter size), appears to be inordinately high. It is recommended to correct any such errors in the billed consumption total for the year, rather than consider these volumes part of Systematic Data Handling Error. |
| **Total annual operating cost (optional input)**<br>Find | *This input has been made optional, as it is no longer used in calculating a Performance Indicator. Auditors are welcome to continue to track this input as desired.* These costs include those for operations, maintenance and any annually incurred costs for long-term upkeep of the drinking water supply and distribution system. It should include the costs of day-to-day upkeep and long-term financing such as repayment of capital bonds for infrastructure expansion or improvement. Typical costs include employee salaries and benefits, materials, equipment, insurance, fees, administrative costs and all other costs that exist to sustain the drinking water supply. Depending upon water utility accounting procedures or regulatory agency requirements, it may be appropriate to include depreciation in the total of this cost. This cost should not include any costs to operate wastewater, biosolids or other systems outside of drinking water. |

| Item Name | Description |
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| **Unauthorized Consumption (UC)**<br>Find | Includes water illegally withdrawn from fire hydrants, illegal connections, bypasses to customer consumption meters, or tampering with metering or meter reading equipment; as well as any other ways to receive water while thwarting the water utility's ability to collect revenue for the water. Unauthorized consumption results in uncaptured revenue and creates an error that understates customer consumption. In most water utilities this volume is low and, if the water auditor has not yet gathered detailed data for these loss occurrences, it is recommended to use the default value of 0.25% of the Billed Authorized Consumption volume. However, if the auditor has investigated unauthorized occurrences, and has well validated data that indicates the volume from unauthorized consumption is substantially higher or lower than that generated by the default value, then the auditor should enter a quantity that was derived from the utility investigations. Note that a value of zero will not be accepted since all water utilities tend to have some volume of unauthorized consumption occurring in their system. |
| **Unavoidable Annual Real Losses (UARL)**<br>Find | The UARL is a theoretical reference value representing the technical low limit of leakage for well managed systems in good condition, with aggressive active leakage control. It is a key variable in the calculation of the Infrastructure Leakage Index (ILI).<br><br>UARL (gallons) = (5.41Lm + 0.15Nc + 7.5Lc) x P x 365 d/year,<br>or<br>UARL (litres) = (18.0Lm + 0.8Nc + 25.0Lc) x P x 365 d/year<br><br>where:<br>Lm = length of mains (miles or kilometres)<br>Nc = number of customer service connections<br>Lp = the average length of customer service connection piping (feet or metres)<br>(see the Worksheet "Service Connection Diagram" for guidance on deterring the value of Lp)<br>Lc = total length of customer service connection piping (miles or km)<br>Lc = Nc X Lp (miles or kilometres)<br>P = Average operating pressure (psi or metres) (see Average Operating Pressure definition)<br><br>**NOTES ON THE UARL AND ILI:**<br>1. This Free Water Audit Software version 6 presents the calculated UARL and ILI for systems of all sizes and all pressures. Some published research is now available on predicting how UARL is likely to be modified when modeling low leakage limits in systems that are very small (< 3000 conn), or have very low average pressures, or have very high pressures (aka boundary cases). Inherent over- or under- estimation of UARL volume may exist in these boundary cases, as they operate at or near the limits of the UARL model assumptions. More widespread application and understanding of system specific corrections to the UARL model in these boundary cases is now likely to occur, but are not included in the FWAS at the time of this publication. Caution is advised when using the standard UARL modeled value (and subsequently the ILI) for boundary cases. In boundary cases, the ILI may still be considered a general Performance Indicator, but not used as an absolute performance measurement or for benchmark comparisons.<br>2. The UARL term is based on average operating pressure in a given audit year, and a utility's current pressure conditions may not be optimized. Thus, ILI should always be interpreted with some measure of pressure, and only used for tracking progress if all justifiable pressure management has already been completed. |
| **Unbilled Authorized Consumption** | All consumption that is unbilled, but still authorized by the utility. This includes Unbilled Metered Authorized Consumption (UMAC) + Unbilled Unmetered Authorized Consumption (UUAC). See "Authorized Consumption" for more information. |
| **Unbilled Metered Authorized Consumption (UMAC)**<br>Find | Metered consumption which is authorized by the water utility, but, for any reason, is deemed by utility policy to be unbilled. This might for example include metered water consumed by the utility itself in treatment or distribution operations, or metered water provided to civic institutions free of charge. **It does not include water supplied to neighboring utilities (water exported) which may be metered but not billed.** |
| **Unbilled Unmetered Authorized Consumption (UUAC)**<br>Find | Any kind of Authorized Consumption which is neither billed nor metered. This component typically includes water used in activities such as fire fighting, flushing of water mains and sewers, street cleaning, fire flow tests conducted by the water utility, etc. In most water utilities it is a small component.<br><br>This component does NOT include water supplied to neighboring utilities (water exported) which is unmetered and unbilled – an unlikely case. Also, if any potable water used at a water treatment plant is tapped from a location upstream of the meter(s) used to determine the Volume from Own Sources in the audit, this is outside of the boundary of the audit and should therefore not be included as part of Unbilled, Unmetered Authorized Consumption.<br><br>This component has many sub-components of water use which may not yet be quantified. The default is 0.25% of the Billed Authorized Consumption volume (BMAC + BUAC), and is recommended for temporary use if customized estimates are not yet available, with recommendation to begin tracking and estimating these volumes for the next audit.<br><br>Note that a value of zero is not permitted, since all water utilities likely have some volume of water in this component occurring in their system. |
| **Units and Conversions** | The user may develop an audit based on one of three unit selections:<br>1) Million Gallons (US)<br>2) Megalitres (Thousand Cubic Metres)<br>3) Acre-feet<br>Once this selection has been made in the instructions sheet, all calculations are made on the basis of the chosen units. Should the user wish to make additional conversions, a unit converter is provided below (use drop down menus to select units): |

| Item Name | Description |
|---|---|
| | Enter Units: Convert From… / Converts to….. <br> 100 Million Gallons (US) = 306.888329 Acre-feet <br> (conversion factor = 3.0689) |
| **Variable Production Cost (VPC) (applied to Real Losses)** <br> Find | The cost to produce and supply the next unit of water (e.g., $/million gallons). This cost can include both short-run and long-run marginal costs. See the VPC data grading questions on IDG tab for examples of short-run and long-run marginal costs that may be included. <br><br> It is common to apply the VPC unit cost to the volume of Real Losses. However, if water resources are strained and the ability to meet future drinking water demands is in question, then the water auditor may be justified in applying the Customer Retail Unit Charge to the Real Loss volume, rather than applying the Variable Production Cost. |
| **Volume from Own Sources (VOS)** <br> Find | The volume of water withdrawn (abstracted) from water resources (rivers, lakes, streams, wells, etc) controlled by the water utility, and then treated for potable water distribution. Most water audits are compiled for utility retail water distribution systems, so this volume should reflect the amount of treated drinking water that entered the distribution system. Often the volume of water measured as treated effluent of the treatment works is slightly less than the volume measured at the raw water source, since some of the water is used in the treatment process. Thus, it is useful if flows are metered at the effluent of the treatment works. Water treatment plants are also often supplied potable drinking water and therefore are a "customer" of the water utility. If the service connection line serving the water treatment plant is downstream of treated water effluent flowmeters, this water should be metered and billed as billed authorized consumption. In this case, this volume of water does not enter into any calculations for Volume from Own Sources. If the service connection line suppling potable water to the treatment plant is upstream of treated water effluent flowmeters, then this water is considered "process" water and included with calculations accounting for process water use. <br> If metering exists only at the raw water source, an adjustment for water used in the treatment process should be included to account for water consumed in treatment operations such as filter backwashing, basin flushing and cleaning, plant potable water consumption (if the supply is drawn upstream of effluent flowmetering.) and similar uses. If the audit is conducted for a wholesale water agency that sells untreated water, then this quantity reflects the measure of the raw water, typically metered at the source. |
| **Volume from own sources: error adjustment** <br> Find | An estimate or measure of the degree of inaccuracy that exists in the master (production) meters measuring the annual Volume from own Sources, and any error in the data trail that exists to collect, store and report the summary production data. This adjustment is a weighted average number that represents the collective error for all master meters for all days of the audit year and any errors identified in the data trail. Meter error can occur in different ways. A meter or meters may be inaccurate by under-registering flow (did not capture all the flow), or by over-registering flow (overstated the actual flow). Data error can occur due to data gaps caused by temporary outages of the meter or related instrumentation. All water utilities encounter some degree of inaccuracy in master meters and data errors in archival systems are common. Enter a positive percentage or volume, then select 'under-registration' or 'over-registration' from the drop-down immediately adjacent. **See Water Supplied Error Adjustments definition for guidance on how to calculate this input.** |
| **Water Exported (WE)** <br> Find | The Water Exported volume is the bulk water conveyed or sold by the water utility to neighboring water systems that exists outside of their service area. Typically this water is metered at the custody transfer point of interconnection between the two water utilities. Usually the meter(s) are owned by the water utility that is selling or transfering the water: i.e. the exporter. If the water utility who is compiling the annual water audit sells or transfers bulk water in this manner, they are an exporter of water. <br><br> Note: The Water Exported volume is typically sold to wholesale customers who are charged a wholesale rate that is different than retail rates charged to the retail customers existing within the service area. Many state regulatory agencies require that the Water Exported volume be reported to them as a quantity separate and distinct from the retail customer billed consumption. For these reasons - and others - the Water Exported volume is always quantified separately from Billed Authorized Consumption in the standard water audit. **Be certain not to "double-count" this quantity by including it in both the Water Exported box and the Billed Metered Consumption box of the water audit Worksheet. This volume should be included only in the Water Exported box.** |
| **Water Exported: Error Adjustment (WEEA)** <br> Find | An estimate or measure of the volume by which the Water Exported volume is incorrect. This adjustment is a weighted average that represents the collective error for all of the metered and archived exported flow for all days of the audit year. Meter error can occur in different ways. A meter may be inaccurate by under-registering flow (did not capture all the flow), or by over-registering flow (overstated the actual flow). Error in the metered, archived data can also occur due to data gaps caused by temporary outages of the meter or related instrumentation. All water utilities encounter some degree of error in their metered data, particularly if meters are aged and infrequently tested. Occasional errors also occur in the archived data. Enter a positive percentage or volume, then select 'under-registration' or 'over-registration' from the drop-down immediately adjacent. If regular meter accuracy testing is conducted on the meter(s) - which is usually conducted by the water utility selling the water - then the results of this testing can be used to help quantify the meter error adjustment. Corrections to data gaps or other errors found in the archived data should also be included as a portion of this meter error adjustment. **See Water Supplied Error Adjustments definition for guidance on how to calculate this input.** |
| **Water Imported (WI)** <br> Find | The Water Imported volume is the bulk water purchased to become part of the Water Supplied volume. Typically this is water purchased from a neighboring water utility or regional water wholesale supplier, and is metered at the custody transfer point of interconnection between the two water utilities. Usually the meter(s) are owned by the water supplier selling the water to the utility conducting the water audit. The water supplier selling the bulk water usually charges the receiving utility based upon a wholesale water rate. |

| Item Name | Description |
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| **Water Imported: Error Adjustment (WIEA)**<br><br>Find | An estimate or measure of the volume by which the Water Imported volume is incorrect. This adjustment is a weighted average that represents the collective error for all of the metered and archived imported flow for all days of the audit year. Meter error can occur in different ways. A meter may be inaccurate by under-registering flow (did not capture all the flow), or by over-registering flow (overstated the actual flow). Error in the metered, archived data can also occur due to data gaps caused by temporary outages of the meter or related instrumentation. All water utilities encounter some level of meter inaccuracy, particularly if meters are aged and infrequently tested. Occasional errors also occur in the archived metered data. Enter a positive percentage or volume, then select 'under-registration' or 'over-registration' from the drop-down immediately adjacent. If regular meter accuracy testing is conducted on the meter(s) - which is usually conducted by the water utility selling the water - then the results of this testing can be used to help quantify the meter error adjustment. **See Water Supplied Error Adjustments definition for guidance on how to calculate this input.** |
| **Water Supplied Error Adjustments**<br>Find | **Disclaimer**: The guidance provided below should be considered general, representing a typical approach to determining Error Adjustment. Supply metering setups, metering technologies, instrumentation, data recording/archival, and data management systems can vary significantly from one water utility to the next. Inherent margins of error will also vary among different testing and calibration methods and the measurement systems being tested. Other factors that may be important include, but are not limited to, frequency of testing and calibration practices, data communication outages in the audit period, tested flowrates versus typical operating flowrates, and test durations. All of these factors must be considered when assessing Error Adjustment for the Water Supplied inputs. Each specific situation should be carefully analyzed to determine the most appropriate approach for determining the Error Adjustment to input, if any.<br><br>**General**: For the Water Supplied inputs, there are three typical sources of error that may warrant an Error Adjustment on the Worksheet.<br>1. **Meter error:** measurement inaccuracy in the meter(s) used to derive the input volume, typically identified through in-situ flow accuracy testing. Applicable for VOS, WI and WE. If no such testing has been performed, adjustment for meter error is not typically recommended.<br>2. **Data transfer error**: inaccuracy in archived volumes, typically due to gaps in data, programming errors impacting unit conversions, and/or programming errors impacting totalization of measured volumes over the audit period. Applicable for VOS, WI and WE. These errors are typically identified through electronic calibration to verify data transfer at the secondary device (i.e. conversion to mA, meter transmitter or similar instrumentation) and/or the tertiary device (i.e. SCADA, historian or other computerized archival system).<br>3. **Net distribution storage change**: The difference between end of audit period and beginning of audit period for total finished water stored, downstream of the system input meter(s). Typically applicable for VOS or WI. This volume is typically derived by comparing distribution storage tank water levels at end and beginning of the water audit period and using approximate tank geometry to convert levels to volumes.<br><br>**Derivation Guidance**:<br>If an Error Adjustment input is being calculated as a volume, each source of error (described above) may be separately calculated, with careful consideration of under- vs over-registration, then added together to determine the composite volume to input. The composite input should be entered on the Worksheet as a positive number, then under- or over-registration selected on the adjacent dropdown.<br>If an Error Adjustment input is being calculated as a percent, some very general guidance for calculating each error source (described above) is provided below. The auditor is again cautioned that each specific water supply setup needs to be evaluated closely as noted in the Disclaimer. Refer to the latest AWWA M36 Manual for additional discussion and guidance on this matter.<br><br>1. Meter error: If in-situ flow accuracy testing has been performed, and inherent testing method error is understood, first the *meter accuracy %* may be determined as follows:<br>*meter accuracy % = System input meter(s) volume / Reference volume*<br><br>Then, the *meter error %* may be determined as follows: □<br>*meter error % = meter accuracy % - 100%*<br><br>2. Data transfer error: If electronic calibration at the secondary (i.e. conversion to mA, meter transmitter or similar instrumentation) and/or tertiary (i.e. SCADA, historian or other computerized archival system) devices has been performed, first the *data transfer accuracy %* may be determined as follows:<br>*data transfer accuracy % = Tertiary device volume / Reference volume (typically at Secondary device)*<br><br>Then, the *data transfer error %* may be determined as follows:□<br>*data transfer error % = data transfer accuracy % - 100%*<br><br>If no error is identified, or if electronic calibration has not been performed, or if no secondary or tertiary devices exist, a *data transfer error %* adjustment is not typically recommended.<br><br>3. Net distribution storage change. If meter error and/or data transfer error are being calculated as a %, it is recommended to make the adjustment for net distribution storage change as a volume adjustment, directly in the VOS or WI input, as applicable.<br><br>The final step is to add *meter error %* and *data transfer error %:*<br>*Error Adjustment % = meter accuracy % + data transfer error %*<br><br>If the total Error Adjustment % calculates out as a negative number, it represents an under-registration. Vice versa, if positive. The composite input should be entered on the Worksheet as a positive number, then under- or over-registration selected on the adjacent dropdown. □ |
| **WATER LOSSES**<br><br>Find | = apparent losses + real losses<br>= water supplied - authorized consumption<br><br>Water Losses are the difference between Water Supplied and Authorized Consumption. Water losses can be considered as a total volume for the whole system, or for partial systems such as transmission systems, pressure zones or district metered areas (DMA), if one of these configurations are the basis of the water audit. |

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**Average Length of Customer Service Line**

The three figures shown on this worksheet display the assignment of the Average Length of Customer Service Line, Lp, for the three most common piping configurations.

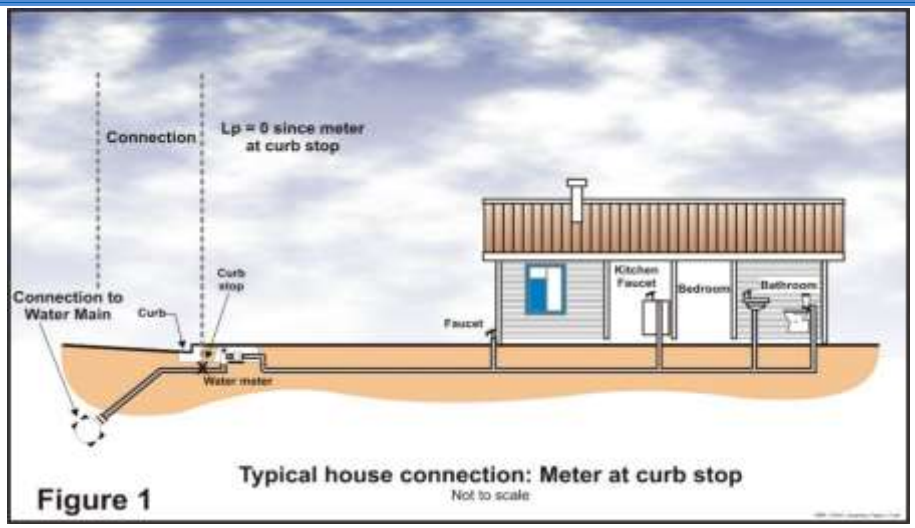
**Figure 1** shows the configuration of the water meter outside of the customer building next to the curb stop valve. In this configuration Lp = 0 since the distance between the curb stop and the customer metering point is essentially zero.

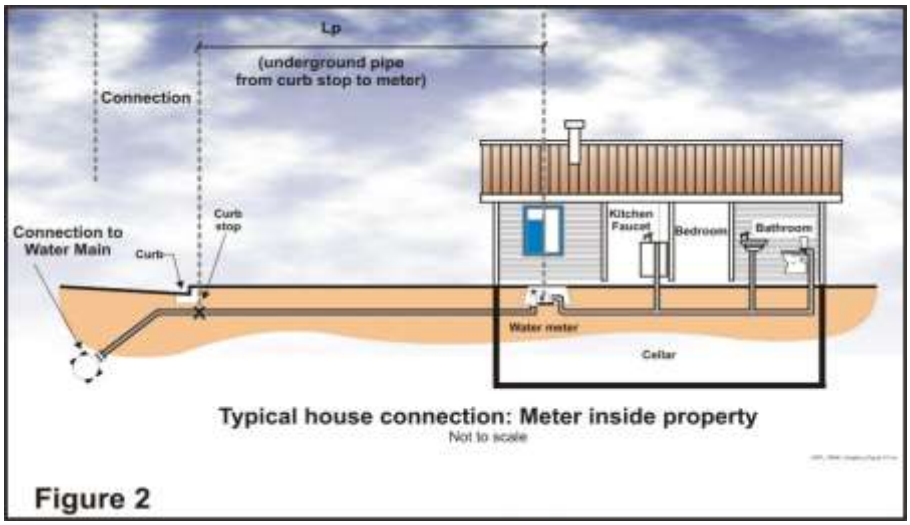
**Figure 2** shows the configuration of the customer water meter located inside the customer building, where Lp is the distance from the curb stop to the water meter.

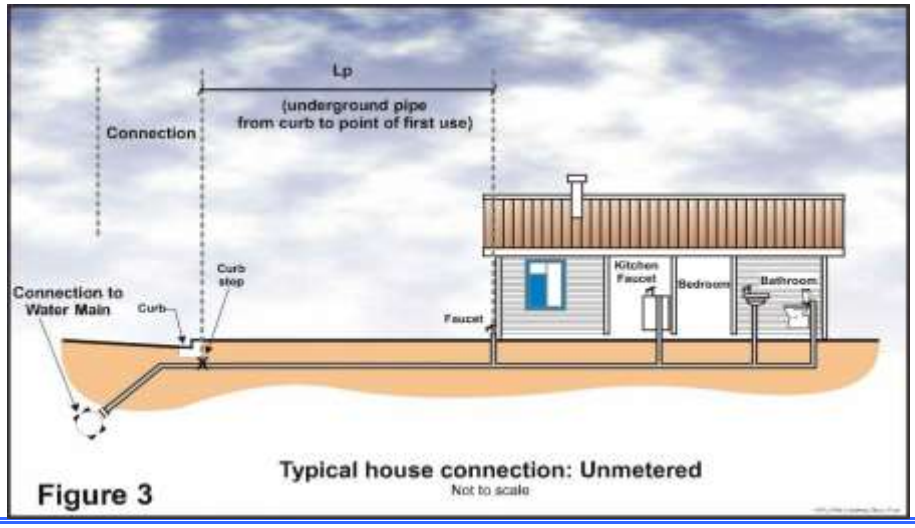
**Figure 3** shows the configuration of an unmetered customer building , where Lp is the distance from the curb stop to the first point of customer water consumption, or, more simply, the building line.

In any water system the Lp will vary notably in a community of different structures, therefore the average Lp value is used and this should be approximated or calculated if a sample of service line measurements has been gathered.

Click for more information



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American Water Works Association
Dedicated to the World's Most Important Resource®

**AWWA Free Water Audit Software - Version 6.0**
developed by the
Water Loss Control Committee of the American Water Works Association
December 2020

World Water Loss Day
4th December

This software is intended to serve as a basic tool to compile a preliminary, or "top-down", water audit. It is recommended that users also refer to the current edition of the AWWA M36 Publication, Water Audits and Loss Control Programs, for detailed guidance on compiling a comprehensive, or "bottom-up", water audit using the same water audit methodology.

*DEVELOPED BY:*

| | | |
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A special thanks to those members of the AWWA Water Loss Control Committee and other water industry stakeholders who assisted in the review and testing of this software.

*REFERENCES:*

1. Kunkel, G., G. Trachtman, A. Wyatt, and W. Jernigan. *Water Loss Control Committee Report: Key Performance Indicators for Non-Revenue Water—AWWA's 2020 Position*. 2020. Journal AWWA. https://awwa.onlinelibrary.wiley.com/doi/full/10.1002/awwa.1428
2. Kunkel, G. et al. *AWWA WLCC Reference Water Audit Dataset*. 2020. AWWA. Denver, CO.
3. *AWWA Water Audits and Loss Control Programs, M36 Publication.* 5th Edition, (forthcoming) 2021. AWWA. Denver, CO.
4. Trachtman G., A. Wyatt, et al. 2019. *Assessment of Performance Indicator for Non-Revenue Water Target Setting and Progress Tracking*. AWWA. Denver, CO.
5. Trachtman G., A. Wyatt, et al. 2019. *WRF 4695: Guidance on Implementing an Effective Water Loss Control Plan*. Water Research Foundation. Denver, CO.
6. Lambert, A. 2020. *Low ILIs and Small Systems.* Llandudno, UK. https://leakssuitelibrary.com
7. *Good Practices on Leakage Management, Main Report*. EU Reference Document. European Commission, Luxembourg. 2015.
   https://circabc.europa.eu/sd/a/1ddfba34-e1ce-4888-b031-6c559cb28e47/Good%20Practices%20on%20Leakage%20Management%20-%20Main%20Report_Final.pdf
   https://circabc.europa.eu/sd/a/ec13ae01-7800-4114-8d72-98827b509e18/Good%20Practices%20on%20Leakage%20Management%20-%20Case%20Study%20document._Final.pdf
8. Service Connection Diagrams courtesy of Ronnie McKenzie, WRP Pty Ltd.
9. Sturm, R., W. Jernigan, C. Stief, and D. Blackwell. *Level 1 Water Audit Validation Guidance Manual*. 2nd Edition, (forthcoming) 2021. Project #5057. Denver: Water Research Foundation.

*VERSION HISTORY:*

| Version: | Release Date: | Number of Worksheets: | Key Features and Developments |
|---|---|---|---|
| v1 | 2005/ 2006 | 5 | The AWWA Water Audit Software was piloted in 2005 (v1.0 beta). The early versions (1.x) of the software restricted data entry to units of Million Gallons per year. For each entry into the audit, users identified whether the input was measured or estimated. |
| v2 | 2006 | 5 | The most significant enhancement in v2 of the software was to allow the user to choose the volumetric units to be used in the audit, Million Gallons or Thousand Cubic Metres (megalitres) per year. Two financial performance indicators were added to provide feedback to the user on the cost of Real and Apparent losses. |
| v3 | 2007 | 7 | In v3, the option to report volumetric units in acre-feet was added. Another new feature in v3 was the inclusion of default values for two water audit components (unbilled unmetered and unauthorized consumption). v3 also included two examples of completed audits in units of million gallons and Megalitres. Several checks were added into v3 to provide instant feedback to the user on common data entry problems, in order to help the user complete an accurate water audit. |
| v4 - v4.2 | 2010 | 10 | v4 (and versions 4.x) of the software included a new approach to data grading. The simple "estimated" or "measured" approach was replaced with a more granular scale (typically 1-10) that reflected descriptions of utility practices and served to describe the confidence and accuracy of the input data. Each input value had a corresponding scale fully described in the Grading Matrix tab. The Grading Matrix also showed the actions required to move to a higher grading score. Grading descriptions were available on the Reporting Worksheet via a pop-up box next to each water audit input. A water audit data validity score is generated (max = 100) and priority areas for attention (to improve audit accuracy) are identified, once a user completes the requied data grading. A service connection diagram was also added to help users understand the impact of customer service line configurations on water losses and how this information should be entered into the water audit software. An acknoweldgements section was also added. Minor bug fixes resulted in the release of versions 4.1 and 4.2. A French language version was also made available for v4.2. |
| v5 | 2014 | 12 | In v5, changes were made to the way Water Supplied information is entered into software, with each major component having a corresponding Master Meter Error Adjustment entry (and data grading requirement). This required changes to the data validity score calculation; v5 of the software uses a weighting system that is, in part, proportional to the volume of input components. The Grading Matrix was updated to reflect the new audit inputs and also to include clarifications and additions to the scale descriptions. The appearance of the software was updated in v5 to make the software more user-friendly and several new features were added to provide more feedback to the user. Notably, a dashboard tab has been added to provide more visual feedback on the water audit results and associated costs of Non-Revenue Water. A comments sheet was added to allow the user to track notes, comments and to cite sources used. |
| v6 | 2020 | 11 | v6 brings an overhaul to the user interface for data grading, now presented as a series of questions on the Interactive Data Grading (IDG) tab for each input that, when answered (by selecting best-fit answer from a dropdown menu), automically determines the data grade for the given input. This provides transparency to the data practices selected and which specifically are limiting, removes subjectivity in data grade assignments, and provides clarity on candidate next steps for data validity improvements. IDG tab includes navigation buttons across top banner for ease of movement between inputs, and color signals for completion. The Worksheet (fka Reporting Worksheet) includes overt designation of error adjustment as "under" or "over" for the 3 Water Supplied inputs, as well as Customer Metering Inaccuracies. This makes the convention consistent, transparent, and reduces chance of user error. A Blank Sheet has been added allowing the user to, as desired, perform supplemental calculations or capture additional relevant information. The Dashboard has been overhauled to include Data Validity, NRW Components and Key Performance Indicators (KPIs). KPIs are presented in gauge format, depicting the specific KPI result against the range of results from Level 1 validated data in North America (see Web Resources, Start Page). Percentage-based indicators (% of supply, % of cost) removed as these indicators were deemed unreliable and sunset by the AWWA Water Loss Control Committee, subsequent to research and reporting from its NRW Performance Indicators Task Force. |

If you have questions or comments regarding the software please contact us via email at: wlc@awwa.org

APPENDIX E

# 2022 BASIN 8-1 ALTERNATIVE UPDATE

# Basin 8-1 Alternative 2022 Update

Submitted by: Orange County Water District
City of La Habra
Irvine Ranch Water District

Submitted to: California Department of Water Resources

January 1, 2022

# Table of Contents

I. Overview

II. La Habra-Brea Management Area

III. OCWD Management Area

IV. South East Management Area

V. Santa Ana Canyon Management Area

Attachment One: DWR Comments on 2017 Alternative and Responses

# BASIN 8-1 ALTERNATIVE OVERVIEW

The Sustainable Groundwater Management Act (SGMA) requires all high- and medium-priority basins, as designated by the California 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.

The agencies within Basin 8-1 collaborated to prepare and submit an Alternative to a Groundwater Sustainability Plan (GSP) on December 22, 2016. 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), the Alternative presented an analysis of basin conditions that demonstrated that Basin 8-1 had operated within its sustainable yield over a period of at least 10 years. On July 17, 2019, DWR determined that the Alternative satisfied SGMA objectives and was therefore approved.

Approved alternatives are required to submit annual reports to DWR on April 1 of each year, and to resubmit the alternative by January 1 every five years. Annual reports were submitted to DWR as follows:

- Water Year 2016-17 – March 29, 2018
- Water Year 2017-18 – March 29, 2019
- Water Year 2018-19 – March 30, 2020
- Water Year 2019-20 – March 30, 2021

This document represents the first five-year update, which is due January 1, 2022.

This update has been jointly prepared by the Orange County Water District (OCWD), Irvine Ranch Water District (IRWD); and the City of La Habra Groundwater Sustainability Agency (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. 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 purposes of this report, the Basin 8-1 Alternative approved by DWR on July 17, 2019, is referred to as the 2017 Alternative. The first five-year update will be referred to as the 2022 Update. The 2017 Alternative was a comprehensive document showing that Basin 8-1 had been managed sustainably for more than 10 years. For the 2022 Update, the focus is on documenting that the basin has continued to be operated sustainably during the five years since the 2017 Alternative was submitted and to present any new information. As such, background information, such as Basin Hydrogeology, and other sections with no new information are not repeated in the 2022 Update.

As described in the 2017 Alternative, Basin 8-1 was sub-divided into four management areas: La Habra-Brea, OCWD, South East, and Santa Ana Canyon Management Areas (Figure 1-1). The 2022 Update contains four chapters, one for each management area.

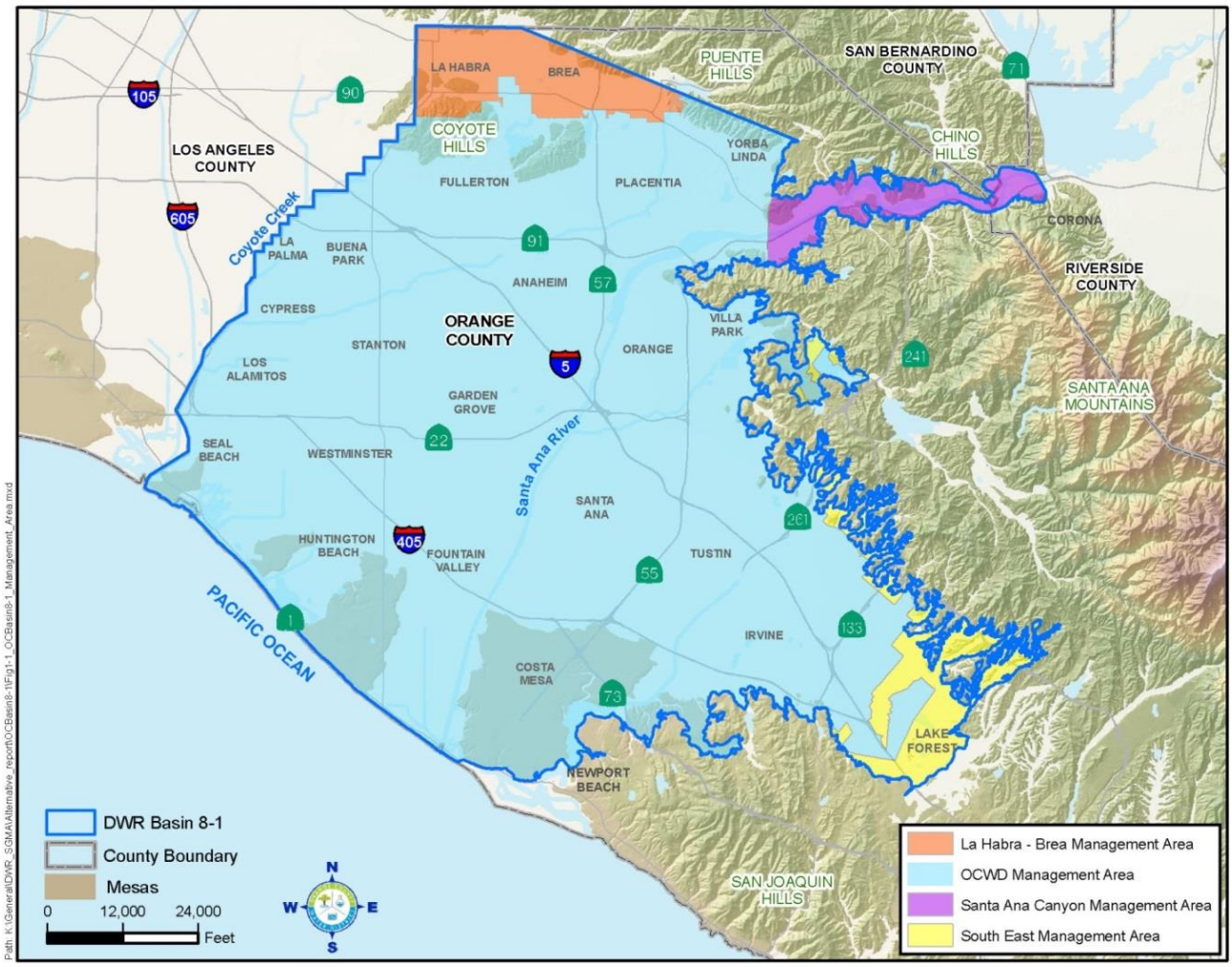


Figure 1-1: Basin 8-1 Management Area Boundaries

In its evaluation of the Basin 8-1 Alternative, DWR provided four recommendations that they encouraged “be given due consideration and suggest incorporating any resulting changes to the Alternative in future updates.” The recommendations and responses to these recommendations are in Attachment 1 and incorporated into the 2022 Update where appropriate.

# 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 |
| LACPW | Los Angeles County 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 |
| PFAS | Per- and polyfluoroalkyl substances |
| 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 |

# Basin 8-1 Alternative

# La Habra-Brea Management Area

# 2022 UPDATE

Submitted by: City of La Habra

On behalf of: City of La Habra
City of Brea

January 1, 2022

# Basin 8-1 Alternative

# La Habra-Brea Management Area

# 2022 UPDATE

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Prepared for the Department of Water Resources, pursuant to Water Code §10733.6(b)(3)

January 1, 2022

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# LA HABRA-BREA MANAGEMENT AREA

## SECTION 1. EXECUTIVE SUMMARY

The agencies within Basin 8-1 collaborated to prepare and submit an Alternative to a Groundwater Sustainability Plan (GSP). In accordance with Water Code §10733.6(b)(3), the Alternative presented an analysis of basin conditions that demonstrated that the Basin had operated within its sustainable yield over a period of at least 10 years. The Alternative was submitted to DWR on December 22, 2016. On July 17, 2019, DWR determined that the Alternative satisfied SGMA objectives and was therefore approved.

Approved alternatives are required to submit annual reports to DWR on April 1 of each year. Annual reports for Basin 8-1 were submitted to DWR as follows:

- Water Year 2016-17, Submitted on March 29, 2018
- Water Year 2017-18, Submitted on March 29, 2019
- Water Year 2018-19, Submitted on March 30, 2020
- Water Year 2019-20, Submitted on March 30, 2021

According to Water Code §10733.8, “At least every five years after initial submission of a plan pursuant to Section 10733.4, the department shall review any available groundwater sustainability plan or alternative submitted in accordance with Section 10733.6, and the implementation of the corresponding groundwater sustainability program for consistency with this part, including achieving the sustainability goal. The department shall issue an assessment for each basin for which a plan or alternative has been submitted in accordance with this chapter, with an emphasis on assessing progress in achieving the sustainability goal within the basin. The assessment may include recommended corrective actions to address any deficiencies identified by the department.”

The Basin 8-1 Alternative, submitted on December 22, 2016, will be referenced to as the 2017 Alternative. This document represents the first five-year update, herein referenced as the 2022 Update, which is due January 1, 2022. The 2017 Alternative was a comprehensive document showing that Basin 8-1 had been managed sustainably for more than 10 years. For the 2022 Update, the focus is on documenting that the basin has been continued to be sustainably management during the five years since the 2017 Alternative was submitted and to present any new information from the last five years. As such, the 2017 Alternative is considered a key reference document with background information that is not duplicated in the 2022 Update.

The La Habra-Brea Management Area overlies the extents of the 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.

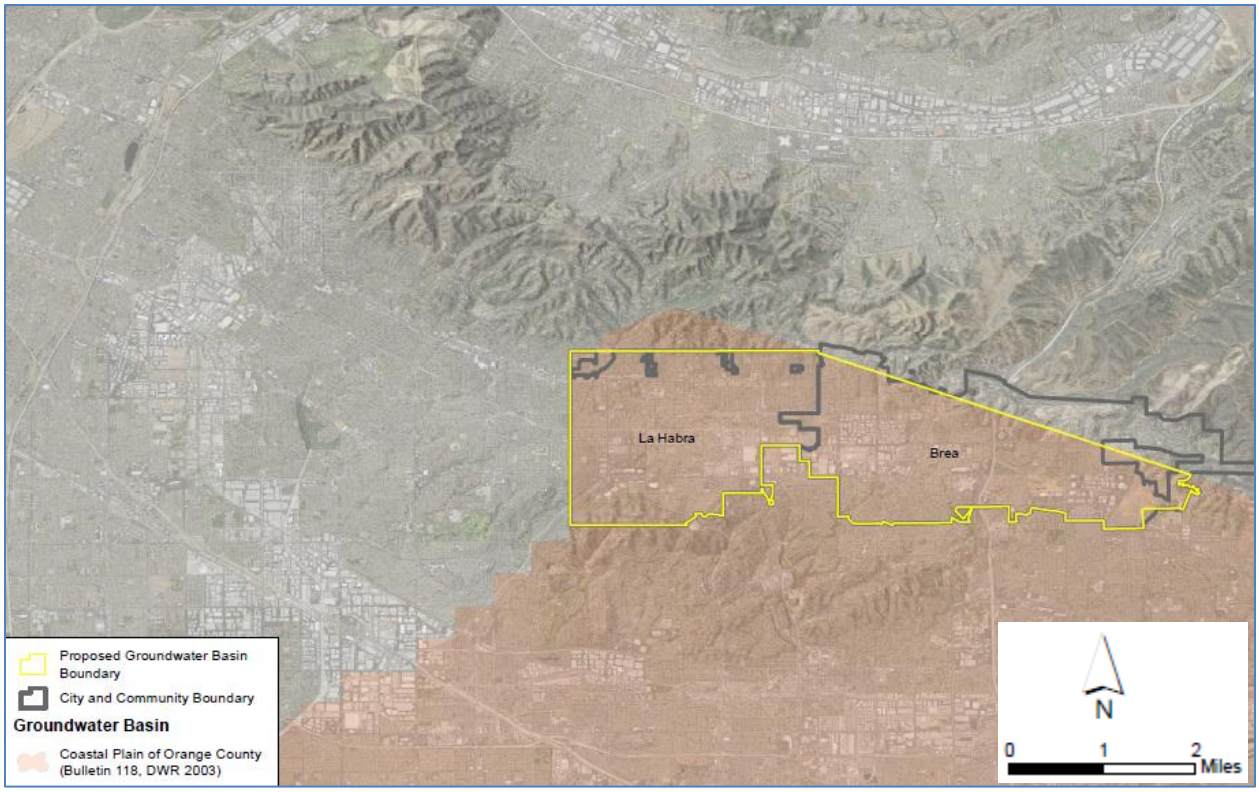


Figure 1-1. La Habra Groundwater Basin.

Groundwater resources protection is considered a critical component for safeguarding the long-term sustainability of the La Habra Groundwater Basin. The La Habra GSA has continued to sustainably manage groundwater resources within the La Habra Groundwater Basin. Groundwater production over the past five years has been within the safe yield of the basin. Accordingly, no undesirable effects have been observed within the La Habra-Brea Management Area.

As the City of La Habra (or City) 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.

# SECTION 2. AGENCY INFORMATION

## 2.1 HISTORY OF AGENCIES IN LA HABRA GROUNDWATER BASIN

Historically, the Cities of La Habra and Brea have managed the groundwater resources in the La Habra Groundwater Basin. The history of the agencies can be found in the 2017 Alternative.

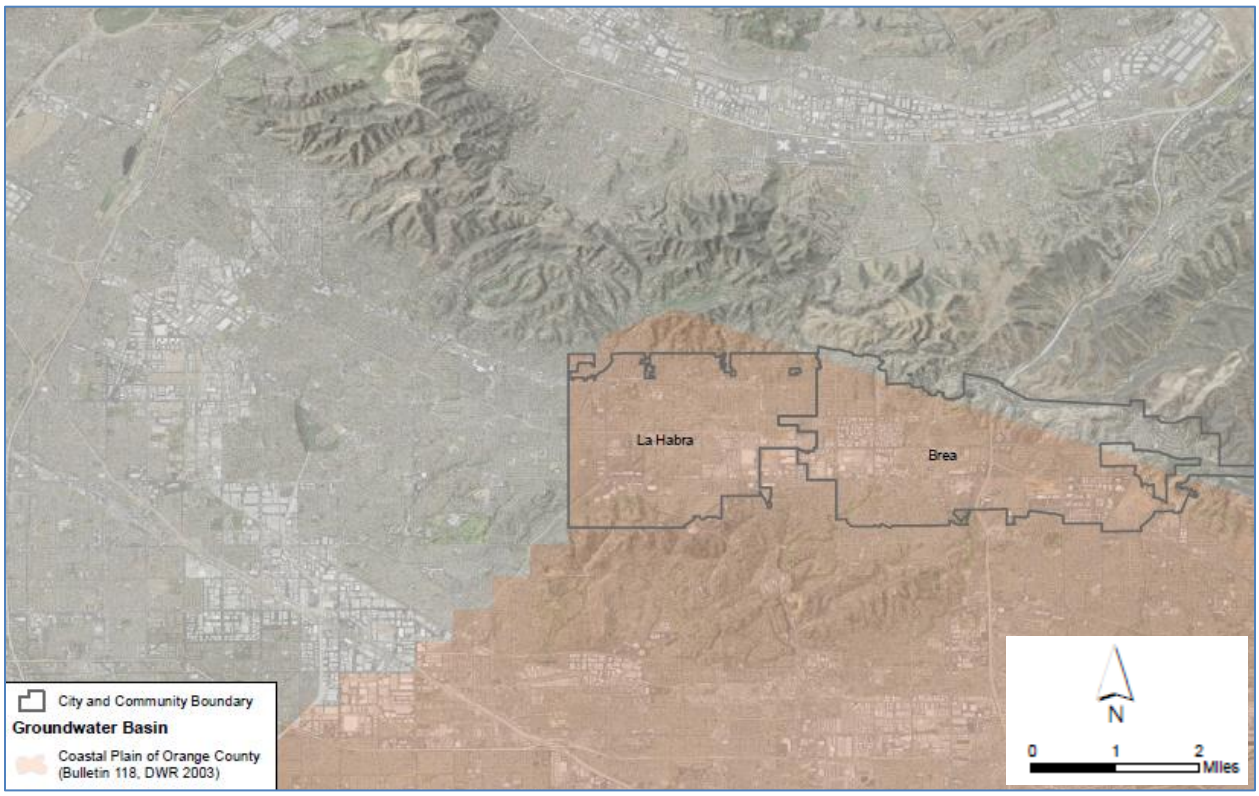


Figure 2-1: Cities of La Habra and Brea within Basin 8-1.

## 2.2 GOVERNANCE AND MANAGEMENT STRUCTURE

See the 2017 Alternative for a discussion on governance and management structure.

## 2.3 LEGAL AUTHORITY

See the 2017 Alternative for a discussion on legal authority.

## 2.4 BUDGET

See the 2017 Alternative for a discussion on the budget.

# 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).

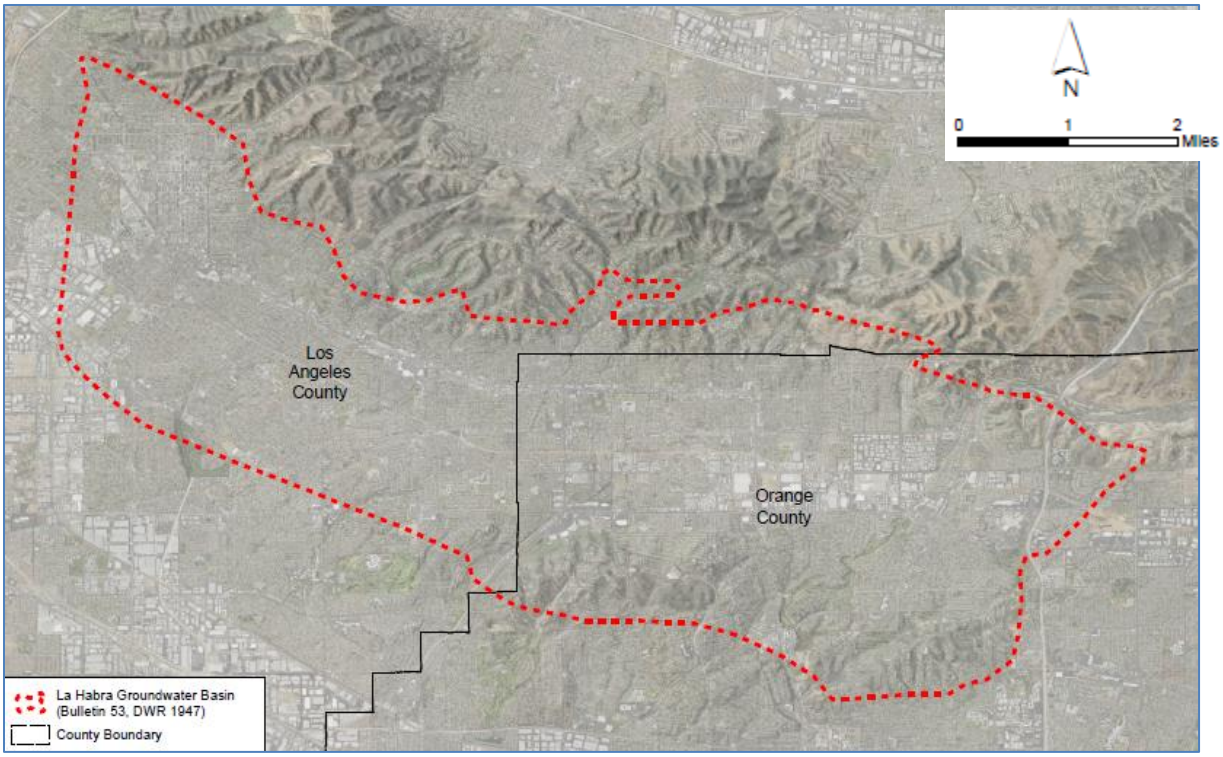


Figure 3-1: Historical La Habra Groundwater Basin (DWR, 1934. DWR, 1937).

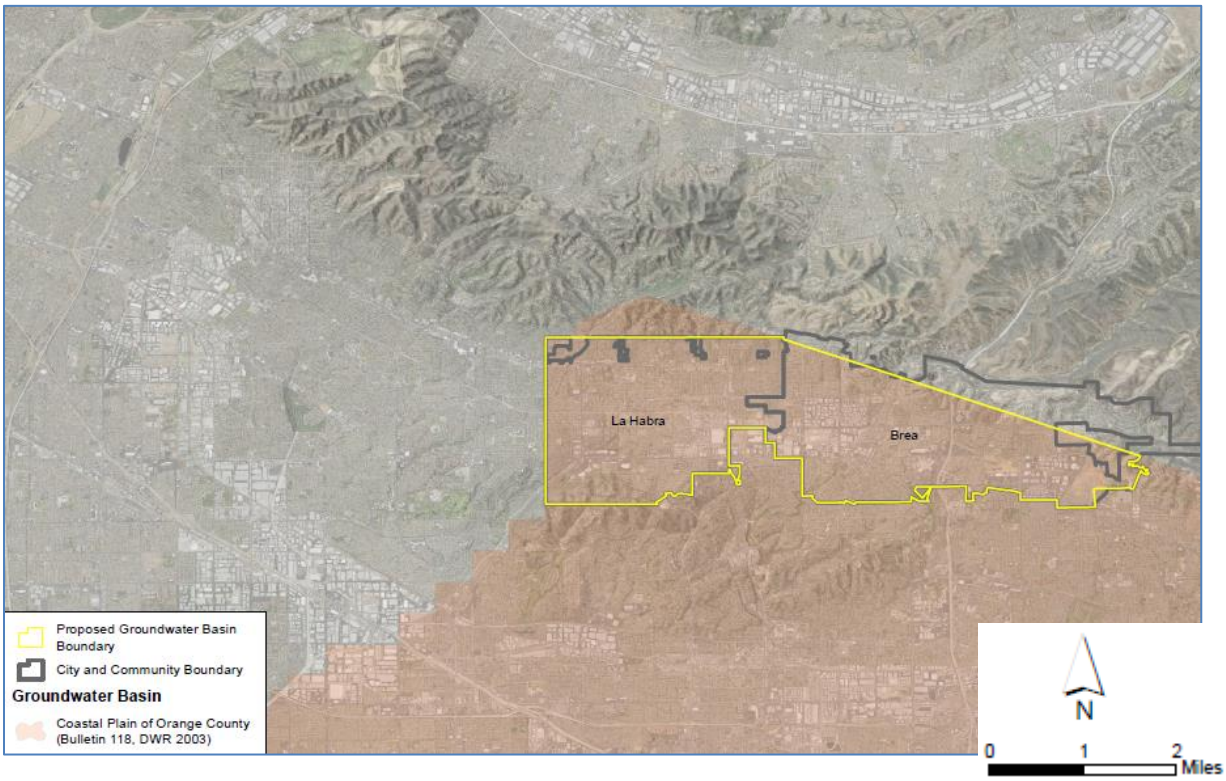


Figure 3-2. La Habra Groundwater Basin.

### 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 to 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 more recent years. 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 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 capacities of the La Bonita Well and the Portola Well are 850 gpm and 1,200 gpm, respectively.

The City of Brea owns and operates one non-potable groundwater well used for irrigation at the 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. Acre-Feet per Year.

| Year | City of La Habra | City of Brea[1] | Total |
|---|---|---|---|
| 2011 | 1,849 | 76 | 1,925 |
| 2012 | 1,865 | 86 | 1,951 |
| 2013 | 3,073 | 82 | 3,155 |
| 2014 | 4,094 | 121 | 4,215 |
| 2015 | 3,630 | 50 | 3,680 |
| 2016 | 3,547 | 86 | 3,633 |

| Year | City of La Habra | City of Brea[1] | Total |
|---|---|---|---|
| 2017 | 3,200 | 96 | 3,295 |
| 2018 | 2,653 | 111 | 2,763 |
| 2019 | 2,158 | 88 | 2,245 |
| 2020 | 2,493 | 108 | 2,600 |
| AVERAGE | 2,856 | 90 | 2,946 |

1 Does not include small additional pumping within the City of Brea by a privately owned groundwater production well.

Sources: 2015 Urban Water Management Plans (Arcadis, 2016). City of La Habra. City of Brea.

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 | Unknown | 450 |
| Memory Garden Memorial Park | -- | Irrigation | Unknown | Unknown |

### 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).

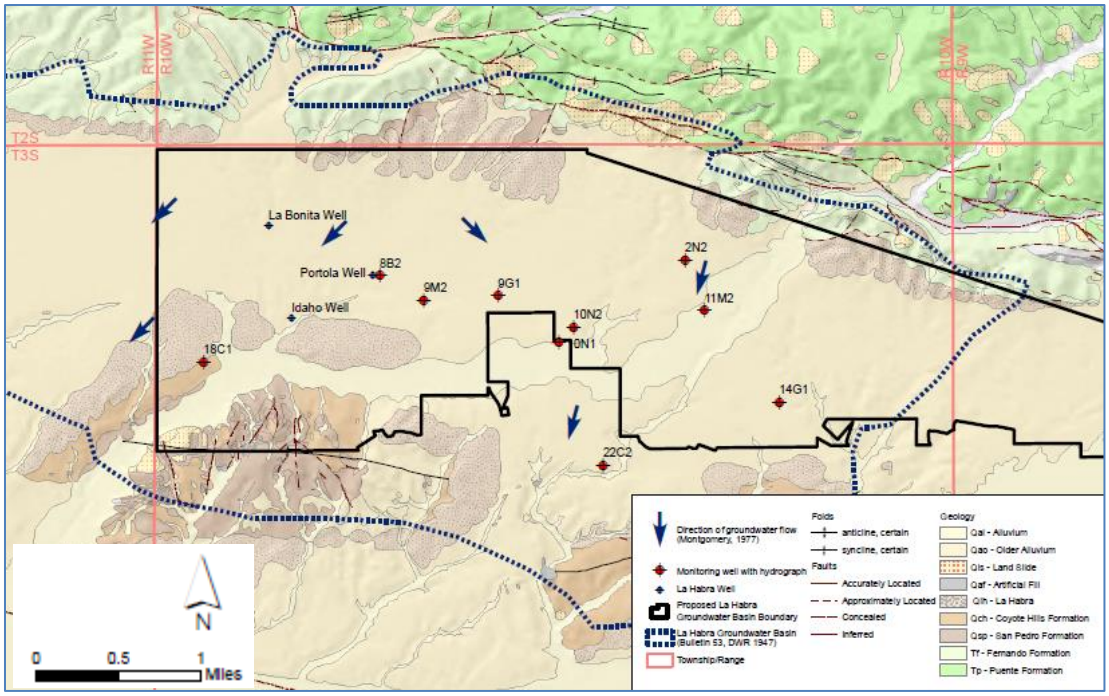


Figure 3-3: Groundwater Elevation Monitoring Wells.

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. This corresponds to DWR Bulletin No. 53 (1947) stating that the La Habra Groundwater Basin was in overdraft. Groundwater levels recovered about 60 feet from the 1940s through 1972 at well T3/R10-14G1. 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).

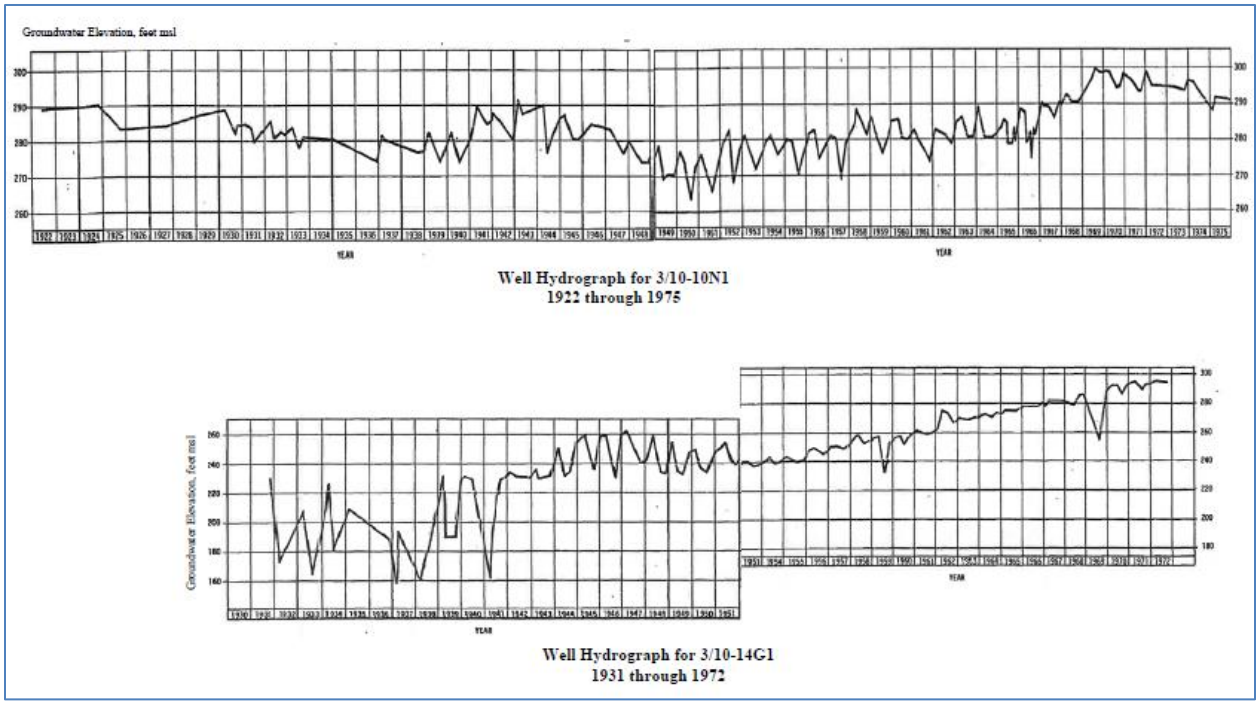


Figure 3-4: Early Well Hydrograph. 1922 Through 1975.

Source: Montgomery, 1977.

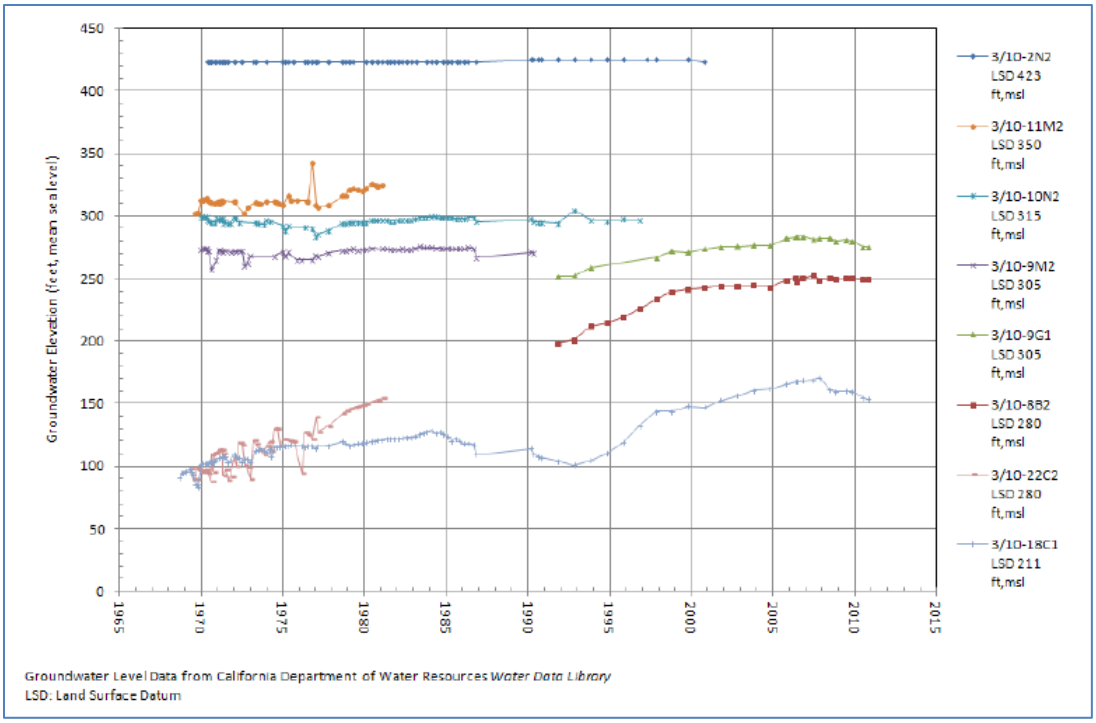


Figure 3-5: Groundwater Level Hydrographs.

Source: Stetson, 2014.

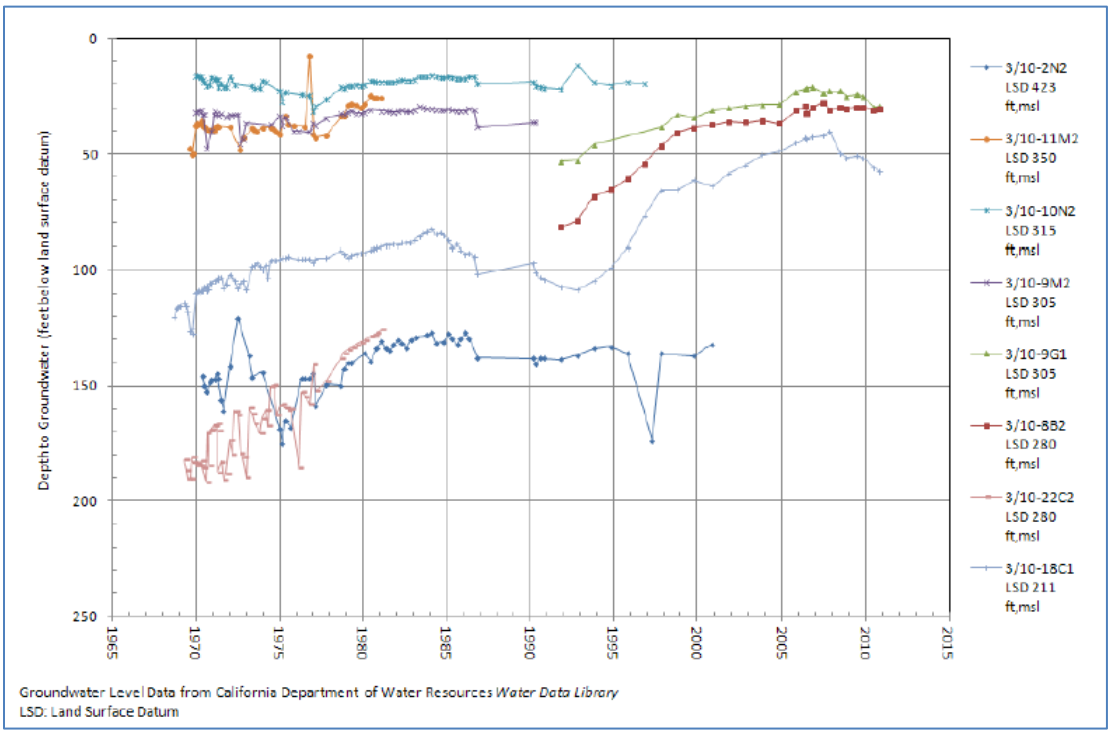


Figure 3-6: Depth to Groundwater.

Source: Stetson, 2014.

The hydrograph for the monitoring well with both recent data and a long period of record is shown in the figure below. Recent groundwater level data suggest that groundwater levels are stable and the basin is in balance.

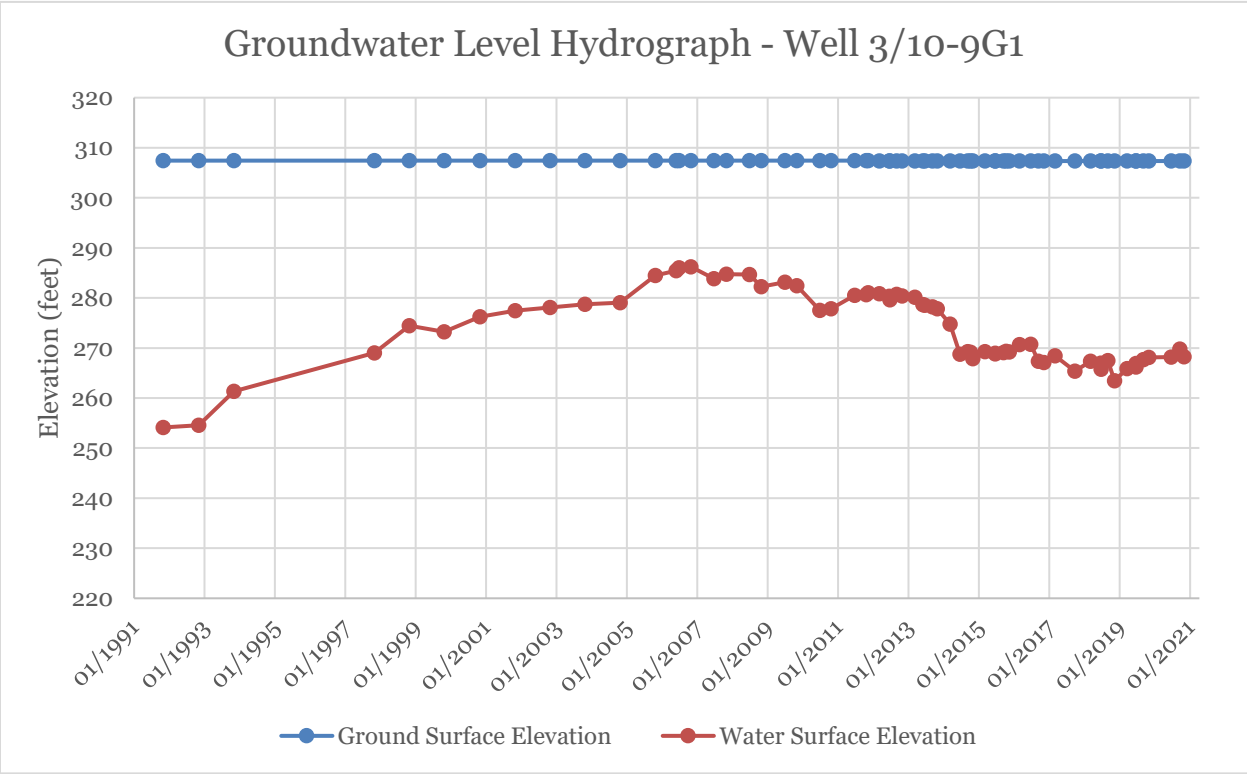


Figure 3-7: Recent Groundwater Level Hydrograph.

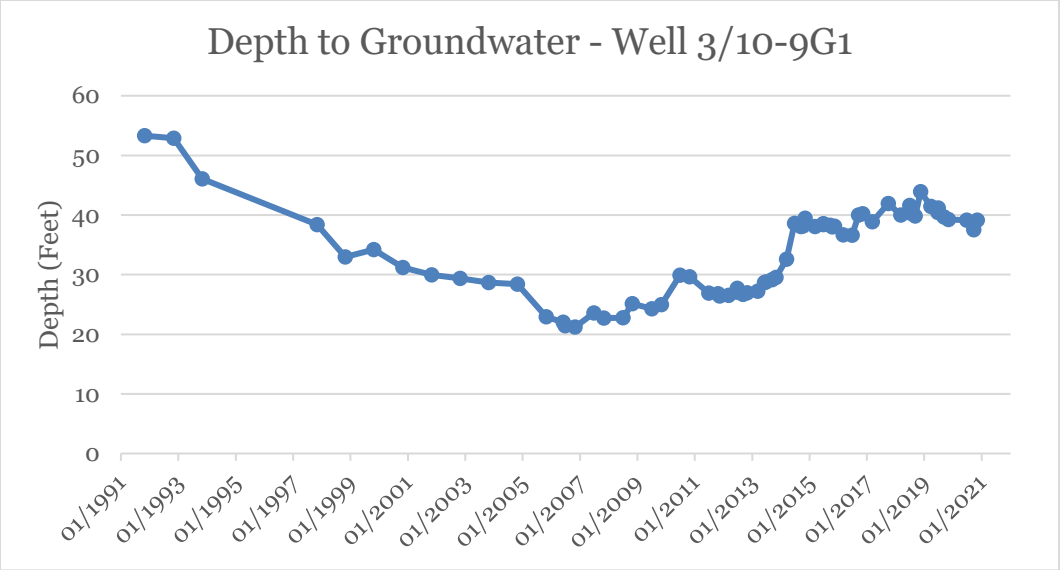


Figure 3-8: Recent Depth to Groundwater.

## 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 most recent 10-year average TDS concentrations in the La Bonita, Portola, and Idaho wells are 1,052 mg/l, 750 mg/l, and 802 mg/l, respectively.

Overall, groundwater from the San Pedro Aquifer is considered to be of fair to good quality (Montgomery, 1979). However, groundwater produced from the La Habra Groundwater Basin is not currently used directly for potable purposes due to water quality concerns that predate SGMA legislation. 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).

Groundwater production wells in Brea are 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 below shows historical water quality for select constituents. Recent State database water quality results indicate reported exceedances in raw groundwater for nitrate, perchlorate, volatile organic compounds (VOCs), and radioactivity, with the most recent violation occurring in 2014 (Safe Drinking Water Information System).

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, 2021). There is also no evidence of land subsidence within the La Habra Groundwater Basin according to the Department of Water Resources' SGMA Data Viewer. Vertical displacement estimates are

derived from Interferometric Synthetic Aperture Radar (InSAR) data and show only a minimal positive vertical displacement within the area (DWR, 2021a). Accordingly, there are no known land subsidence undesirable results caused by depletion of groundwater resources.

### 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, some of which are concrete lined.

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.

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). Within the La Habra Valley, an estimated 15% of precipitation contributes to aquifer recharge as direct percolation of precipitation. The 40-year average rainfall (14 inches) results in a water supply from precipitation within the 10,160-acre drainage area of approximately 1,780 AFY (Stetson, 2013).

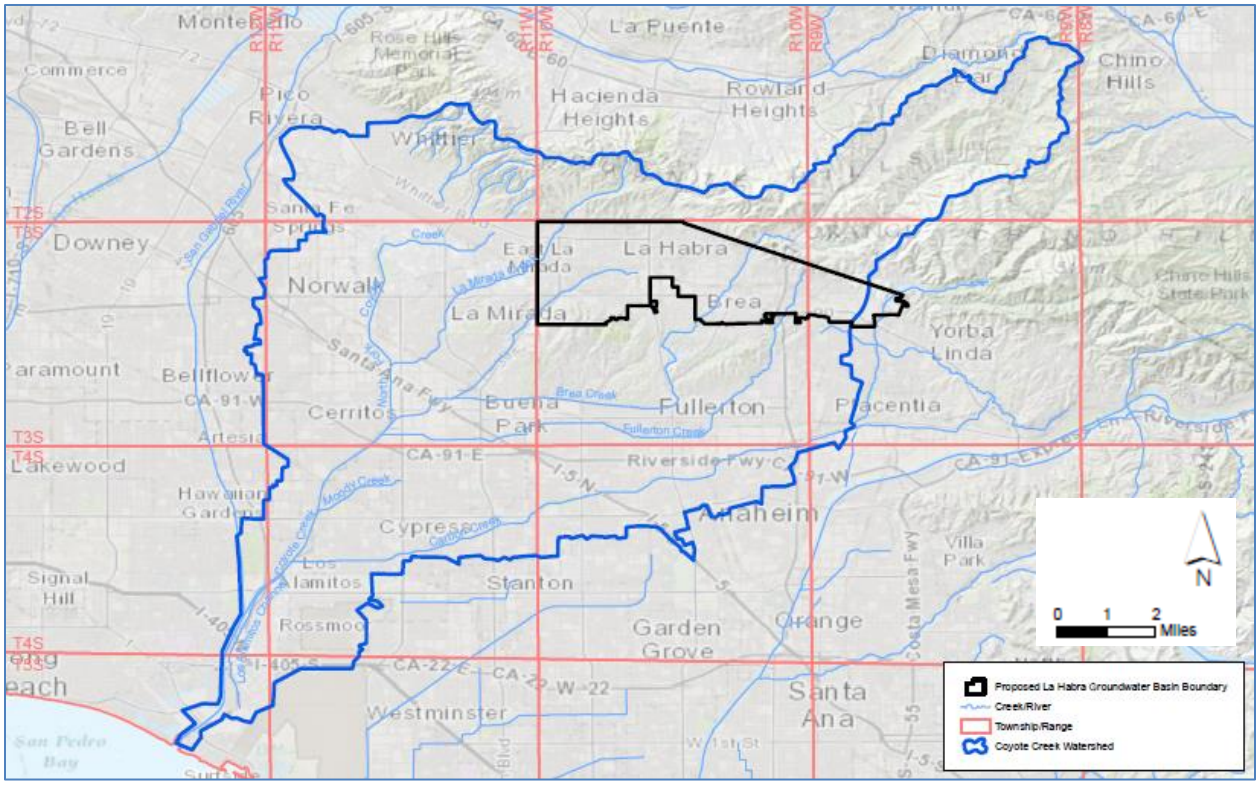


Figure 3-9: Coyote Creek Watershed.

A review of available references was conducted to identify any potential presence of Groundwater Dependent Ecosystems (GDEs) in the La Habra-Brea Management Area and to review potential impacts groundwater extraction may have on the ecosystems. DWR's Natural Communities (NC) dataset includes two habitat classes which are associated with groundwater: wetland features and vegetation types. Small areas of GDEs such as Palustrine, scrub-shrub, seasonally flooded wetlands, have been found on the western portion of the La Habra Groundwater Basin. Groundwater dependent vegetation, such as Coast Live Oak, Willow, and Riparian Mixed Hardwood have been found in small areas within the central and eastern portions of the La Habra Groundwater Basin (DWR, 2021b). As shown in Figure 3-10 below, groundwater extraction does not occur near groundwater dependent vegetation or wetlands. Likewise, potential groundwater recharge locations are not located near groundwater dependent vegetation; therefore, any future recharge project would not alter the current natural ecosystem. La Habra's groundwater production wells extract groundwater from the San Pedro formation, the deepest aquifer unit that forms the La Habra Groundwater basin, which is significantly deeper than the than the perched alluvial (Yerkes, 1972). The areas of vegetation identified as groundwater dependent ecosystems are along the base of the surrounding hills at the limits of the basin and are also supported by surface water runoff and rainfall. Cross sections in the region indicate shallow groundwater in those areas.

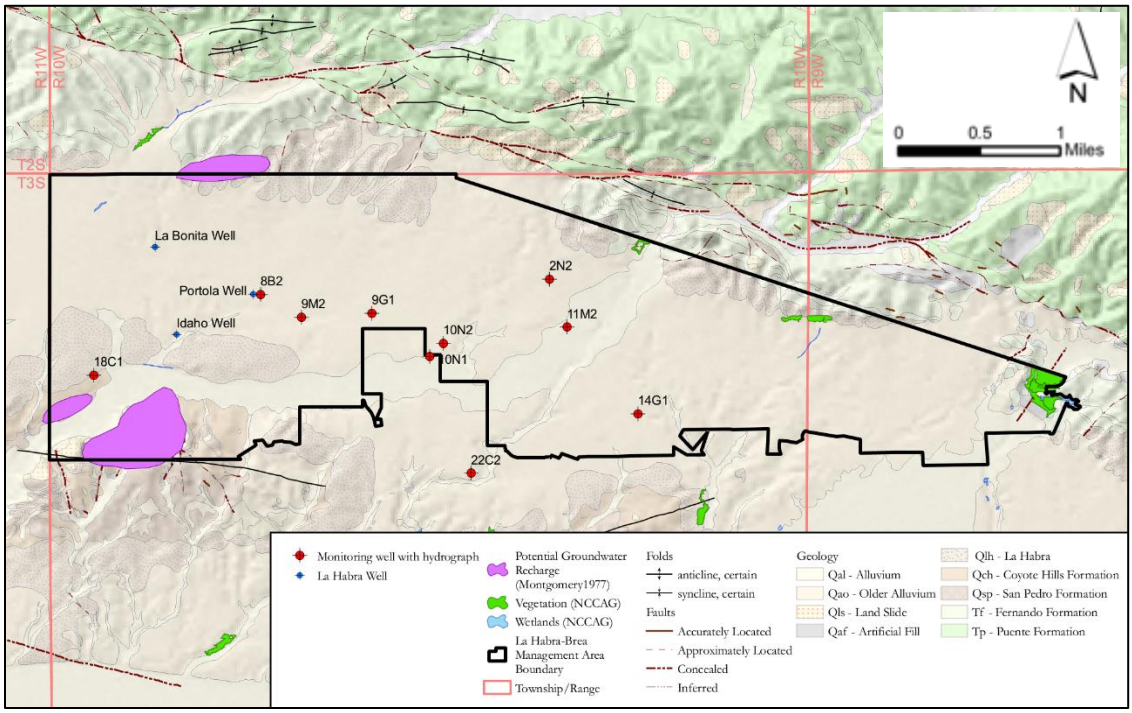


Figure 3-10: Groundwater Dependent Ecosystems.

# 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.

Recharge components of the water budget consist of mountain front and streamflow recharge and deep percolation of precipitation. Various hydrogeologic studies show that annual natural recharge ranges from 3,300 AFY to 3,900 AFY. No measurable subsurface inflow occurs into the La Habra- Brea Management Area. Additionally, no artificial recharge occurs in the La Habra-Brea Management Area at this time.

Outflow components of the water budget consist of groundwater production and subsurface outflow. Groundwater production in La Habra-Brea Management Area 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 westerly near Coyote and La Mirada Creeks into the Coastal Plain of Los Angeles (Central Basin), and southerly at the gap between the East and West Coyote Hills into the main Coastal Plain of Orange County (Stetson, 2014). Subsurface outflow ranges from 2,200 to 5,500 AFY (OCWD 2015).

## 4.2 CHANGES IN GROUNDWATER STORAGE

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 which have shown rising trends since the 1970s. Available groundwater level data indicate groundwater levels have generally increased or remained stable over the last five years. See Section 3.2.3. These conditions indicate groundwater storage changes in the La Habra Groundwater Basin are within an acceptable range and undesirable results are not present.

## 4.3 WATER YEAR TYPE

The estimated water budget is based on normal/average water year type. However, historical hydrographs indicate stable or rising groundwater levels, even during dry and prolonged drought years, indicating that the water year type has little impact on the water budget.

## 4.4 ESTIMATE OF SUSTAINABLE YIELD

Groundwater production within the La Habra-Brea Management Area is managed by the establishment of a safe yield so that the groundwater levels and storage capacity in the La Habra Groundwater Basin will be maintained.

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 based on the natural recharge and natural discharge methods. Stetson conducted a re-evaluation of Montgomery's 1977 safe yield analysis in 2013 to re-determine the estimated safe yield based on the natural recharge method. The average of these two methods (natural discharge and natural recharge) 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 static 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.

## 4.5 ESTIMATED WATER BUDGET

The estimated water budget is shown in Table 4-1 below. There is currently insufficient data to determine precise estimates of the water budget components; accordingly, the water budget is presented as ranges.

Table 4-1: Estimated Water Budget

| Budget Component | Estimated Range [1] |
|---|---|
| *Inflows* | |
| Precipitation | 1,600 - 1,800 |
| Mountain Front Recharge | 1,700 - 2,100 |
| Incidental/Other Recharge | Unknown |
| *Outflows* | |
| Subsurface Outflow | 2,200 – 5,500 |
| Groundwater Extraction | 2,000 – 4,000 |
| **BALANCE[1]** | **0** |

1 This water budget is based on previous historically estimated inflows and outflows in the La Habra Groundwater Basin. Available water level data show rising or stable groundwater levels indicating the Basin is in balance. Therefore, the historical estimates may not account for all of the recharge occurring in the Basin.

Sources: Montgomery, 1977. OCWD, 2015. Stetson, 2013.

# 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 is 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 have previously been reported by DWR for wells 3/10-9G1, 3/10-8B2, and 3/10-18C1; however, only well 3/10-9G1 is currently being reported. Currently, La Habra is working to expand its monitoring network. See Section 9.2 for additional information.

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 in the future if a land subsidence is determined to be likely to cause undesirable results.

# 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 Ordnance 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.

Stormwater Pollution Prevention

The City of La Habra is under the Regional Water Quality Control Board (RWQCB) National Pollutant Discharge Elimination System (NPDES) permit, Order R8-2009-0030. The current adopted permit requires mandates for the implementation of water quality control programs including adopting development standards for existing and new development. Although the NPDES permitting program is intended to protect surface water quality by preventing unauthorized stormwater discharges and discharges to navigable water, groundwater quality is also protected through the NPDES program incidental percolation of surface water into the groundwater occurs.

The City of La Habra implements additional best management practices to prevent pollutant discharges. To assist developers and owners with implementation of NPDES requirements and best management practices for construction projects, the City of La Habra has created a Construction Runoff Guidance Manual. Likewise, the Model Water Quality Management Plan has been developed to address urban runoff and pollution. A water quality ordinance has been adopted (La Habra Municipal Code Chapter 13.24) to locally enforce California stormwater regulations. Additionally, the City of La Habra conducts investigations, inspections, trainings, maintenance, and public education to reduce pollution and contamination. These management practices

Blending Program

As discussed in Section 3.2.5, groundwater contamination exists in portions of the La Habra Groundwater Basin. To manage groundwater quality concerns, the City of La Habra blends groundwater from the La Habra Groundwater Basin with imported water (both groundwater and surface water) in order to reduce contaminant levels prior to distribution. See also Section 11.4 discussion on management programs.

## 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. See the 2017 Alternative for additional information.

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, and water quality, discussed below in Sections 9, 10, and 11, respectively. Seawater intrusion and land subsidence are not occurring in the La Habra-Brea Management Area, and are not anticipated to occur; therefore, they are not actively managed at this time. Likewise, groundwater-surface water interactions are not actively managed at this time. No undesirable results have been observed in the La Habra Groundwater Basin.

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. MANAGING 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

The City of La Habra recognizes the great importance of monitoring groundwater levels and acknowledges the current data gaps in the monitoring network. Monitoring groundwater levels is critical to basin management because water levels impact other potential undesirable results: loss of groundwater in storage, degraded water quality, land subsidence, and depletion of interconnected surface water. Groundwater levels can serve as a proxy for identifying potential impacts related to other groundwater conditions.

As discussed in Section 5.2, the City has measured non-pumping and pumping groundwater elevations at its production wells since 2008. At the time the Alternative was first being developed, there were several additional wells actively being monitored in the La Habra Basin by other agencies. These wells with water level data included wells 3/10-9G1, 3/10-8B2, and 3/10-18C1. Many of these wells are no longer being monitored which is causing data gaps. Accordingly, La Habra is currently evaluating potential groundwater wells for inclusion into an expanded monitoring program as part of compliance under SGMA. The need for standard and multi-level monitoring wells to monitor the three aquifers of the basin is being investigated. The La Habra GSA may potentially request State assistance through the Technical Services Support program to install additional monitoring wells. The proposed monitoring program will include wells located within the vicinity of the La Habra Basin. La Habra has been in coordination with the Department of Water Resources regarding wells located in the La Habra Basin that have previously been included in bulletins/reports published by the Department of Water Resources (DWR) in order to acquire pertinent well information that is not publicly available. These wells and other existing monitoring wells are currently being screened and evaluated for available data and suitability for inclusion in the monitoring network for the La Habra Groundwater Basin. Updates and modifications to the monitoring network will be discussed in the next Annual Report.

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 levels within the wells do 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.

## 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-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 and current beneficial uses of the groundwater. Currently, the Santa Ana Regional Water Quality Control Board has designated the beneficial uses of groundwater in the La Habra-Brea Management Area to be Municipal and Domestic Supply and Agriculture.

The La Habra Groundwater Basin is currently managed within the safe yield, and groundwater levels have shown rising or stable trends in recent years, as shown by the available groundwater level hydrographs (see Section 3.2). Likewise, no other potential impacts are occurring such as loss of capacity at groundwater production wells, water quality degradation, or land subsidence. Accordingly, there are currently no undesirable results occurring related to the chronic lowering of groundwater levels.

## 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. Accordingly, no undesirable results are occurring. General water levels trends have shown rising and recovering groundwater levels over the past several decades with water levels being relatively stable for the past several years. Additionally, the prolonged and significant regional drought between 2011-2017 did not cause water levels to lower significantly or unreasonably. See Section 3.2.

Recognizing that historical water levels have been significantly lower in previous decades, the La Habra GSA will continue to monitor groundwater levels to determine if chronic or significant lowering of groundwater levels are observed. If declines are observed, the La Habra GSA will evaluate its groundwater management operations, re-evaluate the safe yield, and establish minimum thresholds, where appropriate, and in accordance with SGMA.

# SECTION 10. MANAGING 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; consequently, water in storage is similarly anticipated to remain steady.

## 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. As discussed in Section 4.4, the approximate safe yield of the basin is 4,500 AFY, determined by taking the average of two methods to determine the natural discharge and natural recharge of the basin.

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. More recently, groundwater levels appear to be stable indicating no unreasonable loss of groundwater in storage.

The City of La Habra maintains sustainable groundwater production by maintaining and coordinating groundwater production within the estimated safe yield of the La Habra Groundwater Basin. This results in no undesirable results caused by depletion of groundwater in storage.

### 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.

As discussed in Section 9.2, the City has evaluated the current monitoring network and has determined additional monitoring of groundwater elevations is required in the La Habra Groundwater Basin. Additional monitoring wells are currently being evaluated for inclusion into the monitoring program. When 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 or 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).

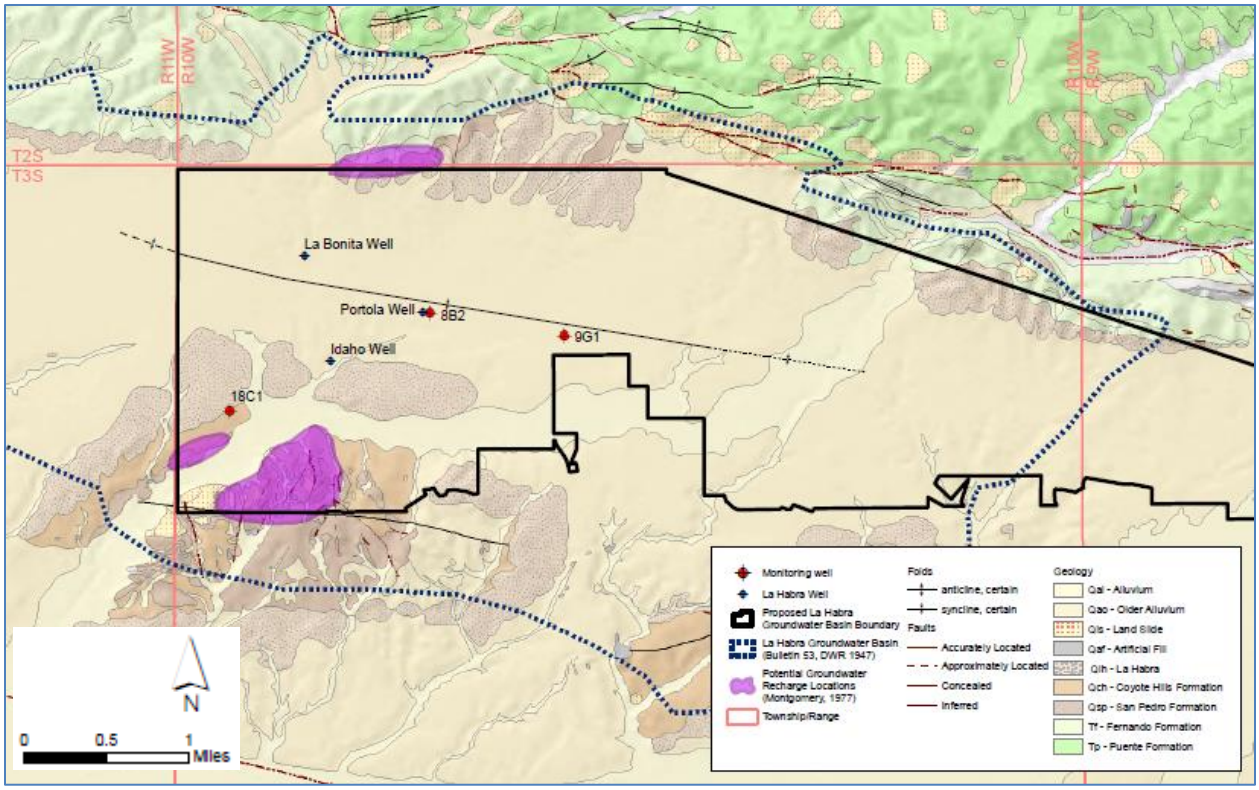


Figure 10-1: Potential Groundwater Recharge Locations.

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 implements stormwater control practices as required by the NPDES permit. Stormwater recharge activities in compliance with the NPDES permit program may occur in the future.

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. Currently, there are no observed undesirable results observed related to the chronic loss of groundwater in storage. Since the Basin is managed within the safe yield, no chronic loss of groundwater in storage is anticipated.

## 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 groundwater management operations, re-evaluate the safe yield, and establish minimum thresholds, where appropriate, and in accordance with SGMA. Groundwater levels would be used as a proxy to set thresholds for groundwater in storage.

# SECTION 11. MANAGING BASIN 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). However, groundwater produced from the La Habra Groundwater Basin is currently blended with imported water prior to distribution in order to reduce certain contaminant levels.

## 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 State Water Resources Control Board Division of Drinking Water (DDW) 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 groundwater quality of the La Habra-Brea Management Area and prevent groundwater quality degradation include well construction, abandonment, and destruction policies, wellhead protection measures, control of migration and remediation of contaminated water, and control of saline water. Indirectly, the City of La Habra's Stormwater contamination protection programs help prevent groundwater quality degradation as well. See Section 6.

As discussed in Section 3.2.5, groundwater contamination exists in portions of the La Habra Groundwater Basin. The contaminants in the local groundwater are primarily naturally occurring and are not caused by excess groundwater production. Consequently, the only effective management action to address groundwater with existing poor water quality is treatment. As discussed previously, the City of La Habra blends groundwater from the La Habra Groundwater Basin with imported water (both groundwater and surface water) in order to reduce contaminant levels prior to distribution.

## 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 or management actions. 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. Currently, groundwater produced from the La Habra Groundwater Basin is able to be put to beneficial use as a potable water supply. Historically, groundwater quality in the La Habra Groundwater Basin has been variable with areas with poor water quality; however, these historical water quality issues are not caused by groundwater management actions or current groundwater production (see Section 3.2.5). Thus, no undesirable results related to degraded water supply are occurring. See Section 11.6 below for further discussion.

## 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. As discussed previously, the current water quality concerns in the La Habra Groundwater Basin are naturally occurring and are not caused by over-production or other groundwater management actions. These concerns pre-date SGMA legislation and are currently being managed through a blending program. Drinking water distributed to residents in the cities of Brea and La Habra currently meet all regulatory requirements. Accordingly, undesirable results as defined above in Section 11.5 by the definition of “significant and unreasonable” are not occurring and are not anticipated to occur due to groundwater production being managed within the Basin sustainable yield. If groundwater water quality trends indicate declining water quality, additional management actions will be established.

# SECTION 12. MANAGING 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. MANAGING 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. Accordingly, sustainable management criteria or active monitoring are not required at this time. 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 if it is determined that there is a potential for significant or unreasonable land subsidence to occur. The need for land surface subsidence monitoring will be considered on an annual basis.

# SECTION 14. MANAGING 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). As discussed previously in Section 3.2.7, there are small areas overlying the La Habra Groundwater Basin identified as GDEs. The areas of vegetation identified as groundwater dependent ecosystems are along the base of the surrounding hills at the limits of the basin where groundwater is shallow. The vegetation is also supported by surface water runoff and rainfall. Additionally, these areas are not located near the groundwater production wells which produce from the confined San Pedro aquifer. Accordingly, groundwater production is not anticipated impact surface waters and local habitats Thus, there is no evidence that groundwater depletions will impact surface water or groundwater dependent ecosystems within the La Habra-Brea Management Area.

# SECTION 15. PROTOCOLS FOR MODIFYING MONITORING PROGRAMS

Available data and groundwater management programs are reviewed annually. Additionally, data gaps are identified and evaluated. 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 protocols for water quality sampling are discussed in the 2017 Alternative.

## 15.2 ESTABLISHMENT OF PROTOCOLS FOR GROUNDWATER ELEVATION/STORAGE

The protocols for groundwater level measurements are discussed in the 2017 Alternative.

# 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. 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.

DWR, 2021a. DWR. SGMA Data Viewer. Accessed November 9, 2021. https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer#landsub

DWR, 2021b. DWR. Natural Communities Commonly Associated with Groundwater (NCCAG) Dataset Viewer. Accessed November 9, 2021. https://gis.water.ca.gov/app/NCDatasetViewer/

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), 2021. Areas of Land Subsidence in California. Accessed November 9, 2021. 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

## 2022 UPDATE

Prepared by: Orange County Water District

January 1, 2022

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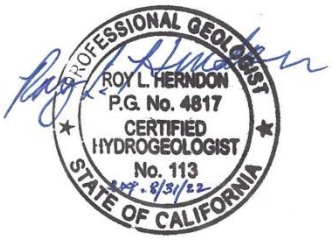


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Prepared for the Department of Water Resources, pursuant to Water Code §10733.6(b)(3), (c) and §10733.6

January 1, 2022

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# 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 2.5 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 the Sustainable Groundwater management Act (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.

The agencies within Basin 8-1 collaborated to prepare and submit an Alternative to a Groundwater Sustainability Plan (GSP). In accordance with Water Code §10733.6(b)(3)(c), the Basin 8-1 Alternative presented an analysis of basin conditions that demonstrated that Basin 8-1 had operated within its sustainable yield over a period of at least 10 years. The Alternative was submitted to DWR on December 22, 2016. On July 17, 2019, DWR determined that the Alternative satisfied SGMA objectives and was therefore approved.

Approved alternatives are required to submit annual reports to DWR on April 1 of each year. Annual reports for Basin 8-1 were submitted to DWR as follows:

- Water Year 2016-17, submitted on March 29, 2018
- Water Year 2017-18, submitted on March 29, 2019
- Water Year 2018-19, submitted on March 30, 2020
- Water Year 2019-20, submitted on March 30, 2021

*Note, the DWR Water Year extends from Oct. 1 to Sept. 30.

According to Water Code §10733.8, "At least every five years after initial submission of a plan pursuant to Section 10733.4, the department shall review any available groundwater sustainability plan or alternative submitted in accordance with Section 10733.6, and the implementation of the corresponding groundwater sustainability program for consistency with this part, including achieving the sustainability goal. The department shall issue an assessment for each basin for which a plan or alternative has been submitted in accordance with this chapter, with an emphasis on assessing progress in achieving the sustainability goal within the

basin. The assessment may include recommended corrective actions to address any deficiencies identified by the department."

This document, called the 2022 Update, represents the first five-year update, which is due January 1, 2022.

**For purposes of this report, the Basin 8-1 Alternative submitted on December 22, 2016, will be referred to as the 2017 Alternative. The first five-year update will be referred to as the 2022 Update for ease of reference. The 2017 Alternative was a comprehensive document showing that Basin 8-1 had been managed sustainably for more than 10 years. For the 2022 Update, the focus is on documenting that the basin has been sustainably managed during the five years since the 2017 Alternative was submitted and to present relevant new information from the last five years. As such, the 2017 Alternative is considered a key reference document with background information that is not duplicated in the 2022 Update.**

## 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 for the Principal Aquifer as of June 2021 are shown in Figure 1-2.

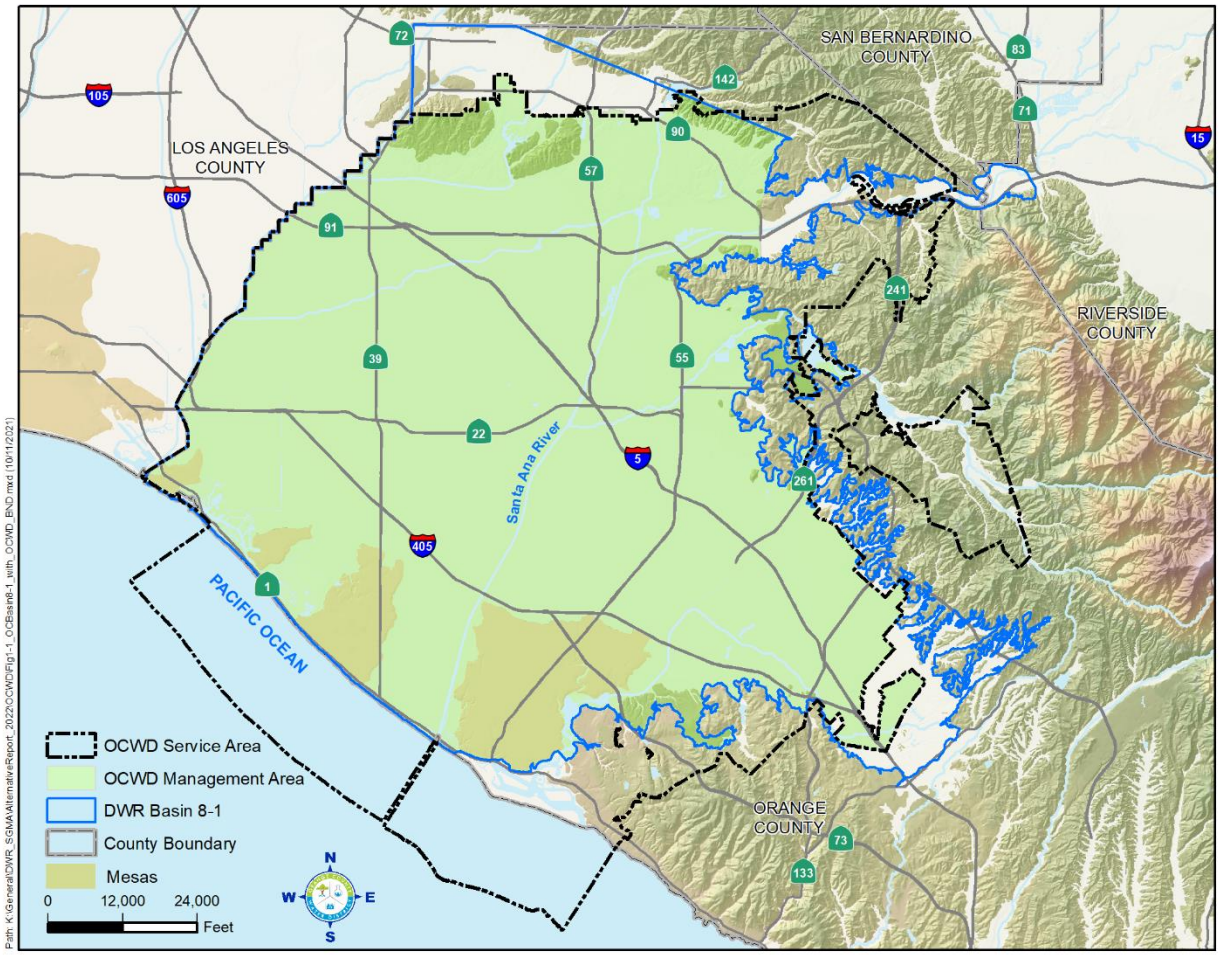



Figure 1-1: Basin 8-1, OCWD Service Area and OCWD Management Area

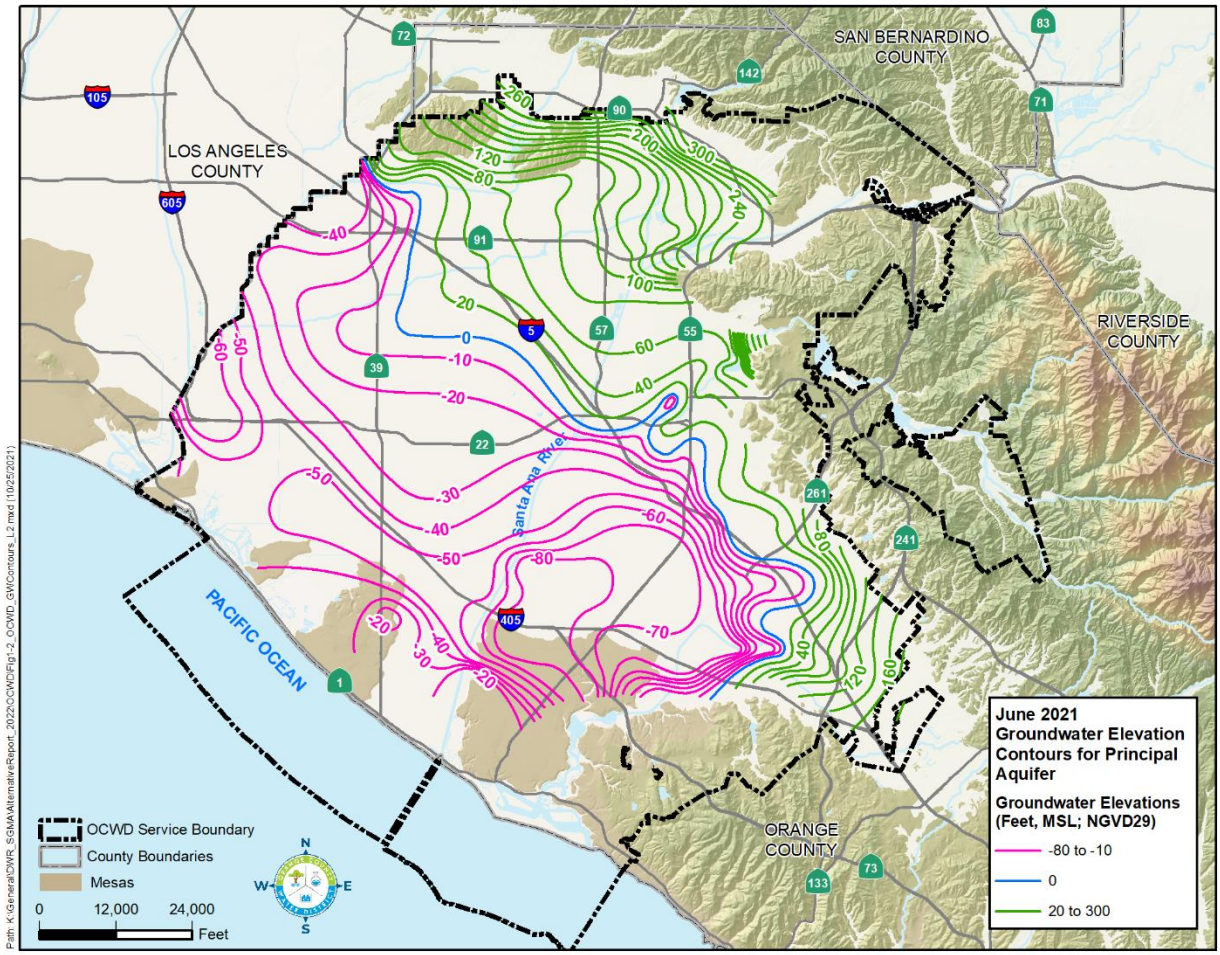



Figure 1-2: Groundwater Elevation Contours for the Principal Aquifer, June 2021

## 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.

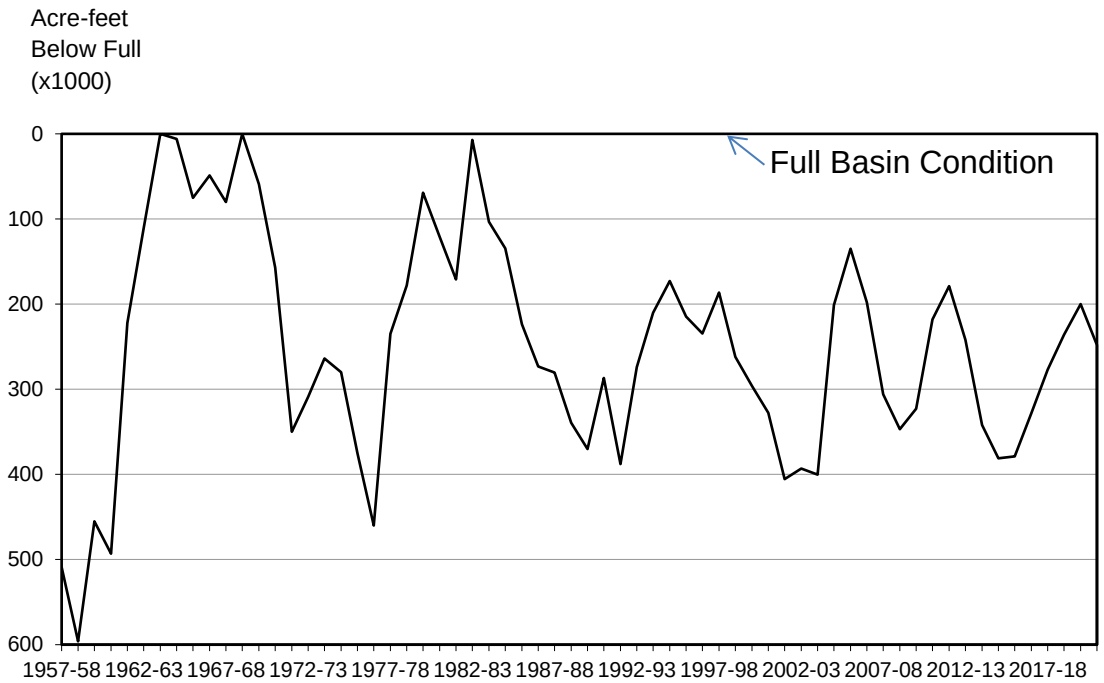



Figure 1-3: Available Basin Storage WY1957-58 to 2020-21

## 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 2020 (OCWD, 2020).

There are several regional groundwater contamination plumes within the OCWD Management Area, all of which are under active remediation, and some are being evaluated for additional remediation. The U.S. Environmental Protection Agency (EPA) is the lead agency in overseeing a remedial investigation/feasibility study (RI/FS) to develop an interim remedy for the VOC plume in the North Basin area. OCWD is conducting an RI/FS to develop an interim remedy for the plume in the South Basin area. Investigations and remediation for individual contaminant source sites within the North Basin and South Basin areas are 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.

### Per- and Polyfluoroalkyl Substances (PFAS)

Per- and polyfluoroalkyl substances (PFAS) are a group of thousands of manmade chemicals that includes perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS). PFAS compounds have been 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 Division of Drinking Water (DDW) began requiring testing for PFAS compounds in some groundwater production wells in the OCWD area.

As a result of required testing, as of September 2021, approximately 60 wells in the OCWD service area have been temporarily turned off until treatment systems can be constructed. As additional wells are tested, this figure may increase.

In April 2020, OCWD as the groundwater basin manager, executed a multi-party agreement with the impacted groundwater producers to fund and construct the necessary treatment systems for production wells impacted by PFAS compounds. OCWD expects the treatment systems to be constructed for the approximately 60 impacted wells within the next 2 to 3 years.

## LAND SUBSIDENCE

Ground surface elevations rise and fall due to groundwater conditions in the OCWD Management Area and do 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 OCWD water years (WY)1999-2000 to 2020-21 are shown in Figure 1-4. The OCWD water year extends from July 1 to June 30.

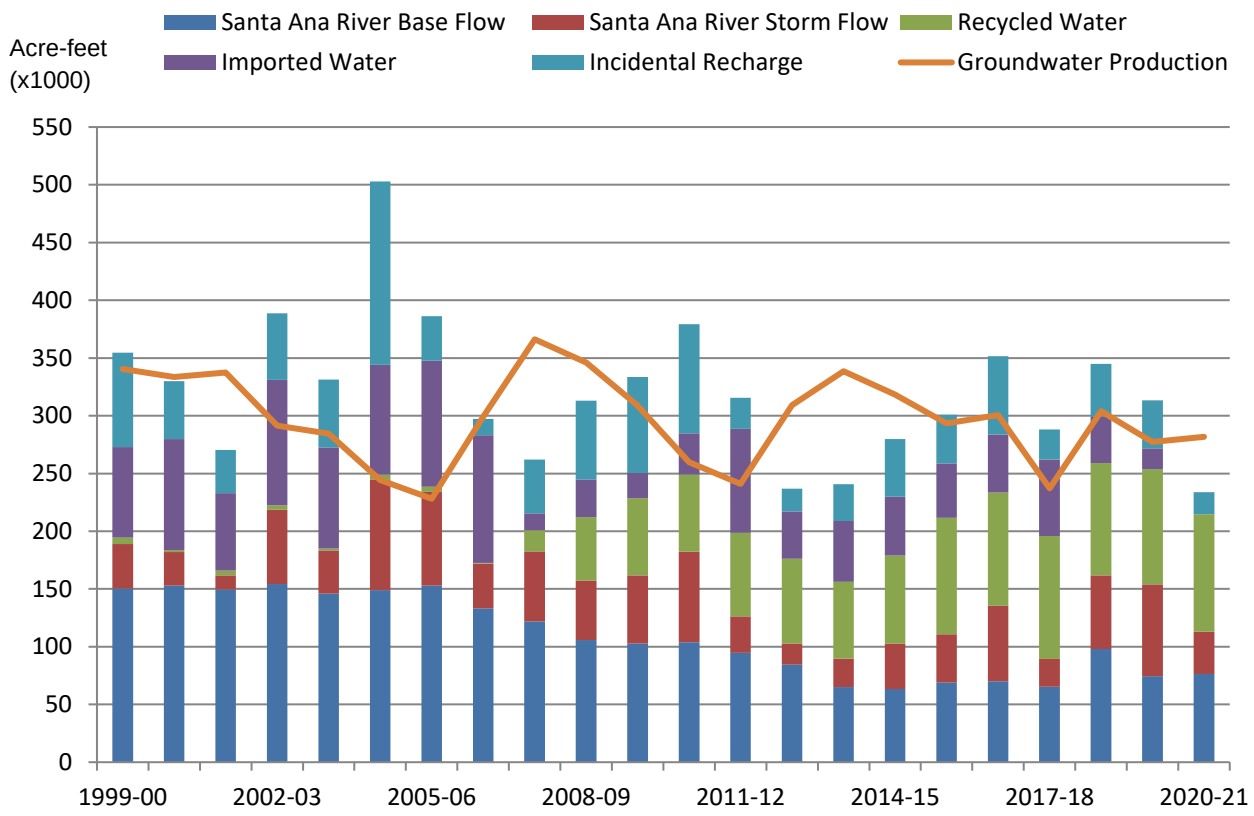



Figure 1-4: Basin Production and Recharge Sources, WY1999-20 to 2020-21

## 1.3 WATER RESOURCE MONITORING PROGRAMS

Water resource monitoring programs for groundwater, surface water, recycled water, and imported water remain unchanged (see 2017 Alternative for list). The only slight modification is the replacement of the CA Statewide Groundwater Elevation Monitoring (CASGEM) Program with annual data reports required for SGMA compliance.

## 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

The average annual water demand within the OCWD Management Area for the most recent five water years, WY2016-17 to 2020-21 is approximately 400,000 acre-feet. Total water demands

in the management area are met by a combination of groundwater, imported water, and recycled water. From WY1996-97 to present, water demands have ranged between 367,000 and 526,000 acre-feet per year but have generally decreased, as shown in Figure 1-5. It is noted that water demands in WY2015-16 reflect mandatory demand reductions imposed by the State Water Board in response to an extended drought. OCWD strives to sustainably maximize both production from the basin and recharge of the groundwater basin.

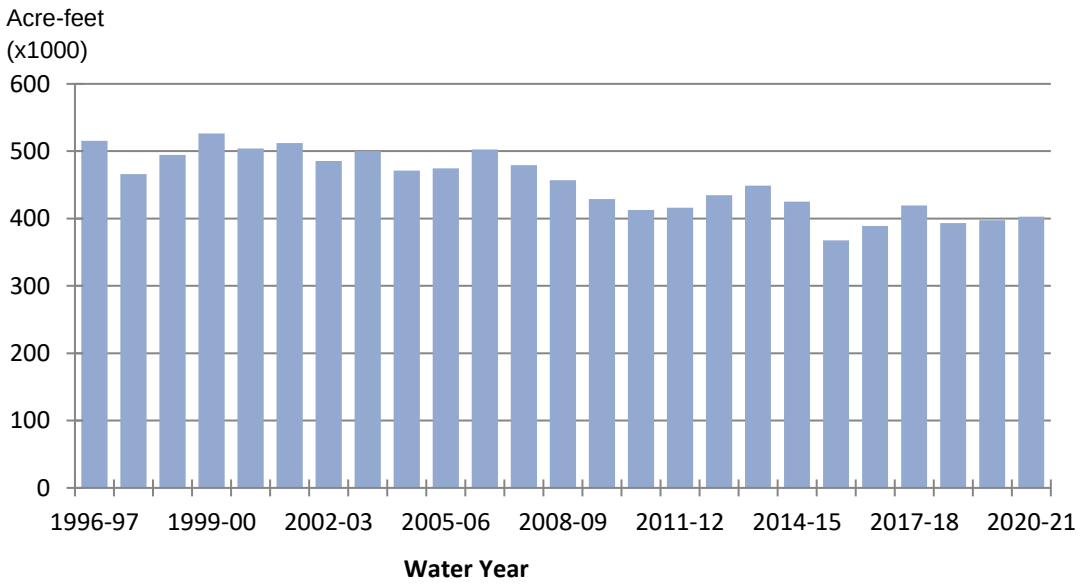



Figure 1-5: Total Water Demands within OCWD, WY1997-98 to 2020-21

## 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.

In January 2020, in preparation for the impacts of PFAS to groundwater supply, OCWD adopted a Per- and Polyfluoroalkyl Substances (PFAS) Policy. Central to this policy is OCWD's desire to maintain a groundwater supply of suitable quality for all existing and potential beneficial uses. Among other items, the policy states that OCWD will fund the lowest reasonable and efficient treatment system design and construction costs to remove PFAS compounds for groundwater producers. Additionally, the policy states that OCWD will fund 50 percent of operation and maintenance expenses up to $75 per acre-foot plus potential adjustments.

As of September 2021, approximately 60 production wells operated by 11 groundwater producers have been temporary shut down until treatment systems can be constructed. OCWD expects these treatment systems to be constructed within the next 2 to 3 years.

### RECYCLED WATER PRODUCTION

OCWD's Groundwater Replenishment System (GWRS) produces up to 100 million gallons per day (mgd) of highly treated recycled water. The GWRS Final Expansion is under construction and will be on-line in early 2023. The final expansion will increase plant capacity to 130 mgd. GWRS 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 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.

### 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.

Work is underway to characterize intrusion in the Sunset Gap, including installation of monitoring wells, development of a groundwater flow model, and feasibility studies. This information is needed to guide design of a potential new seawater barrier in the Sunset Gap.

## 1.5 NOTICE AND COMMUNICATION

The local agencies that produce the majority of the groundwater from the basin include 19 cities, water districts, and a private water company. 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 groundwater level trends demonstrate the undesirable result of "chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply" is not present. 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. Chronic lowering of groundwater levels is not anticipated to occur in the future in the OCWD Management Area due to OCWD's management programs.

### 1.6.2 Sustainable Management: Basin Storage

OCWD manages basin storage within an established operating range 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.

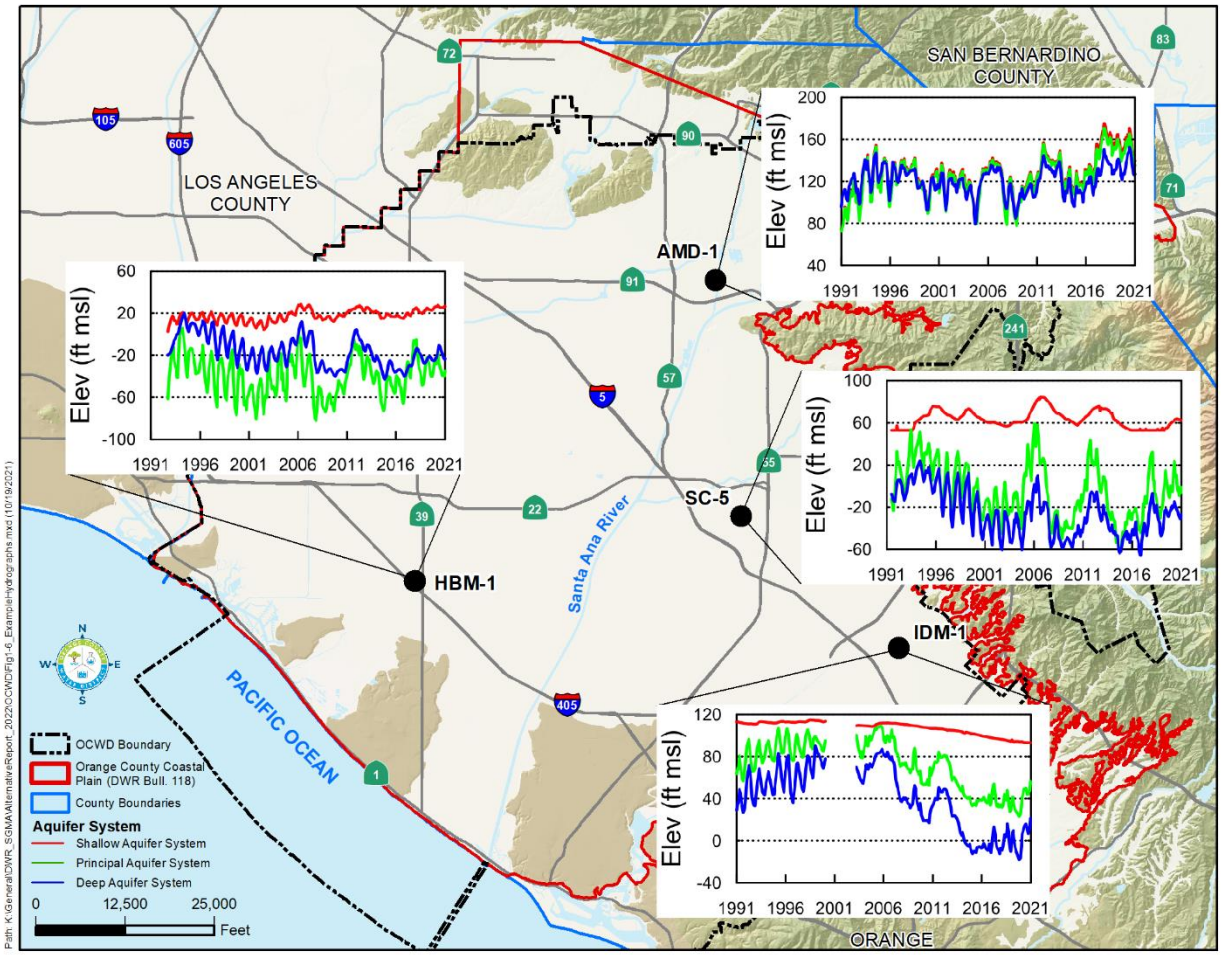



Figure 1-6: Example Hydrographs

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 properties. This calculation is checked against an annual water budget that accounts for all production, measured recharge and estimated unmeasured recharge (also referred to as "incidental recharge"). The amount of available or unfilled storage from the theoretical full condition is shown 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 groundwater quality. OCWD's network of approximately 400 monitoring wells is 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 the groundwater producers to comply with Title 22 requirements. An additional approximately 120 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 Maximum Contaminant Level (MCL). These sampling protocols are designed to detect water quality problems at the earliest possible stage.

The recent detections of per- and polyfluoroalkyl substances (PFAS) in groundwater have affected the use of groundwater by 11 groundwater producers. As described in detail later in this report, OCWD is taking steps to restore the beneficial uses of impacted groundwater by installing treatment systems to remove PFAS.

The undesirable result of "significant and unreasonable degradation of water quality 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 two seawater intrusion barriers, monitoring and evaluating barrier performance, monitoring and evaluating susceptible coastal areas, and coastal groundwater management.

The Alamitos Seawater Intrusion Barrier manages seawater intrusion in the Alamitos Gap. The Talbert Seawater Intrusion Barrier manages seawater intrusion in the Talbert Gap. Work is underway to further characterize intrusion in the Sunset Gap, including construction of additional monitoring wells, further development of the Alamitos Barrier groundwater model to evaluate seawater intrusion in the area of the Sunset Gap, and feasibility studies to evaluate potential future barrier design.

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 of significant and unreasonable land subsidence that substantially interferes with surface uses. Within the OCWD Management Area ground surface movements rise and fall as basin storage levels rise and fall. 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 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 MCL, 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

- Constructing a new seawater barrier in the Sunset Gap
- Constructing water quality improvement projects

## 1.9 CONCLUSION

OCWD has been managing the OCWD Management Area since its formation by the State Legislature in 1933. Monitoring and management programs described in the 2017 Alternative, submitted in compliance with CA Code of Regulations (Title 23, Division 2, Chapter 1.5, Subchapter 2) demonstrated that the groundwater basin has been and will continue to be sustainably managed. The Alternative submitted in 2017 and approved by DWR in 2019 demonstrated that the OCWD Management Area 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). The 2022 Update, prepared to satisfy Water Code §10733.8, shows that the OCWD Management area continues to be managed sustainably.

**Please note that for consistency, the same chapter headings used in the 2017 Alternative are used in the 2022 Update. The goal of the update is to present new relevant information that has become available over the last five years. Where there is no new relevant information, the reader is directed to the 2017 Alternative by reference.**

# 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 the Sustainable Groundwater Management Act (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 2.5 million residents living within OCWD's boundaries. With passage of 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 approximately 200 large-capacity wells for retail water use. There are also approximately 120 small-capacity wells that pump water from the basin. OCWD protects and manages the groundwater resource for long-term sustainability, while meeting approximately 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 2.5 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 groundwater production increased from approximately 150,000 acre-feet per year in the mid-1950s to a high of over 366,000 acre-feet per year in WY2007-08.

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 from 1933 to 2015 is provided in the 2017 Alternative. Significant events that have occurred during the last five years are as follows:

**2018:** GWRS sets the Guinness World Record for most wastewater recycled in 24 hours. The official amount was 100,008,000 gallons.

**2019:** OCWD's Philip L. Anthony Water Quality Laboratory was the first public agency laboratory in California to achieve state certification to analyze for PFAS in drinking water. OCWD launched the nation's largest pilot program to test various treatment options for PFAS.

**2019**: Construction of the GWRS Final Expansion began. Construction is anticipated to be completed in early 2023. Once complete the plant will produce up to 130 mgd and recycle 100 percent of reclaimable sources from the Orange County Sanitation District.

**2021:** U.S. Army Corps of Engineers approves Prado Conservation Pool increase up to elevation 505 feet mean sea level (approx. 20,000 acre-feet of storage) based on the Prado Basin Ecosystem Restoration and Water Conservation Feasibility Study.

**2021**: The first PFAS treatment system, at Fullerton's KIM-1A production well, is completed and the well returned to service.

## 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)

Further details on OCWD governance and management are described in the 2017 Alternative. 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

A description of OCWD's legal authority is described in the 2017 Alternative.

A copy of the OCWD Act, which has been the basis for OCWD's sustainable management of its portion of Basin 8-1 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 a summary description of OCWD's budget structure, see the 2017 Alternative. For more recent information, see OCWD's website at www.ocwd.com where detailed budget reports are published annually.

# 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 the Alternative, except as identified below. The OCWD service area includes 90 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 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.

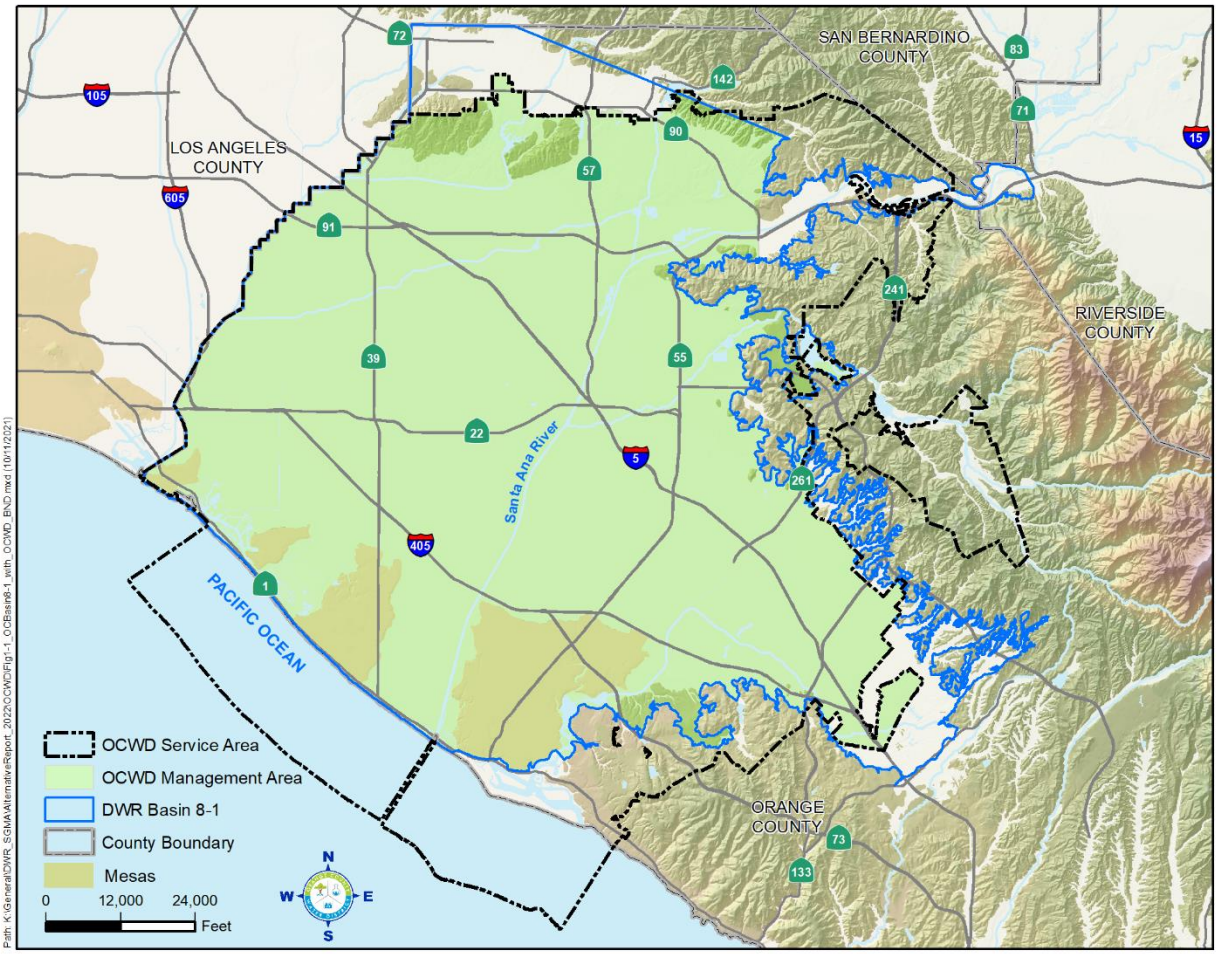



Figure 3-1: Basin 8-1, OCWD Service Area and OCWD Management Area

## 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 and have not changed since the 2017 Alternative. Retail water providers within OCWD's service area are shown in Figure 3-3. The OCWD Management Area with a population of approximately 2.5 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 groundwater 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.

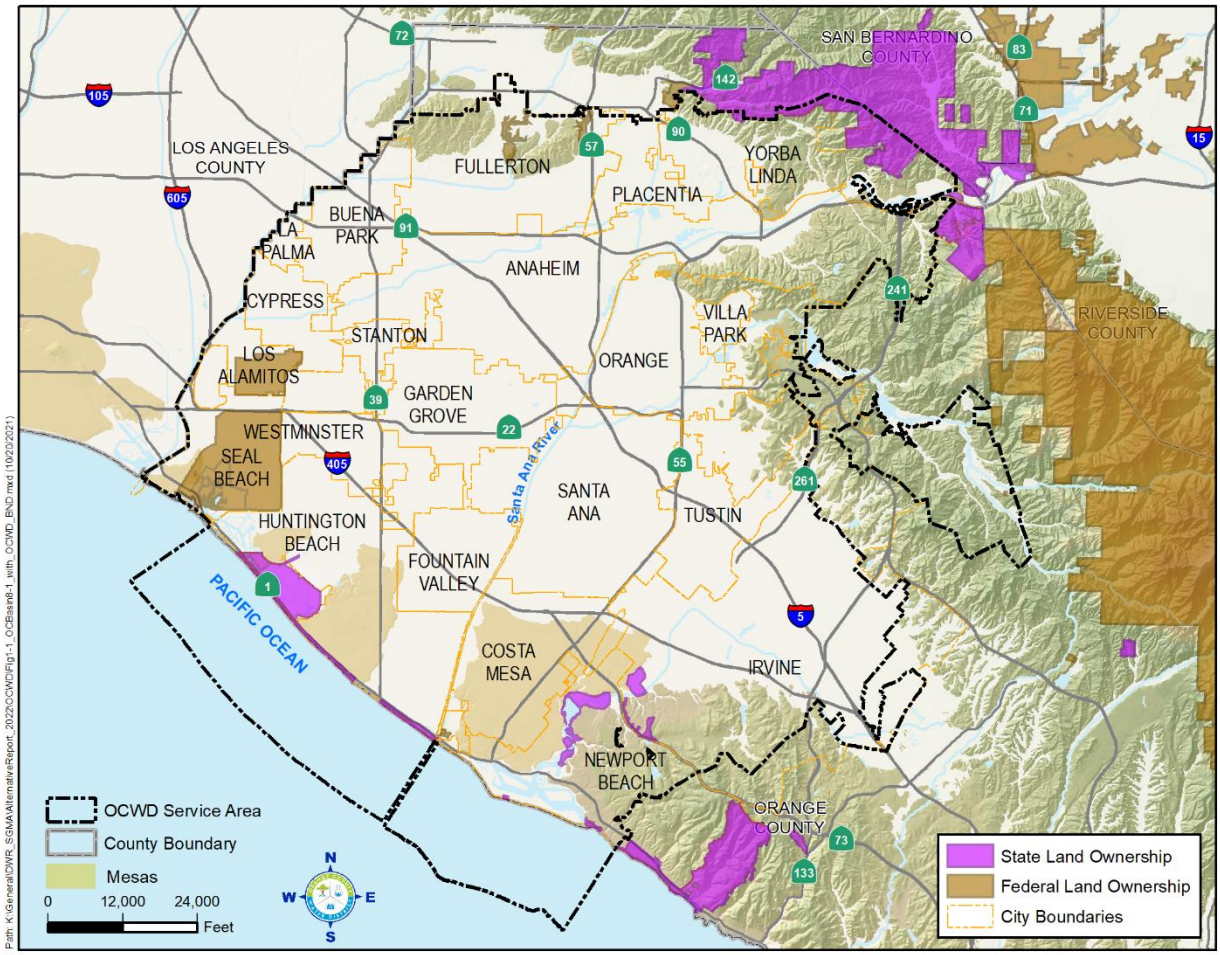



Figure 3-2: Federal and State Lands

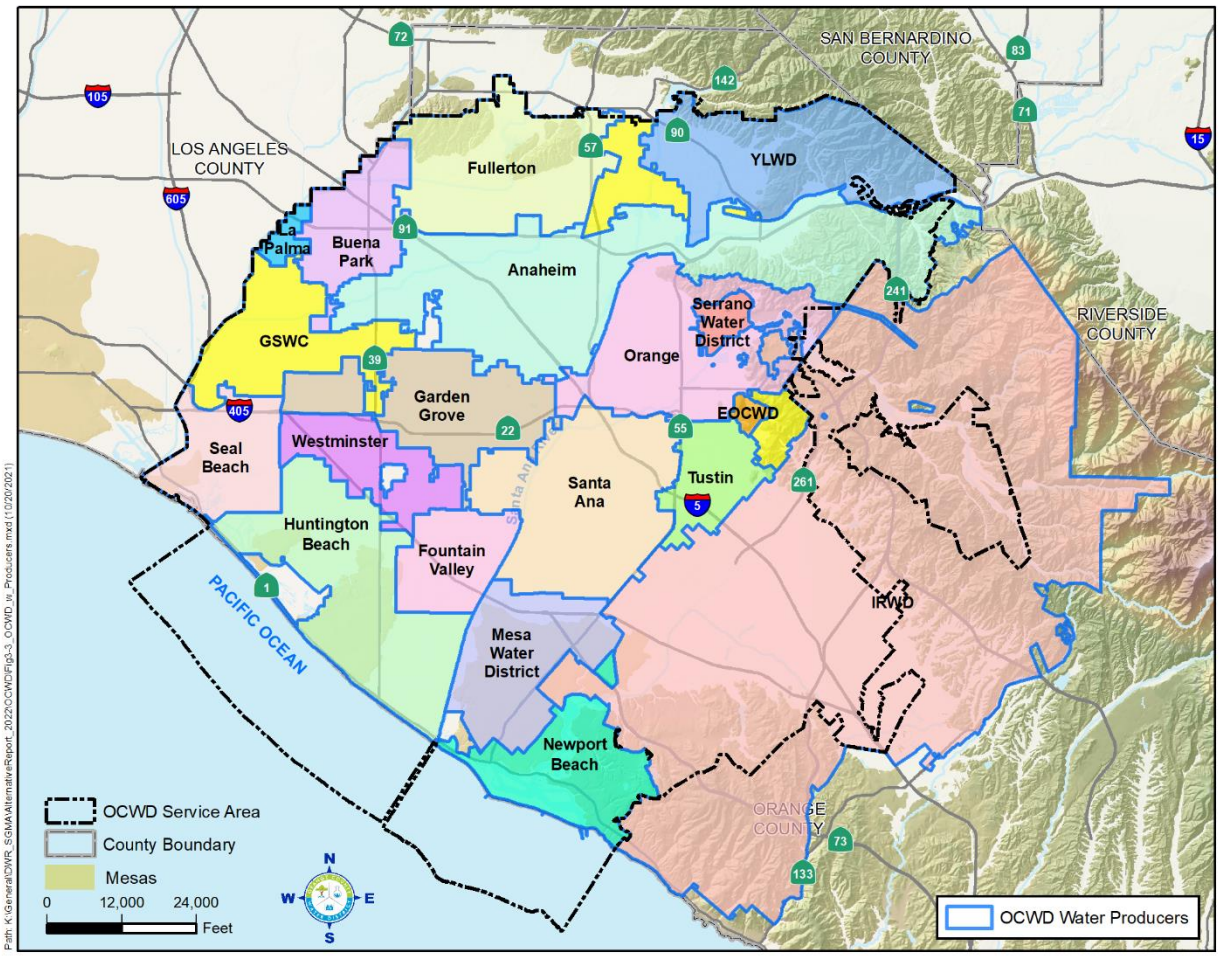



Figure 3-3: Retail Water Supply Agencies

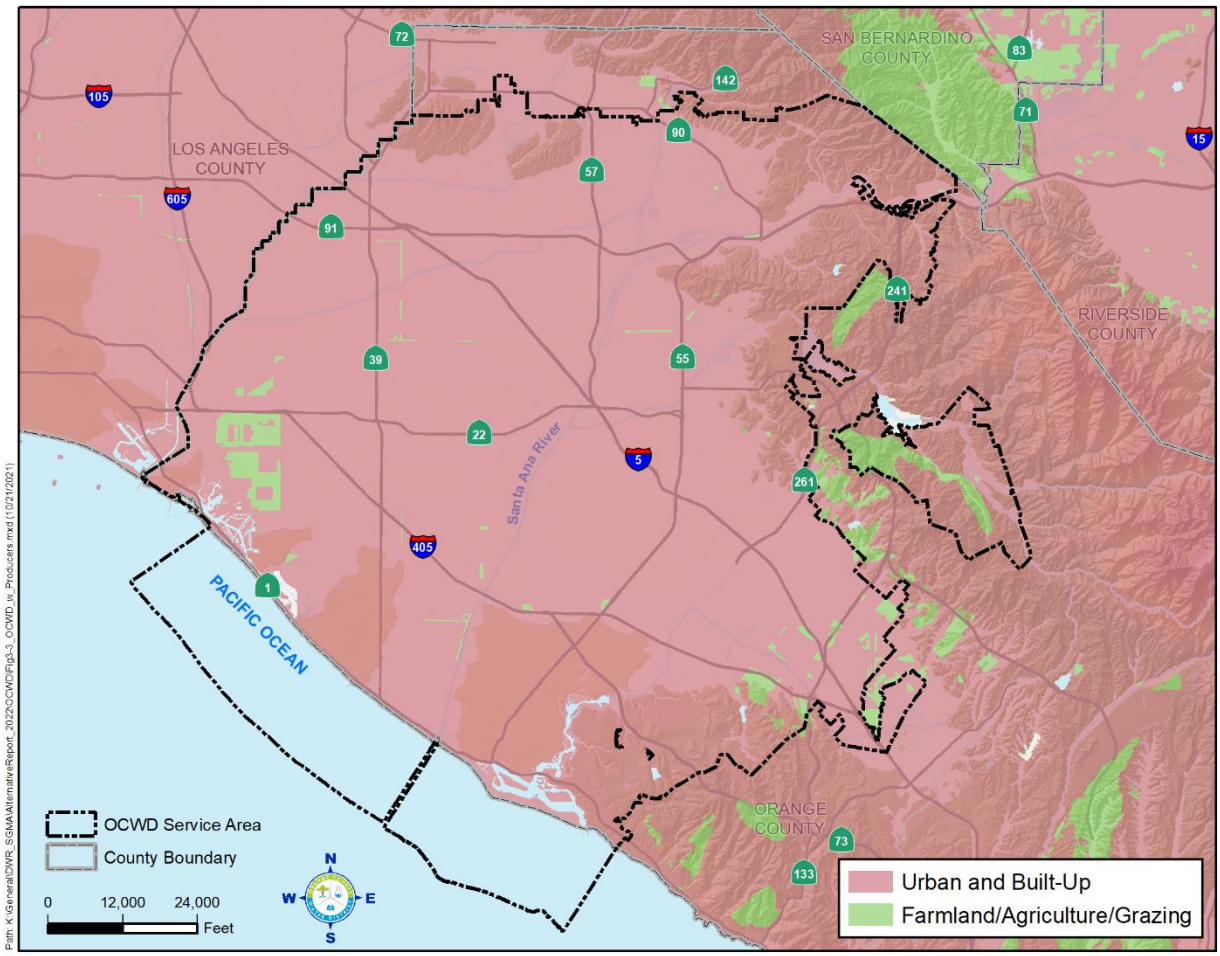



Figure 3-4: Land Uses

## 3.2 GROUNDWATER CONDITIONS

This section describes the groundwater conditions within the OCWD Management Area. The focus is on data from the last five years. For some historical data, please see the 2017 Alternative. The description includes groundwater elevation, pumping patterns, storage levels, groundwater quality, 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 2021. The contour maps for each of the three aquifer systems are prepared annually. The contour maps are 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.

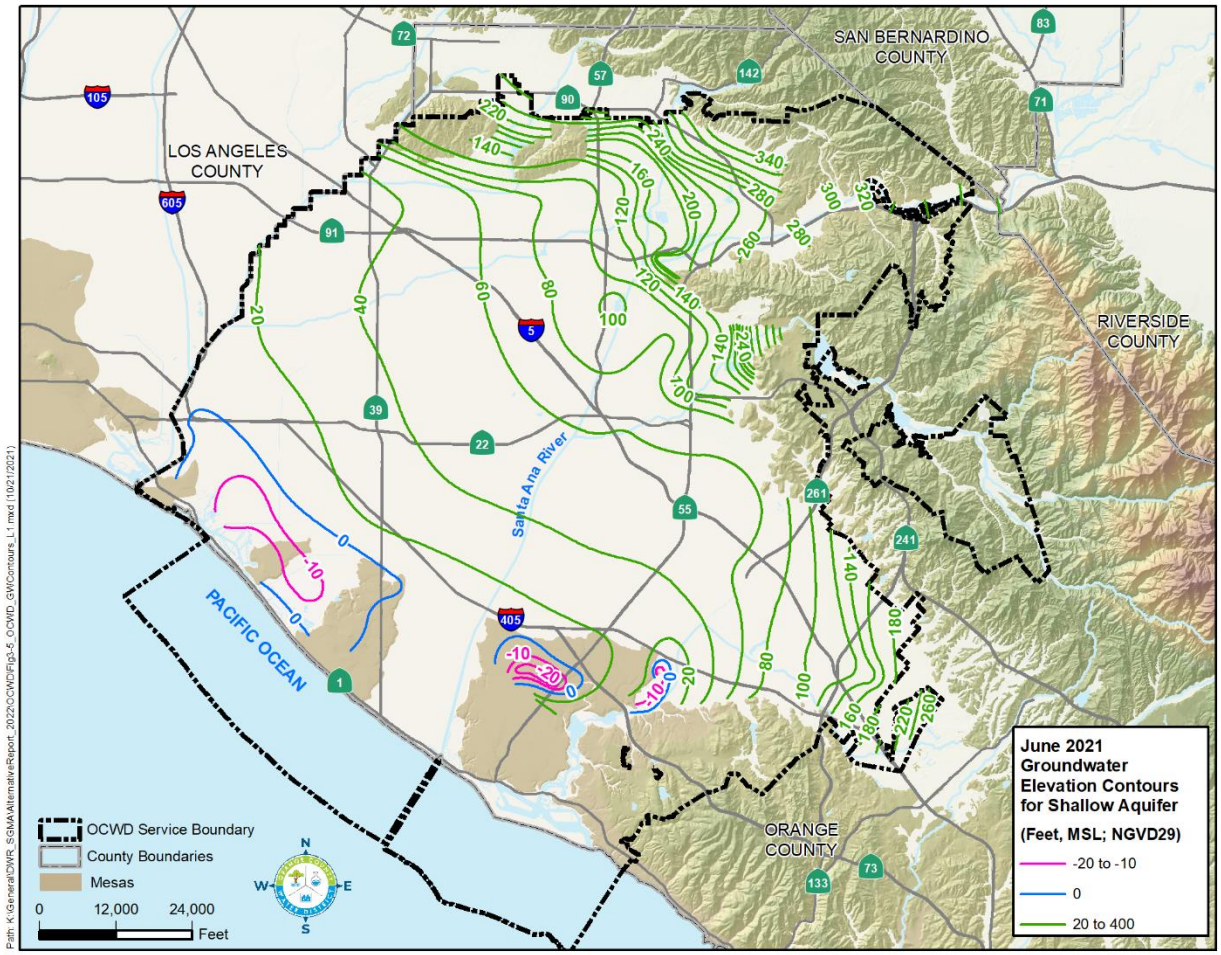



Figure 3-5: Groundwater Elevation Contours for the Shallow Aquifer, June 2021

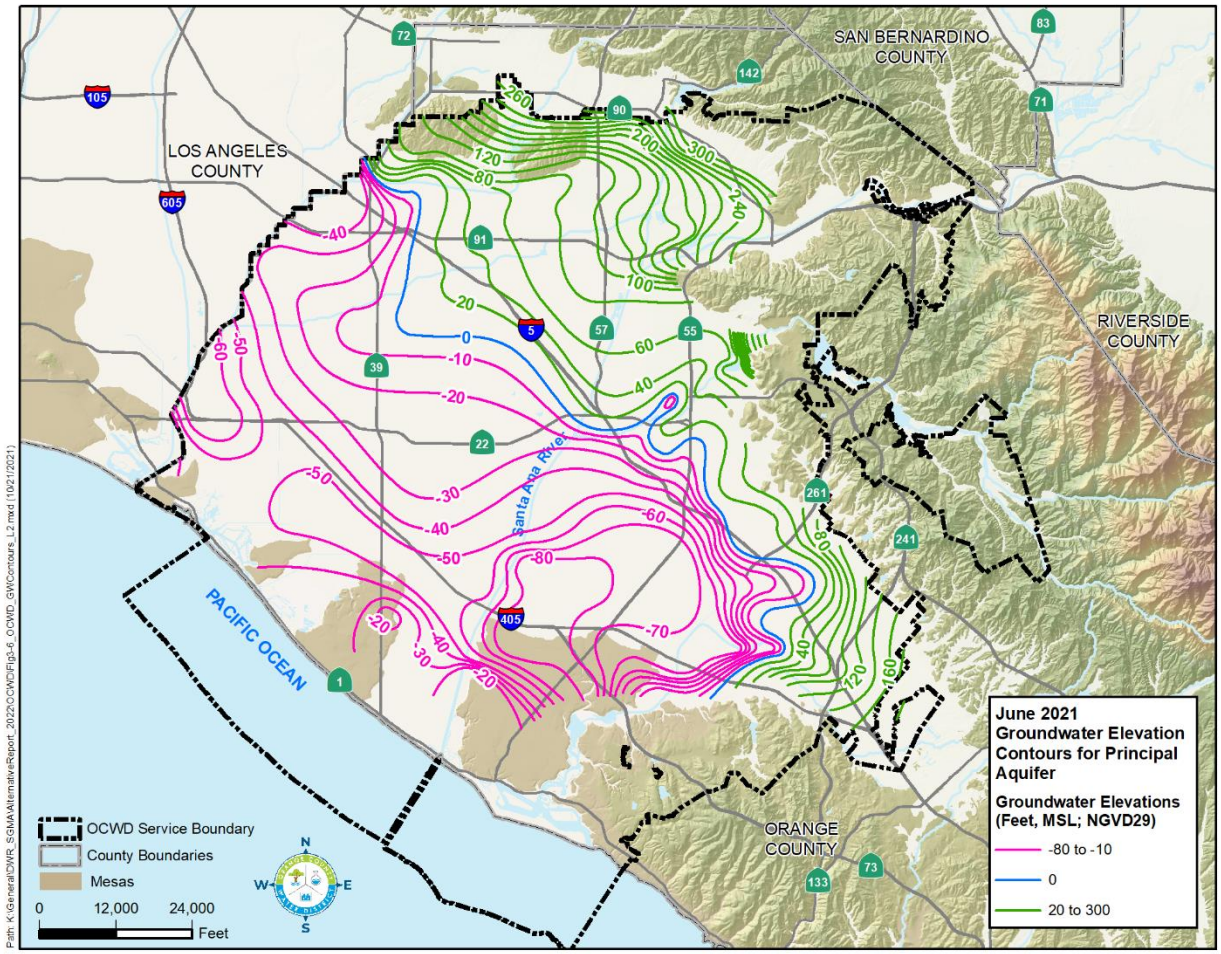



Figure 3-6: Groundwater Elevation Contours for the Principal Aquifer, June 2021

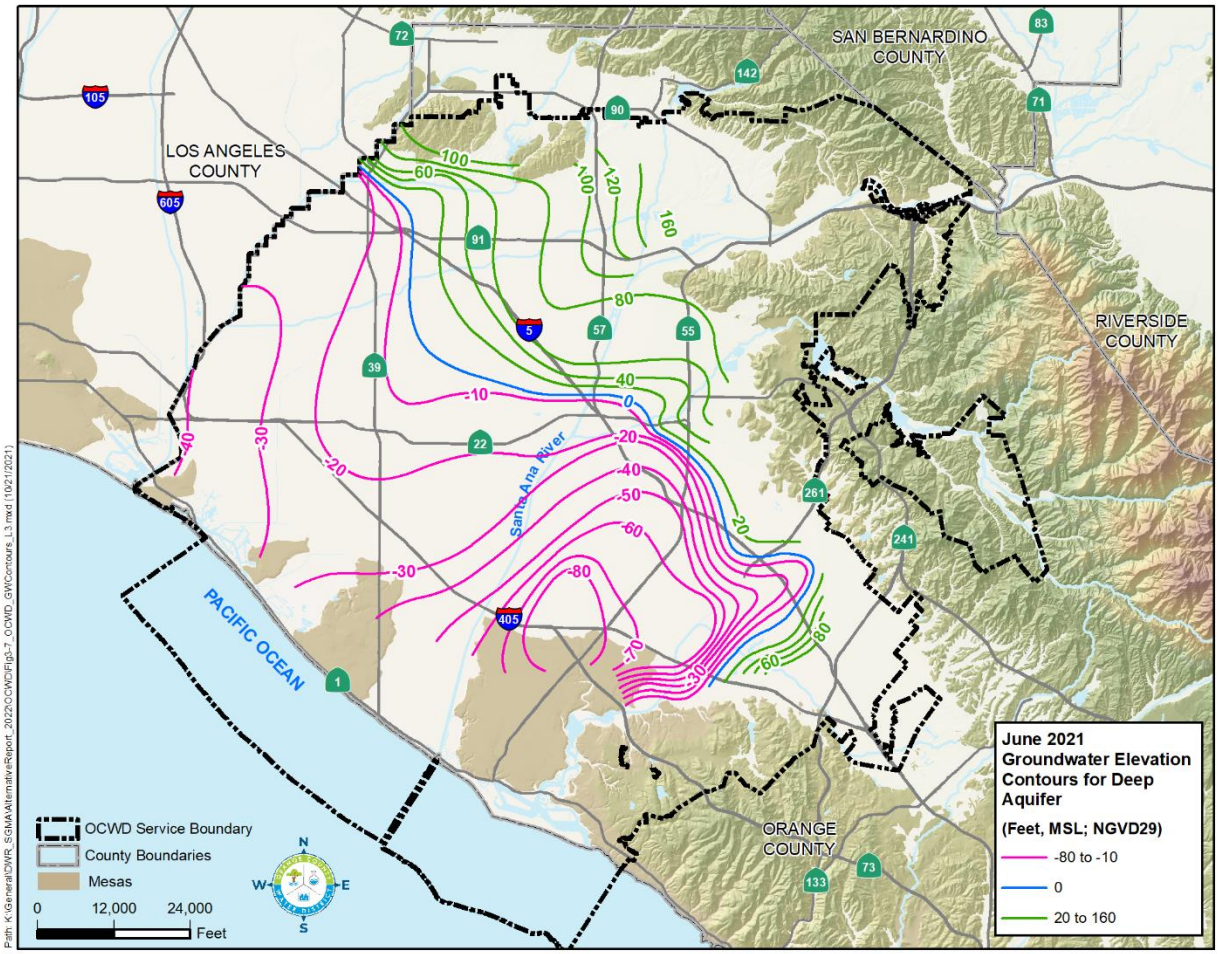
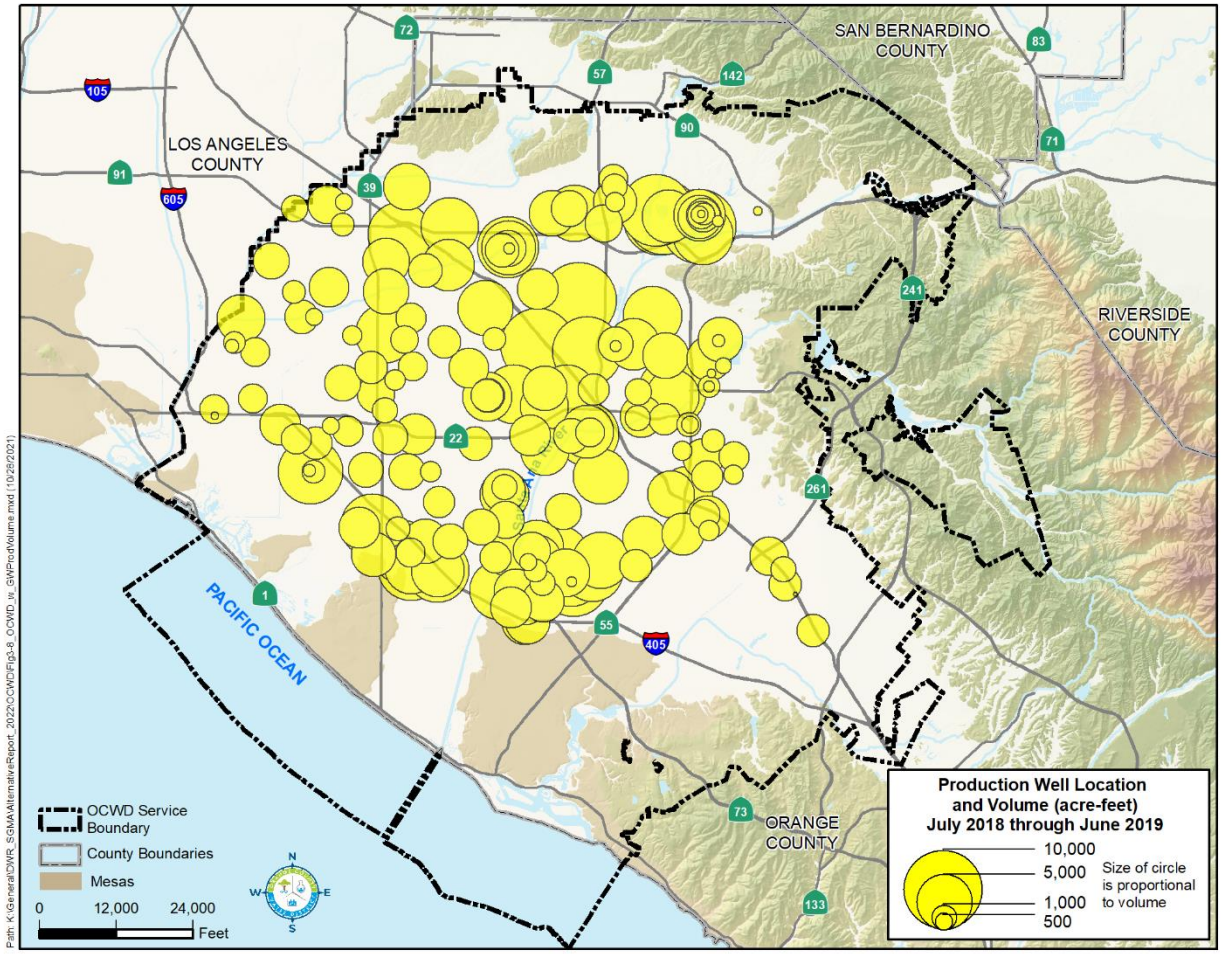



Figure 3-7: Groundwater Elevation Contours for the Deep Aquifer, June 2021

## 3.2.2 Regional Pumping Patterns

Active wells pumping water from the basin are shown in Figure 3-8. The approximately 200large-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 basin. Please note that due to the recent impacts of COVID and PFAS, data from WY2018-19 is presented to show the typical average distribution of pumping in the basin.




* Due to impacts from COVID-19 FY 2018-19 groundwater production was chosen to be representative of typical pumping patterns.

Figure 3-8: Groundwater Production, WY2018-19

## 3.2.3 Long-Term Groundwater Elevation Hydrographs

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.

Groundwater elevation trends can be examined using seven wells with long-term groundwater level data, the locations of which are shown in Figure 3-9. Figures 3-10 and 3-11 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. Well A-27 was destroyed in May 2012. To continue this hydrograph, water levels from nearby OCWD monitoring well, AMD-9/1 is used. A comparison of water levels when the two wells were in operation show they are nearly identical.

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 Metropolitan Water District of Southern California's (MWD) Short-Term Seasonal Storage Program by local groundwater 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 3-12 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.

For additional information and background information on groundwater level measurements, see the 2017 Alternative.

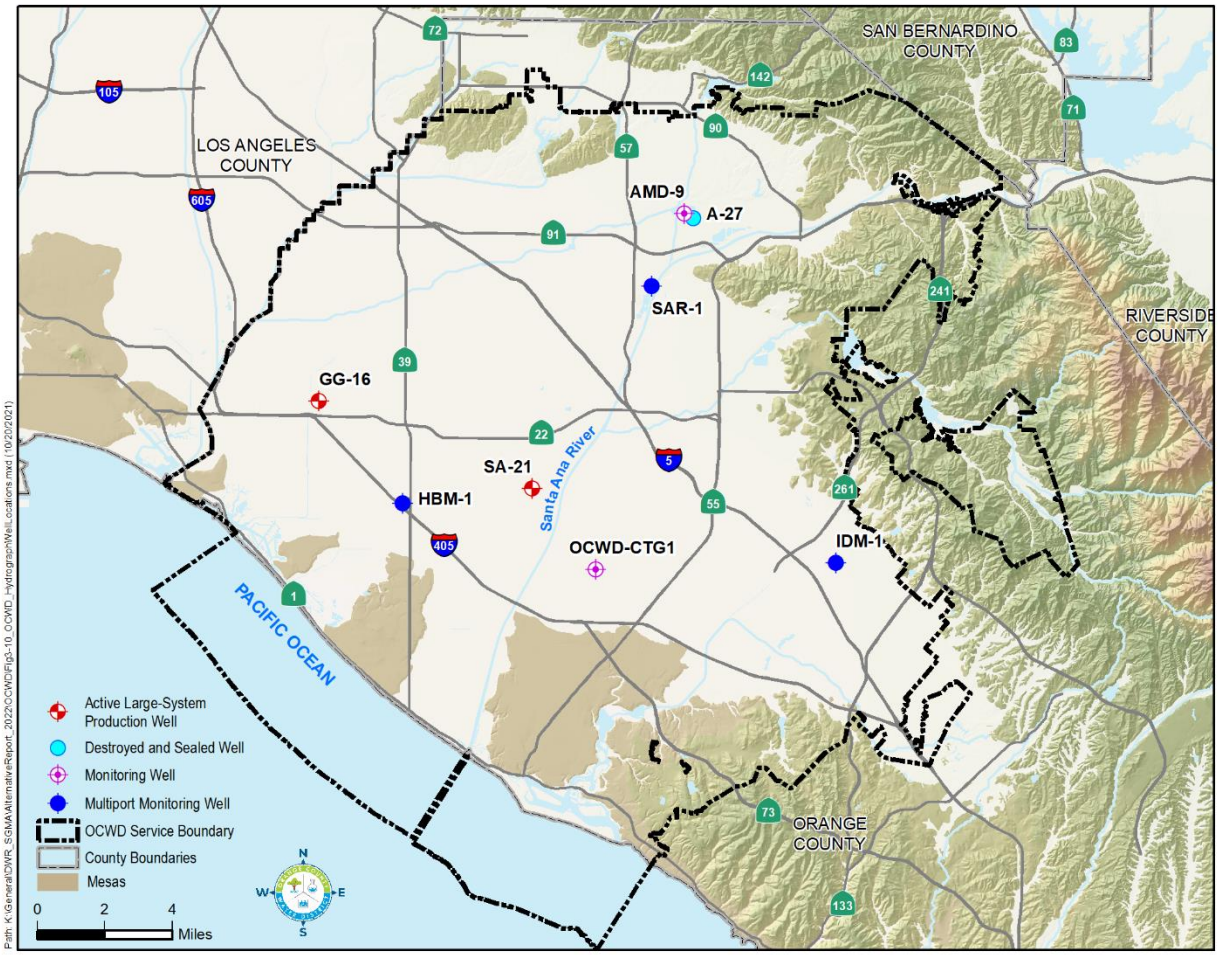



Figure 3-9: Location of Long-Term Groundwater Elevation Hydrographs

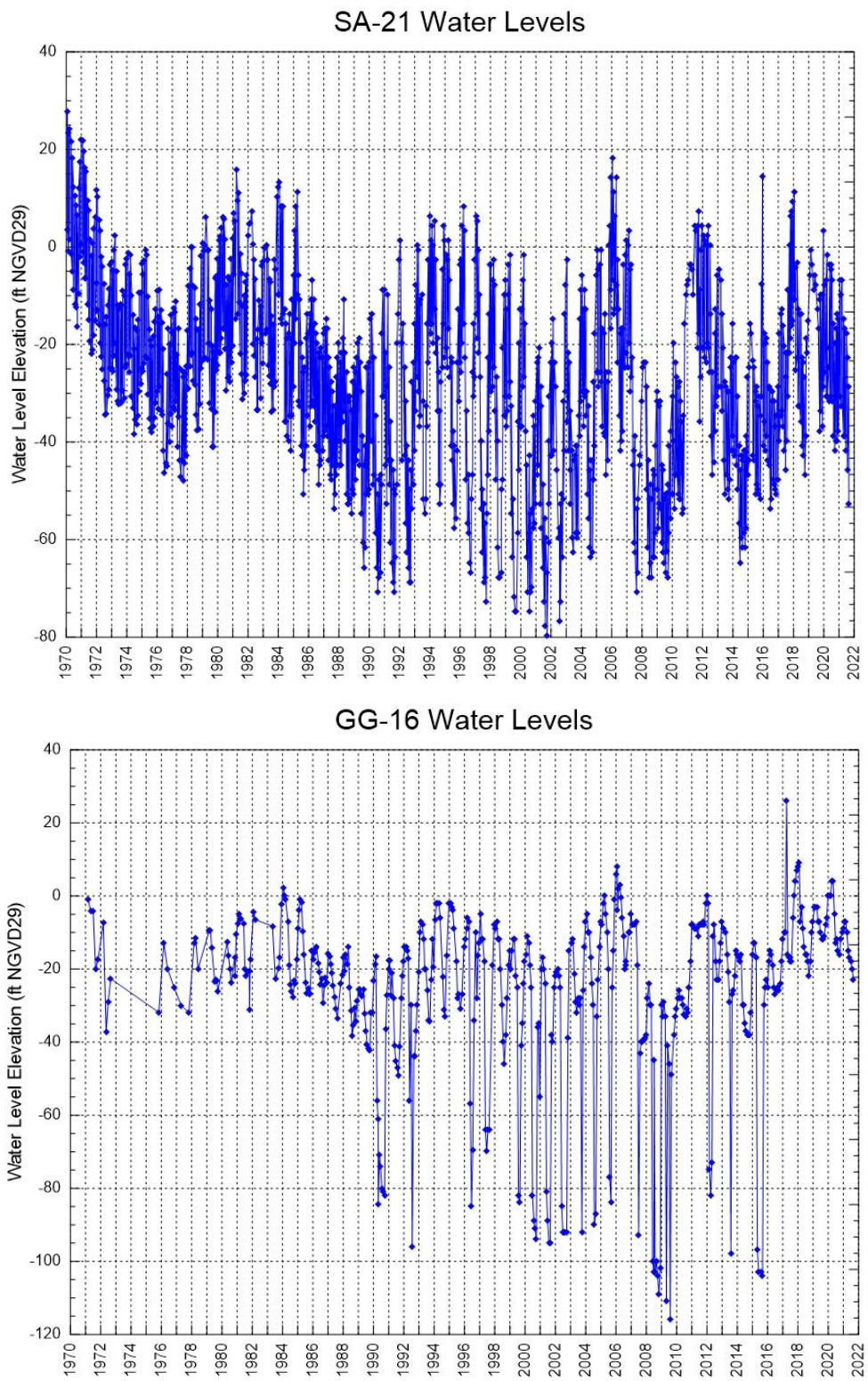



Figure 3-10: Water Level Hydrographs of Wells SA-21 and GG-16 in Pressure Area

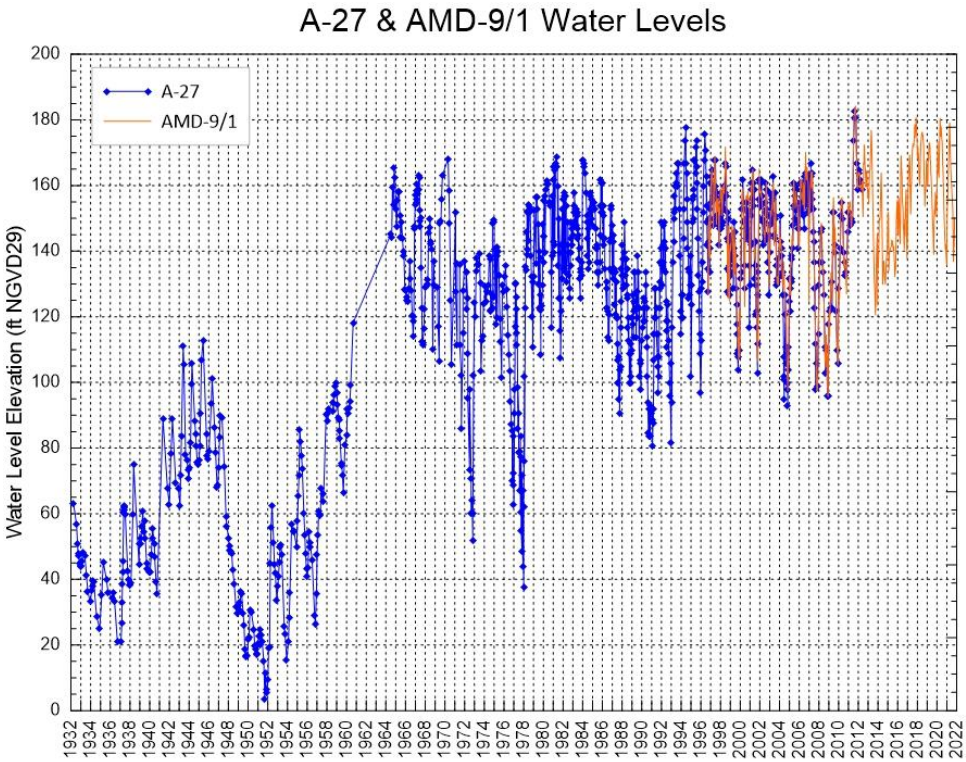



Figure 3-11: Water Level Hydrograph of Well A-27/AMD-9 in Forebay Area

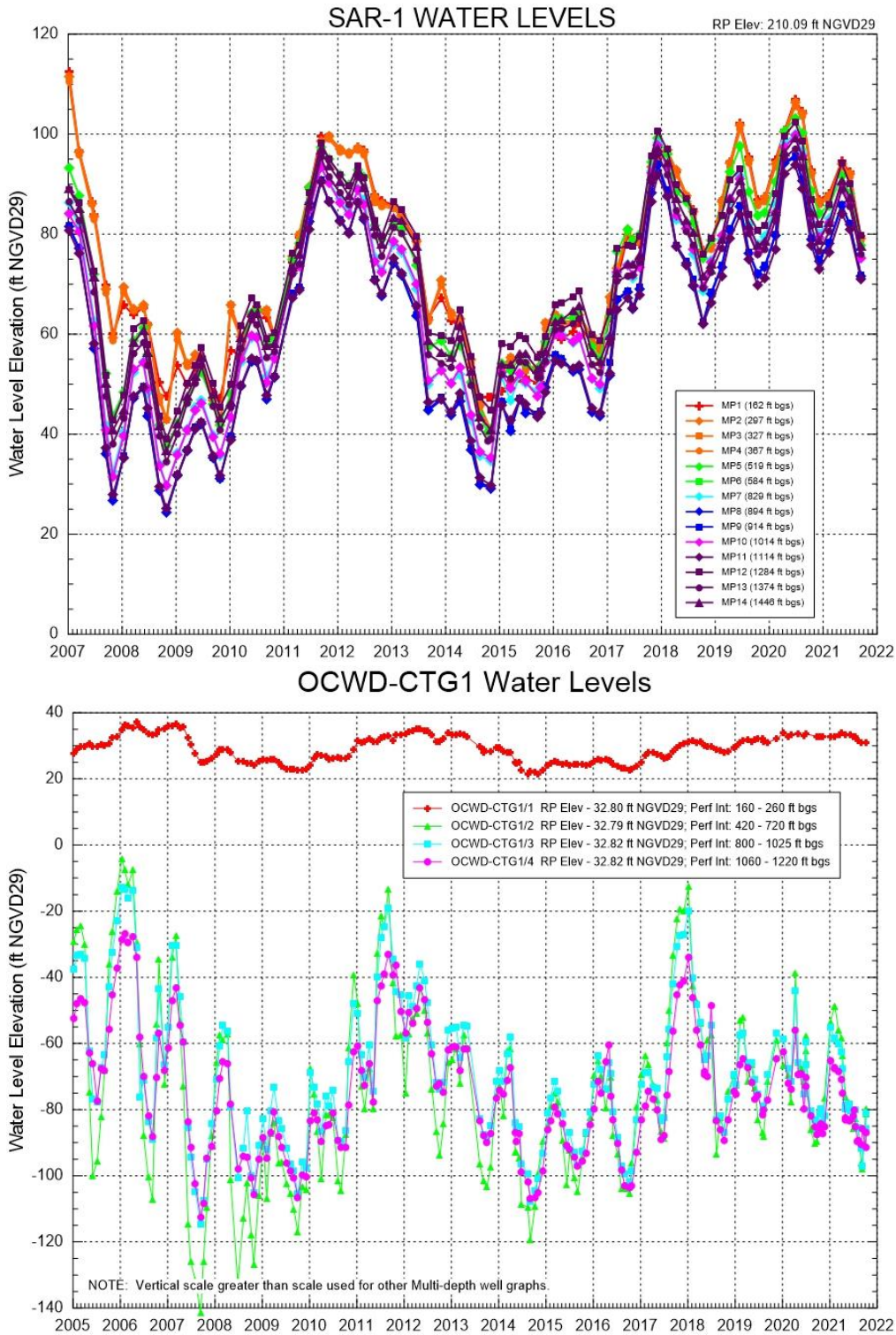



Figure 3-12: Water Level Hydrographs of Wells SAR-1 and OCWD-CTG1

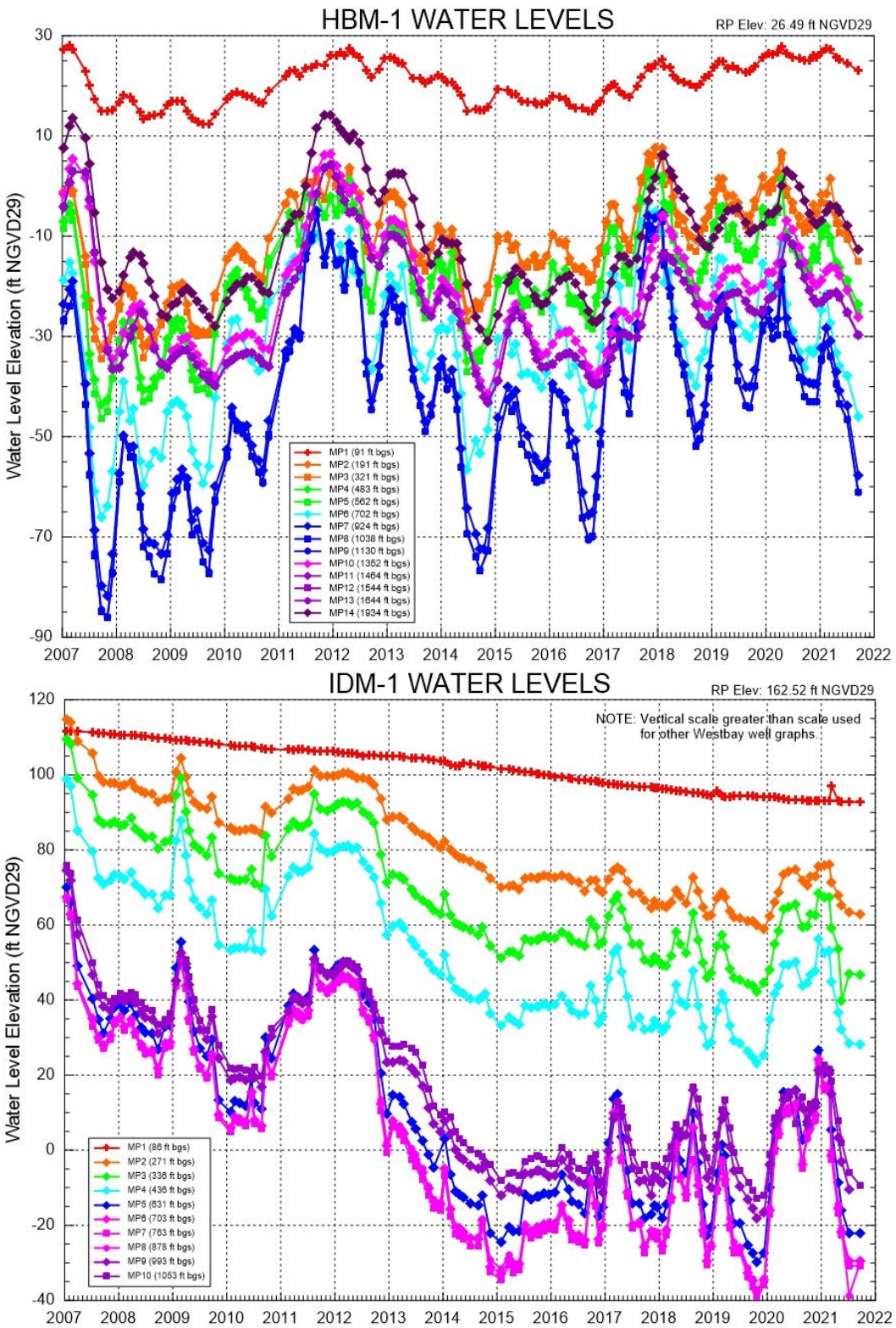



Figure 3-13: Water Level Hydrographs of Wells HBM-1 and IDM-1

### 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. Figure 1-3 shows how storage has fluctuated from 1958 to 2021. 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 3-14.

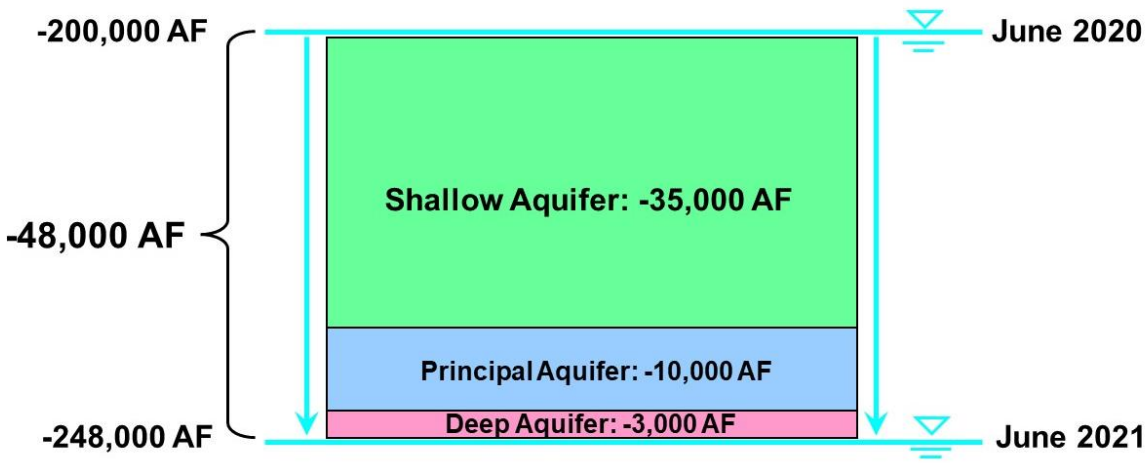



Figure 3-14: Groundwater Storage Change, June 2020 to June 2021

## 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 3-15). 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 evaluations of proposed projects and operating scenarios.

For more detailed information about the model, please refer to the 2017 Alternative.

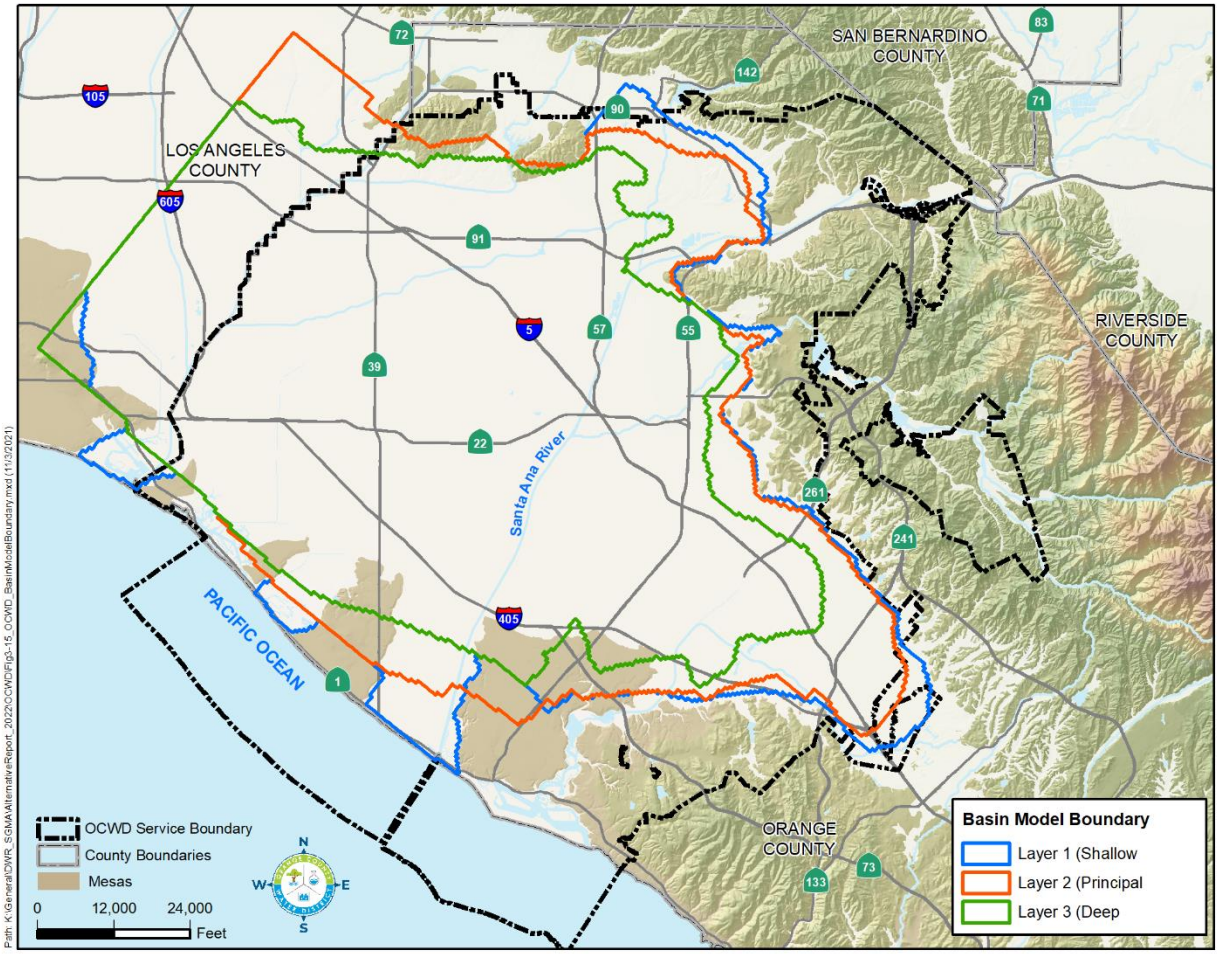



Figure 3-15: OCWD Groundwater Basin Model Boundaries

OCWD staff update the basin groundwater model approximately every three to five years. Major changes and improvements since the 2017 Alternative was submitted include:

1. Extension of the model transient calibration through WY2016-17. The new calibration period is November 1990 to June 2017 which includes a wide range of basin storage conditions as well as a wide range of hydrologic conditions.
2. Addition of new recharge basin, La Palma Basin.
3. Updating aquifer parameters, i.e., hydraulic conductivity and storage parameters, changes during calibration (still in progress).
4. Model layer revision in Irvine Sub Basin 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 concentrations 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 TDS and nitrate (as N) in each of the 39 groundwater management zones in the watershed. Management Zones established by the Regional Water Board within the OCWD Management Area are shown in Figure 3-16. The TDS water quality objectives and ambient water quality levels for the two zones within the OCWD Management Area are shown in Table 3-1.

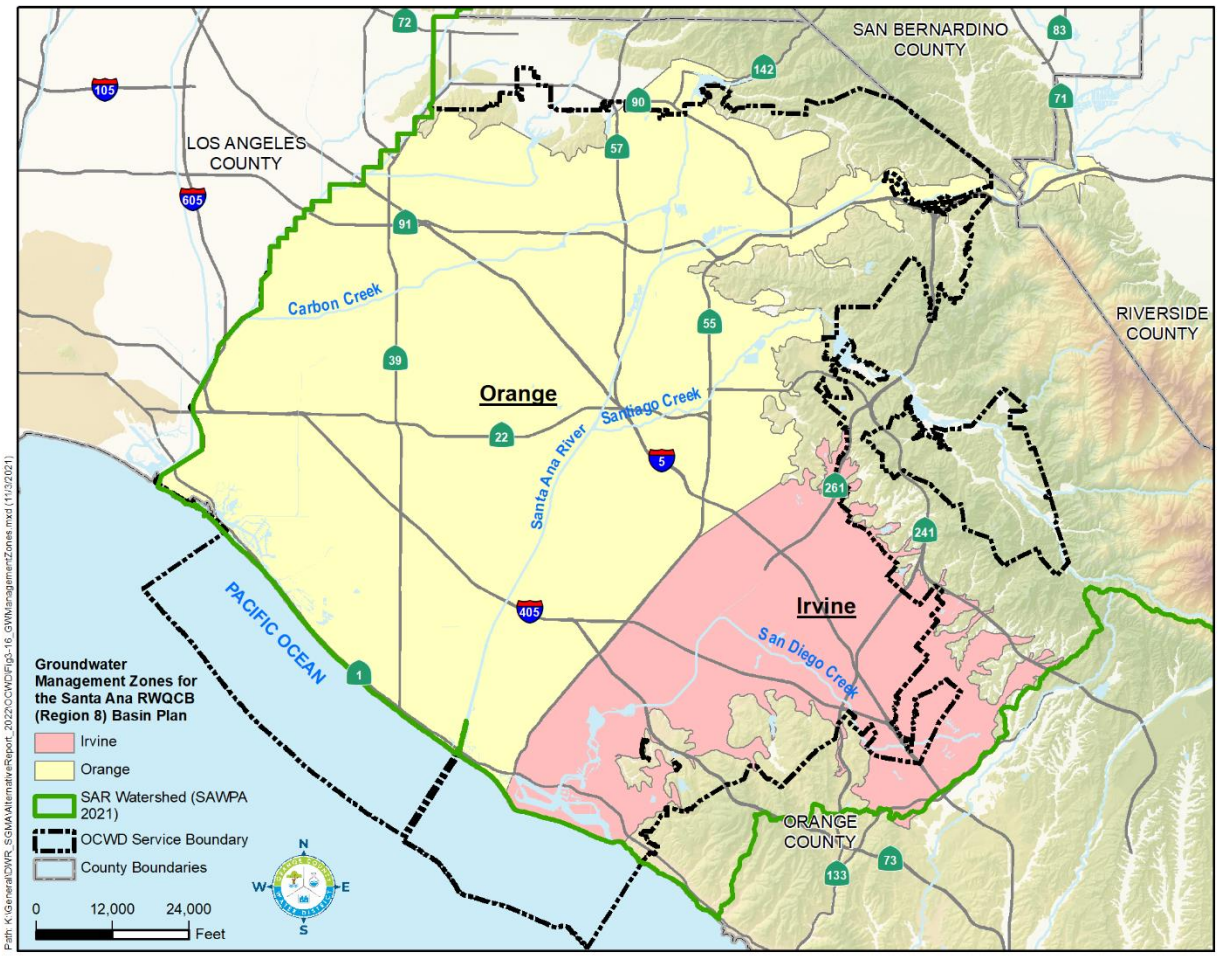



Figure 3-16: Regional Water Board Groundwater Management Zones

Table 3-1: TDS Water Quality Objectives for Lower Santa Ana River Basin Management Zones

| Groundwater Management Zone | Water Quality Objective | 2018 Ambient Quality* |
|---|---|---|
| Orange | 580 mg/L | 603 mg/L |
| Irvine | 910 mg/L | 877 mg/L |

*Water Systems Consulting, 2020.

Figure 3-17 shows the average TDS at production wells in the basin for WY2016-17 to 2020-21. In general, the TDS concentrations in the Principal Aquifer in the Orange Groundwater Management Zone 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 Groundwater 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.

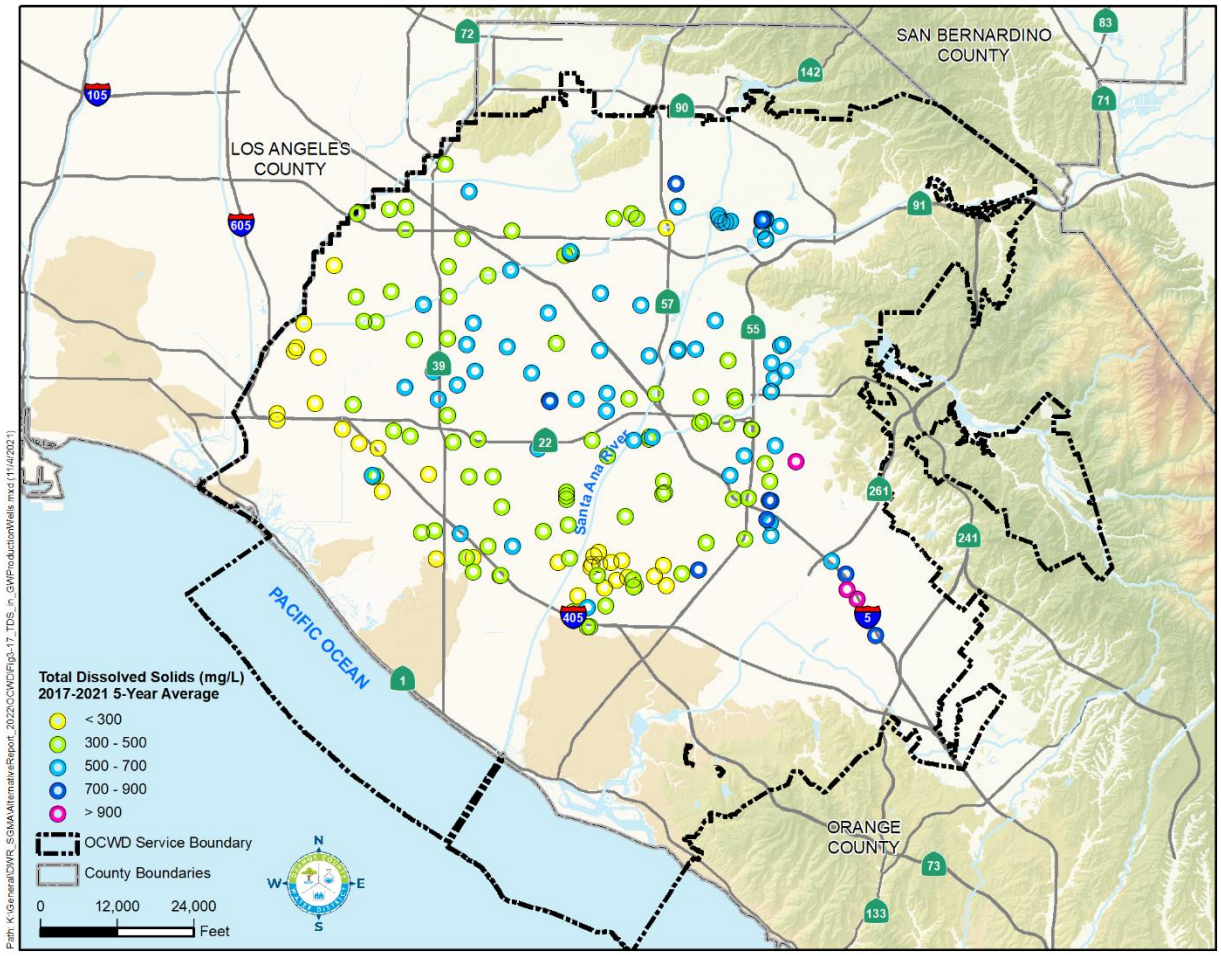



Figure 3-17: TDS in Groundwater Production Wells,
5-year average, WY2016-17 to 2020-21

## 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 (as N) 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 3-18 shows the 5-year average nitrate (as N) levels in production wells for WY2016-17 to 2020-21. In general, nitrate (as N) concentrations in the Orange Groundwater Management Zone are generally less than 5 mg/L. There are some localized areas with concentrations greater than 10 mg/L. In cases where pumped groundwater exceeds the MCL, the groundwater producer treats the water to reduce nitrate (as N) levels prior to being served to customers.

Table 3-2: Nitrate (as N) Water Quality Objective for Lower Santa Ana River Basin Management Zones

| Groundwater Management Zone | Water Quality Objective | 2018 Ambient Quality* |
|---|---|---|
| Orange | 3.4 mg/L | 3.0 mg/L |
| Irvine | 5.9 mg/L | 6.37 mg/L |

*Water Systems Consulting, 2020.

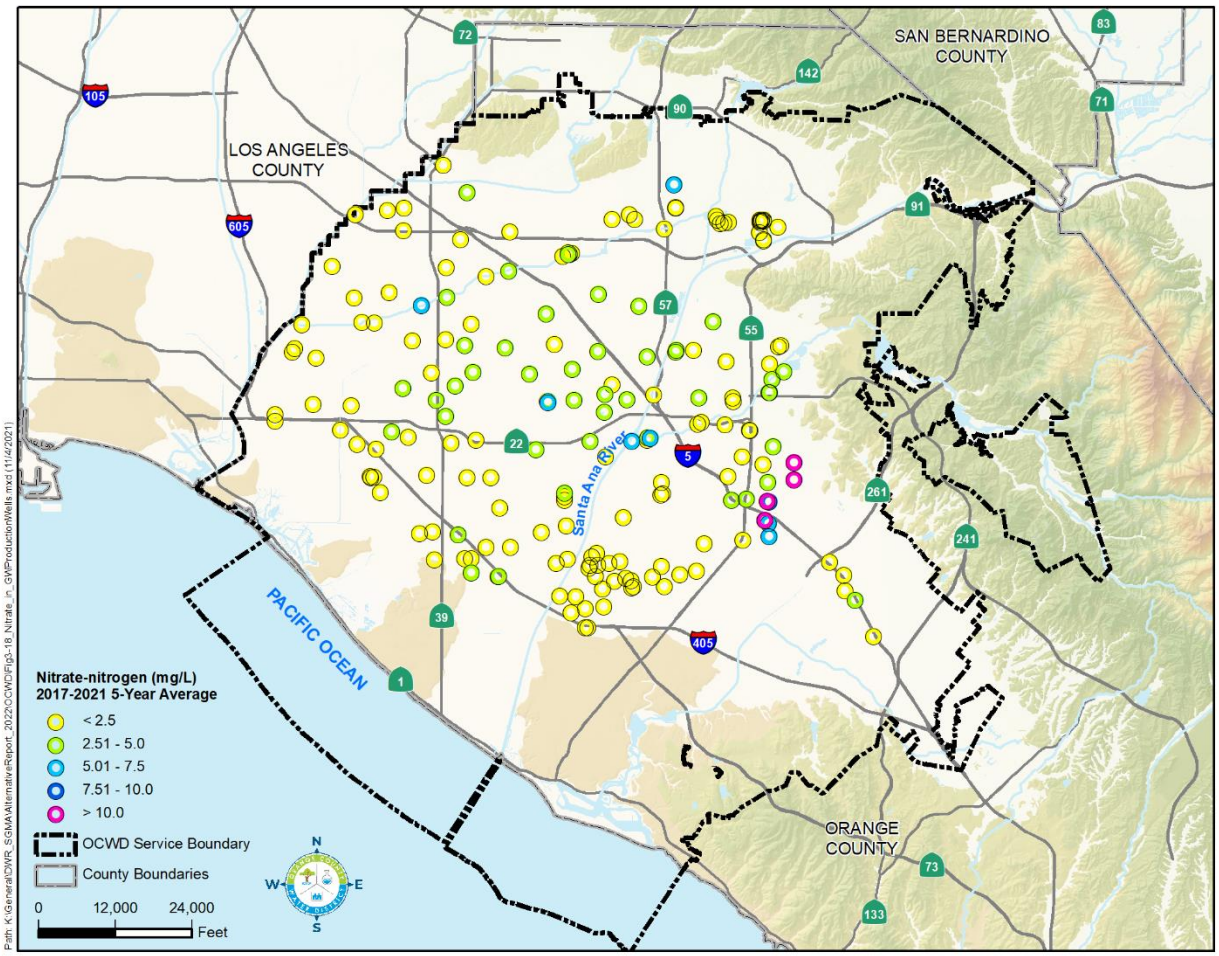



Figure 3-18: Nitrate (as N) Levels in Groundwater Production Wells, 5-year average, WY2016-17 to 2020-21

## Per- and polyfluoroalkyl substances (PFAS)

Per- and polyfluoroalkyl substances (PFAS) are a group of thousands of manmade chemicals that includes perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS). PFAS compounds have been 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 Division of Drinking Water (DDW) began requiring 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 or nanogram/L, ng/L), respectively. In March 2021, DDW established a third PFAS RL for perfluorobutane sulfonate (PFBS) at 5,000 ppt. The DDW recommends the public water systems not serve any water exceeding the RL – effectively making the RL a *de facto* interim MCL while the state undertakes the formal process to set an enforceable MCL. In response to DDW's issuance of the revised RL, as of September 2021, approximately 60 wells in the OCWD service area have been temporarily turned off until treatment systems can be constructed. As additional wells are tested, this figure may increase. The state has begun the process of establishing MCLs for PFOA and PFOS; in July 2021, the state Office of Environmental Health Hazard Assessment (OEHHA) released draft Public Health Goals (PHGs) for PFOA and PFOS or 0.007 ng/L and 1 ng/L, respectively, for public comment. After the PHGs are finalized, DDW will formally begin developing corresponding MCLs and currently anticipates issuing a final MCL by 2023 or 2024. OCWD anticipates the MCLs will be set at or below the RLs.

In April 2020, OCWD as the groundwater basin manager, executed a multi-party agreement with the impacted groundwater producers to fund and construct the necessary treatment systems for production wells impacted by PFAS compounds. The PFAS treatment projects include the design, permitting, construction, and operation of PFAS treatment systems for impacted production wells. Each well treatment system will be evaluated for use with either granular activated carbon (GAC), ion exchange (IX), or an alternative novel sorbent 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 laboratory detection limit. 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. The groundwater producers will own the treatment systems once they are completed. With financial assistance from OCWD, the groundwater producers will operate and maintain the new treatment systems once they are constructed.

To minimize alternative water supply 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. As of September 2021, construction contracts have been awarded for treatment systems for production wells owned by the cities of Orange (Phase 1), and Garden Grove, Serrano Water District, and Yorba Linda Water District. The City of Anaheim has also awarded a design-build contact (phase A) for 8 impacted wells, that will be reimbursed by OCWD. The City of Fullerton's well KIM-1A treatment system has been completed and is in operation. Additional construction contracts are anticipated to be awarded for impacted wells operated by the cities of Fullerton (Main Plant), Orange (Phase 2), Santa Ana, Tustin, Irvine Ranch Water District and East Orange County Water District by early 2022. OCWD expects the treatment systems to be constructed for the approximately 60 impacted wells within the next 2 to 3 years.

As monitoring continues and additional wells are taken off-line due to PFAS detections reported at or near the current RL (or future MCL), OCWD will continue to partner with the affected groundwater 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 WY2020-21 was expected to be approximately 325,000 acre-feet but declined to 282,000 acre-feet primarily due to PFAS impacted wells being turned off around February 2020. OCWD expects groundwater production to be in the area of 250,000 acre-feet in WY2021-22 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 levels similar to years prior to PFAS impacts.

## Contamination Plumes

Major groundwater contamination sites within the OCWD Management Area include areas where contamination has migrated significantly beyond the contamination sources and threaten to further impact the groundwater quality. These plumes, shown in Figure 3-19, are in the process of being remediated, and some are being evaluated for additional remediation.

The North Basin Volatile Organic Compound (VOC) plume area contains contaminated groundwater primarily in the Shallow Aquifer, which is generally less than 200 feet deep with 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 state 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 RI/FS.

The South Basin plume area contains VOCs and perchlorate. OCWD has collected extensive data to delineate the comingled 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.

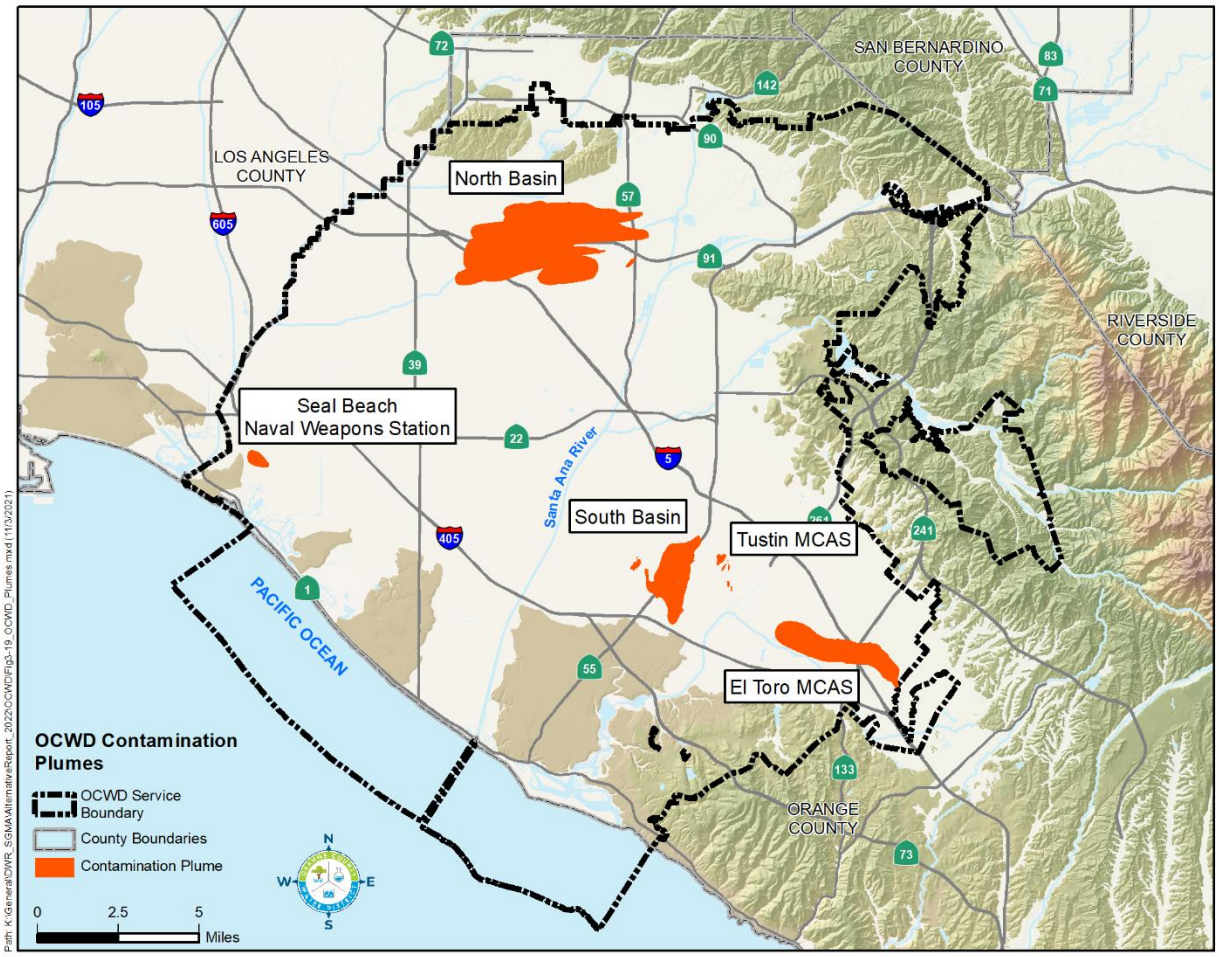



Figure 3-19: Groundwater Contamination Plume Locations

## 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 3-20. Note that new wells added within the last five years are shown in Figure 3-20.

Background information on these gaps is contained in the 2017 Alternative. Ongoing activities related to seawater intrusion protection is described in subsequent sections of this report.

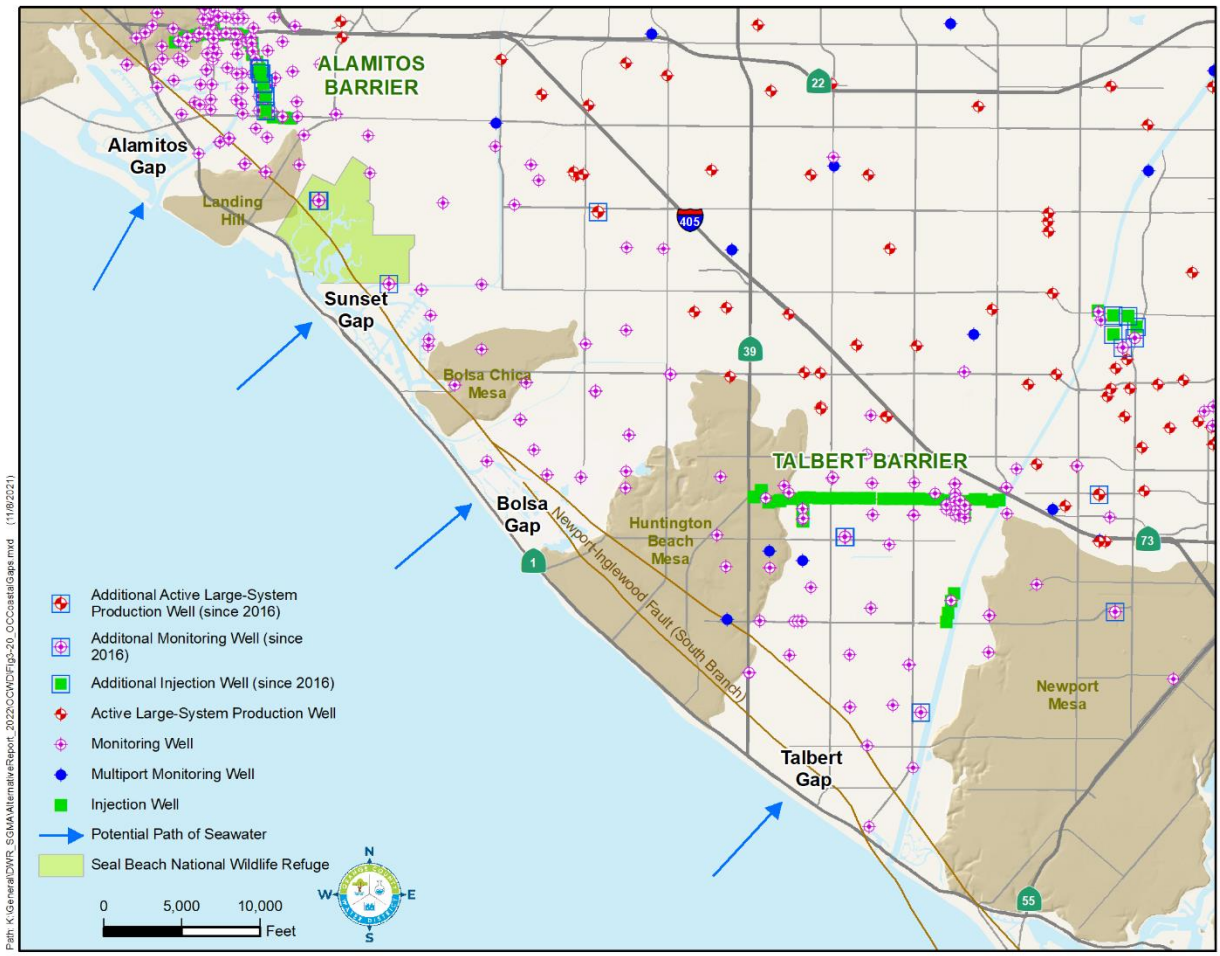



Figure 3-20: Orange County Coastal Gaps

## 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 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).

Ground surface elevations rise and fall due to groundwater conditions in the OCWD Management Area, and there is no indication of widespread irreversible 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 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. 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 habitat. 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 17$^{th}$ Street in Santa Ana, there is minimal riparian habitat, and the river is a losing reach with engineered facilities to infiltrate surface water into the 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. 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 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.

# 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, water injected in the Talbert and Alamitos Barriers, and water injected in the Mid-Basin Injection wells. The majority of measured recharge occurs in the District's surface water system, which receives Santa Ana River baseflow and storm flow, GWRS 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, sometimes referred to as "incidental recharge," between 20,000 and 160,000 acre-feet per year. Net unmeasured recharge is the amount of unmeasured recharge remaining in the basin after accounting for underflow losses to Los Angeles County and relatively minor groundwater inflows/outflows at the coastal gaps. Under average hydrologic conditions, net incidental recharge averages 66,000 acre-feet per year. This average was substantiated during calibration of the Basin Model and is also consistent with the estimate of 58,000 acre-feet per year 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.

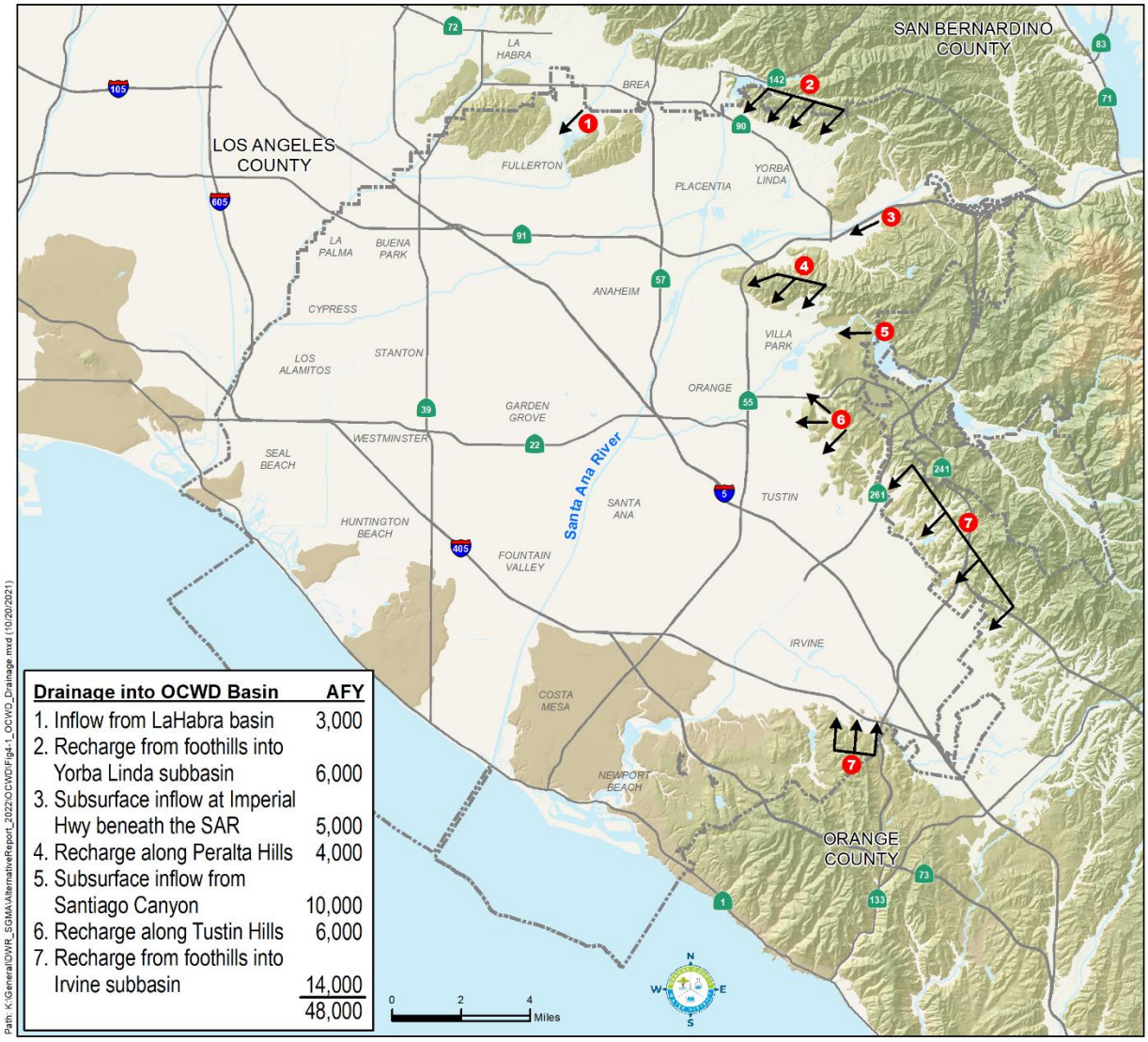



Figure 4-1: Estimated Subsurface Inflow

## 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 a private water company 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 acre-feet per year. These include small mutual water companies, agricultural companies, golf courses, cemeteries (irrigation wells), 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 acre-feet per year based on groundwater elevation gradients and aquifer transmissivity (DWR, 1967; McGillicuddy, 1989). The Water Replenishment District of Southern California (WRD) 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 acre-feet per year 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.

Recent updates to the OCWD groundwater model show that subsurface outflow averaged approximately 13,000 acre-feet per year during the period 1991 to 2017 with a range of 5,000 to 25,000 acre-feet per year. Due to differences in model-estimated inter-basin groundwater flows, OCWD and WRD are jointly conducting a study to evaluate OCWD's Basin Model and WRD's groundwater model of Central Basin in Los Angeles County constructed by the USGS. The goal is to improve each model's ability to more closely represent local groundwater conditions and thereby more accurately estimate inter-basin groundwater flows.

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.

### 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, which includes wet and dry years. Basin storage levels from WY1957-58 to 2020-21 are shown in Figure 1-3. 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 OCWD's July 1 to June 30 water year.

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. 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.

As mentioned in Section 1.2, 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 WY1999-2000 to 2020-21 are shown in Figure 1-4.

## 4.4 WATER BUDGETS

The OCWD Management Area water budget for WY2016-17 to 2020-21 is presented in Table 4-1. Estimated water budgets for dry years, average years and wet years as well as a future projected budget are presented in the 2017 Alternative.

Table 4-1 Water Budget, WY2016-17 to 2020-21

| FLOW COMPONENT | 2016-17 | 2017-18 | 2018-19 | 2019-20 | 2020-21 |
|---|---|---|---|---|---|
| INFLOW | | | | | |
| Santa Ana River baseflow | 70,000 | 65,400 | 98,000 | 74,500 | 76,400 |
| Santa Ana River stormflow | 65,400 | 24,100 | 63,700 | 79,500 | 36,600 |
| Recycled Water (GWRS/Alamitos Barrier) | 98,000 | 106,400 | 97,200 | 99,700 | 101,700 |
| Imported Water | 50,400 | 66,100 | 40,300 | 18,100 | 0 |
| Net Estimated Unmeasured or Incidental Recharge* | 67,900 | 26,200 | 45,600 | 41,400 | 19,100 |
| TOTAL INFLOW: | 351,700 | 288,200 | 344,800 | 313,200 | 233,800 |
| OUTFLOW | | | | | |
| Groundwater Production | 300,700 | 237,200 | 303,800 | 277,200 | 281,800 |
| TOTAL OUTFLOW: | 300,700 | 237,200 | 303,800 | 277,200 | 281,800 |
| CHANGE IN STORAGE: | 51,000 | 51,000 | 41,000 | 36,000 | (48,000) |

# 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 in the 2017 Alternative. The only change is related to the termination of CASGEM, which is being replaced by annual reporting required by SGMA.

## 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 publicly-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. New wells constructed in the last five years are highlighted in these figures. 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 WRD 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. Appendix A of the 2017 Alternative presented a comprehensive list of all wells in OCWD's database. This list included 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 in 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 uses 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.

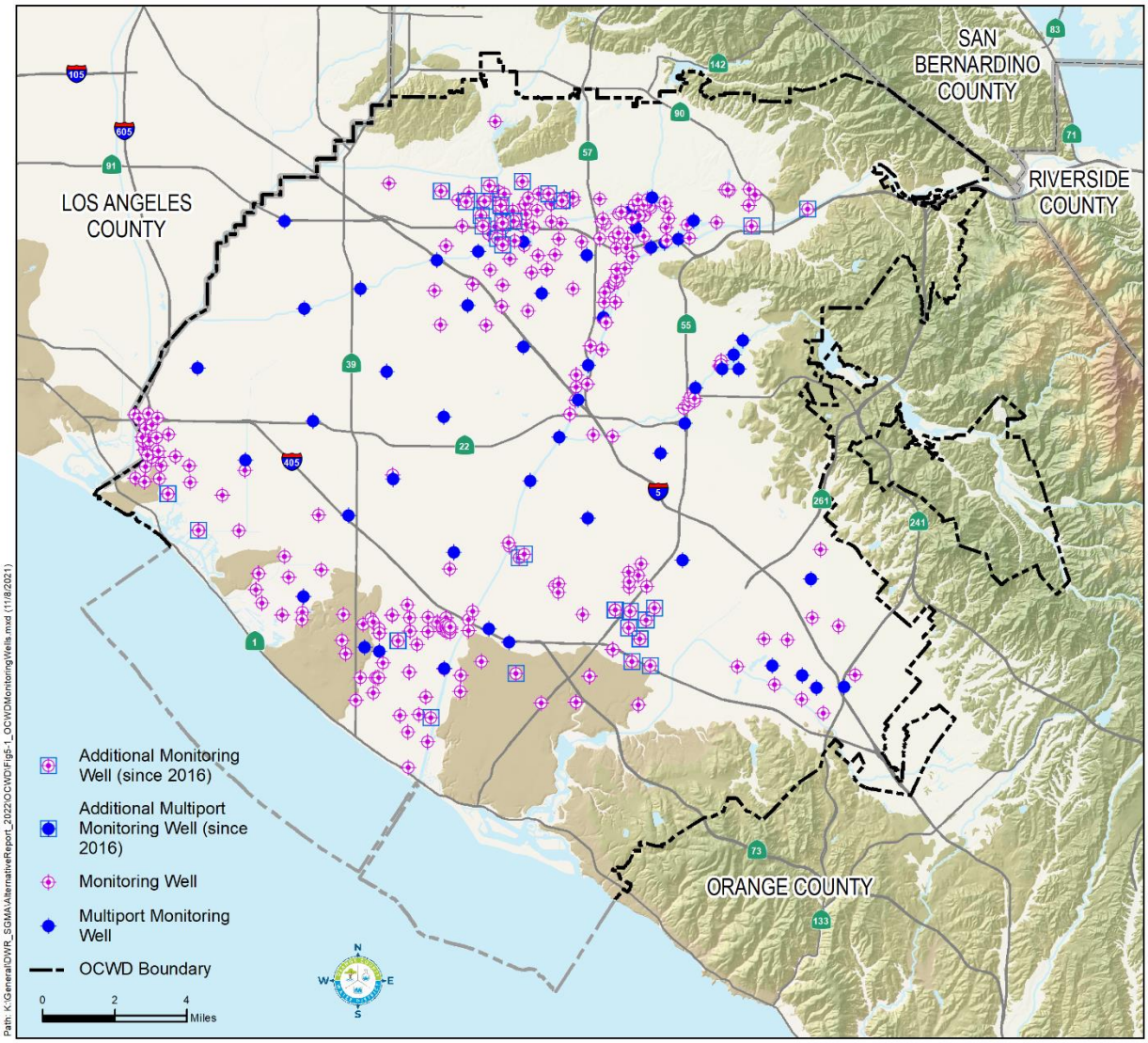



Figure 5-1: OCWD Monitoring Wells

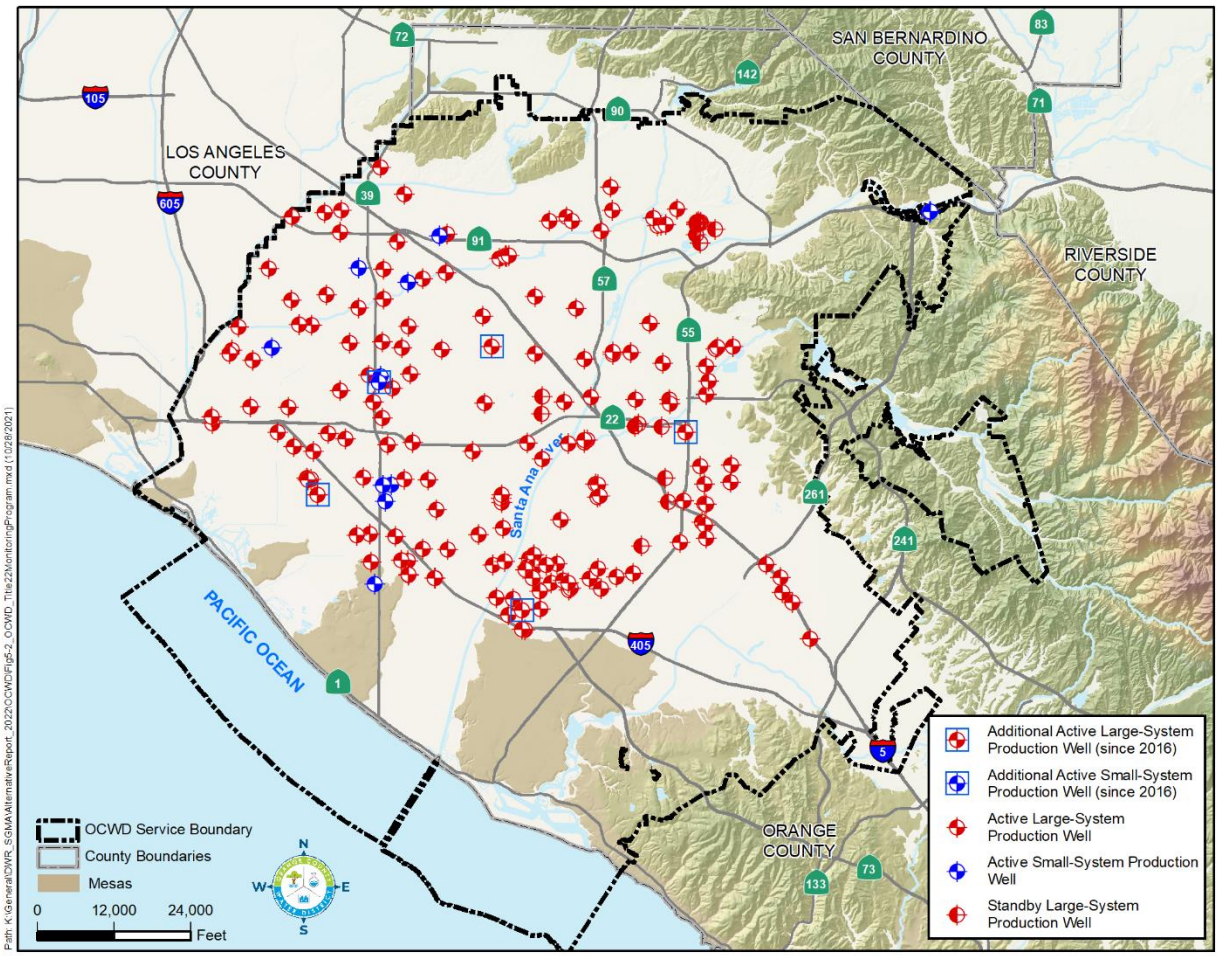



Figure 5-2: Large and Small System Drinking Water Wells in Title 22 Monitoring Program

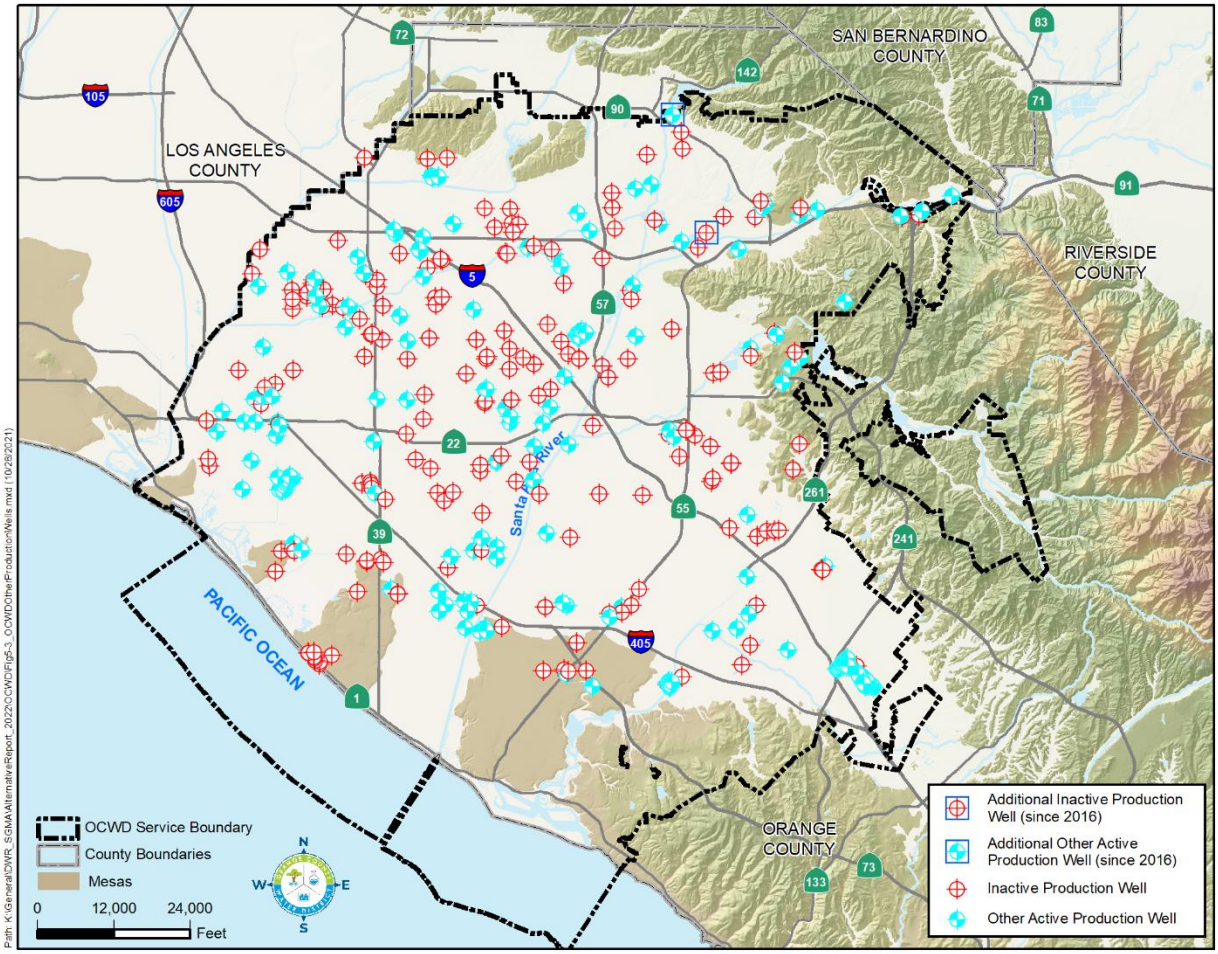



Figure 5-3: Private Domestic, Irrigation and Industrial Wells in OCWD Monitoring Program

## 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 as 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 voluntarily 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.

### 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 CASGEM program. The monitoring well network developed for the CASGEM program 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.

In 2021, DWR instructed agencies that submitted an Alternative to begin submitting data to the SGMA portal. As a result, CASGEM data was incorporated into annual data submittals required for SGMA compliance. For the 2022 Update, OCWD reviewed the CASGEM network and updated it, primarily in removing wells that were no longer accessible, and changed the name to the SGMA Monitoring Well Network.

Figures 5-4 to 5-6 present the monitoring well locations for each of the three aquifer systems. The SGMA network includes wells within the OCWD, La Habra-Brea, Santa Ana Canyon, and Southeast Management Areas. The City of La Habra Groundwater Sustainability Agency will be reporting water levels from the La Habra Management Area separately. Two wells monitored by the Irvine Ranch Water District (IRWD) that are located in the Southeast Management area, IRWD-LA1 and IRWD-LA4 (Figure 5-5) are included in the SGMA reports that OCWD will submit to DWR.

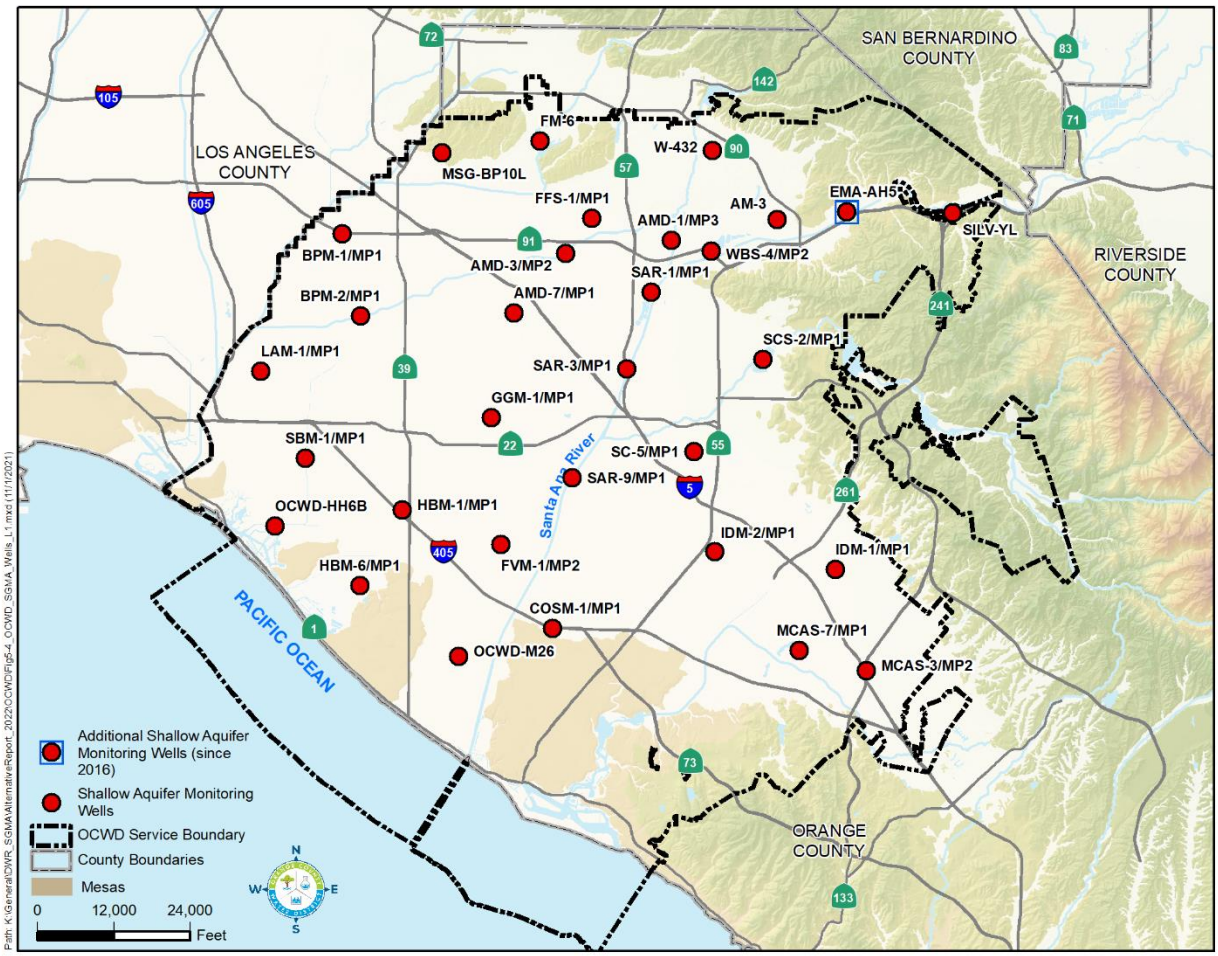



Figure 5-4: SGMA Shallow Aquifer System Monitoring Well Network

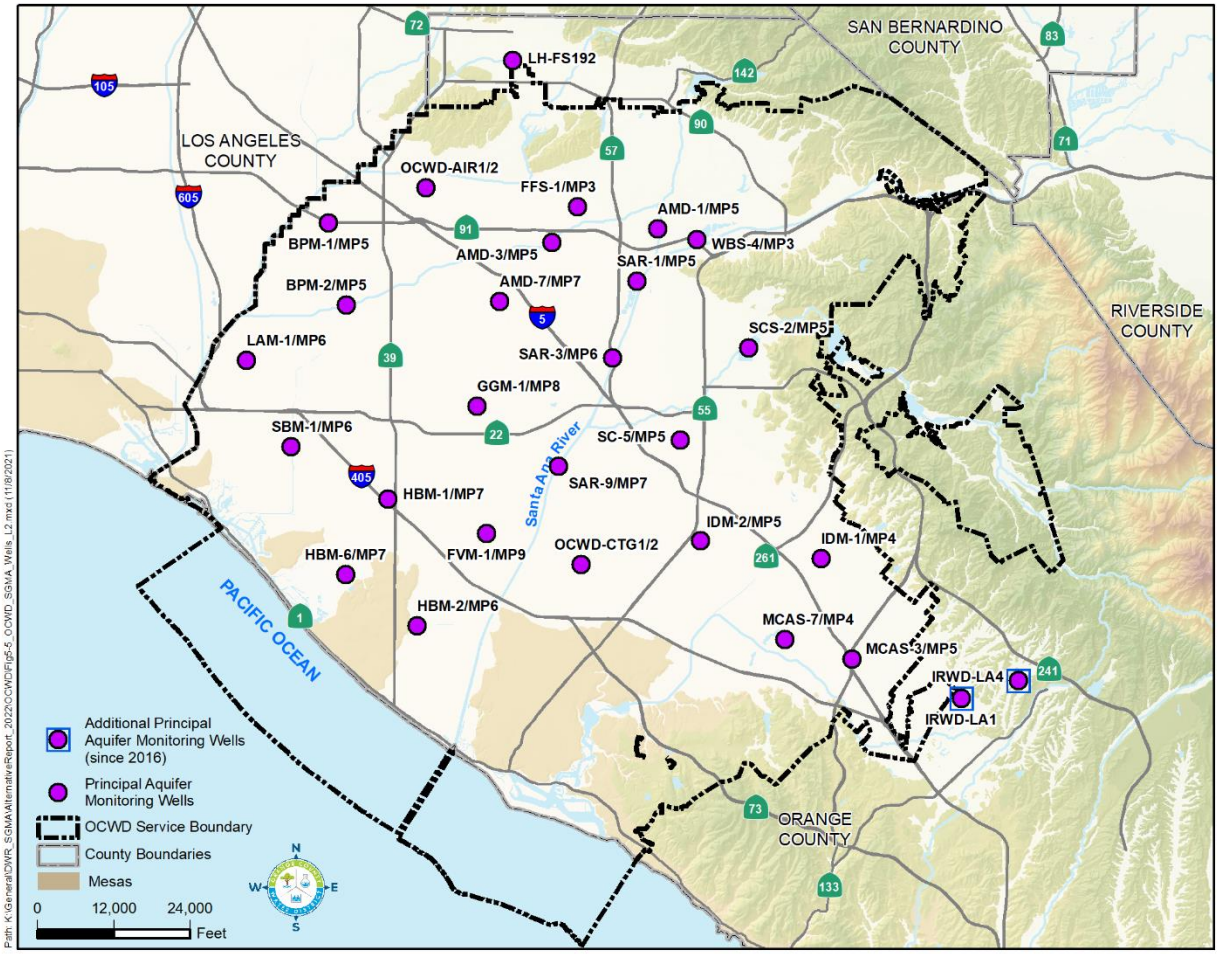



Figure 5-5: SGMA Principal Aquifer System Monitoring Well Network

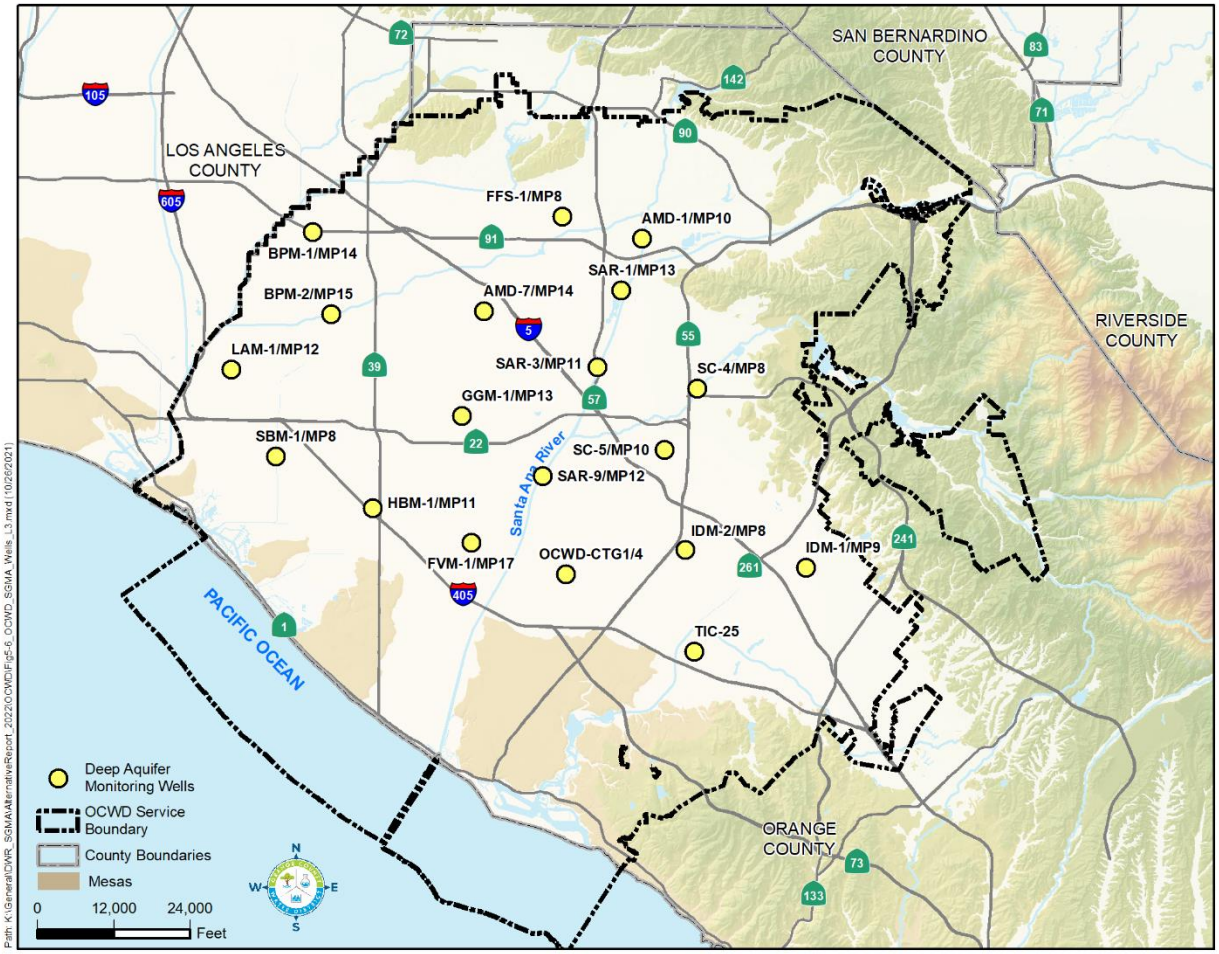



Figure 5-6**:** SGMA Deep Aquifer System Monitoring Well Network

## 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 regulations from the DDW and EPA. 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 2020, OCWD water quality staff collected 15,496 samples, 4,139 of which were collected from drinking water wells.

OCWD developed specific programs to monitor the North Basin and South Basin plumes \\as described in the 2017 Alternative. Several new monitoring wells were constructed within the last five years for the North Basin and South Basin plume areas as shown on 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 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, La Palma 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.

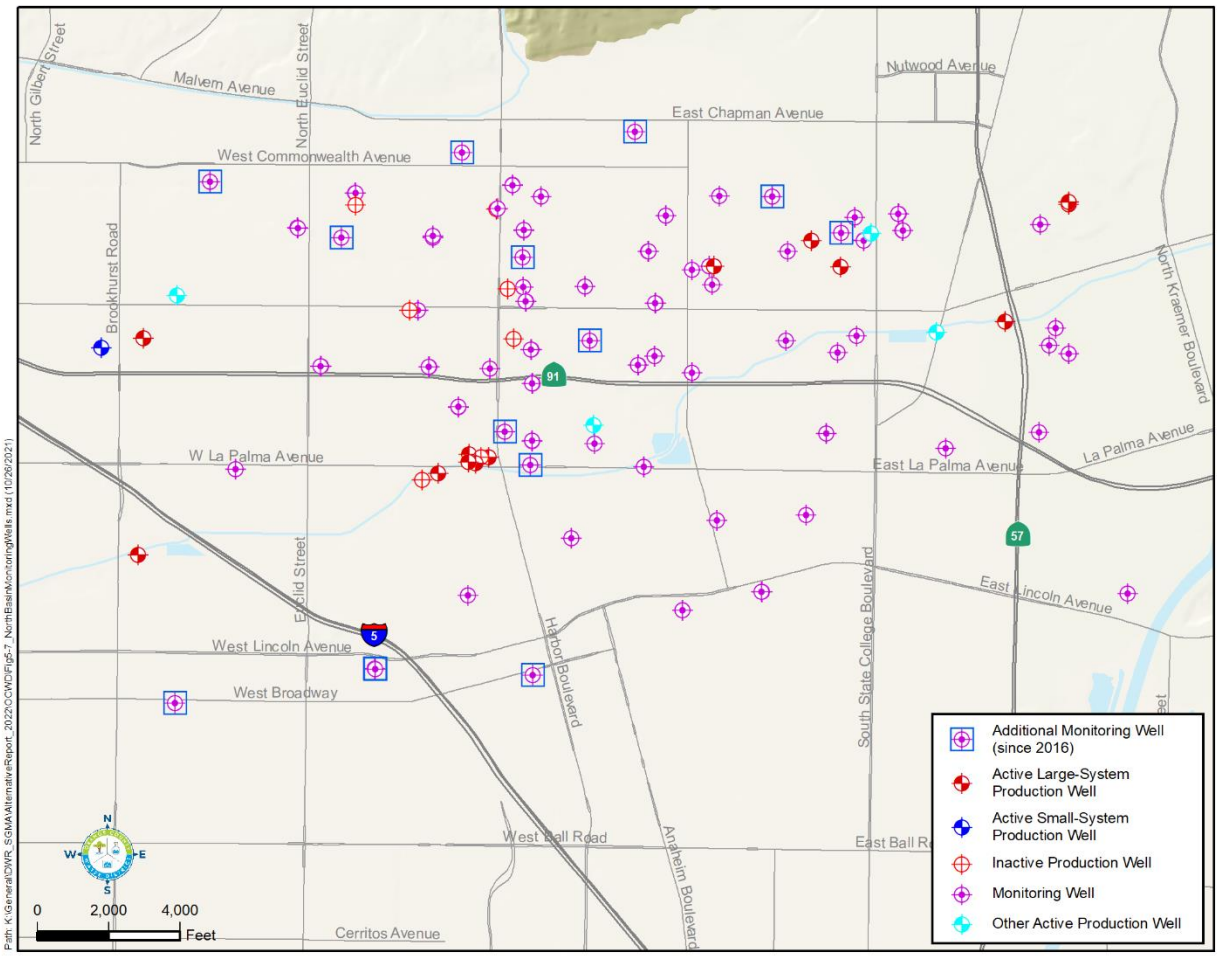



Figure 5-7: North Basin Groundwater Protection Program Monitoring Wells

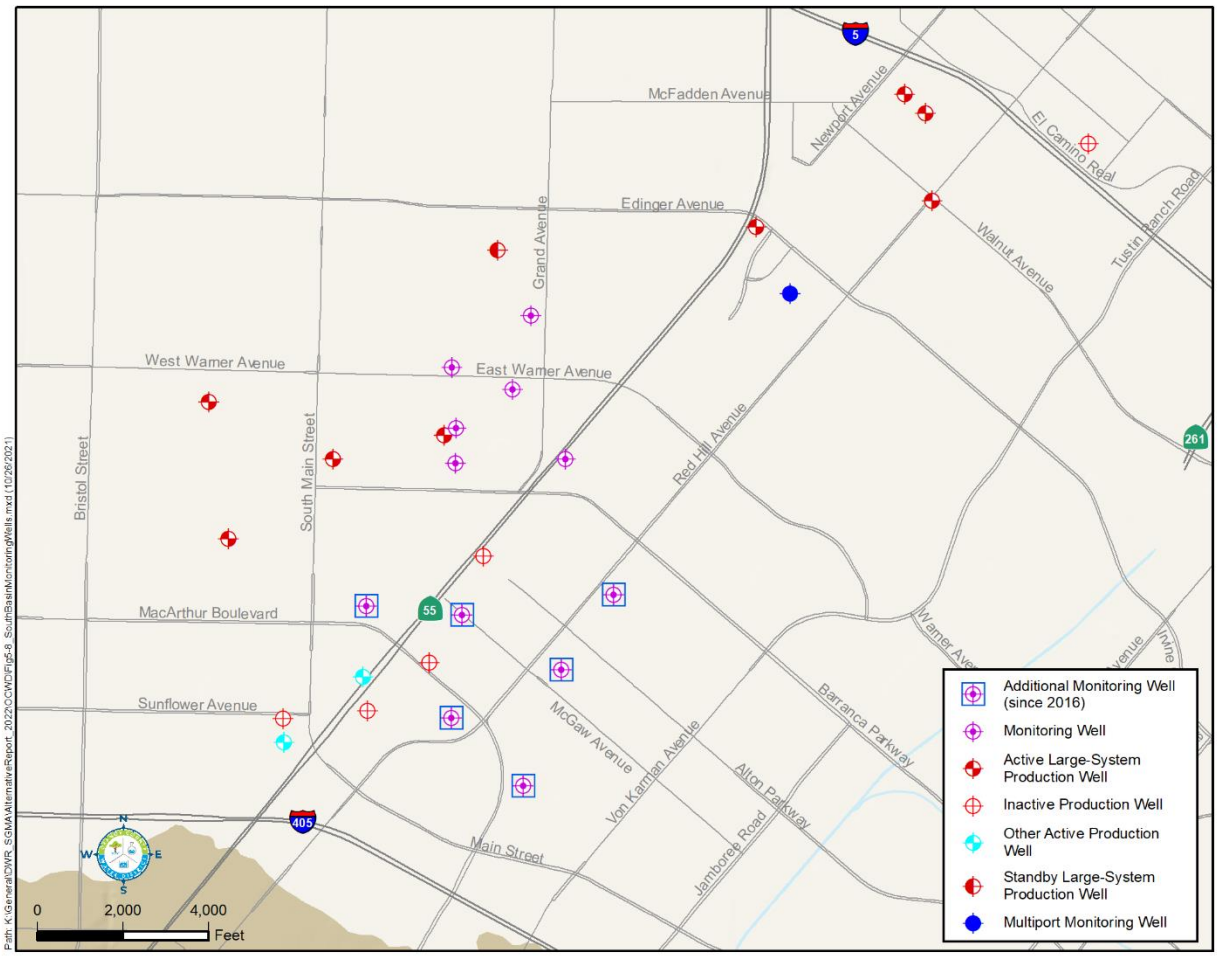



Figure 5-8: South Basin Groundwater Protection Program Monitoring Wells

## 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.

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 Los Angeles County Public Works (LACPW). LACPW 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 over 430 individual sampling points.

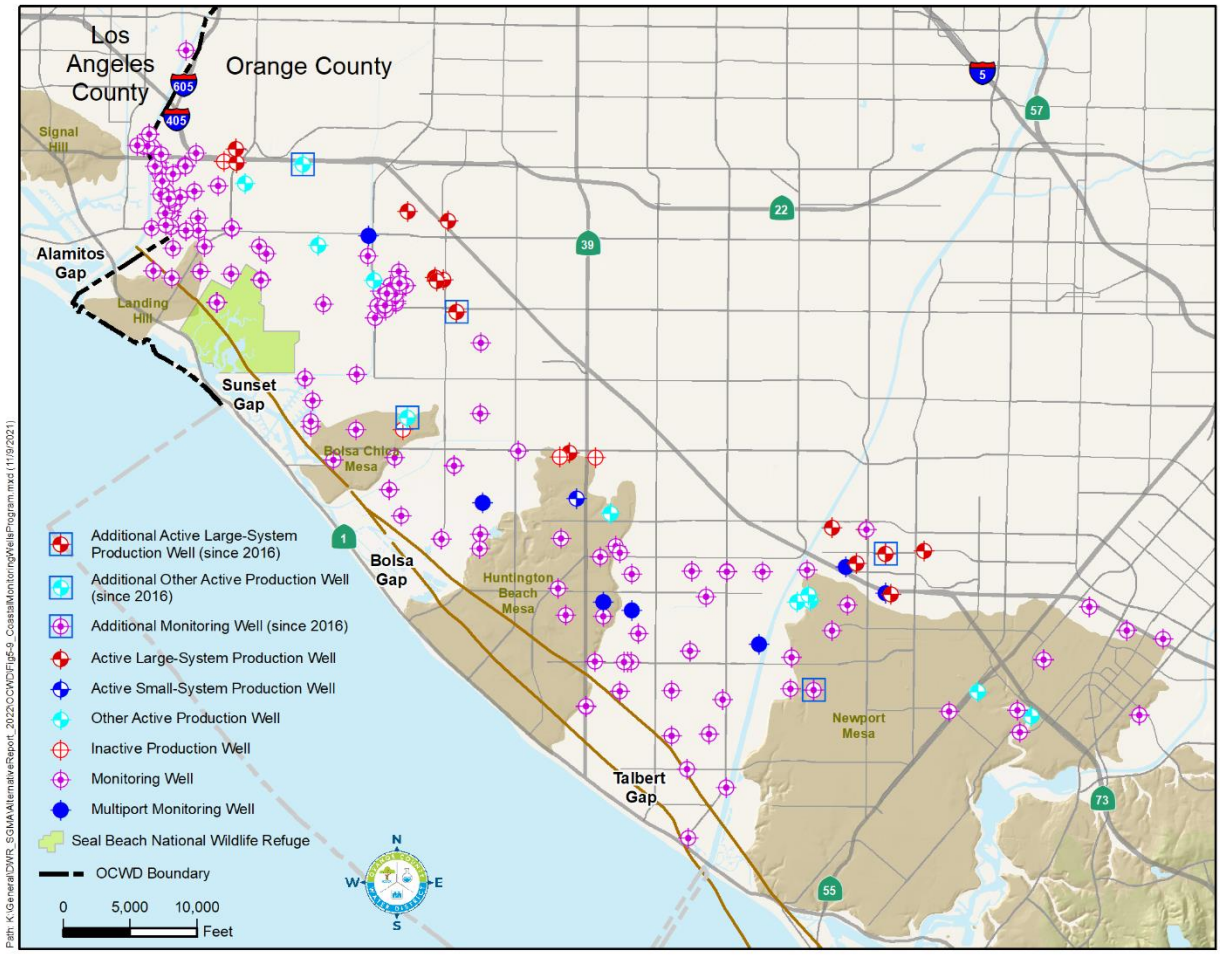



Figure 5-9: Seawater Intrusion Monitoring Wells

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, was presented in Appendix A of the 2017 Alternative.

Groundwater levels are measured bi-monthly (every 2 months) at the majority of coastal monitoring wells and 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. 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.

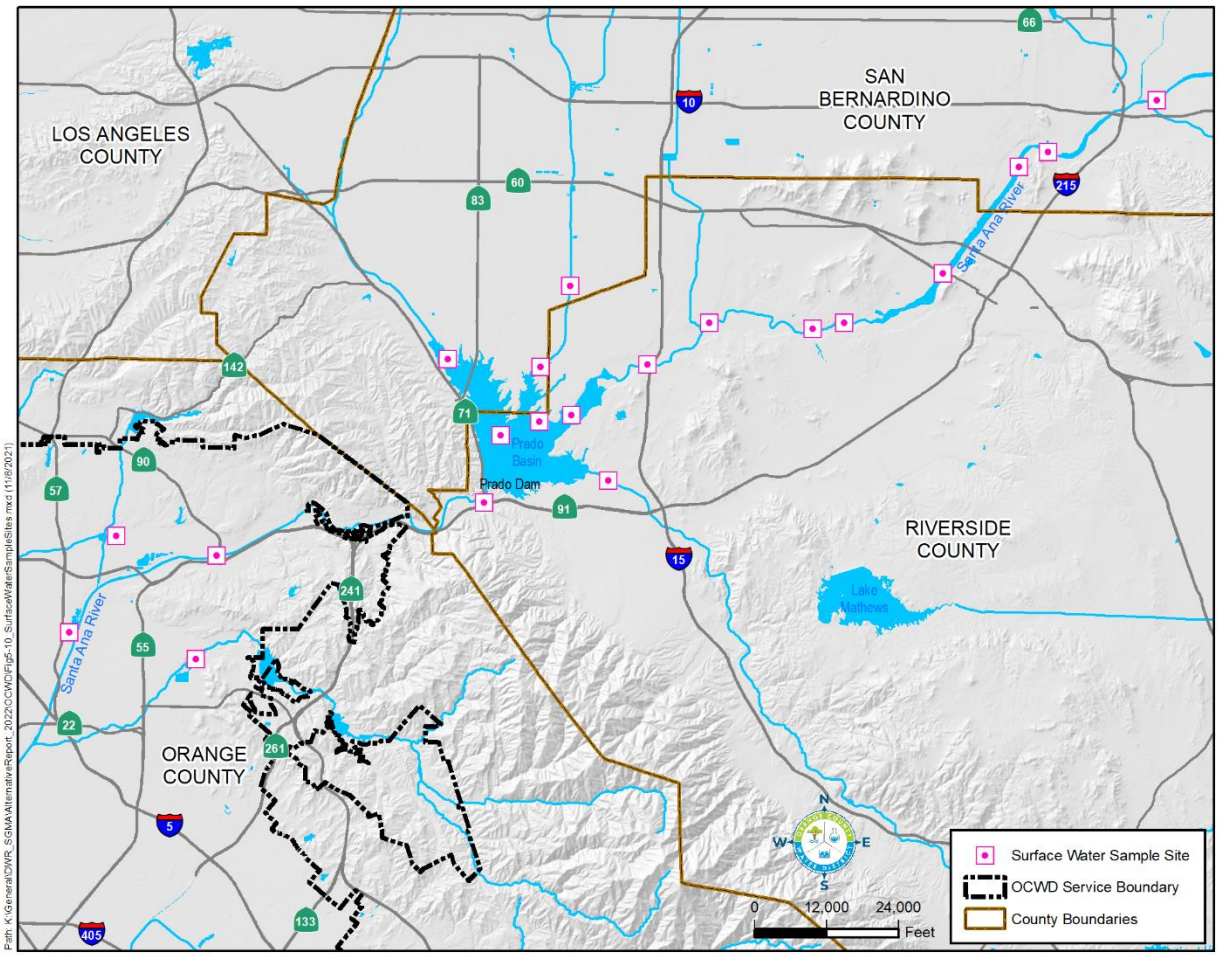



Figure 5-10: Surface Water Monitoring Locations

## 5.3.1 Surface Water Monitoring Programs

The surface water monitoring programs include:

- Santa Ana River Monitoring (SARMON) Program
- The Basin Monitoring Program Task Force (Task Force)
- Santa Ana River Watermaster
- Emerging constituents
- Imported water from MWD

Detailed descriptions of each program are contained in the 2017 Alternative.

Within the last five years, additional work has been done by the watershed-wide Emerging Constituents Monitoring Task Force administered by the Santa Ana Watershed Project Authority (SAWPA). 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 Board (R8-

2009-0071). OCWD monitored two sites twice a year on the Santa Ana River for this program. The SAWPA testing program was resumed voluntarily 2019, with the addition of PFAS monitoring; the program was not continued in 2020 and has been functionally replaced by the statewide PFAS Investigation Orders issued to upper watershed wastewater dischargers.

OCWD monitors for Constituents of Emerging Concern (CECs), including PFAS, at two surface water sites quarterly on the Santa Ana River and at various locations within District recharge facilities below Prado Dam. Samples are analyzed for pharmaceuticals, endocrine disruptors and other emerging constituents such as personal care products, food additives, and pesticides.

### 5.3.2 Recycled Water Monitoring

Use and monitoring of GWRS water is regulated by the  Regional Water Board and DDW. Performance of the GWRS is monitored on a routine basis.  Monitoring wells to monitor and track GWRS water are located adjacent to surface recharge basins located in Anaheim, downgradient of Mid-Basin Injection wells, and near the injection wells of the Talbert Seawater Barrier as shown on Figure 5-11.  Additional details on recycled water monitoring and reporting are presented in the 2017 Alternative.  Similar 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.

In March 2020, OCWD's Mid-Basin Injection (MBI) Project went on-line.  This project started in April 2015 with the operation of a demonstration well (MBI-1).  The MBI Project is located in the city of Santa Ana, primarily at Centennial Park and injects up to 10 million gallons of GWRS water a day into the Principal Aquifer and includes four new injection wells, MBI-2, 3, 4, and 5. Additionally, a total of four nested monitoring wells were installed as part of the MBI Project to track the quality and movement of injection water prior to reaching down gradient production wells.  Nested wells SAR-10 and -11 were installed downgradient of MBI-1.  To track the movement of GWRS water from the four new injection wells, SAR -12 and -13 were constructed (see Figure 5-11).

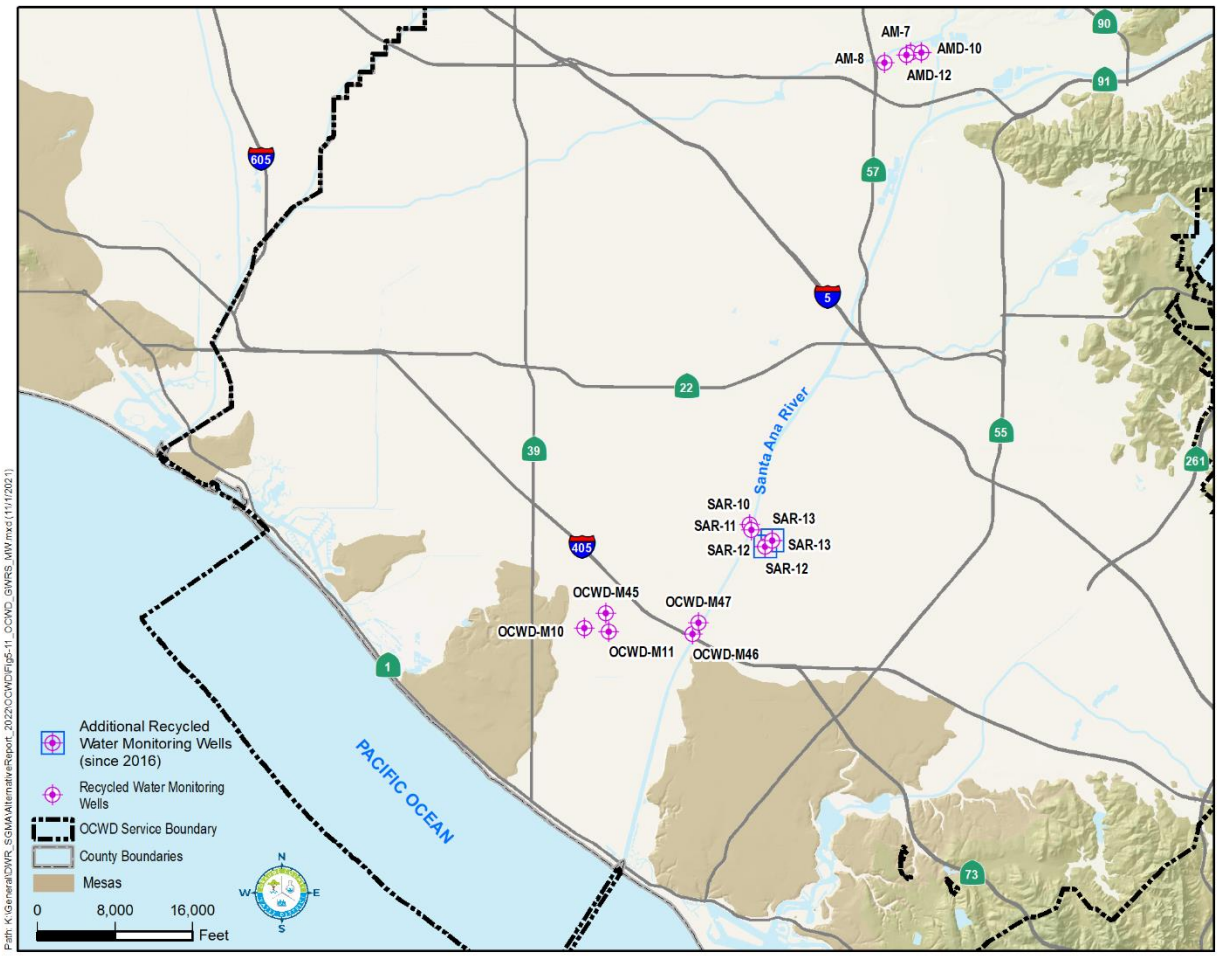



Figure 5-11: Recycled Water Monitoring Wells

# SECTION 6 WATER RESOURCE MANAGEMENT PROGRAMS

## 6.1 LAND USE ELEMENTS RELATED TO BASIN MANAGEMENT

The OCWD Management Area is highly urbanized as shown on Figure 3-4. 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

The 2017 Alternative presented a comprehensive list of plans related to basin management, including:

- Municipal Stormwater Permit
- The OC Plan which is the combined North Orange County Integrated Regional Water Management Plan (IRWM), Central Orange County IRWM, and Coastal Watershed Management Plan
- OWOW 2.0 Plan which is the IRWM Plan for the Santa Ana Watershed

- Municipal Water District of Orange County (MWDOC) 2020 Regional Urban Water Management Plan
- Municipal Water District of Orange County (MWDOC) 2016 Orange County Reliability Study

### 6.1.2 Land Use Development and Water Demands and Supply

Water demands within the OCWD Management Area between WY1989-90 and 2020-21 have fluctuated between approximately 367,000 and 526,000 acre-feet per year but have leveled off in the past few years to approximately 400,000 acre-feet per year as shown in Figure 1-5.

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 2.5 million people. OCWD has employed groundwater management techniques to increase the annual yield from the basin including operating over 1,000 wetted acres of infiltration basins. Annual groundwater production increased from approximately 150,000 acre-feet in the mid-1950s to a high of over 366,000 acre-feet in WY2007-08. OCWD strives to maximize production from the basin through maximizing recharge of the groundwater basin. The basin is managed within the established groundwater storage operating range independently of total regional water demands as total water demands are met by a combination of groundwater and imported water.

### 6.1.3 Well Construction, Management, and Closure

Well construction, management and closure are regulated by various state agencies. To comply with federal Safe Drinking Water Act requirements regarding the protection of drinking water sources, the DDW 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.

Well construction ordinances adopted and implemented by the Orange County Health Care Agency (OCHCA) and certain 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.

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.

Information on the status of wells is kept within OCWD's Water Resource Management System data base. Since the 2017 Alternative was submitted, a total of 15 production wells were properly destroyed and sealed. During this same period, a total of 9 new production wells were constructed.

## 6.2 GROUNDWATER QUALITY PROTECTION AND MANAGEMENT

OCWD has a number of policies and programs to project groundwater quality. The list of programs below is described in detail in the 2017 Alternative.

- OCWD Groundwater Protection Policy (2014)
- Various Salinity Management Programs
    - Seawater Intrusion Barriers
    - Coastal Pumping Transfer Program
    - Groundwater Replenishment System
    - Septic Systems
    - Nitrogen and Selenium Management Program
    - Groundwater Desalters and Inland Empire Brine Line and Non-Reclaimable Waste Line
    - Basin Monitoring Program Task Force
    - Salinity Management and imported Water Workgroup
    - Nitrate Management Program

### 6.2.1 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 are responsible for contaminating 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
- 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 list of potential contaminants of greatest concern for basin water quality management. More details on these are presented in the 2017 Alternative.

- Per- and polyfluorinated Alkyl Substances (PFAS)
- Methyl Tertiary Butyl Ether (MTBE)
- Volatile Organic Compounds (VOCs)
- N-Nitrosodimethylamine (NDMA)
- 1,4-Dioxane
- Constituents of Emerging Concern (CECs)

As new chemicals become of scientific interest or are regulated, the OCWD laboratory develops the analytical capability and becomes certified in the approved method to process compliance samples. In 2019, the District's lab became the first public agency laboratory in the state of California to achieve state certification to analyze PFAS in drinking water. The District has invested over $1 million in monitoring equipment to test for PFAS and other CECs.

OCWD is committed to (1) track new compounds of concern; (2) research chemical occurrence and treatment; (3) communicate closely with the DDW on prioritizing investigation and guidance; (4) coordinate with OC San, 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 OC San that began operating in 2008. Secondary treated wastewater that otherwise would be discharged to the Pacific Ocean is purified using a three-step process to produce high-quality water used to control seawater intrusion and recharge the basin. As shown on Figure 6-1, the system includes four major components (1) the Advanced Water Purification Facility (AWPF), (2) the Talbert Seawater Intrusion Barrier, (3) Mid-Basin Injection wells, and (4) four dedicated recharge basins.

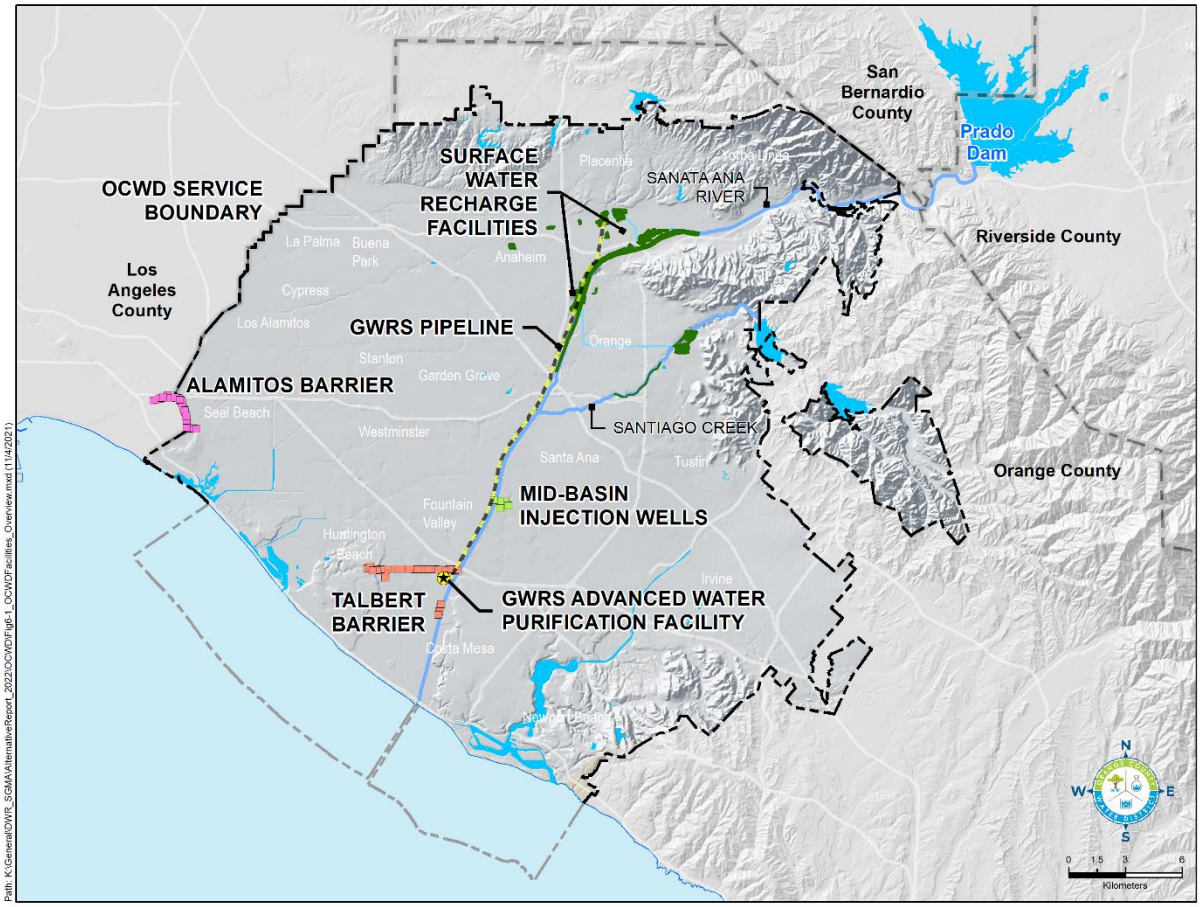



Figure 6-1: Groundwater Replenishment System

# 6.4 FINAL EXPANSION

The GWRS Final Expansion (GWRSFE) Project began in 2019 with a budget of $310 million. It is the third and final phase of the project to build-out capacity of the GWRS facility that treats

secondary effluent from OC San to drinking water standards for groundwater replenishment. As discussed above, the GWRS first began operating in 2008 producing 70 mgd and in 2015, it underwent a 30 mgd expansion. When the Final Expansion is completed in 2023, the plant will have the capacity to produce 130 mgd.

In order to produce 130 mgd, additional treated wastewater from the OC San is required. This additional water will come from OC San's Treatment Plant 2, which is located in the city of Huntington Beach approximately 3.5 miles south of the GWRS. Since the current GWRS facility only receives influent from OC San's Plant No. 1, new secondary effluent conveyance facilities are required at OC San' Plant No. 2 to convey the secondary effluent to GWRS. These conveyance facilities include an effluent pump station, two flow equalization tanks and rehabilitation of an existing pipeline.

In order for secondary effluent from OC San's Plant No. 2 to be recycled by GWRS, Santa Ana Regional Interceptor (SARI) flows must be segregated. Currently, SARI flows are not permitted to be recycled through GWRS due to the industrial and treatment facility discharges that currently flow in the SARI pipeline. Therefore, in addition to the conveyance facilities, modifications will be made to OC San Plant No. 2 headworks facilities to segregate the SARI flows and treat these flows separately for discharge to the ocean outfall. This project is referred to as the Plant No. 2 Headworks Modification Project. In addition to the Plant No. 2 Headworks Modification Project, an upgrade to OC San's Plant No. 2 water pump station is required to feed the headworks with reclaimable water. This Plant Water Pump Station Project is also considered part of the complete GWRSFE Project. An overview of the sites and the project locations of the GWRSFE are shown in Figure 6-2.

Figure 6-2: GWRS Final Expansion Overview

The GWRSFE is anticipated to be completed and operational in 2023. Once completed, the GWRS will recycle 100 percent of OC San's reclaimable sources and produce enough water to meet the needs of over one million people.

## 6.5 CONJUNCTIVE USE PROGRAMS

The conjunctive use of surface and groundwater has been the foundation of OCWD's basin management strategy since it was formed in 1933. OCWD Managed Aquifer Recharge (MAR) program began in 1936 when it began purchasing portions of the Santa Ana River channel, eventually acquiring six miles of the channel in Orange County, in order to maximize the recharge of 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 acre-feet per year.

OCWD has developed a diverse recharge portfolio including water from the Santa Ana River and tributaries, imported water, and recycled water supplied by the GWRS. The basin also receives natural recharge (also called incidental recharge) from precipitation and subsurface inflow.

### 6.5.1 Sources of Recharge Water Supplies

Water supplies used to recharge the groundwater basin are listed in Table 6-1. Figure 6-3 shows the historical recharge by source from 1936 to 2021. Table 4-1 presents the annual recharge by source for WY2016-17 to 2020-21.

#### 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 base flow. Both the Santa Ana River base flow and storm flow vary from year to year. 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. OCWD has water rights to all storm flows and base 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 and Mid-Basin Injection Wells, recharged in Kraemer, Miller, La Palma 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 Alamitos Barrier |

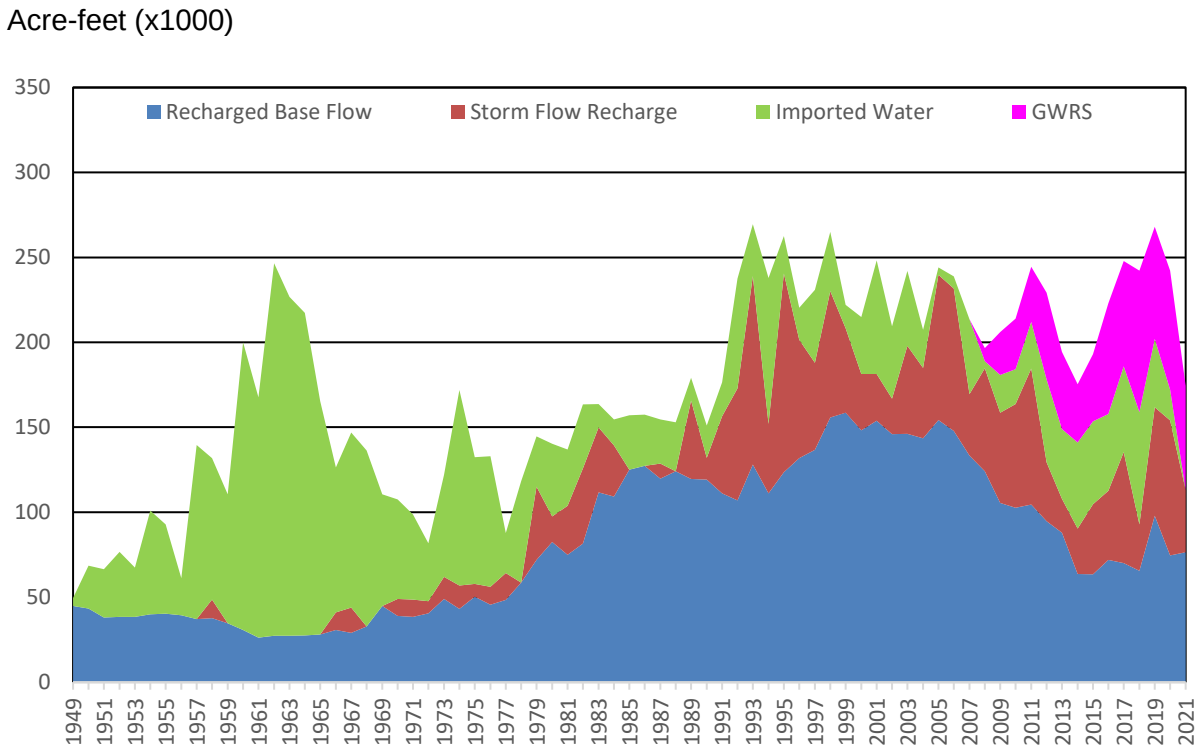



Figure 6-3: Historical Recharge in Surface Water Recharge System

## Incidental Recharge

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.

## Recycled Water

The basin receives two sources of recycled water for recharge. The primary source is the GWRS, which currently has the capacity to produce 103,000 acre-feet per year of recycled water. This will be increasing to 134,000 acre-feet per year, when the GWRS Final Expansion is complete in 2023. Recycled water from the GWRS is percolated in the surface water system and injected into the Talbert Seawater Barrier, and the Mid-Basin Injection wells. Operation of GWRS is explained in detail in Section 5.

The second source of recycled water is the Leo J. Vander Lans Treatment Facility which supplies water to the Alamitos Seawater Barrier. The capacity of the Vander Lans Treatment

Facility was expanded from 3 mgd to 8 mgd but has generally not operated above 4 mgd for extended periods of time for various reasons. WRD is working on increasing this facility's online performance. 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 6-4. Connections OC-28, OC-11 and OC-13A supply OCWD with Colorado River Aqueduct water. Connection OC-59 supplies OCWD with State Water Project water, and OC-28A (co-located with OC-28) supplies OCWD with a variable blend of water from these two sources.

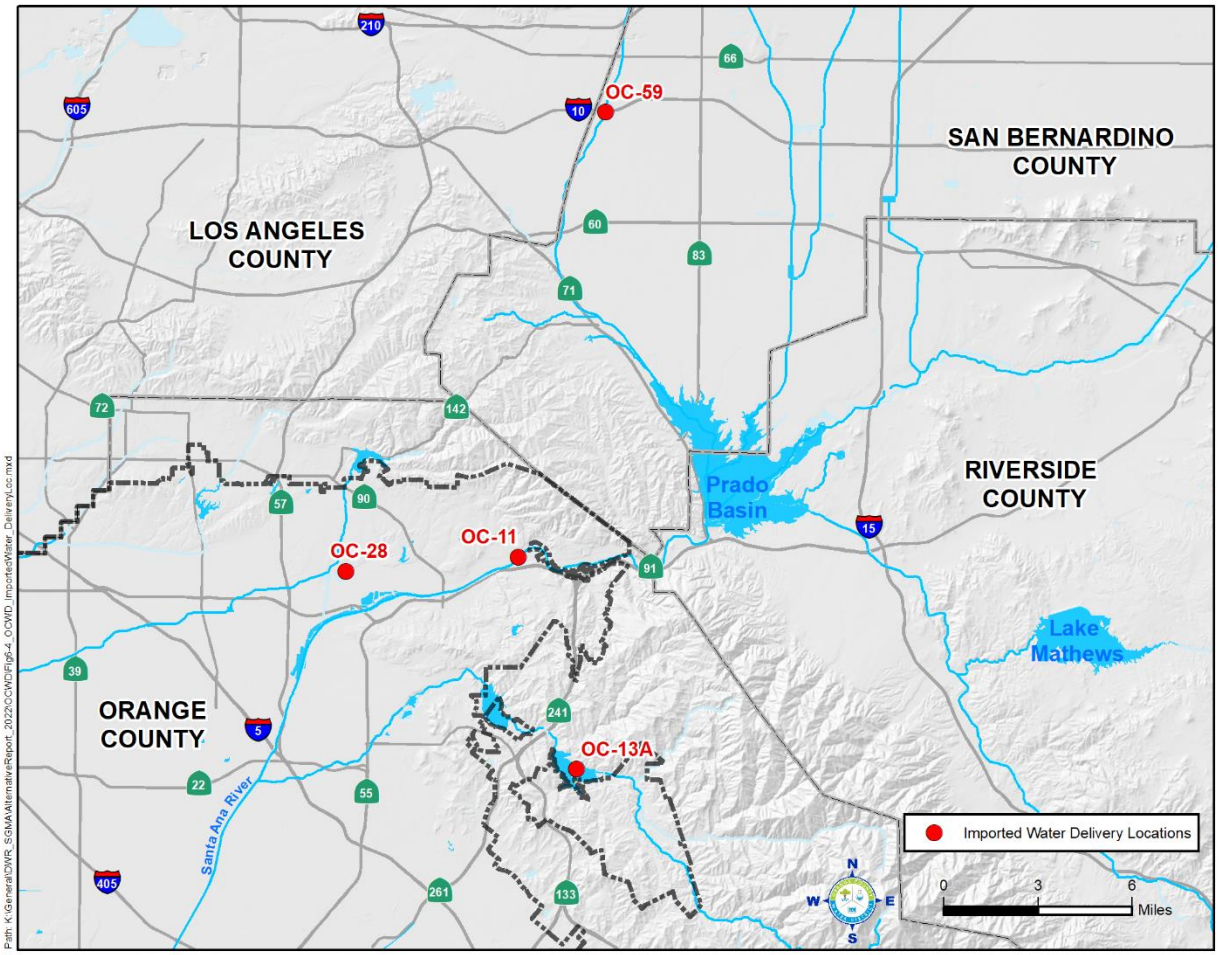



Figure 6-4: Locations of Imported Water Deliveries

## 6.5.2 Surface Water Recharge Facilities

OCWD operates a network of 25 surface water facilities located adjacent to the Santa Ana River in the City of Anaheim and Santiago Creek in the City of Orange as shown in Figure 6-5. The system has a total storage capacity of over 25,000 acre-feet. OCWD carefully tracks the amount of water being recharged in each facility on a daily basis.

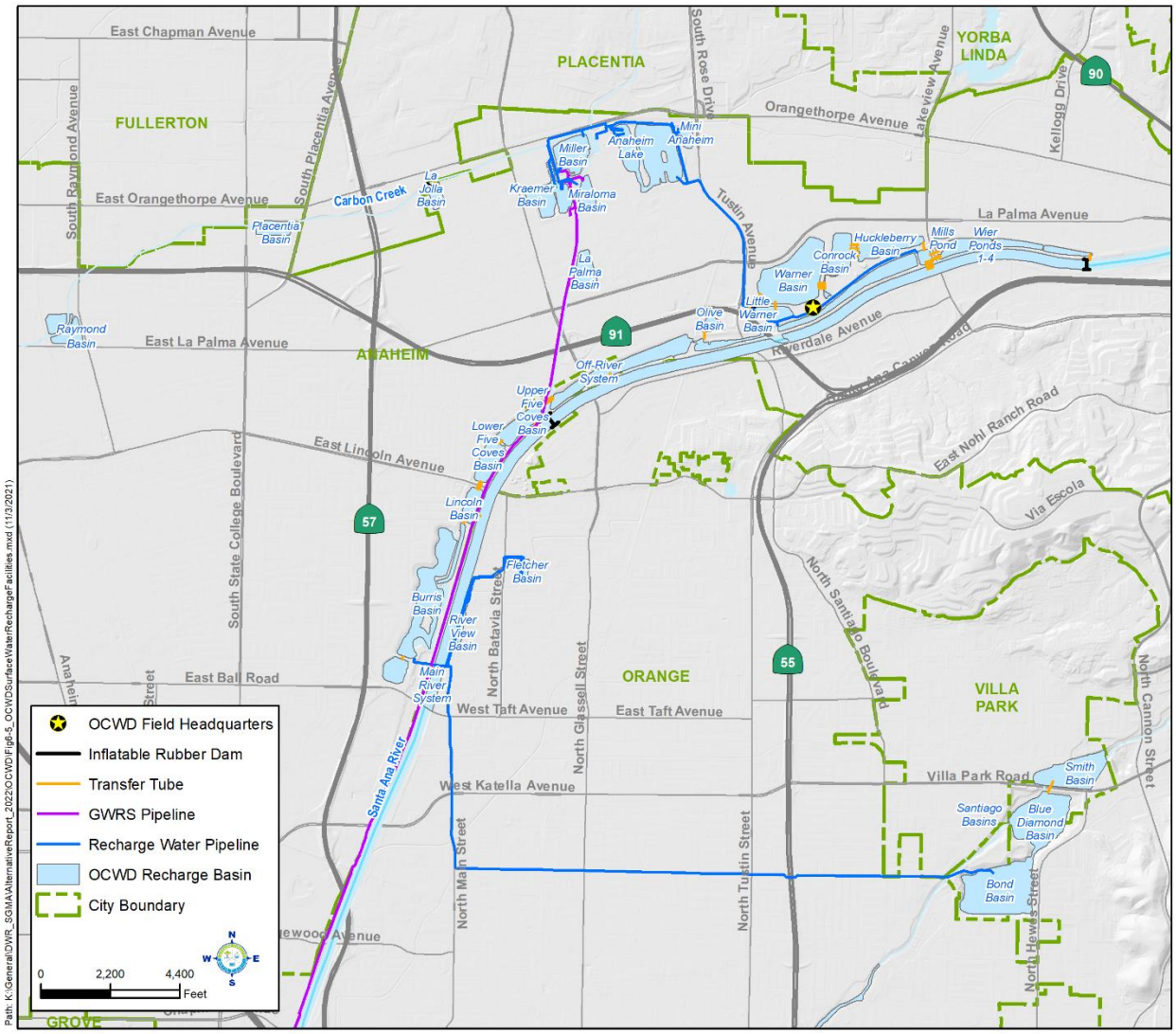



Figure 6-5: OCWD Surface Water Recharge Facilities

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.

## 6.6 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. Areas susceptible to intrusion are the Talbert, Bolsa, Sunset, and Alamitos gaps as shown 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

### 6.6.1 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. Doubling the 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 (GWRS water), and improved barrier operations, such as more frequent backwashing 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.

### 6.6.2 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 line 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 LACPW) and currently include 58 injection wells and 238 active monitoring wells as shown in Figure 3-26. The barrier is operated and maintained by LACPW under the direction of the Alamitos Barrier Joint Management Committee (JMC), whose membership includes OCWD, LACPW, 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 44 injection wells have been installed over eight phases of well construction. Most recently in 2018, with the addition of 17 new injection wells at 8 locations to control breaches through the barrier where well spacing was too large and injection capacity too small.

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
- Budgeting, replenishment assessment and considering other important policy decisions

## 7.2 PUBLIC PARTICIPATION

On September 30, 2021, OCWD sent a letter via email to all of the Basin 8-1 agencies to inform them that the 2017 Alternative was being updated and would be available for review and comment. No comments were received by any of the agencies contacted.

A draft of the 2022 Update was presented to the OCWD Board and posted on the OCWD website on November 18, 2021, to allow for public review and comment. The final 2022 Update was presented to the OCWD Board on December 15, 2021. At this board meeting, a resolution was adopted to support the submission of the 2022 Update to DWR.

## 7.3 COMMUNICATION PLAN

Proactive community outreach and public education are central to OCWD. The 2017 Alternative provides detailed information on OCWD's communication plan.

# 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 formation 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 3-10 through 3-13). 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 key wells formerly designated under the CASGEM program which has been superseded by annual reporting required under SGMA. OCWD will be reporting water level data for the basin except for the La Habra-Brea Management Area.

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 report.

## 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. Figures 3-5, 3-6, and 3-7 show the groundwater elevation contours for June 2021 for all three basin aquifers. The changes in groundwater elevations for the three aquifers are also calculated on an annual basis. The water level changes for each of the three aquifers for June 2020 to June 2021 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 properties 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.

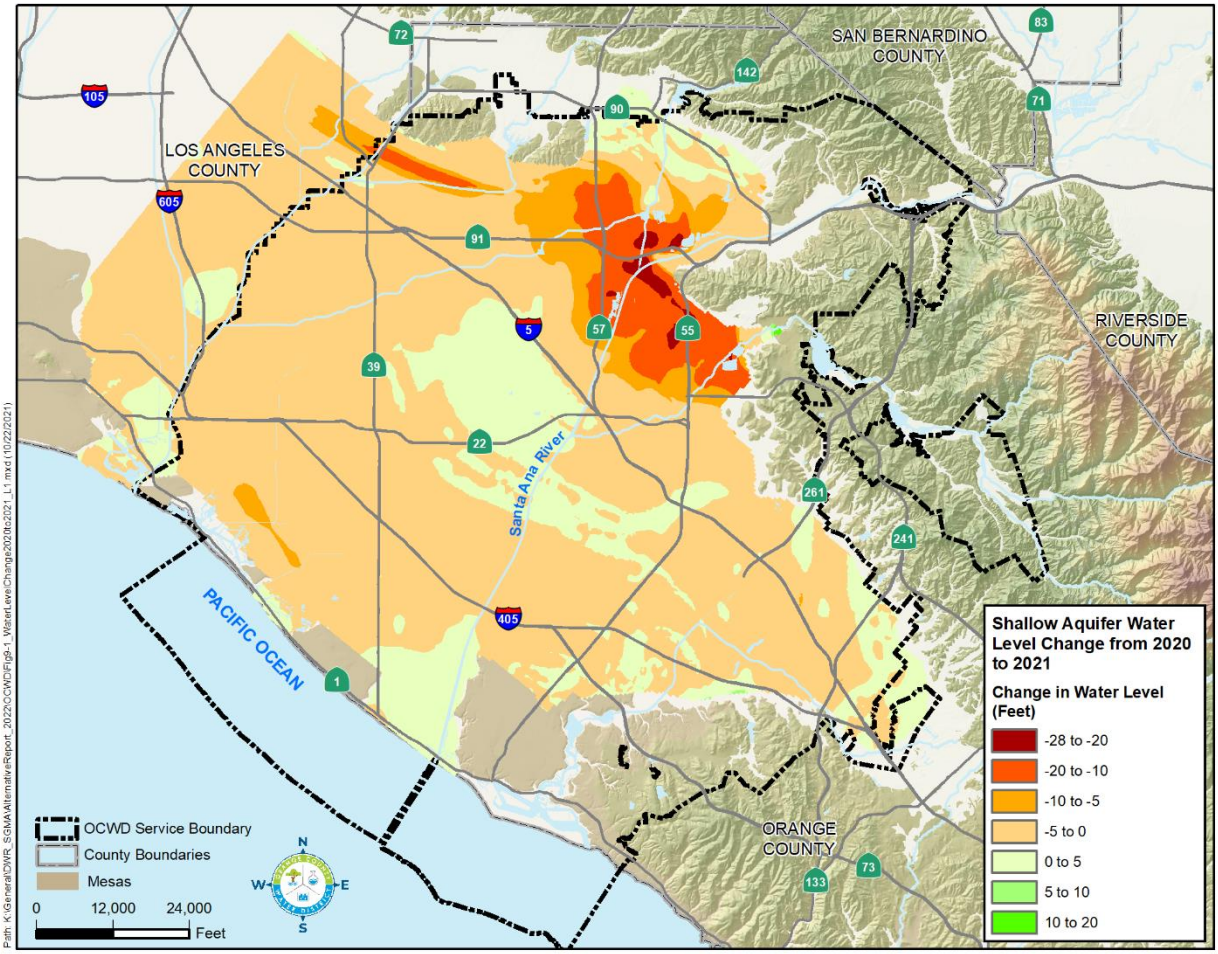



Figure 9-1: Shallow Aquifer Water Level Change, June 2020 to June 2021

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 operation of the Alamitos and Talbert Seawater Intrusion Barriers and the Coastal Pumping Transfer Program.

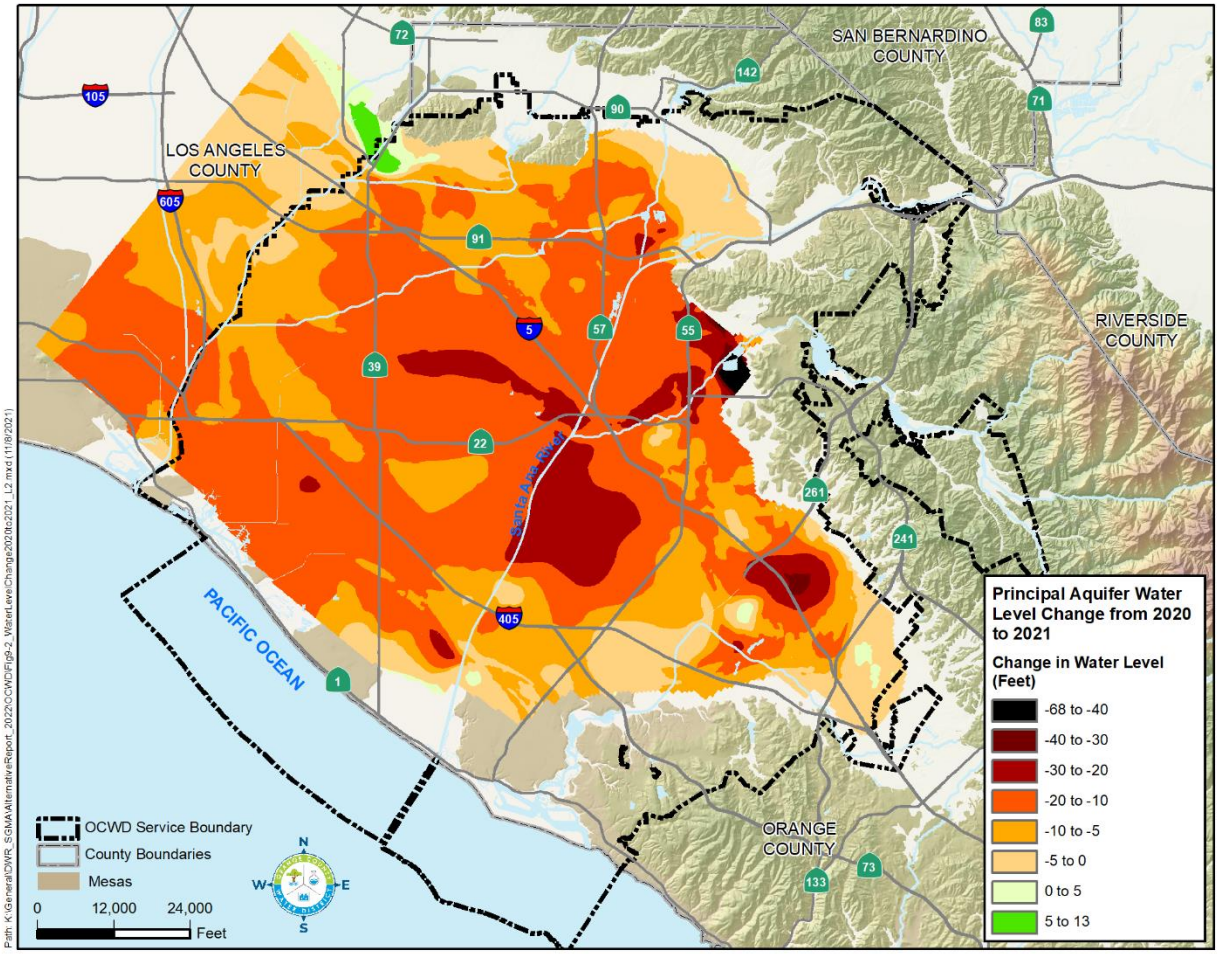



Figure 9-2: Principal Aquifer Water Level Change, June 2020 to June 2021

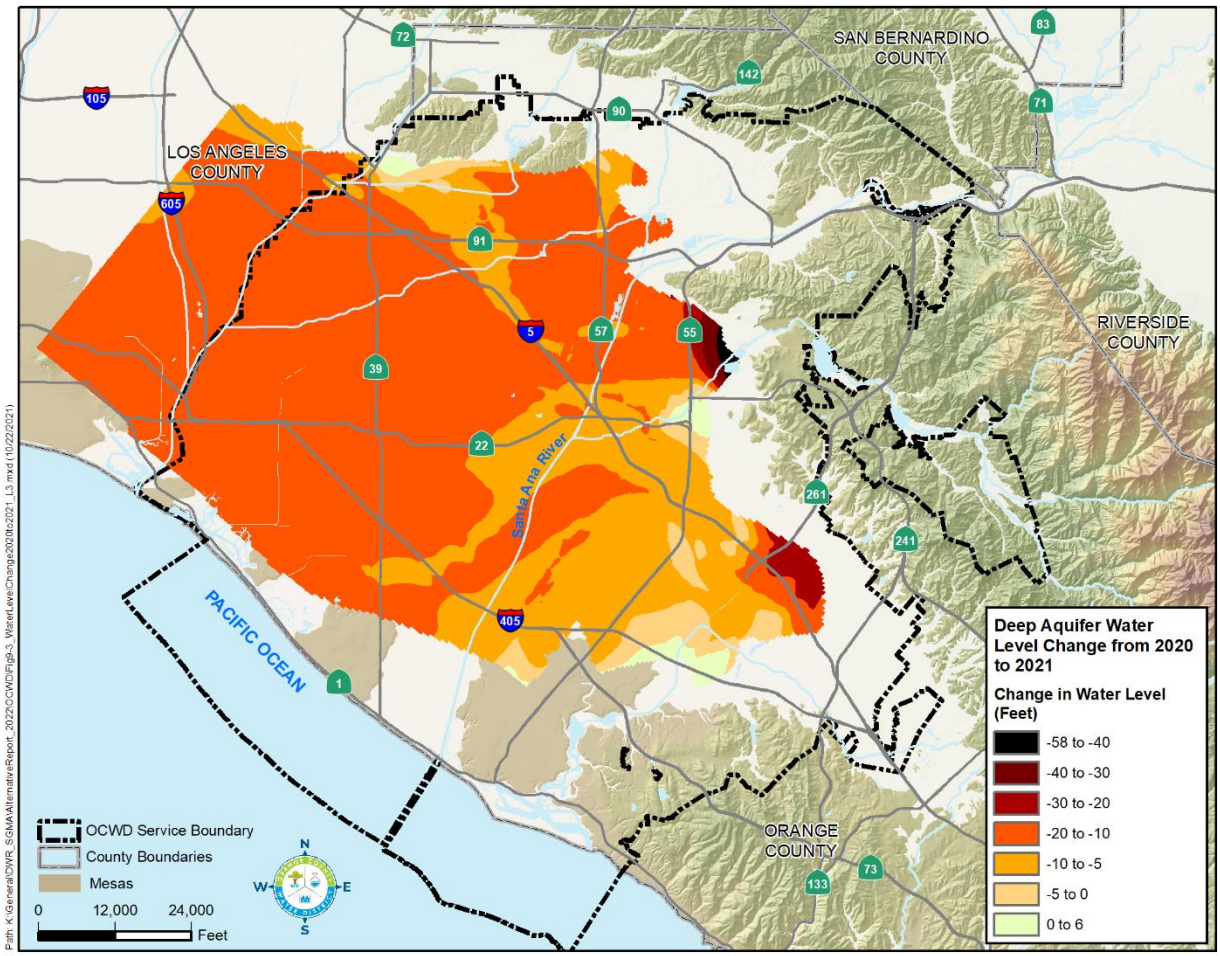



Figure 9-3: Deep Aquifer Water Level Change, June 2020 to June 2021

## 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-feet 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 generally 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 WY1958-59 to 2020-21 is shown in Figure 1-3.

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 (DWR, 2014) 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." (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.

## 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 establishing how much groundwater can be pumped from the basin for the following year. 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 groundwater pumping, purchase less imported replenishment water, and the potential for more groundwater outflow to Los Angeles County.

### 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 a given 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 WY1999-00 are shown in Figure 1-4.

### 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). 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 further 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.

The methodology for setting the BPP and OCWD polices related to the BPP are described further in the 2017 Alternative.

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. 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 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.

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 |

### 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.

## 10.4 DEVELOPING NEW LOCAL WATER RESOURCES POLICY

In July 2020, the District adopted a policy called the Developing New Local Water Resources Policy to acknowledge that the local multi-billion-dollar economy and 2.5 million citizens that rely on groundwater as their primary water supply require a reliable, sustainable and economical

water source to remain healthy and strong. It further acknowledges that the imported water that is purchased annually to meet the needs of the groundwater producers is becoming uncertain as environmental, agricultural, and urban interests maneuver to obtain a greater share and is susceptible to impacts from climate change. The Policy contains the following tenets:

- The District recognizes the impacts of climate change and their ability to disrupt predictions of future local water supplies for the District's service territory
- The District will evaluate and undertake economical and environmentally sensitive projects and programs to work towards the goal of ensuring adequate water supplies are always available to its service territory
- The types of projects that will be evaluated include: (1) Maximizing Santa Ana River base and storm flow capture, (2) Increasing water conservation, (3) Increasing water recycling, (4) Improving the reliability of imported water supplies, (5) Brackish water desalination, (6) weather modification/cloud seeding; and (7) Seawater desalination

## 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 store up to 66,000 acre-feet of water 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.

## 10.4.1 Water Demands

Water demands within the OCWD Management Area for WY2016-17 to 2020-21 averaged 400,000 acre-feet per year (Figure 6-1). Total demand includes the use of groundwater, surface water from Santiago Creek and Irvine Lake, recycled water, and imported water.

## Projected Water Demands

OCWD estimated future total water demands (including recycled water) within the OCWD Management Area to be approximately 431,000 acre-feet per year in 2050. This is based on a water demand study jointly funded by OCWD and MWDOC. This study was undertaken to assist the 19 major groundwater producers in the development of their 2020 Urban Water Management Plans. Water Demands within the OCWD Management Area was determined by summing the 19 producer future estimates and water produced by private, mutual water company, and irrigation wells.

### Drought Management

During a drought, flexibility to manage pumping from the basin becomes increasingly important. The OCWD Management Area may experience a decline in the supply of recharge water (local supply of Santa Ana River water and net incidental recharge) of 55,000 acre-feet per year 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 acre-feet per year 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.

## 10.5 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.

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<br>• Decreases revenue to the OCWD<br>• Increases water cost for groundwater producers<br>• Does not require additional recharge facilities<br>• 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<br>• Replenishment could be in the form of in-lieu water (additional imported water delivered to groundwater producers instead of groundwater pumping)<br>• Water transfers and exchanges could be utilized to provide the increased supply of recharge water<br>• May be dependent on building and maintaining excess recharge capacity (which may be underutilized in non-drought years) |
| Combination of the Above | • A combination of the approaches provides flexibility and a range of options for refilling the basin |

## 10.6 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.

# 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 include monitoring, remediation of contaminated groundwater, and recharging high-quality recycled water. 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 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 2020, OCWD completed an evaluation of future TDS and nitrate concentrations in the Orange and Irvine Management Zones (OCWD, 2020). Figure 3-16 shows the areal extent of these zones, which are not to be confused with the OCWD Management Area that is the subject of this report. The 2020 update is similar to an analysis conducted in 2016 (OCWD, 2016) and involved using a model to evaluate the effects of different basin management scenarios on TDS and nitrate concentrations over the next 30 years. One of the key outputs of the model is the calculated ambient TDS and nitrate concentrations for groundwater in the Orange and Irvine Management Zones. The model-calculated ambient concentration represents a volume-weighted average value for the Shallow and Principal Aquifers. 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 and injection wells
- Quantity and quality of unmeasured recharge, such as percolation of irrigation water into the groundwater basin
- Measurements of groundwater pumping
- Estimates of groundwater outflow from the Orange Management Zone

The most significant change from the prior analysis is the impact of the GWRS Final Expansion, which increases the volume of low-TDS recycled water recharged by 30,000 acre-feet per year. Because OCWD is obtaining the additional water from OC San Plant No. 2, the overall TDS of the recycled water generated increases slightly from 60 mg/L to 86 mg/L.

The quantity and quality of water recharged in the model for the Baseline Scenario are shown in Table 11-1.

Table 11-1: Baseline Projected Future Salt Inflows

| Source of Water Recharge | Volume (acre-feet/yr) | TDS Conc. (mg/L) | Mass (tons/yr) |
|---|---|---|---|
| Deep percolation of precipitation* | 6,500 | 100 | 900 |
| Percolation of applied water* | 9,000 | 1,900 | 23,200 |
| Subsurface inflow* | 44,500 | 1,290 | 78,200 |
| SAR base flow | 52,000 | 700 | 49,500 |
| SAR storm flow | 50,000 | 200 | 13,600 |
| Recycled water (GWRS) | 133,000 | 86 | 15,600 |
| Alamitos Barrier | 2,500 | 350 | 950 |
| MWD imported water | 0 | 0 | 0 |
| Total | 297,000 | 449 | 181,200 |

*Component of unmeasured recharge

The Baseline Scenario assumes that no imported water is used for recharge for the 30-year period and is utilized to compare with other model runs and determine how changing model inputs affect the predicted concentration. The projected trend for TDS for the Baseline declines from the current ambient groundwater concentration of 603 mg/L to 569 mg/L in 30 years as shown in Figure 11-1. Seven additional scenarios were run to model different quantities of recharge source water. The projected 30-year TDS for these scenarios range from 559 mg/L to 580 mg/L. This shows the tremendous impact of low-TDS GWRS water in lowering the overall salinity in the basin over time regardless of how much water is obtained from other recharge sources, such as higher TDS imported water.

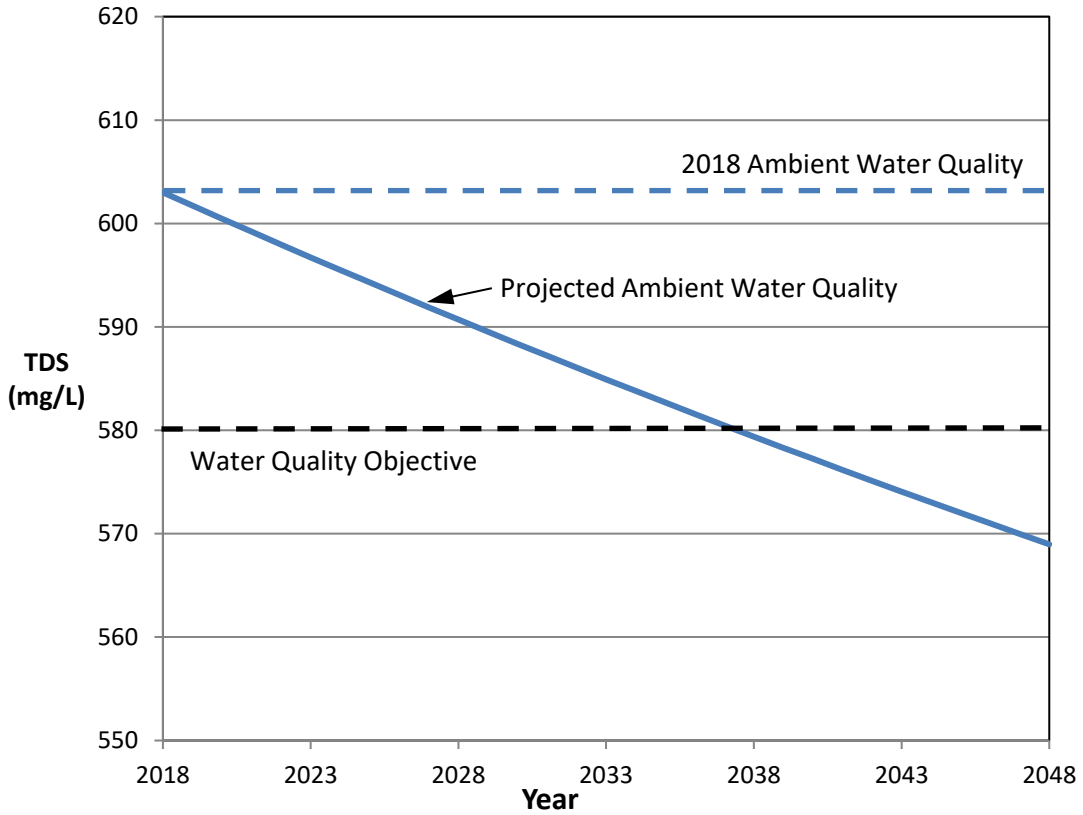



Figure 11-1: Estimated TDS Concentration in Base Case for 30-year Period

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, N) concentration for each inflow component was estimated using available data. Table 11-2 summarizes the inflow terms and their nitrate-N concentrations for the Baseline Scenario.

The flow-weighted average nitrate (as N) concentration for all inflows to the management zone is 2.3 mg/L. The initial concentration was set at 2.95 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 (as N) concentration gradually decreases. For the Baseline Scenario, the ambient nitrate (as N) concentration is projected to decrease from 2.95 mg/L to 2.8 mg/L over the course of 30 years. Again, as with TDS, the impact of recharging large volumes of high quality GWRS water lowers nitrate concentrations in basin groundwater over time.

Table 11-2: Baseline Future Nitrate (as N) Inflows

| Inflow | Volume (Acre-Feet/yr) | Nitrate-N Conc.(mg/L) | Mass (tons/yr) |
|---|---|---|---|
| Deep percolation of precipitation* | 6,500 | 1 | 9 |
| Percolation of applied water* | 9,000 | 10 | 122 |
| SAR base flow | 52,000 | 3.6 | 255 |
| SAR storm flow | 50,000 | 1.3 | 88 |
| Imported water recharge | 0 | 0 | 0 |
| Recycled water recharge (GWRS) | 133,000 | 1.0 | 181 |
| Subsurface inflow* | 44,500 | 4.2 | 253 |
| Alamitos Barrier | 2,000 | 1.4 | 4 |
| Total | 297,000 | 2.3 | 657 |

*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, including PFAS. The locations of these projects, except for PFAS, are shown in Figure 11-2. PFAS projects are located at specific groundwater producer wells.

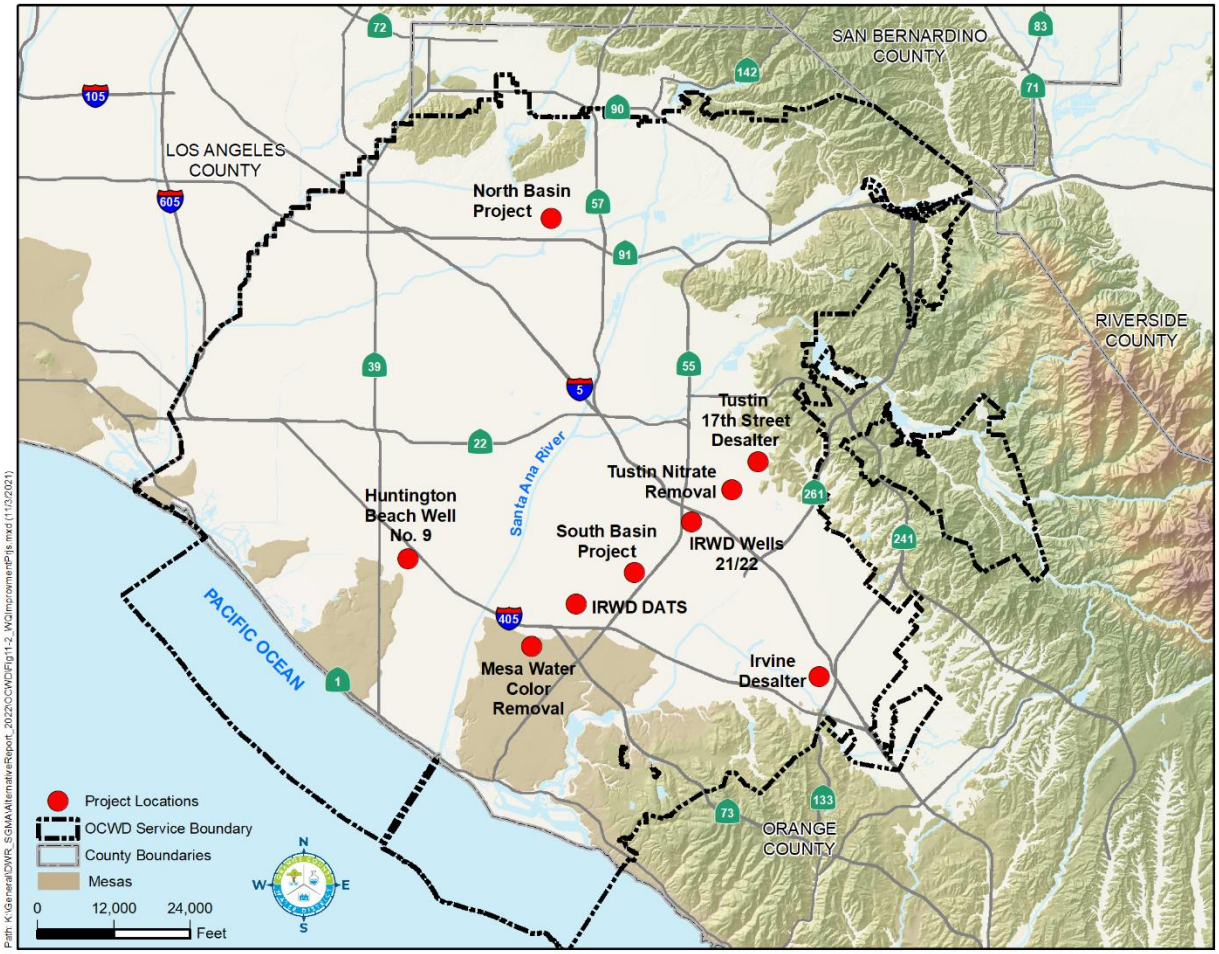



Figure 11-2: Water Quality Improvement Projects and Programs

## 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 11-3. 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. In September 2020 the USEPA included the North Basin site on the National Priorities (Superfund) List.

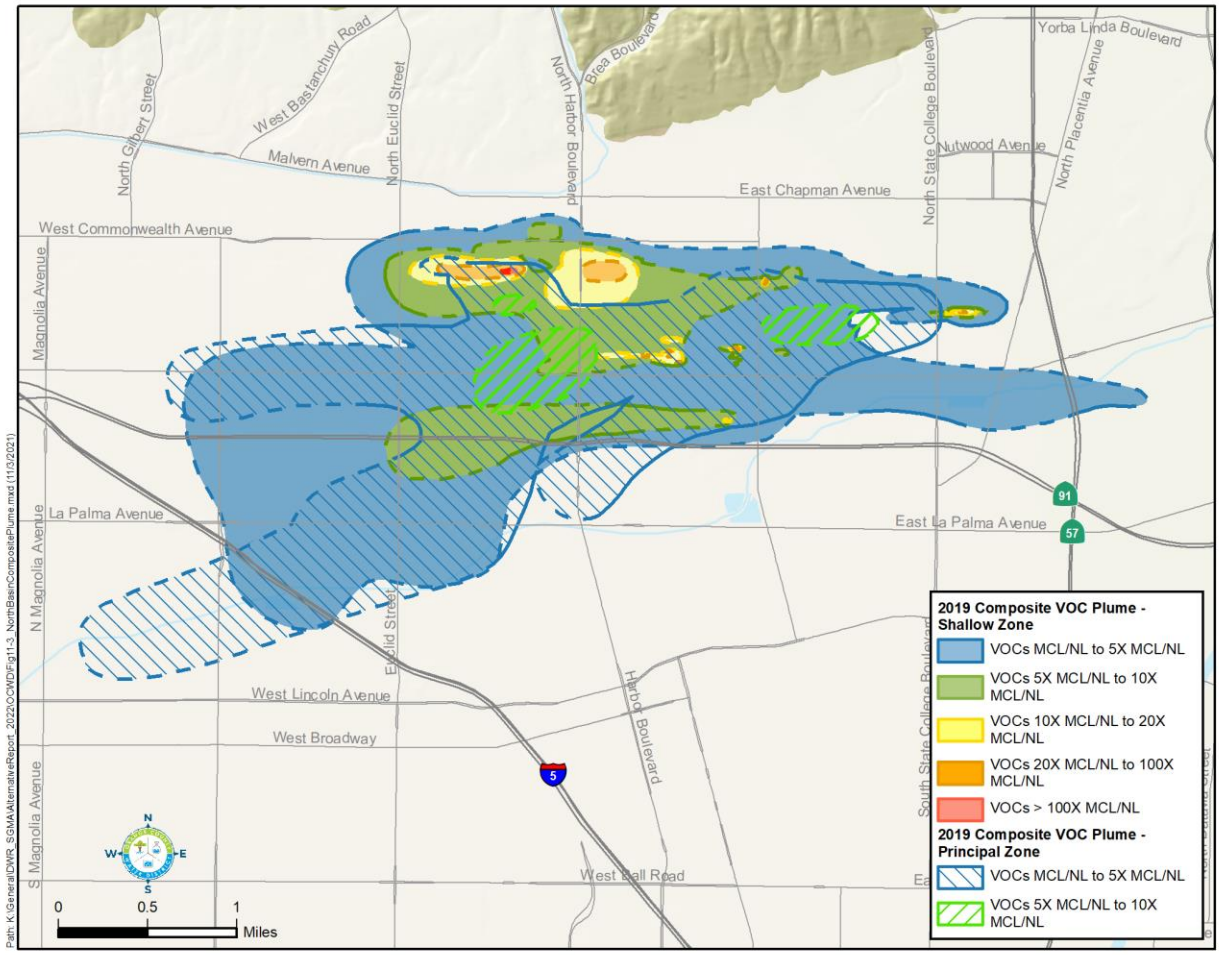



Figure 11-3: North Basin Groundwater VOC Plume

## South Basin Groundwater Protection Program

Groundwater contaminated with VOCs and perchlorate in the South Basin area of the groundwater basin is shown in Figure 11-4. Elevated concentrations of perchloroethylene (PCE), trichloroethylene (TCE), and perchlorate were detected in Irvine Ranch Water District's Well No. 3, located in Santa Ana. OCWD's remedial investigation has resulted in the delineation of an approximately 2-mile long comingled contaminant plume. With the remedial investigation complete, OCWD is proceeding with a feasibility study to evaluate and develop remedial measures in cooperation with regulatory agencies and stakeholders following the NCP process. In tandem with OCWD's remediation program to address off-site contamination, the Regional Water Board and DTSC are overseeing investigation and remediation activities at the contaminant source sites.

## 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. Most of the major defendants have settled the litigation with OCWD, and funds from these settlements have been set aside for use at such time as treatment is required at drinking water wells.

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).

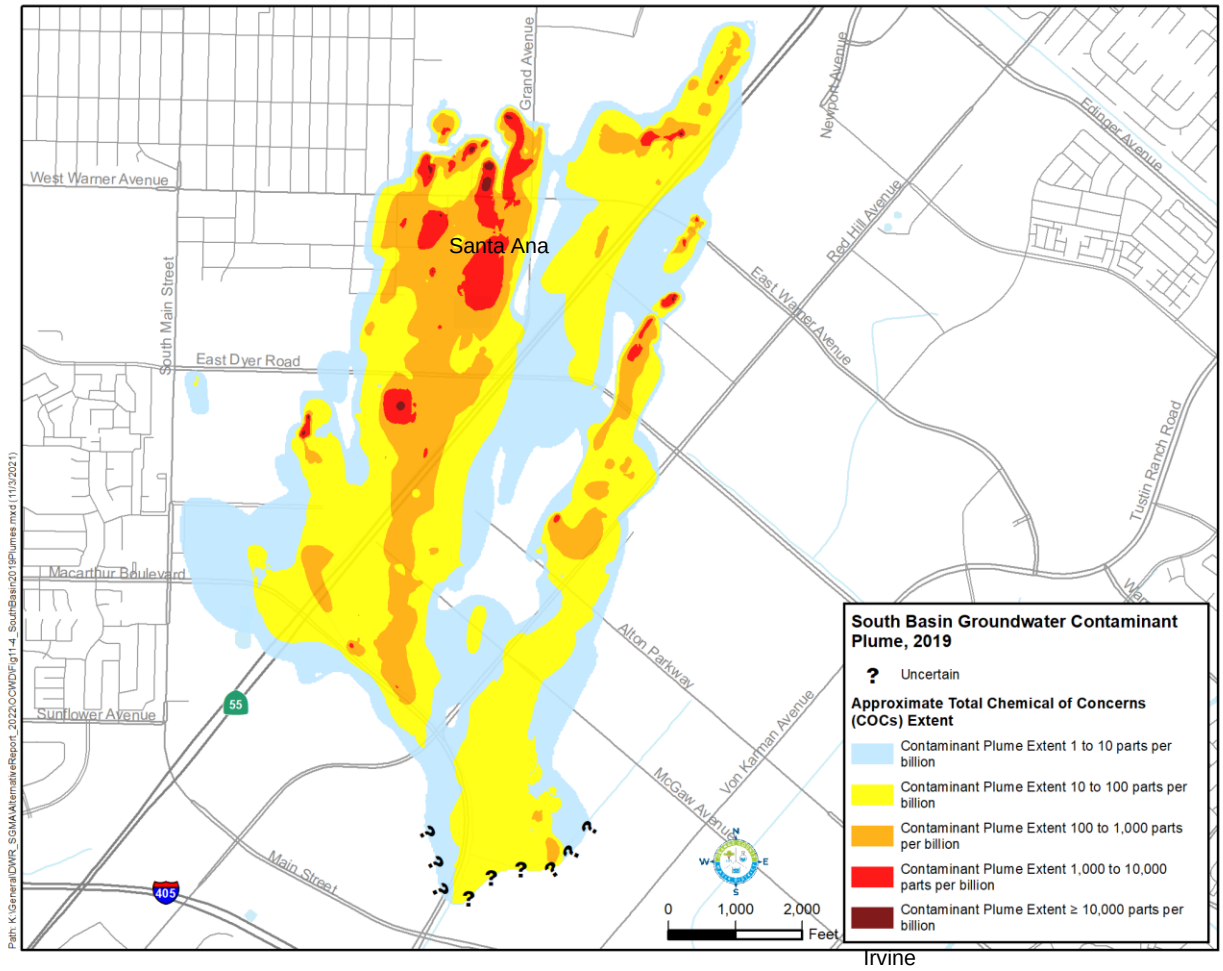



Figure 11-4: South Basin Groundwater Contaminant Plume

## 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 impacted the groundwater basin. In 1990 the USEPA placed the site on the National Priorities List. 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 IRWD. Operating since 2007, 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 acre-feet per year. 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 acre-feet per year**.**

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 acre-feet per year. OCWD provides a financial subsidy to the City of Tustin in the form of a BEA exemption to help offset the treatment costs.

## 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 acre-feet per year 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 for potable supply. In 2001, Mesa Water District opened its Colored Water Treatment Facility capable of treating 5.8 mgd. This facility was replaced in 2012 by the 8.6-mgd Mesa Water Reliability Facility that uses nano-filtration 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 owned and operated by the IRWD since 2002 that uses nano-filtration membranes. This facility purifies 7.4 mgd of amber-colored water.

## PFAS Treatment Systems

In 2020 OCWD as the groundwater basin manager, executed a multi-party agreement with the impacted groundwater producers to fund and construct the necessary treatment systems for production wells impacted by PFAS compounds. The PFAS treatment projects include the design, permitting, construction, and operation of PFAS treatment systems for impacted production wells. Each well treatment system will be evaluated for use with granular activated carbon (GAC), ion exchange (IX), or an alternative novel sorbent 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 laboratory detection limit. 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. The groundwater producers will own the treatment systems once they are completed; with financial assistance from OCWD, the groundwater producers will operate and maintain the new treatment systems once they are constructed.

To minimize alternative water supply 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. As of September 2021, construction contracts have been awarded for treatment systems for production wells owned by the cities of Orange (Phase 1) and Garden Grove, Serrano Water District, and Yorba Linda Water District. The City of Anaheim has also awarded a design-build contact (Phase A) for 8 impacted wells, that will be reimbursed by OCWD. The City of Fullerton's well KIM-1A treatment system has been completed and is in operation. Additional construction contracts are anticipated to be awarded for impacted wells operated by the cities of Fullerton (Main Plant), Orange (Phase 2), Santa Ana, and Tustin; Irvine Ranch Water District; and East Orange County Water District by early 2022. OCWD expects the treatment systems to be constructed for the approximately 60 impacted wells within the next 2 to 3 years. Figure 11-5 shows locations of wells affected by and to be treated for PFAS.

As monitoring continues and additional wells are anticipated to be taken off-line due to PFAS detections reported at or near the current RL (or future MCL), OCWD will continue to partner with the affected groundwater 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 WY2020-21 was expected to be approximately 325,000 acre-feet but declined to 282,000 acre-feet primarily due to PFAS-impacted wells being turned off around February 2020. OCWD projects groundwater production to be approximately 250,000 acre-feet in WY2021-22 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 increase back to levels similar to years prior to PFAS impacts.

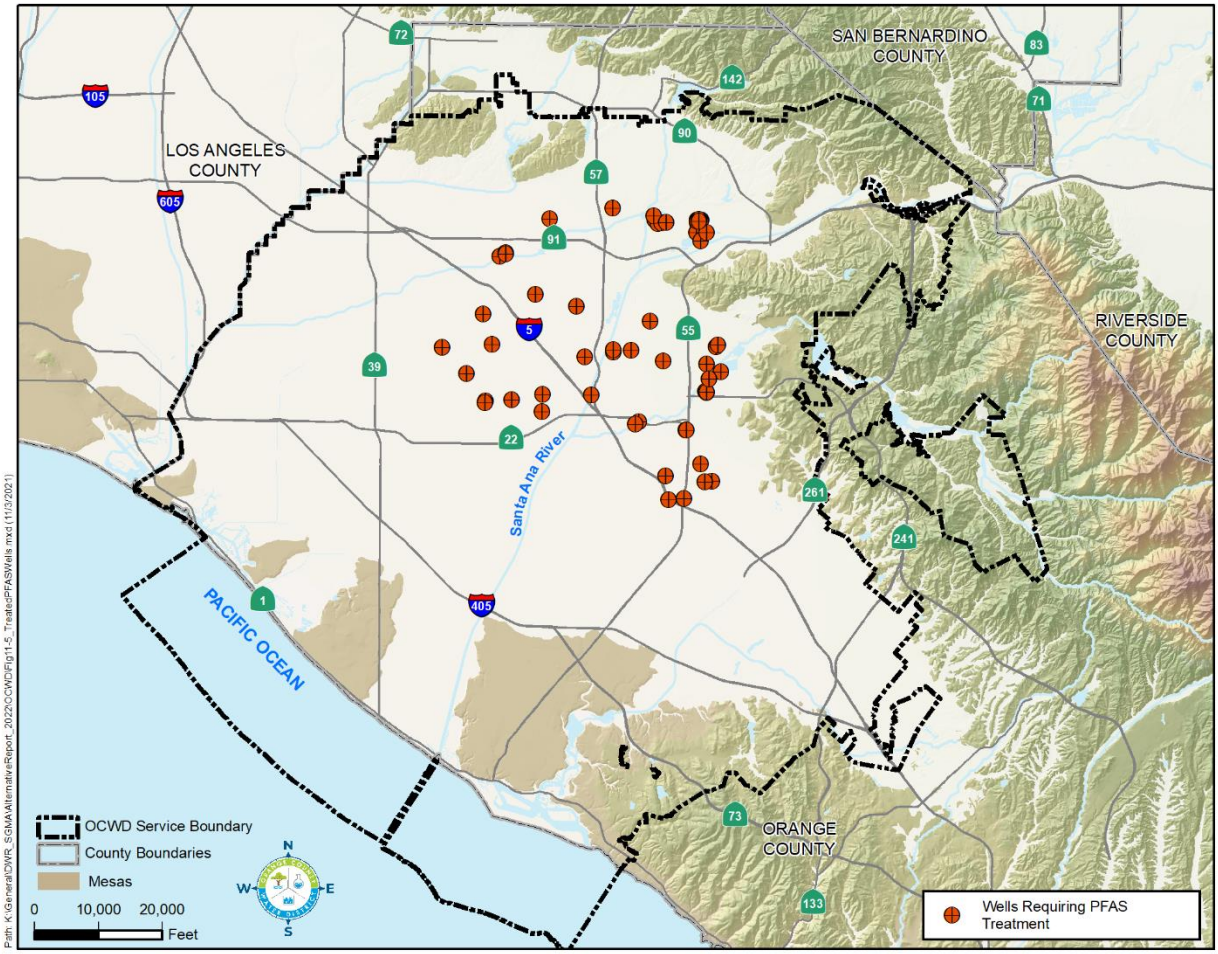



Figure 11-5: Production Wells to be Treated to Remove PFAS

## 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 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 | Average 5-Year Pumping (afy) | Max Production Above BPP (afy) | OCWD BEA Subsidy |
|---|---|---|---|---|---|
| Irvine Desalter | Remove nitrates, TDS, and VOCs | 2001 | 6,990 | 10,000 | Exemption |
| Tustin Desalter | Remove nitrates and TDS | 1998 | 2,240 | 3,500 | Exemption |
| Tustin Nitrate Removal | Remove nitrates | 1998 | 170 | 1,000 | Exemption |
| Mesa Water Colored Water Removal | Remove color | 2011 | 4,605 | 8,700 | Exemption |
| IRWD Wells No. 21 and 22 | Remove nitrates | 2012 | 2,420 | 7,000 | Exemption |
| Huntington Beach Well No. 9 | Remove odor | 2018 | 1,680 (3 yrs) | 3,000 | Partial exemption |

## DEFINITION OF SIGNIFICANT AND UNREASONABLE DEGRADATION OF WATER QUALITY

Three elements must be considered when evaluating the impact of groundwater quality degradation with regard to SGMA undesirable results.

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 quality degradation. If small volumes are negatively affected that do not materially affect the overall 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 prevent 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 3-20.

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 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. 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.

OCWD monitoring well 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. The well is strategically located seaward of the barrier in the middle of the Talbert Gap and is screened within the merged Talbert and Lambda aquifers (see Figure 12-2). 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 freshwater 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 12-2 shows the historical interrelationship between coastal groundwater production, Talbert Barrier injection, and groundwater elevations at well M26 from 2008 to 2021. This figure

shows that groundwater elevations at well M26 have consistently been maintained at or above protective elevations since 2010 with the exception of brief periods related to GWRS shutdowns.

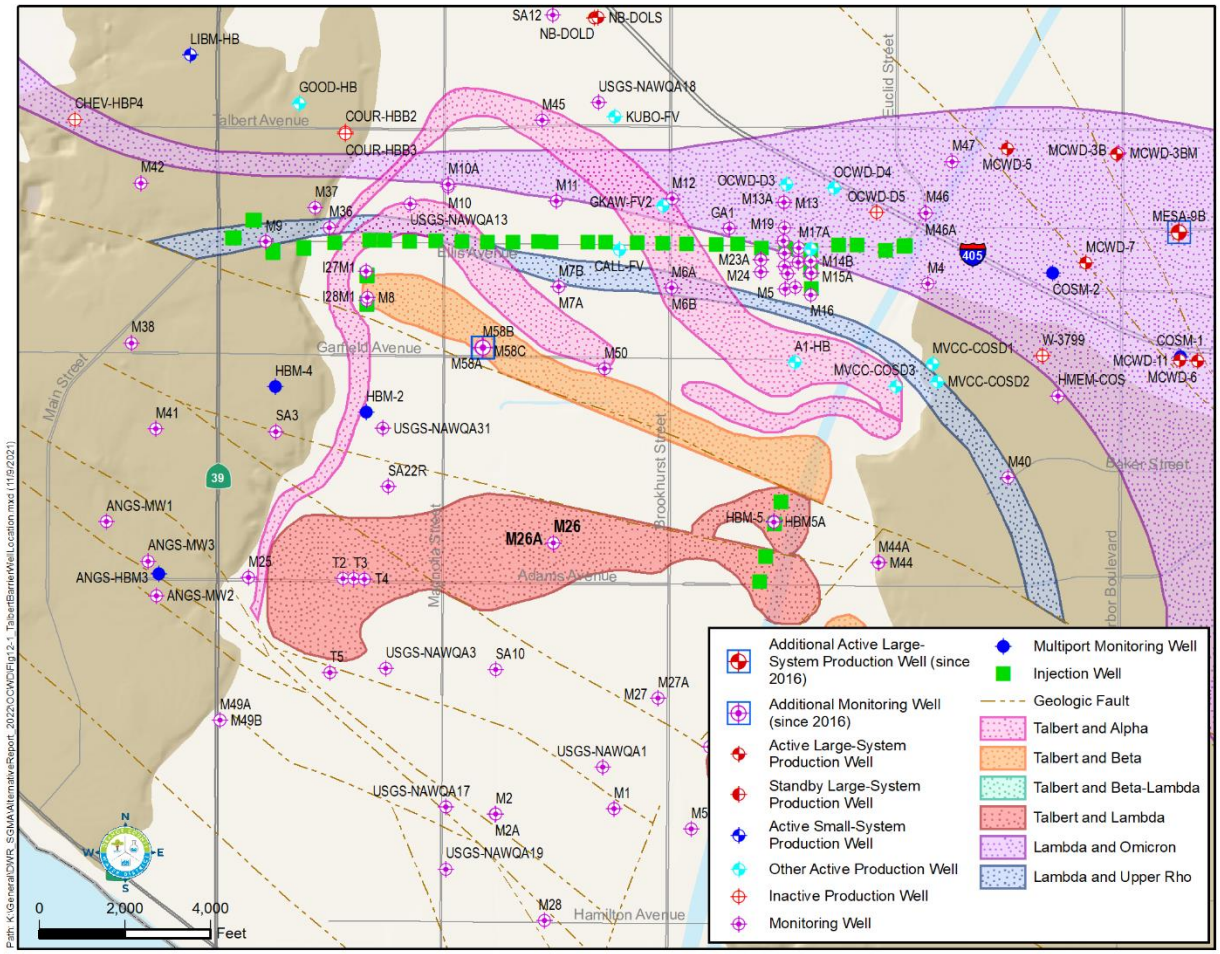



Figure 12-1: Talbert Gap – Seawater Intrusion Barrier

Figure 12-3 shows the 250 mg/L chloride concentration contour in the Talbert and Bolsa gaps and adjacent mesas for 1993, 1998, 2008, and 2020. 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. This figure shows that the 250 mg/L chloride contour has remained relatively unchanged from 2008 to 2020, indicating that the barrier and other basin management programs are keeping seawater intrusion from taking place.

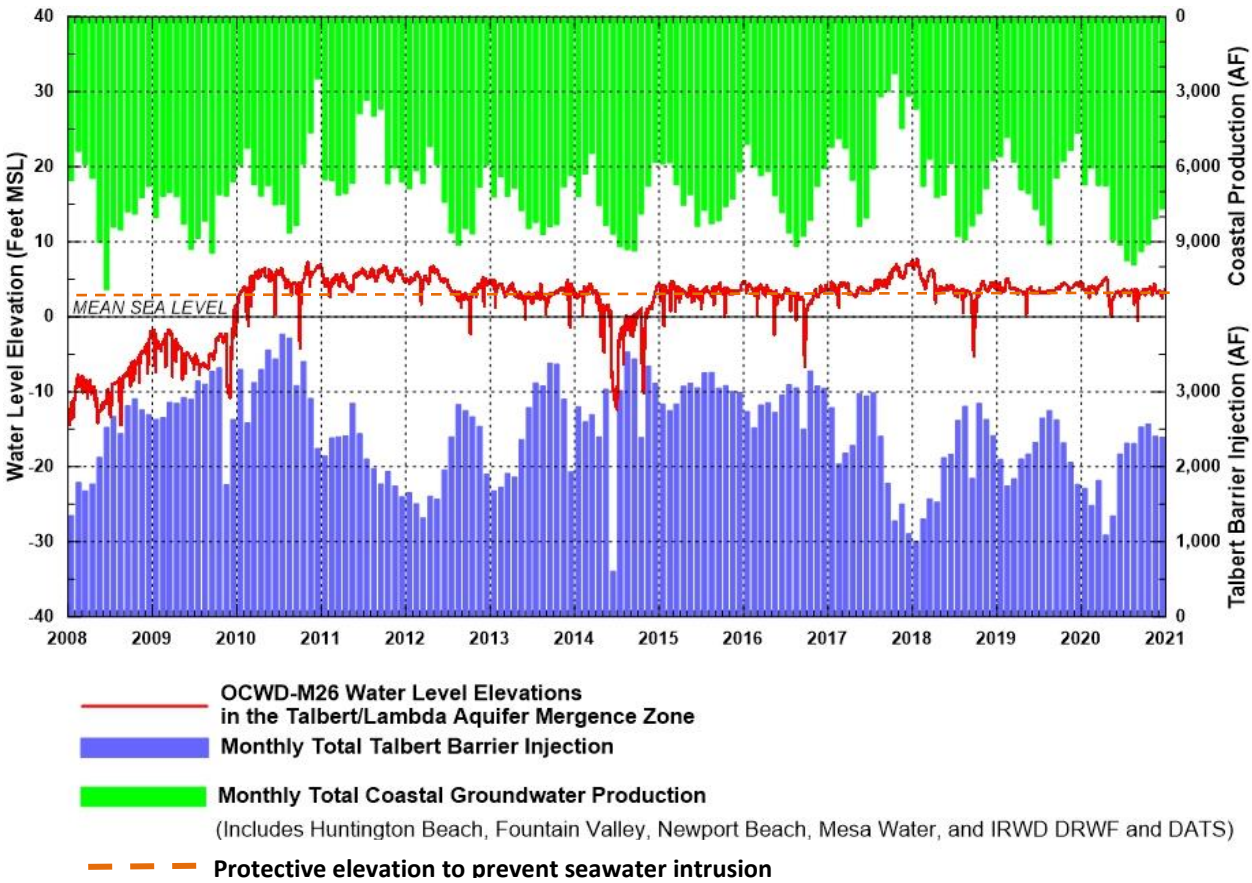


Figure 12-2: Key Well OCWD-M26 Groundwater Levels, Talbert Barrier Injection, and Coastal Pumping

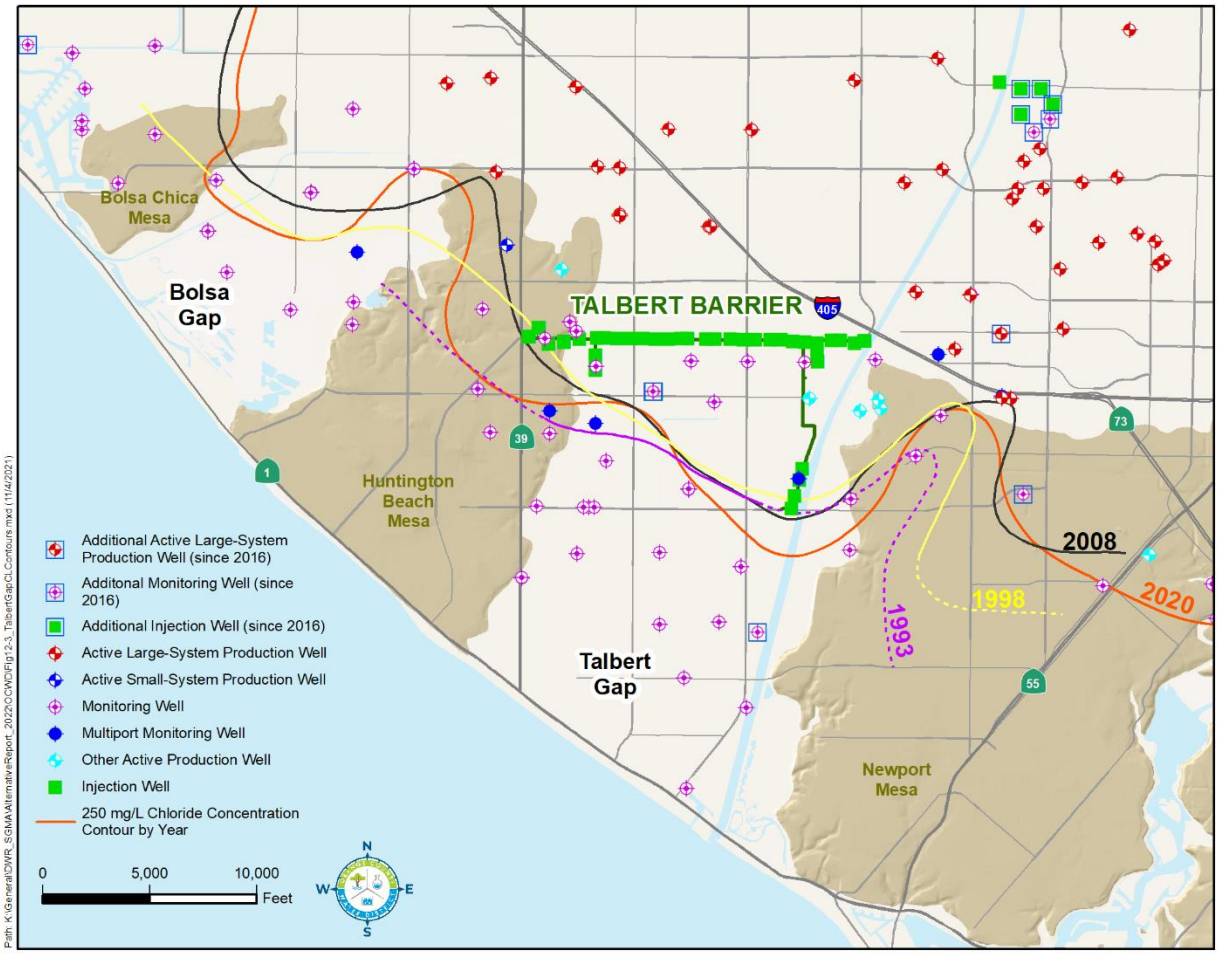



Figure 12-3: Talbert Gap 250 mg/L Chloride Concentration Contours for Selected Years

## 12.1.1 Talbert Barrier Groundwater Model

OCWD has developed a calibrated MODFLOW groundwater model of the Talbert Barrier and surrounding area (Talbert Model). 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 California Department of Public Health requirements contained within the original permit to operate GWRS (RWQCB, 2004; OCWD, 2005). For more information on the Talbert Model, see the 2017 Alternative.

## 12.2 ALAMITOS GAP

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 (Figure 12-4).

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.

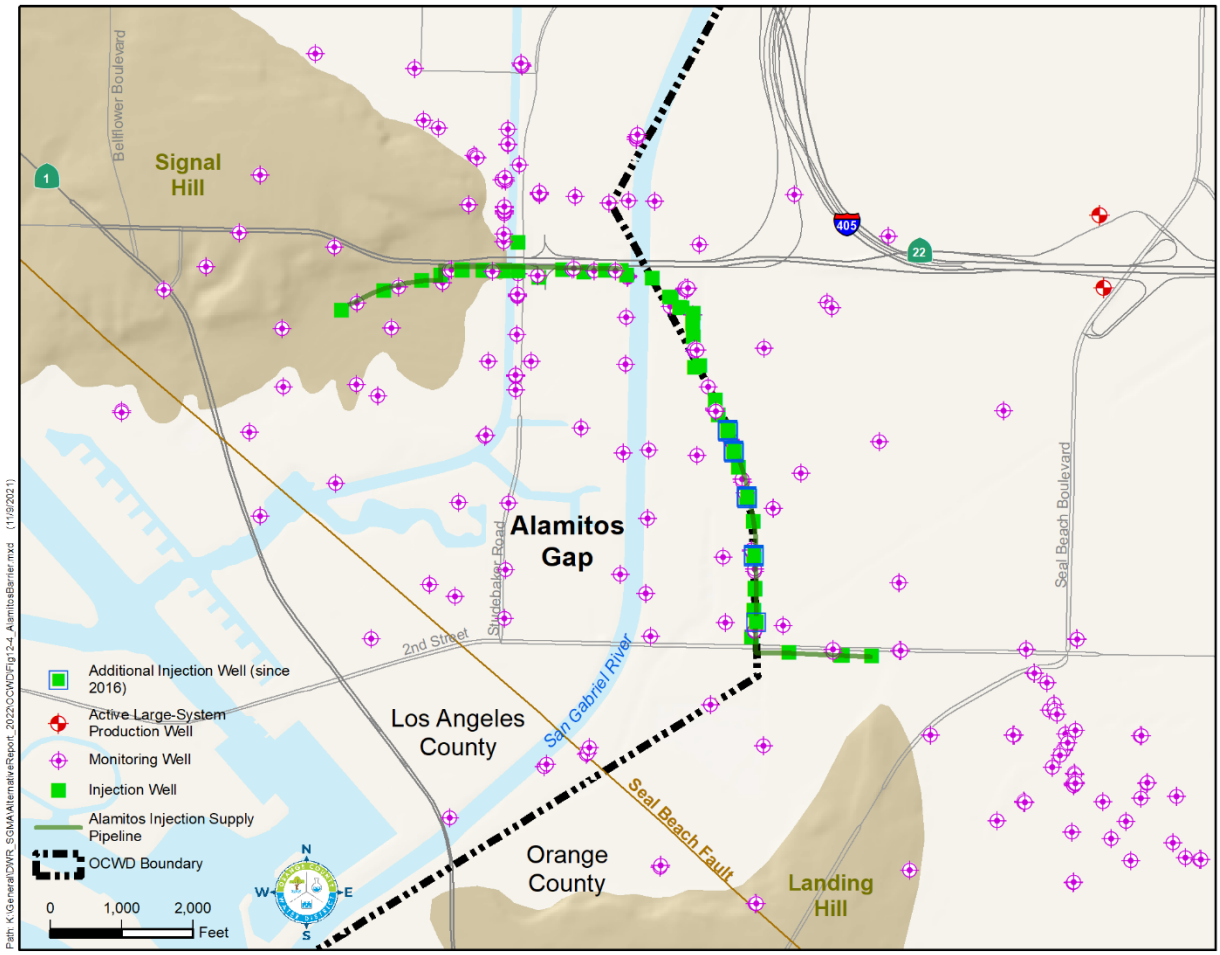



Figure 12-4: Alamitos Gap – Seawater Intrusion Barrier

The pathways for intrusion in Alamitos Gap are similar to the Talbert Gap with the uppermost Recent aquifer 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. 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. The aquifers susceptible to intrusion are generally thinner and finer-grained than their counterparts in Talbert Gap. Therefore, per-well injection capacity in the Alamitos Barrier is about half that of the Talbert Barrier and thus requires more injection wells and denser spacing to achieve sufficient injection for creating a continuous pressure ridge that achieves protective elevations.

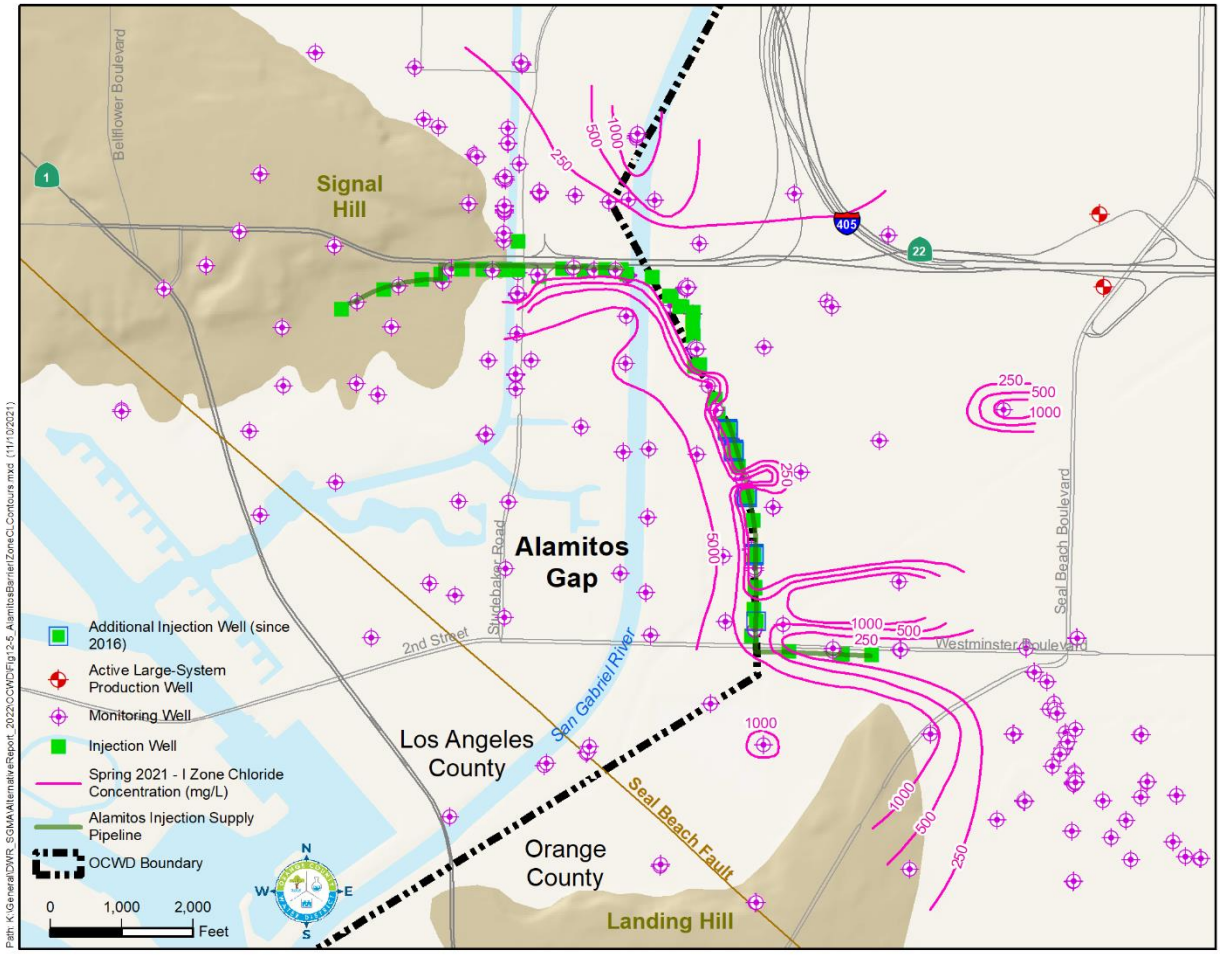



Figure 12-5: Alamitos Gap I Zone Chloride Concentration Contours, 2021

Additional injection wells were constructed as part of the Alamitos Barrier Improvement Project to control the identified breaches through the barrier and to address barrier deficiencies along the north-south reach where injection well spacing was too large and injection well capacity too small. In addition, four monitoring wells and two piezometer were installed to improve monitoring near the barrier. Figure 12-5 shows the extent of chlorine intrusion in the I zone in 2021.

Since the completion of the Alamitos Barrier Improvement Project in 2018, freshwater injection capacity along the north-south barrier alignment has improved with the even distribution of injection flow through the added new wells and water levels along this barrier reach have

achieved and maintained protective elevations, a first since the barrier was constructed over 50 years ago.

LACPW continues to operate and maintain the existing and new barrier facilities as OCWD will continue to work alongside LACPW to monitor the water levels and the barrier performance along the stretch affecting Orange County.

### 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, LACPW, and WRD. 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. For more information on this model, see the 2017 Alternative.

## 12.3 SUNSET GAP

Sunset Gap was historically 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 a cross-section in Figure 12-6. Figure 12-7 shows the location of this cross-section.

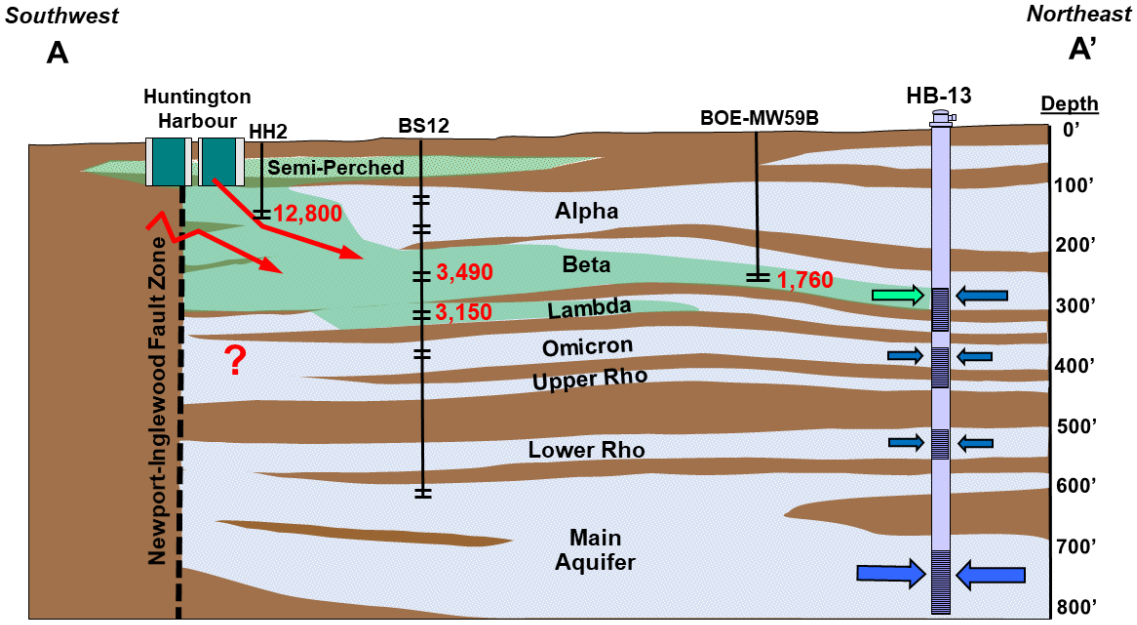



Figure 12-6: Schematic Geologic Cross-Section from Huntington Harbor through Sunset Gap (Fall 2020 Chloride Concentrations, mg/L)

Three potential seawater intrusion 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
- 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 (1967) 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 discovered at two monitoring wells owned by the Boeing Company (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 investigate 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.

One large system production well (HB-12) was shut down and destroyed due to impacts from advancing intrusion in Sunset Gap. From 2012 to 2016, OCWD constructed seven 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 as the first step towards identifying feasible remedies.

In 2021, OCWD began a project to install 11 monitoring wells clustered at five locations: one site in Seal Beach (BS25) and four in Huntington Beach (BS23, BS26, BS27 and BS28). Figure 12-7 shows the location of new wells installed in the last five years and the wells being installed in 2021. The multiple wells at each site will allow for the measurement of groundwater levels and collection of groundwater samples for water quality analyses in specific aquifers at different depths. The information from these monitoring wells may be used to determine if the groundwater flow model needs refinement before finalizing recommendations regarding a potential new seawater barrier in Sunset Gap (e.g., locations and number of injection wells and their injection rates).

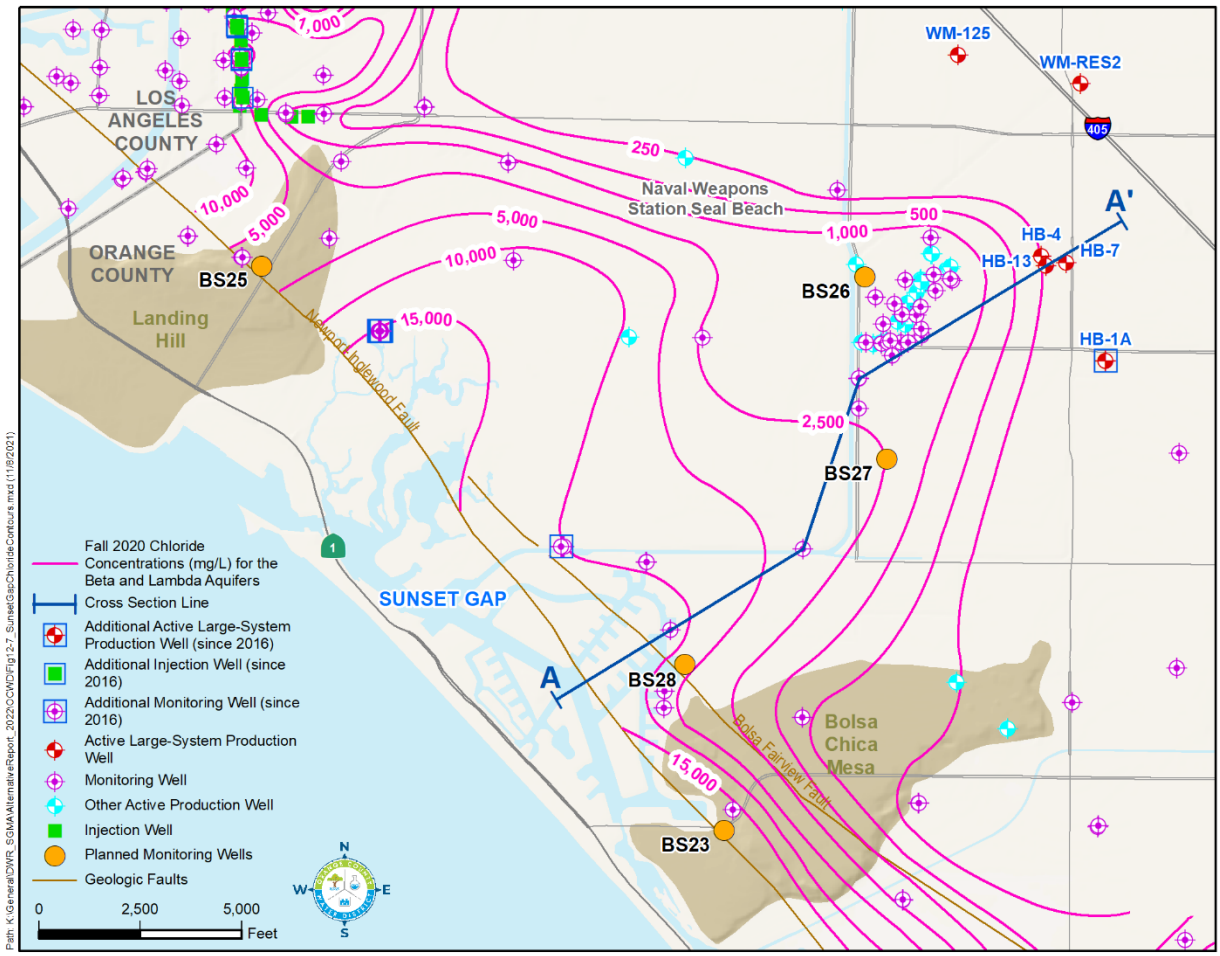



Figure 12-7: Sunset Gap Chloride Concentrations, 2020

## 12.3.1 Evaluation of Sunset Gap Alternatives

The Alamitos Barrier groundwater flow and transport model was recently updated and expanded to include the Sunset Gap area and thereby utilize data from newer OCWD monitoring wells on the Naval Weapons Station Seal Beach (NWSSB). The Alamitos-Sunset Gap model boundaries are shown in Figure 12-8.

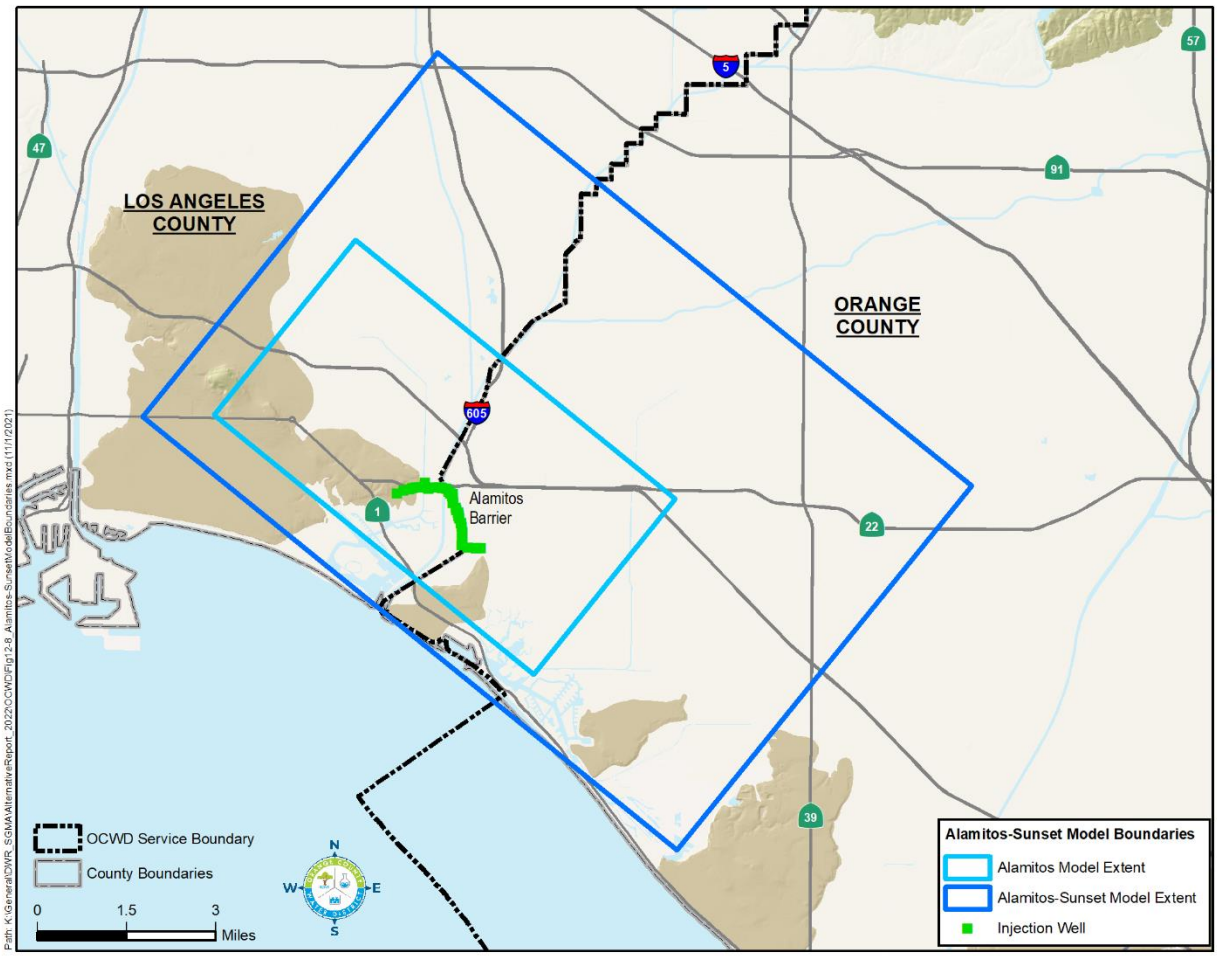



Figure 12-8: Alamitos-Sunset Gap Groundwater Model Boundaries

To date, the calibrated Alamitos-Sunset Gap model has been used to evaluate the effectiveness of five alternatives for a potential seawater intrusion barrier. These and other alternatives will be evaluated with the goal of halting the inland movement of seawater intrusion without significantly raising or lowering groundwater levels in the environmentally sensitive tidal marsh on the NWSSB. The effects, if any, of the simulated alternatives on nearby contaminant plumes will also be evaluated. Other factors to evaluate once the additional predictive scenarios are modeled will include feasibility, constructability, injection water supply, brackish extraction disposal/reuse, and cost.

The number of injection and extraction wells, well spacing, and injection volumes were varied from scenario to scenario to determine the preferred barrier scenario that prevents seawater intrusion by maintaining a seaward gradient without significantly raising or lowering groundwater levels in the environmentally sensitive tidal marsh on the NWSSB. Additionally, the model will run a series of no-barrier predictive scenarios to evaluate the potential maximum future inland extent of seawater intrusion and associated impacts and measures that would likely occur as a result, e.g., groundwater production well loss and/or inland groundwater desalters.

Preliminarily and subject to further analysis, the most favorable approach based on the five predictive scenarios completed so far includes a dual injection/extraction barrier, with an L-shaped injection well alignment around the perimeter of the NWSSB (Figure 12-9). A potential Sunset Gap Barrier Project (SGBP) would be designed to prevent the inland advancement of seawater intrusion near the NWSSB and the Huntington Harbor areas, thus protecting production wells in the cities of Huntington Beach, Seal Beach, and Westminster.

The preliminary favorable injection alignment would include approximately 20 injection well sites spaced approximately 1,500 to 2,000 feet apart (subject to further analysis). Total modeled injection was 13 mgd, with the majority being injected into the Beta and Lambda aquifers.

The preliminary favorable extraction alignment would include three single-point extraction wells screened across the Beta and Lambda aquifers. Total modeled extraction was 3 mgd, or 1 mgd per well. The three potential extraction wells were strategically located just outside (inland) of the Seal Beach National Wildlife Refuge perimeter to provide ample distance from the injection wells while also remaining outside of the NWSSB ordnance areas. Initially, the extracted brackish groundwater would be expected to have a chloride concentration ranging from 5,000 to 15,000 mg/L.

Depending on extracted water disposal/use feasibility and cost, a groundwater treatment plant may be appropriate to remove the high salinity from the groundwater produced by the barrier extraction wells. Reverse osmosis would be the likely treatment process. The technical and economic viability of this supply option would need to be evaluated as part of the future technical work described below.

To provide the injection wells with high-quality fresh water, the several water supply alternatives will be considered, including: (1) Groundwater treatment plant (brackish extraction wells and/or Deep aquifer amber-colored water wells); (2) Satellite wastewater treatment plant; (3) GWRS water via new pipeline; and (4) Imported water.

Future technical analysis that would need to be conducted as part of the feasibility study includes the following:

- Evaluate injection water supply alternatives
- Perform siting study for pipelines and wells
- Evaluate extraction well discharge alternatives
- Identify hydrogeologic data necessary to design, construct, and monitor the performance of barrier facilities
- Develop preliminary project design to support CEQA evaluation
- Estimate staffing needs for barrier operation and maintenance (O&M)
- Provide capital and O&M cost estimate

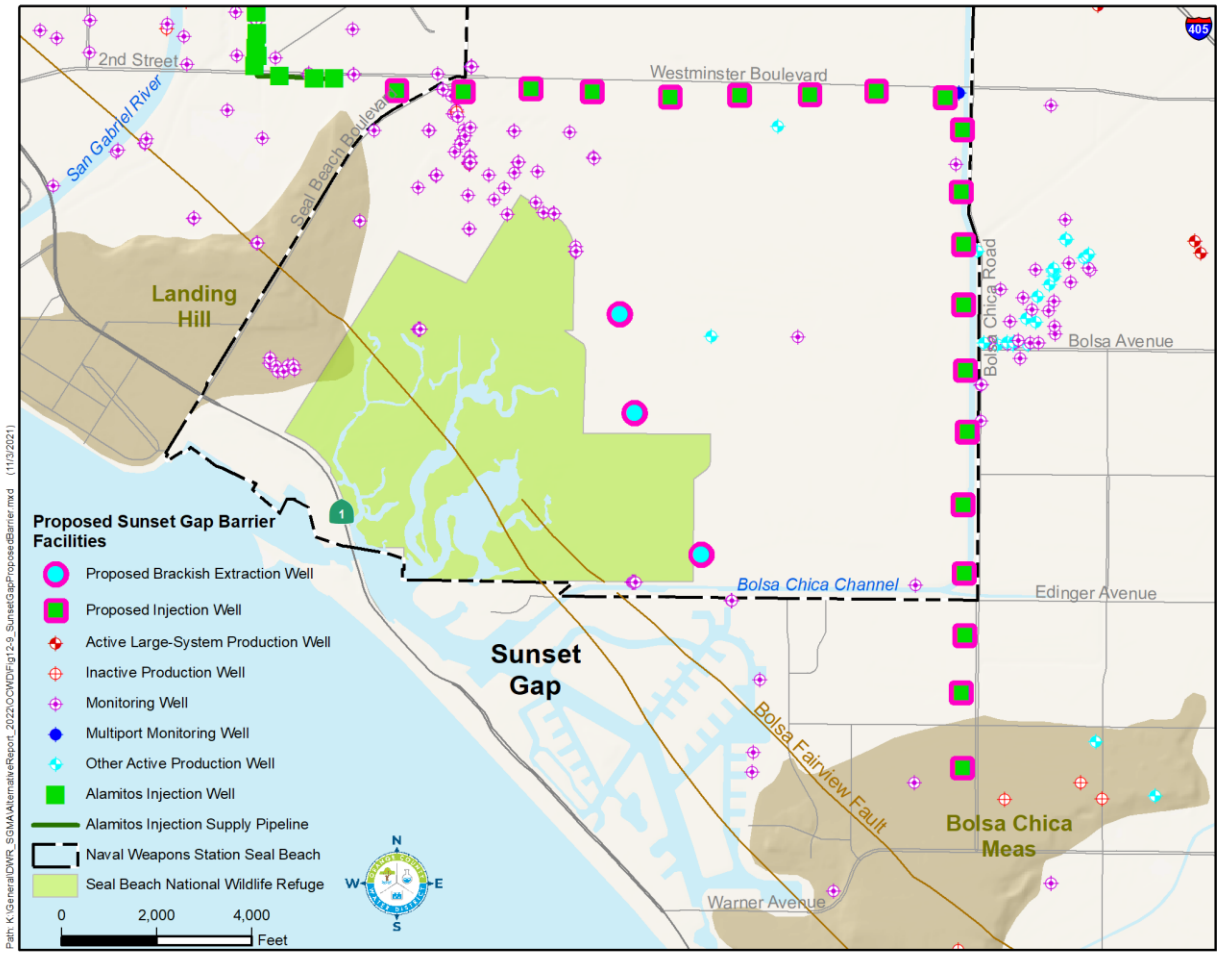



Figure 12-9: Potential Sunset Gap Barrier Project Facilities

## 12.4 BOLSA GAP

In the Bolsa Gap, seawater intrusion extends approximately 1.3 miles inland from the Pacific Ocean. Groundwater monitoring data show that 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, the saline groundwater appears to be largely restricted from migrating inland across the Bolsa-Fairview Fault 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 active production wells or groundwater resources.

## 12.5 NEWPORT MESA

Chloride concentrations in the Beta/Lambda aquifers beneath the Newport Mesa east of the Talbert Gap have either remained stable or decreased over the last 10 years even though groundwater elevations have typically been below sea level in these aquifers in this area. Chloride concentrations in the underlying Main aquifer 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 insurance against 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, as 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 is at the southern margin of the groundwater basin, which geologic formations (including the aquifers with them) have been faulted, uplifted, and eroded. It has been a data gap in which the aquifer stratigraphy and groundwater flow patterns were not well understood. To further characterize this complex portion of the basin, OCWD plans to install a multi-depth cluster of monitoring wells east of John Wayne Airport in early 2022.

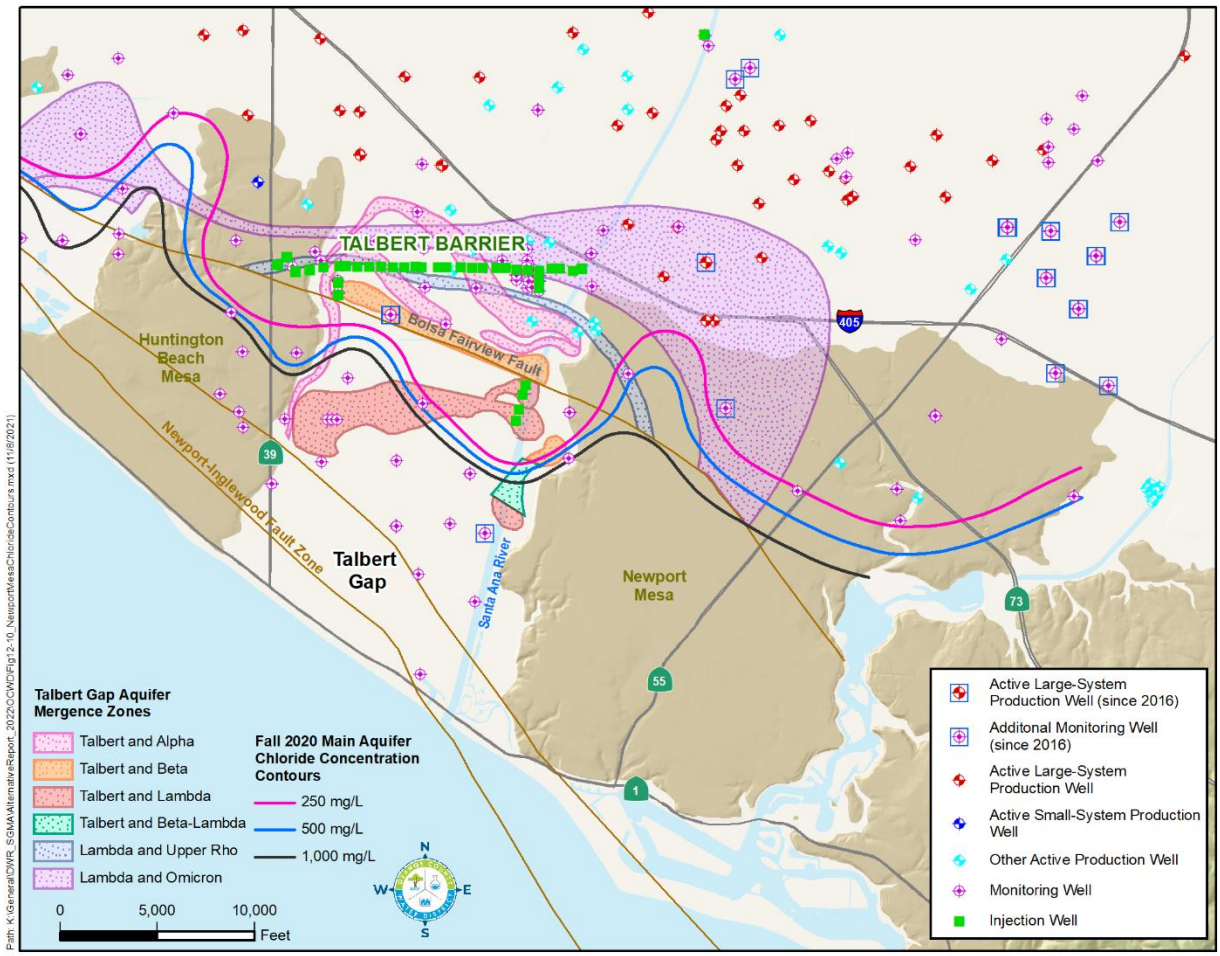



Figure 12-10: Newport Mesa Chloride Contours, 2020

## 12.6 IMPLEMENTATION OF SEAWATER INTRUSION PREVENTION POLICY

Implementation of OCWD's seawater intrusion prevention policy 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 reports 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 includes parameters such as TDS, chloride, and electrical conductivity as indicators of seawater intrusion. Wells have been 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 TDS, 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 2017 Alternative presented GPS data collected by the Orange County Surveyor's office. These data showed that ground surface elevation changes at selected sites from 2002 to 2014 correlate well with changes in groundwater storage.

Recently, as part of DWR's SGMA technical assistance to provide important SGMA-relevant data to Groundwater Sustainability Agency's (GSAs) for Groundwater Sustainability Plan (GSP) development and implementation, DWR contracted with TRE ALTAMIRA, Inc. to provide vertical displacement estimates derived from InSAR data that are collected by the European Space Agency (ESA) Sentinel-1A satellite.

The DWR-commissioned dataset represents measurements of vertical ground surface displacement in more than 200 of the high-use and populated groundwater basins across the California between January 2015 and October 2020. InSAR data coverage began in late 2014 for parts of California, and coverage for the entire study area began on June 13, 2015. Included

in this dataset are point data that represent average vertical displacement values for 100 square meter areas, as well as GIS rasters that were interpolated from the point data; rasters for total vertical displacement relative to June 13, 2015, and rasters for annual vertical displacement rates with earlier coverage for some areas, both in monthly time steps. The level of accuracy is approximately 0.05 feet.

To show subsidence in Basin 8-1, OCWD used the used a layer showing the total land subsidence since the start of the InSAR data on 6/13/2015 and ending on 7/1/2020, which corresponds to the end of the OCWD water year. The GIS layer used was: https://gis.water.ca.gov/arcgisimg/rest/services/SAR/Vertical_Displacement_TRE_ALTAMIRA_v2020_Total_Since_20150613_20200701/ImageServer

Figure 13-1 shows the total land displacement in Basin 8-1 from June 2015 to July 2020. During this time period as shown on Figure 1-3, basin storage increased from 381,000 acre-feet below full conditions to 200,000 acre-feet below full conditions; that is, basin storage increased by 181,000 acre-feet. In addition to increasing groundwater levels, this rise in groundwater storage manifests itself as a rise in ground surface elevation over much of the basin, particularly in the center of the basin where there was as much as 0.15 feet of rise.

A localized area of downward (negative) displacement was observed in Tustin centered around production well T-ED. This is a relatively new well that came on-line in October 2016. Due to pumping of this well, water levels in the Principal Aquifer in the vicinity of the well declined by approximately 60 feet from June 2015 to July 2020. The small decline in ground surface in the vicinity of this well is not surprising given that it is a new well and the relatively fine-grained nature of the aquifer sediments in the area. As with other locations in the basin, we expect the impact of this well to stabilize with future displacements expected to be small.

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 will continue to review InSAR data and other data sources 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.

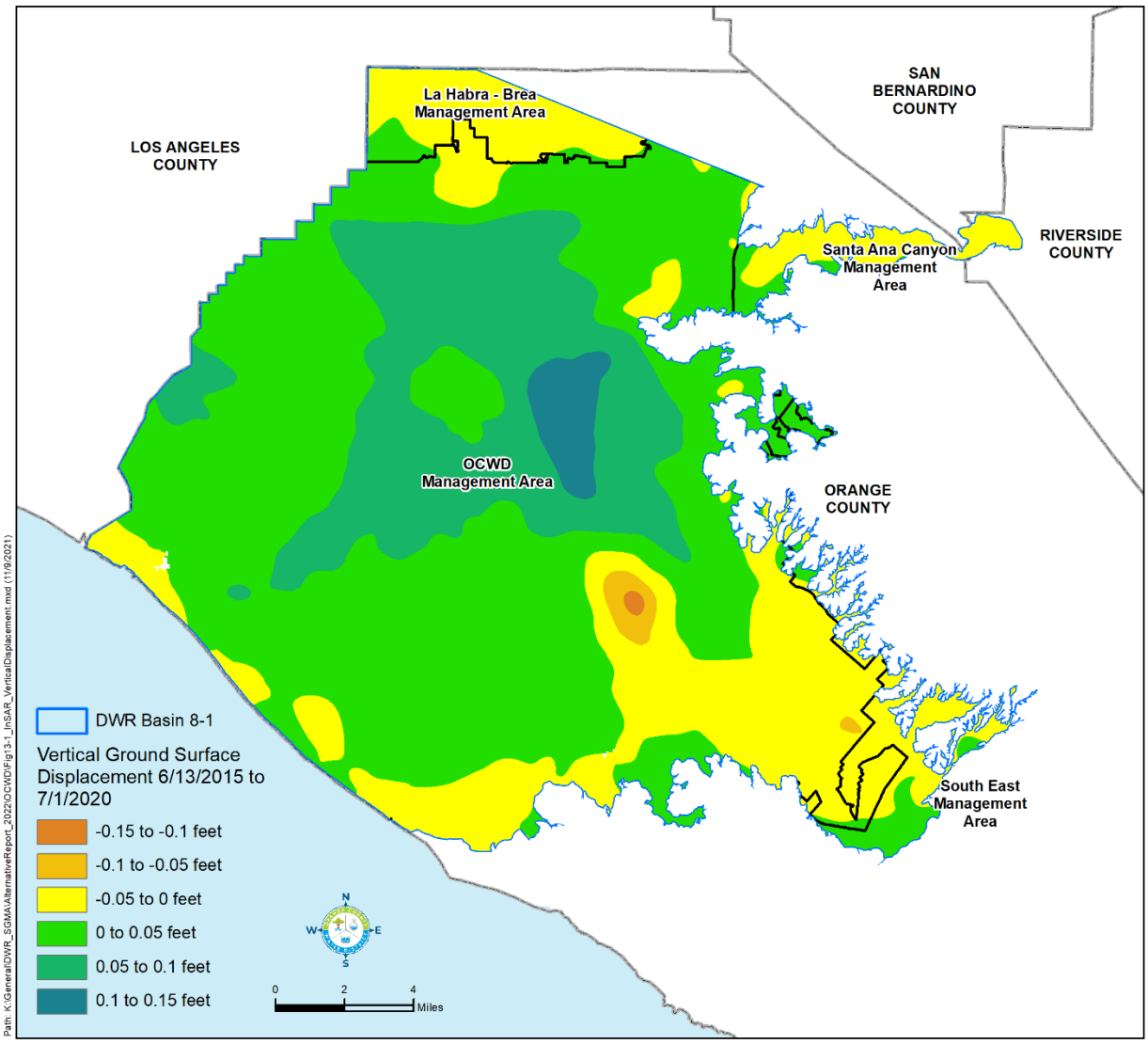



Figure 13-1: Total Vertical Ground Surface Displacement from June 2015 to July 2020

## 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 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.

The two main surface water sources in Orange County are the Santa Ana River and Santiago Creek. 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. Santiago Creek, a major tributary of the Santa Ana River, 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. Additional information on these sources can be found in the 2017 Alternative.

# 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

As described in the 2017 Alternative, OCWD regularly evaluates potential projects, conducts studies and prepares reports and plans (e.g., Long Term Facilities Plan) to continue to sustainably manage the groundwater basin and advance the mission of OCWD. Described below are a few of the key projects and activities OCWD has undertaken over the last five years.

Key activities/projects that were completed in the last five years include:

- Four deep mid-basin injection wells were constructed in Santa Ana (MBI wells). The wells are injecting approximately 8-10 mgd of GWRS water into the center of the basin where groundwater levels tend to be the lowest.
- Alamitos Barrier Improvement Project: 17 new injection wells were constructed at the Alamitos Seawater Barrier to reduce the spacing between wells to improve barrier performance. The additional 1.4-mgd of injection capacity has raised water levels near or at protective elevations.
- Shallow geophysical exploration of the Lower Off-River Channel to characterize the shallow subsurface sediments. This data will be useful in assessing whether or not it is feasible to remove areas of fine-grained sediments to increase facility recharge rates.
- Continued testing of the Riverbed Filtration System (RFS), which is a shallow underdrain system designed to filter SAR water prior to delivery to a recharge basin. Testing conducted thus far shows it has the potential to double the capacity of a receiving basin. Work is also ongoing on how to potentially expand the RFS to the main SAR channel.
- Geophysical evaluation of deeper sediments in the lower SAR to assess the potential of installing a horizonal collector well (e.g., Ranney well) that would be used for recharge of GWRS water. Modeling was also conducted to assess the potential recharge capacity of a “Ranney” type well.

Key activities/projects that are underway include:

- Final expansion of the GWRS to 130 mgd capacity. This is scheduled to be complete in 2023. This project will provide OCWD 30 mgd of new water supply.
- Construction of water treatment facilities at production wells currently impacted by PFAS is ongoing. This is scheduled to be complete by 2024.
- Continued assessment of potential seawater intrusion in the Sunset Gap, including installation of additional monitoring wells, modeling, and feasibility studies.
- Completion of the Integrated Santa Ana River Watershed Model (ISARM), which is the integration of several surface and groundwater models in the upper SAR watershed above Prado Dam. This model will assist OCWD and other upper SAR

watershed stakeholders in determining potential future SAR flows arriving at Prado Dam and the potential impact of future projects on these flows.

- A study to examine the use of Forecast Informed Reservoir Operations (FIRO) at Prado Dam. A Preliminary Viability Assessment (PVA) was completed in July 2021, which showed that FIRO is viable at Prado Dam and able to provide an average of up to 7,000 acre-feet of water depending on how much water can be temporarily impounded (Ralph et al., 2021). Work on the Final Viability Assessment (FVA) is underway and scheduled for completion in mid-2023. In parallel to the FVA is work with the US Army Corps of Engineers to test FIRO at Prado Dam (through a minor deviation from the approved Water Control Plan) for a five-year period, starting in fall 2023.

Future anticipated activities and projects:

- Additional treatment systems may need to be constructed on production wells based on water quality results or changes in regulations.
- Projects may need to be constructed to improve water quality during recharge, such as sorbents to remove contaminants during recharge.
- Projects may needed to facilitate implementation of FIRO at Prado Dam or at Santiago Basins.
- Additional groundwater monitoring wells may need to be constructed to fill data gaps, including the Sunset Gap, and other areas in the basin.
- Design and construction of a potential seawater barrier at the Sunset Gap.
- Implementation of a groundwater contamination remedy in the South Basin area.

# SECTION 17 REFERENCES


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 groundwater 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/.

Boyle Engineering Corporation and Orange County Water District, 1997. *Coastal Groundwater Management Investigation*.

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.

***** 2014. *California Water Plan Update*. October 2014.

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

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.

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.*

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.

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.

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.

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.

Orange County Water District, 1997. *Issues Paper – Development of the Colored Water Zone.* June 1997.

***** 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.

***** 2007. *Report on Evaluation of Orange County Groundwater Basin Storage and Operational Strategy.*

***** 2016. *Salt and Nitrate Projections for Orange County Management Zone*, Final Technical Memorandum by Greg Woodside, July 18, 2016.

***** 2020. *Salt and Nitrate Projections for Orange County Management Zone*, Technical Memorandum by Adam Hutchinson and Kevin O'Toole, December 28, 2020.

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.

Ralph, F. M., Woodside, G., Anderson, M., Cleary-Rose, K., Haynes, A., Jasperse, J., Sweeten,J., Talbot, C.,Tyler, J.,Vermeeren, R., 2021. *Prado Dam Forecast Informed Reservoir Operations Preliminary Viability Assessment.* UC San Diego. Retrieved from https://escholarship.org/uc/item/13091539.

U.S. Geological Survey, 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.

Water Systems Consulting, Inc., 2020. Technical Memorandum: *Recomputation of Ambient Water Quality in the Santa Ana Watershed for the Period 1999 to 2018*.

Irvine Ranch
WATER DISTRICT

# Five Year Update to:

# Basin 8-1 Alternative

# South East Management Area

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Prepared for the Department of Water Resources, pursuant to Water Code §10733.6(b)(3)

January 1, 2022

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# SECTION 1. EXECUTIVE SUMMARY

The South East Management Area is located in the south east portion of the Coastal Plain of Orange County Groundwater Basin (Basin 8-1). The South East Management Area consists of several small, fringe areas south east of the Orange County Water District (OCWD) Management Area. These areas fall within the boundaries of the Irvine Ranch Water District (IRWD), El Toro Water District (ETWD) and the City of Orange service areas. Figure 1-1 shows the IRWD, ETWD and City of Orange areas within the boundaries of the South East Management Area along with the OCWD Management Area.

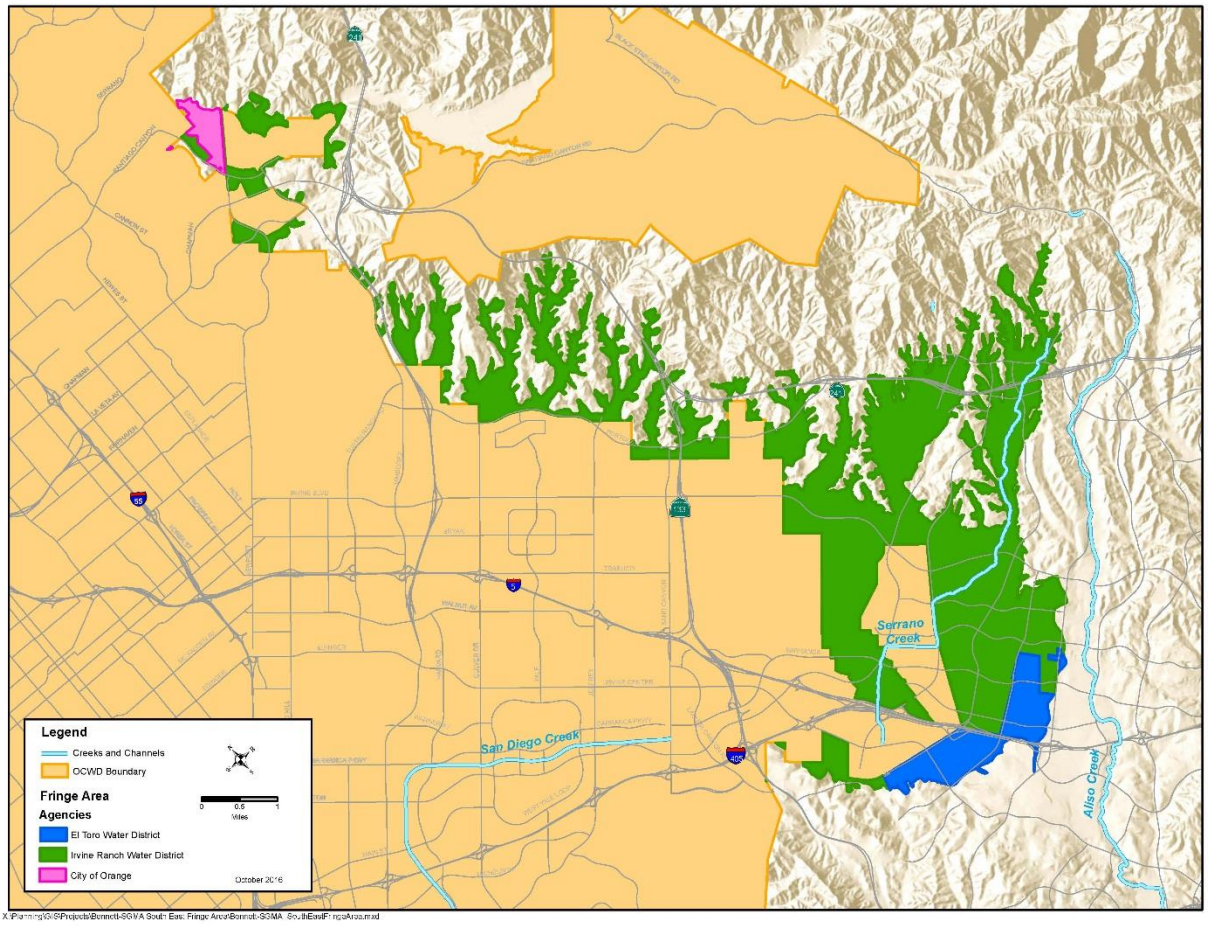



Figure 1-1: Agencies in the South East Management Area

Table 1-1 shows the area (in acres) associated with each agency within the South East Management Area. The South East Management Area covers approximately 4.4 percent of Basin 8-1, which has a total area of 223,600 acres.

Table 1-1: 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 |

Update to 2017 Alternative

This document provides any updates to the 2017 Alternative for the South East Management Area plan, submitted by OCWD on December 2, 2016. The 2017 Alternative, including the South East Management Area was reviewed by the State of California Department of Water Resources (DWR) in July 2019. Based on DWR's assessment, the 2017 Alternative was found to meet the requirements under SGMA and was approved.

Approved alternatives are required to submit annual reports to DWR on April 1 of each year. Annual reports for Basin 8-1 were submitted to DWR as follows:

- Water Year 2016-17, Submitted on March 29, 2018
- Water Year 2017-18, Submitted on March 29, 2019
- Water Year 2018-19, Submitted on March 30, 2020
- Water Year 2019-20, Submitted on March 30, 2021

According to Water Code §10733.8, "At least every five years after initial submission of a plan pursuant to Section 10733.4, the department shall review any available groundwater sustainability plan or alternative submitted in accordance with Section 10733.6, and the implementation of the corresponding groundwater sustainability program for consistency with this part, including achieving the sustainability goal. The department shall issue an assessment for each basin for which a plan or alternative has been submitted in accordance with this chapter, with an emphasis on assessing progress in achieving the sustainability goal within the basin. The assessment may include recommended corrective actions to address any deficiencies identified by the department."

This document represents the first five-year update, which is due January 1, 2022.

Important Note:

**For purposes of this report, the Basin 8-1 Alternative submitted on December 22, 2016, will be referred to as the 2017 Alternative. The first five-year update will be referred to as the 2022 Update for ease of reference. The 2017 Alternative was a comprehensive document showing that Basin 8-1 had been managed sustainably for more than 10 years. For the 2022 Update, the focus is on documenting that the basin has been continued to be sustainably managed during the five years since the 2017 Alternative was submitted and to present any new information from the last five years. As such, the 2017 Alternative is considered a key reference document with background information that is not duplicated in the 2022 Update.**

The water resources in the South East Management Area include surface water from Serrano Creek and numerous smaller tributaries, groundwater and imported water. 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). Historically, groundwater production has been a minor source of water supply for the South East Management Area and there has been no groundwater production since February 2018. Imported water received through the Metropolitan Water District of Southern California is the primary water supply source to meet the water demands within the South East Management Area.

Historically, IRWD has produced groundwater from six wells located in the city of Lake Forest. Groundwater production within the South East Management Area has historically represented less than 2 percent of the potable water supply for IRWD's Lake Forest area and less than 0.2 percent of IRWD's overall potable water supply. 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.

None of IRWD's six wells have been active since February 2018. At the time of the preparation of the Basin-8 Alternative, IRWD was pumping groundwater from only one active well (Well LF-2) in the South East Management Area. In early 2018, due to poor water quality of the well water, IRWD ceased well pumping and the well has been inactive since. IRWD has plans to rehabilitate Well LF-2 and resume groundwater production in the future. In addition, in February 2020, well LF-5 was destroyed due to low water production and high salinity and to also make way for a new pump station on the site where the well was located. While no plans are currently in place, placement for a potential new well was included with the pump station siting.

The five remaining wells within IRWD's Lake Forest portion of the Management Area are currently monitored for groundwater levels on a monthly basis. There are no other programs in the South East Management Area responsible for managing or monitoring groundwater resources at this time. As of the beginning of 2018, the monthly water quality monitoring of the operational well was halted temporarily due to lack of production. Sampling and water quality monitoring will resume at this well when the planned well rehabilitation project is completed. In addition, two wells are to be designated as

groundwater level monitoring wells (LF-1 and LF-4) and added to the Basin 8-1 SGMA monitoring program. The groundwater levels at these wells will be monitored on a monthly basis with the results transmitted to DWR as part of the Basin 8-1 monitoring program.

The approach to sustainably managing the South East Management Area is to continue to monitor groundwater levels and production to ensure that groundwater pumping does not lead to significant and unreasonable conditions such as (1) chronic lowering of groundwater levels, (2) chronic reduction in storage, (3) groundwater quality degradation, (4) inelastic land subsidence or (5) unreasonable adverse effect on surface water resources. Descriptions of these undesirable results can be found in Sections 8 through 14.

# SECTION 2. AGENCY INFORMATION

## 2.1 HISTORY OF AGENCIES IN SOUTH EAST BASIN MANAGEMENT AREA

No update since the 2017 Alternative – See 2017 Alternative.

## 2.2 GOVERNANCE AND MANAGEMENT STRUCTURE

No update since the 2017 Alternative – See 2017 Alternative.

## 2.3 LEGAL AUTHORITY

No update since the 2017 Alternative – See 2017 Alternative.

## 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. Funding for well monitoring, operation, and rehabilitation where applicable is defined in the IRWD's operating or capital budgets. Since the preparation of the 2017 Alternative, there continues to be no groundwater production within ETWD or City of Orange areas of the South East Management Area, therefore these agencies are not be responsible for monitoring and reporting groundwater information.

For this 2022 update, it should be noted that two monitoring wells (LF-1 and LF-4) will be designated to report on monthly water levels which will be transmitted to DWR as part of the Basin 8-1 SGMA monitoring program.

# SECTION 3. MANAGEMENT AREA DESCRIPTION

## 3.1 SOUTH EAST SERVICE AREA

No update since the 2017 Alternative – See 2017 Alternative.

### 3.1.1 Jurisdictional Boundaries

No update since the 2017 Alternative – See 2017 Alternative.

### 3.1.2 Land Use Designations

No update since the 2017 Alternative – See 2017 Alternative.

## 3.2 GROUNDWATER CONDITIONS

Groundwater level trends in the South East Management Area are relatively stable, or rising, consistent with the limited recent groundwater production in the area. Of the six groundwater production wells IRWD has in the area, only one is active and that well is currently not pumping due to groundwater quality issues and required maintenance (see Figure 3-1). As there is no current groundwater pumping and only limited planned future groundwater development, the stable or rising groundwater level trends are expected to continue.

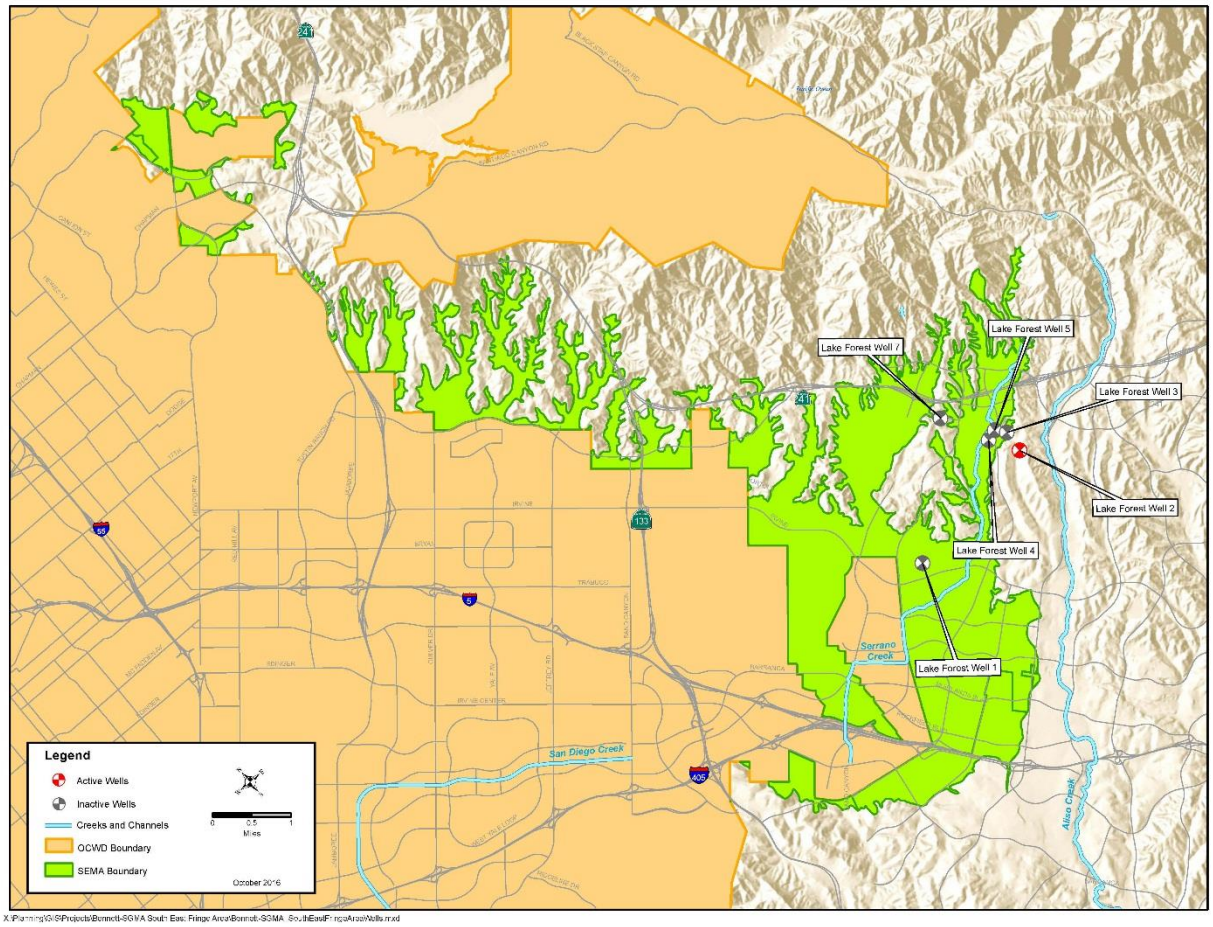



Figure 3-1: Groundwater Production Wells (Active and Inactive)

A study completed in 2002 assessed the potential of the development of future wells in the IRWD Lake Forest area, which is located in the eastern portion of the South East Management Area. It was noted that based on available well driller's logs there was considerable clay in the alluvium and that the specific capacity of these wells is very low. Based on the very low specific capacity results, it appears that the alluvium is characterized by low permeability. This seems to be reflected in the low production capacity of the wells (Boyle 2002).

Since the preparation of the 2017 Alternative, only well LF-2 was operational up through January 2018. Due to water quality issues related to iron and manganese, well LF-2 was taken offline in early 2018 and IRWD plans to rehabilitate the well and construct treatment for the removal of iron and manganese. The rehabilitation project is planned to be performed in late 2022 and depending on the performance and water quality testing results from the well, IRWD may construct a treatment facility to remove iron and manganese. While well LF-2 has not been active in the last few years, it is shown as

“active” on Figure 3-1 because IRWD plans to put well LF-2 back into production once it is rehabilitated and treatment facilities are constructed.

In 2020, well LF-5 was destroyed to make way for a new planned pump station on the site. Well LF-5 was previously used to supplement water in IRWD’s recycled water system. However, due to continual poor water production and high salinity, IRWD ceased the operation of well LF-5, and in February 2020, IRWD destroyed the well. At the site, IRWD plans to construct a new recycled water pump station. Although construction and operation of a new well is not a currently planned project, space is being allocated on the existing site adjacent to the pump station to accommodate a potential new well in the future.

### 3.2.1 Groundwater Levels

The range of observed groundwater levels in the South East Management Area from 2016 to 2021 are summarized in Figure 3-2. It is noted that 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 2021 for IRWD’s Lake Forest wells are shown in Figure 3-2. Historic groundwater level data is available from 1991 through 2001, after which there is no data available until 2015. More recent groundwater level data is available from 2015 to present. Monthly groundwater levels from IRWD’s Lake Forest wells for 2020 to 2021 are shown in Figure 3-3.

In all IRWD wells, groundwater levels are the same or higher in 2021 than they were in 2017. With the exception of LF-1, groundwater levels show a rising trend, indicating that recharge to the area exceeds the discharge. Well LF-1 shows a stable groundwater level trend.

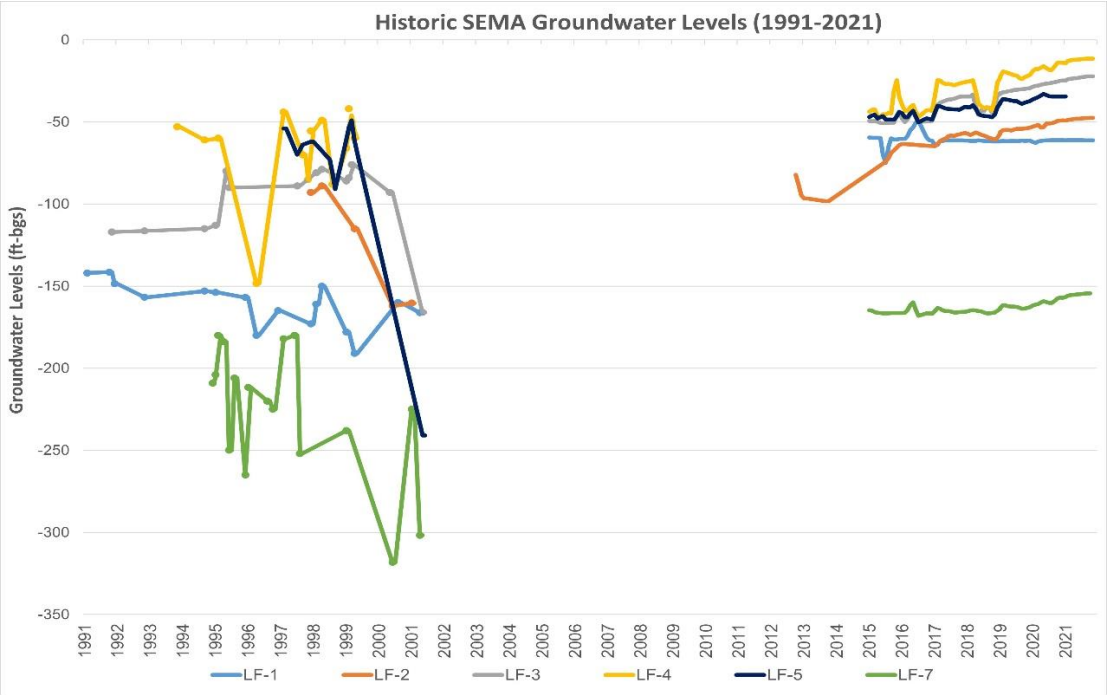



Figure 3-2:Historic Groundwater Levels in South East Management Area, 1991-2021

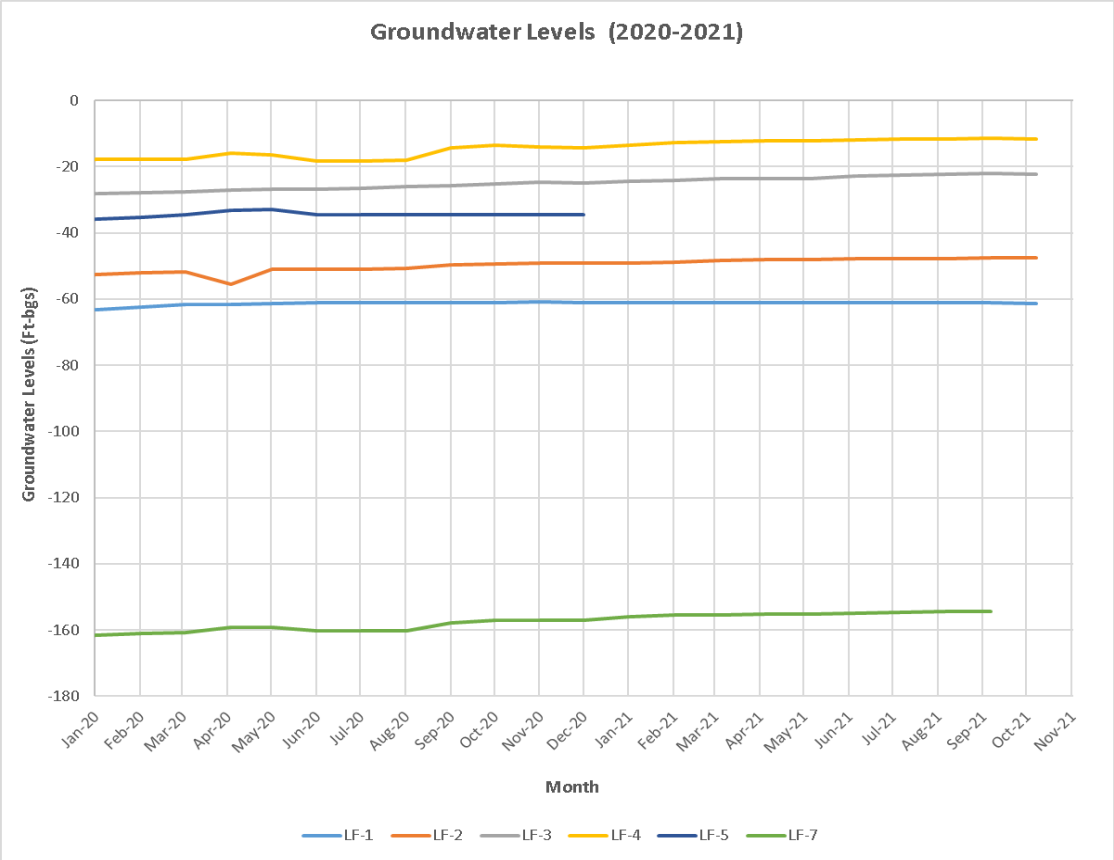



Figure 3-3: Current Groundwater Levels in South East Management Area, 2020-21

### 3.2.2 Regional Pumping Patterns

Table 3-1 summarizes information on all of 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 3-1: 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 | Inactive | 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 | N/A | 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 |

For the 2022 Update, Table 3-2 summarizes average annual pumping from 2016-2021 within the South East Management Area by agency. As shown, ETWD and City of Orange did not pump any groundwater from the South East Management Area during this time period. In IRWD's portion of the South East Management Area none of the existing wells are currently active. Over the last 5 years, well LF-2 annual pumping ranged from 0 acre-feet to 389 acre-feet and averaged approximately 90 acre-feet.

Table 3-2: Annual Pumping Average 2016-2021

| Agency | Average Annual Production (acre-feet/yr.) |
|---|---|
| IRWD | 90 |
| ETWD | 0 |
| City of Orange | 0 |
| Total | 90 |

In the last five years, pumping from LF-2 occurred in 2016 and 2018, after which LF-2 was taken offline. Figure 3-4 shows monthly pumping patterns for LF-2 from 2016 to 2021. Figure 3-5 shows annual pumping by water year (October-September) for 2017 through 2021.

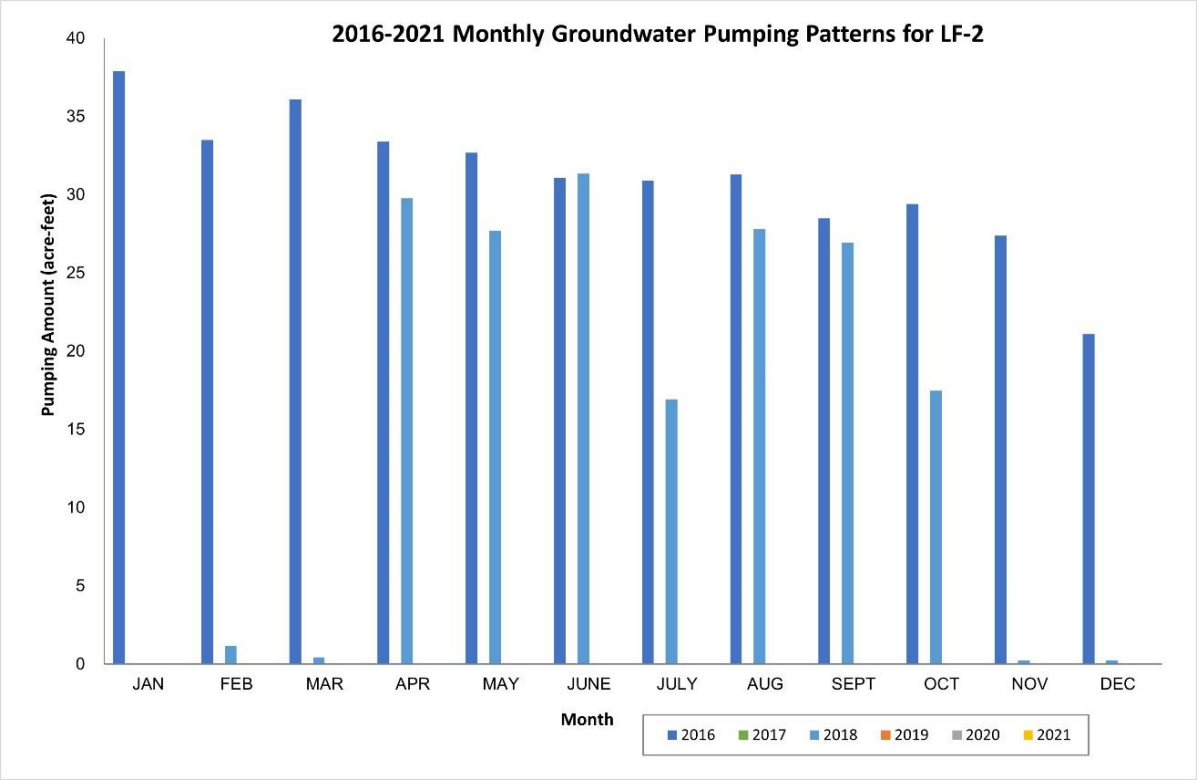



Figure 3-4: Monthly Groundwater Pumping Pattern in Well LF-2, 2016-2021

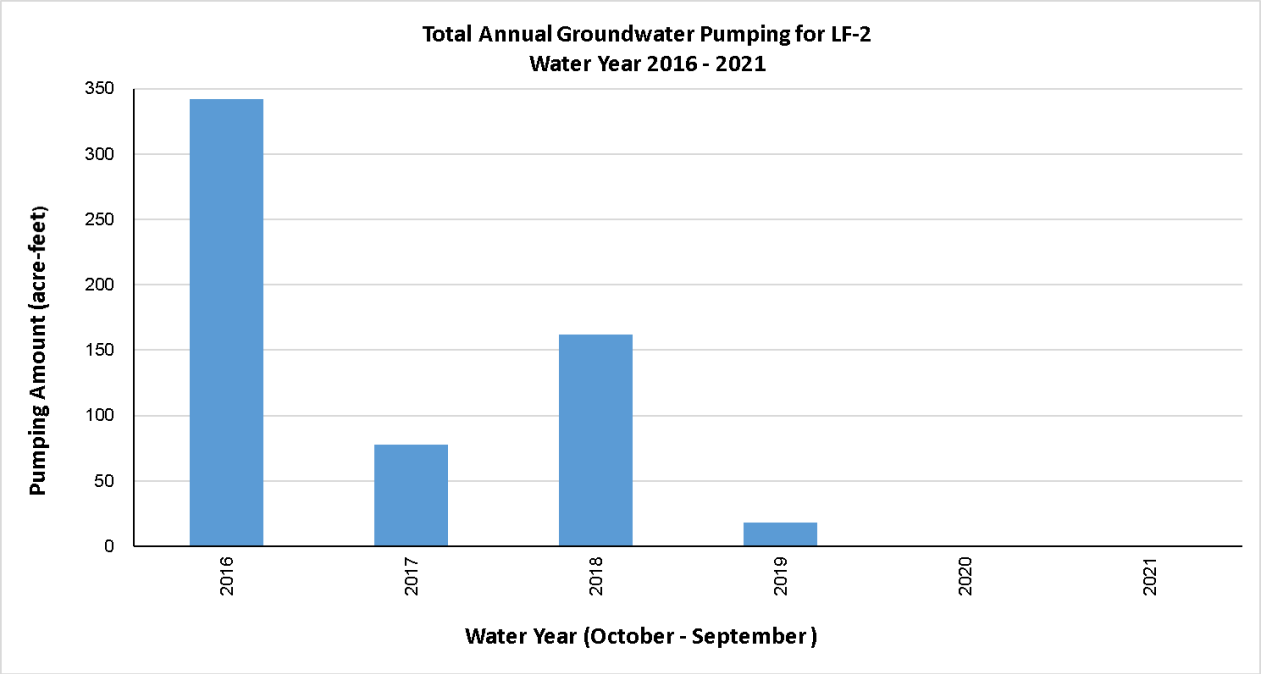



Figure 3-5: Total Annual Pumping for Well LF-2, (Water Year 2016-2021)[1]

*1 All data shown for 2017 on this chart occurs between October and December 2016 of the water year.*

## 3.2.3 Groundwater Storage Data

No update since the 2017 Alternative – See 2017 Alternative.

## 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(Pb), manganese (Mn), electrical conductivity (EC) and total dissolved solids (TDS). Recent groundwater quality data for the South East Management Area which includes arsenic (As) is presented in Table 3-3. As presented, no other water quality data exists for the ETWD and City of Orange areas within the South East Management Area.

Table 3-3: Ground Water Quality in Selected Wells

| Agency | Well Name | Well Use | Date Range | Avg TDS (#)[1] (mg/L) | Avg As (ug/L) | Avg Pb (ug/L) | Avg Mn (mg/L) |
|---|---|---|---|---|---|---|---|
| IRWD | LF-2 | Production | 2016-2018* | 602 | 0.42 | 0.51 | 22.3 |
| 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 | N/A |
| ETWD | N/A | N/A | N/A | N/A | N/A | N/A | N/A |

1 # = Number of Samples

* LF-2 Turned Offline in February 2018

### 3.2.5 Land Subsidence

Non-recoverable land subsidence has not been observed since 2015 in the South East Management Area (see Figure 3-6). The area is not susceptible to land subsidence given the following:

1. Minimal groundwater development exists in the South East Management Area.
2. Groundwater levels are stable or rising and have been for at least the last 10 years.
3. Low risk of future groundwater level declines due to limited planned groundwater production.

As shown in Figure 3-6, the South East Management Area experienced between -0.05 and 0.05 feet of vertical displacement across years 2015 to 2020 with an accuracy of approximately 0.05 feet in data readings.

Recently, as part of DWR's SGMA technical assistance to provide important SGMA-relevant data to Groundwater Sustainability Agency's (GSAs) for Groundwater Sustainability Plan (GSP) development and implementation, DWR contracted with TRE ALTAMIRA, Inc. to provide vertical displacement estimates are derived from InSAR data that are collected by the European Space Agency (ESA) Sentinel-1A satellite.

This dataset represents measurements of vertical ground surface displacement in more than 200 of the high-use and populated groundwater basins across the State of California between January of 2015 and October of 2020. InSAR data coverage began in late 2014 for parts of California, and coverage for the entire study area began in June 13, 2015. Included in this dataset are point data that represent average vertical displacement values for 100 meter by 100 meter areas, as well as GIS rasters that were interpolated from the point data; rasters for total vertical displacement relative to June 13, 2015, and rasters for annual vertical displacement rates with earlier coverage for some areas, both in monthly time steps. The level of accuracy is approximately 0.05 feet.

To show subsidence in Basin 8-1, the layer showing total land subsidence since the start of the InSAR data on 6/13/2015 and ending on 7/1/2020, which corresponds to the end of the water year was used. (GIS layer used: https://gis.water.ca.gov/arcgisimg/rest/services/SAR/Vertical_Displacement_TRE_ALTAMIRA_v2020_Total_Since_20150613_20200701/ImageServer.)

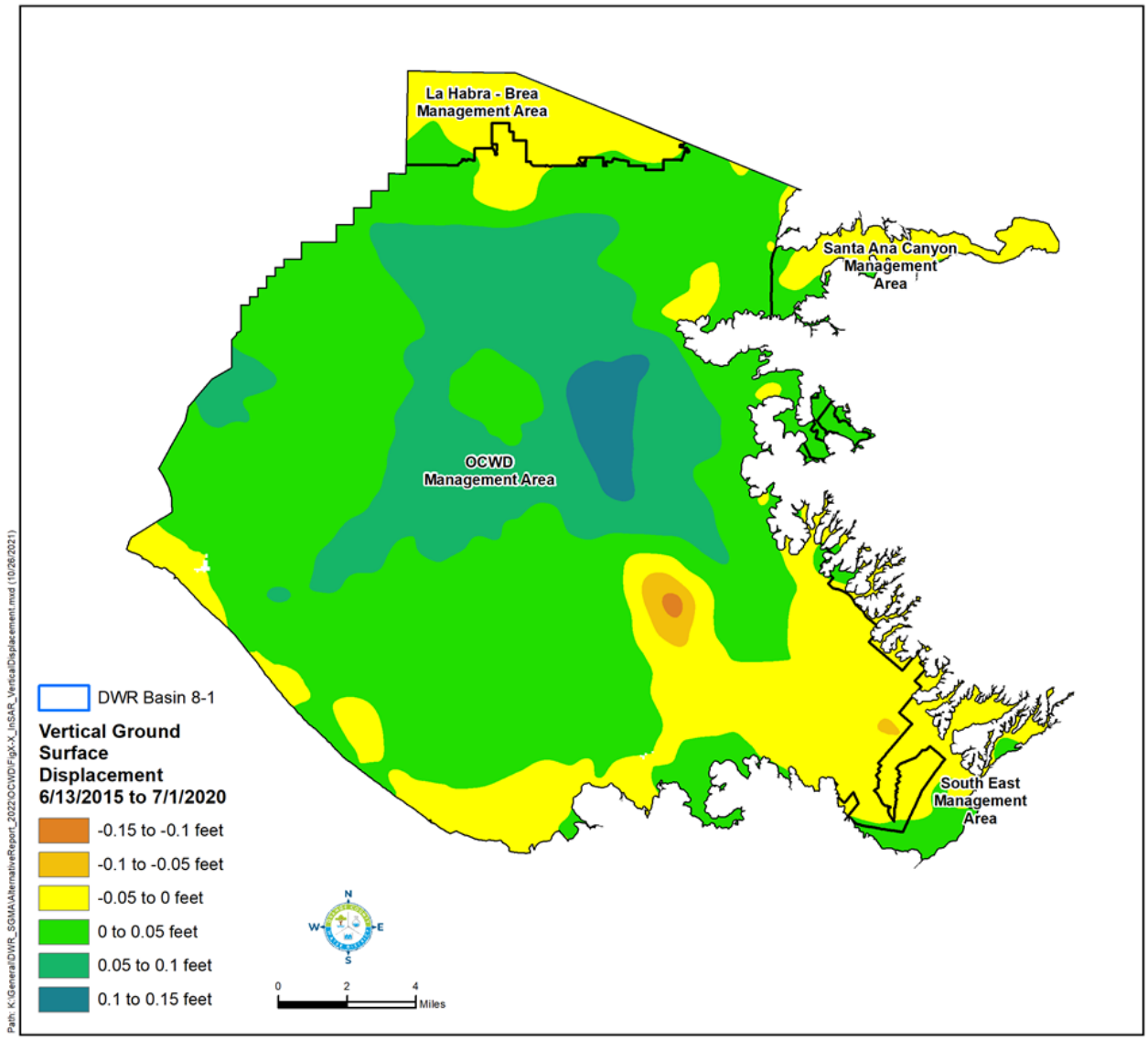



Figure 3-6: Total Vertial Ground Surface Displacement from June 2015 to July 2020

### 3.2.6 Groundwater and Surface Water Interactions and Groundwater Dependent Ecosystems

The primary surface water drainage in the South East Management Area is Serrano Creek. Serrano Creek is an intermittent stream that only flows during the rainy season following storm events. The predominant interaction between the surface flow in the creek and groundwater is percolation from the creek and recharge of the groundwater (see Boyle 2002 Groundwater Supply Evaluation study). Groundwater does not typically discharge at the land surface near the creek. Data from the California Department of

Water Resources (CDWR) NC dataset viewer indicates that there are some areas along Serrano Creek that are designated as groundwater dependent ecosystems (https://gis.water.ca.gov/app/NCDatasetViewer/).

Planned future groundwater pumping in IRWD's Lake Forest portion of the South East Management Area from Well LF-2 will not occur in areas of groundwater dependent ecosystems (GDEs). Some of IRWD's inactive wells are located near the Serrano Creek drainage, but outside the GDE areas. With the exception of Well LF-5, there are no plans to pump groundwater from any of these wells in the future. Well LF-2, which may be pumped in the future, is located outside the Serrano Creek drainage and is not expected to have an impact on GDEs within the Serrano Creek drainage. In the event that a replacement well is constructed near the existing Well LF-5, groundwater monitoring will be implemented to ensure the production from that well does not have an undesirable result on the GDE along Serrano Creek.

# SECTION 4. WATER BUDGET

An average annual groundwater budget for the South East Management Area for the last 5 years is presented in Table 4-1. The simple water budget for the IRWD portion of the South East Management Area is based on measured groundwater production and the subsurface flow calculated by the numerical model for the OCWD Management Area (Basin 8-1 Alternative 2017). The development of individual components in the average annual groundwater budget are described in the following subsections.

## 4.1 BUDGET COMPONENTS

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. Groundwater Production includes an average from 2016-2021. As of 2018, the groundwater production is zero until the LF-2 well can be rehabilitated and placed back in service.

Table 4-1: Average Annual Groundwater Budget

| South East Management Area<br>Groundwater Budget 2016-2021 (acre-feet) | |
|---|---|
| **Item** | **Total (acre-feet)** |
| Recharge | 2,900 |
| Total Inflow | 2,900 |
| Groundwater Production | 90 |
| Subsurface Outflow | 2,810 |
| Total Outflow | 2,900 |
| Change in Storage | 0 |

### 4.1.1 Recharge

Recharge includes infiltration from ephemeral creeks, precipitation and return flow 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. In the base period 2016 to 2021, groundwater production was only conducted by IRWD's Well LF-2. Groundwater production in this well ranged from 0 to 389 acre-ft/yr. from 2016 to 2021 with an average of approximately 90 acre-ft/yr.

### 4.1.3 Subsurface Outflow

Subsurface outflow from the South East Management Area into the OCWD Management Area was estimated using the OCWD groundwater flow model (Basin 8-1 Alternative 2017).

## 4.2 CHANGES IN GROUNDWATER STORAGE

Changes in groundwater storage within the South East Management Area since 2015 have been positive reflecting the rising groundwater levels measured in the wells. As indicated in Section 3.2.1, groundwater levels are the same or higher in 2021 than they were in 2017. With the exception of LF-1, groundwater levels show a rising trend, indicating that recharge to the area exceeds the discharge. Well LF-1 shows a stable groundwater level trend. These trends have persisted despite multiple years of below normal precipitation. 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 previous 10 years (2006-2015), and 90 acre-feet in the last six years (2016-2021). The groundwater level and pumping data indicate groundwater production is below the sustainable yield of the basin.

## 4.3 WATER YEAR TYPE

No update since the 2017 Alternative – See 2017 Alternative.

## 4.4 ESTIMATE OF SUSTAINABLE YIELD

The sustainable yield of the South East Management Area is approximated by the volume of average annual recharge that is estimated to enter the basin (approximately 2,900 acre-ft), as shown in Table 4-1. Average annual groundwater production over the last 5 years, ranging from 0 acre-feet to 389 acre-feet and averaging approximately 90 acre-feet, is significantly below the sustainable yield, which is supported by rising groundwater levels in the area over the same time period. Due to production rate limitations and groundwater quality issues, it is unlikely groundwater production in the South East Management Area will ever increase to the sustainable yield.

## 4.5 CURRENT, HISTORICAL, AND PROJECTED GROUNDWATER BUDGET

IRWD does not plan any significant changes to groundwater use in the South East Management Area that would change the water budget. The historical water budget is

discussed in Section 4.1 and summarized in Table 4-1. Currently, there is no groundwater production in the South East Management Area. Future groundwater production could include bringing Well LF-2 online, replacing Well LF-5, and developing two new wells (see Section 16). No projected groundwater production is currently anticipated within the ETWD and city of Orange portions of the South East Management Area. Any future groundwater production will be managed within the sustainable yield of the aquifer system.

# 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 the existing five wells (whether active or 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 3-1 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, when operating, as required by the California Code of Regulation (Title 22) and California Division of Drinking Water, Santa Ana District. In addition, as of 2021 two monitoring wells will be designated (LF-1 and LF-4) for the monitoring and reporting groundwater elevations in the South East Management Area which will be transmitted to the DWR under the SGMA monitoring program for Basin 8-1. DWR currently requires bi-annual reporting for well monitoring data.

# 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 2020 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 2020 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 (2020) 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 September 30, 2021, OCWD sent a letter via email to all of the Basin 8-1 agencies, including each of the agencies listed above to let them know that the 2017 Alternative was being updated and would be available for review and comment. No comments were received by any of the agencies contacted. The three South East Management Area agencies coordinated with OCWD and the other management areas to prepare the 2022 Update, in accordance with SGMA requirements.

A draft 2022 Update was presented to OCWD staff and posted on the OCWD website on November 17, 2021 to allow for public review and comment. The final 2022 Update was received and filed by the OCWD board in December 2021.

# SECTION 8. SUSTAINABLE MANAGEMENT APPROACH

The Sustainable Management Approach for the South East Management Area is to continue monitoring sustainable conditions and monitor to ensure that conditions do not lead to significant and unreasonable (1) lowering of groundwater levels, (2) reduction in storage, (3) water quality degradation, or (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 3-2 historical groundwater levels in the IRWD's Lake Forest portion of the South East Management Area have shown stable or rising trends and are, in all cases, at the same level or higher than they were in 2017. Because future groundwater pumping in the South East Management Area is expected to be limited, groundwater levels are expected to remain relatively steady in the future.

## 9.2 MONITORING OF GROUNDWATER LEVELS

Groundwater levels are currently monitored in the five wells located in IRWD's Lake Forest portion of the South East Management Area on a monthly basis. This monitoring will continue into the future.

## 9.3 DEFINITION OF SIGNIFICANT AND UNREASONABLE LOWERING OF GROUNDWATER LEVELS

Significant and unreasonable lowering of groundwater levels is defined as a long-term chronic lowering of groundwater levels, despite changes in precipitation patterns. No long-term reduction in groundwater levels in the South East Management Area is expected to occur.

## 9.4 DETERMINATION OF MINIMUM THRESHOLDS

It is not possible to determine a minimum threshold at this time since no undesirable effects due to groundwater levels have occurred in the past and are not foreseen in the future. Nevertheless, the South East Management Area 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, action would be taken and minimum thresholds would be evaluated and established as appropriate.

# 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. Groundwater from subsurface inflow could contain naturally elevated concentrations of TDS and manganese. IRWD has the ability to utilize water produced from non-potable wells to supplement its extensive recycled water system which serves irrigation demands.

## 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:

- Minimal groundwater development exists in the South East Management Area.
- Groundwater levels are stable or rising and have been for at least 10 years.
- Low risk of future groundwater level declines due to limited planned groundwater production.

As discussed previously in Section 3, the Basin 8-1 area will continue to be monitored for changes in InSAR data (via OCWD and consultants) to evaluate ground surface fluctuations within the service area. If irreversible subsidence was found to occur in a localized area in relation to groundwater pumping patterns or groundwater storage conditions, the South East Management Area managers would coordinate with local officials to investigate and develop an approach to address the subsidence.

# SECTION 14. MANAGING GROUNDWATER DEPLETIONS IMPACTING SURFACE WATER

Although IRWD does not have immediate plans for groundwater pumping in areas of GDEs, in the event that replacement or new wells are constructed near sensitive areas, groundwater monitoring will be implemented to ensure the groundwater production does not have an undesirable result on the GDE along Serrano Creek.

# 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

Protocols for modifying monitoring programs are described in the 2017 Alternative.

# 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. Plans to rehabilitate the well are currently going out for construction bid with potential construction expected to start in fall of 2022. The project may include facilities to remove high levels of iron and manganese as needed to meet potable water quality requirements.

There are a number of potential well projects currently in development in the South East Management Area. These include:

- LF-1 and LF-4 designated monitoring well operations.
- LF-2 rehabilitation and water quality treatment planned construction in 2022.
- LF-5 (replacement) future projects may include the possible development of a new production well on or near the existing decommissioned site.
- General well rehabilitation and monitoring projects across the South East Management Area, with approved funding allocated in the capital budgets approved for 2021-2023.

In IRWD's Lake Forest portion of the South East Management Area, a 2002 study by Boyle Engineering Corporation and 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 re-drilling of existing inactive wells. Although IRWD has no near-term plans to drill wells LF-6 and LF-8, it has included a capital project for the design, construction and equipping of LF-1.

A capital project for the design, construction and equipping of LF-1 has been included in IRWD's most recent capital budget, however, there are no plans to begin this specific project. IRWD also has no near-term plans to drill wells LF-6 and LF-8. In 2000, its last active year, LF-1 pumped approximately 230 acre-feet. Over the last 5 years well LF-2 annual pumping has ranged from 0 acre-feet to 389 acre-feet and averaged approximately 90 acre-feet including years of non-operation. It is expected that when LF-1 is redrilled, groundwater production from IRWD's southern portion of the South East Management Area could increase.

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. As of 2021, LF-1 is still currently off line although there are future plans to potentially re-drill and rehabilitate the well in the future.

# SECTION 17. REFERENCES

Following are references and technical studies for the South East Management Area.


- Basin 8-1 Alternative, 2017
- Communication with OCWD. Email dated November 28, 2016.
- Communication with OCWD. Email dated October 21, 2021.
- Communication with OCWD. Email dated November 17, 2021.
- Geohydrology and Acritical-Recharge Potential of the Irvine Area Orange County, California. J. A. Singer, January 8,1973.
- Groundwater Supply Evaluation for the Los Alisos System Phase 1. Boyle Engineering Corporation, July 2002.
- Ground Water Management, Irvine Area, Orange County, California. Harvey O. Banks, Consulting Engineer, Inc.
- Lake Forest Groundwater Conveyance Analysis Results. Dudek, November 5, 2015.
- 2015 Urban Water Management Plan, Irvine Ranch Water District, 2016
- 2020 Urban Water Management Plan, Irvine Ranch Water District, 2021

# Basin 8-1 Alternative

## Santa Ana Canyon Management Area

## 2022 Update

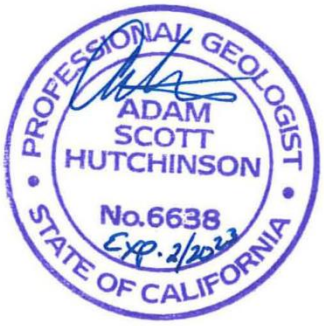
Prepared by: Orange County Water District

January 1, 2021

# Basin 8-1 Alternative

# 2022 Update

# Santa Ana Canyon Management Area

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Prepared for the Department of Water Resources, pursuant to Water Code §10733.6(b)(3),(c) and §10733.8

January 1, 2022

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# 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 (Basin). This Management Area was 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.

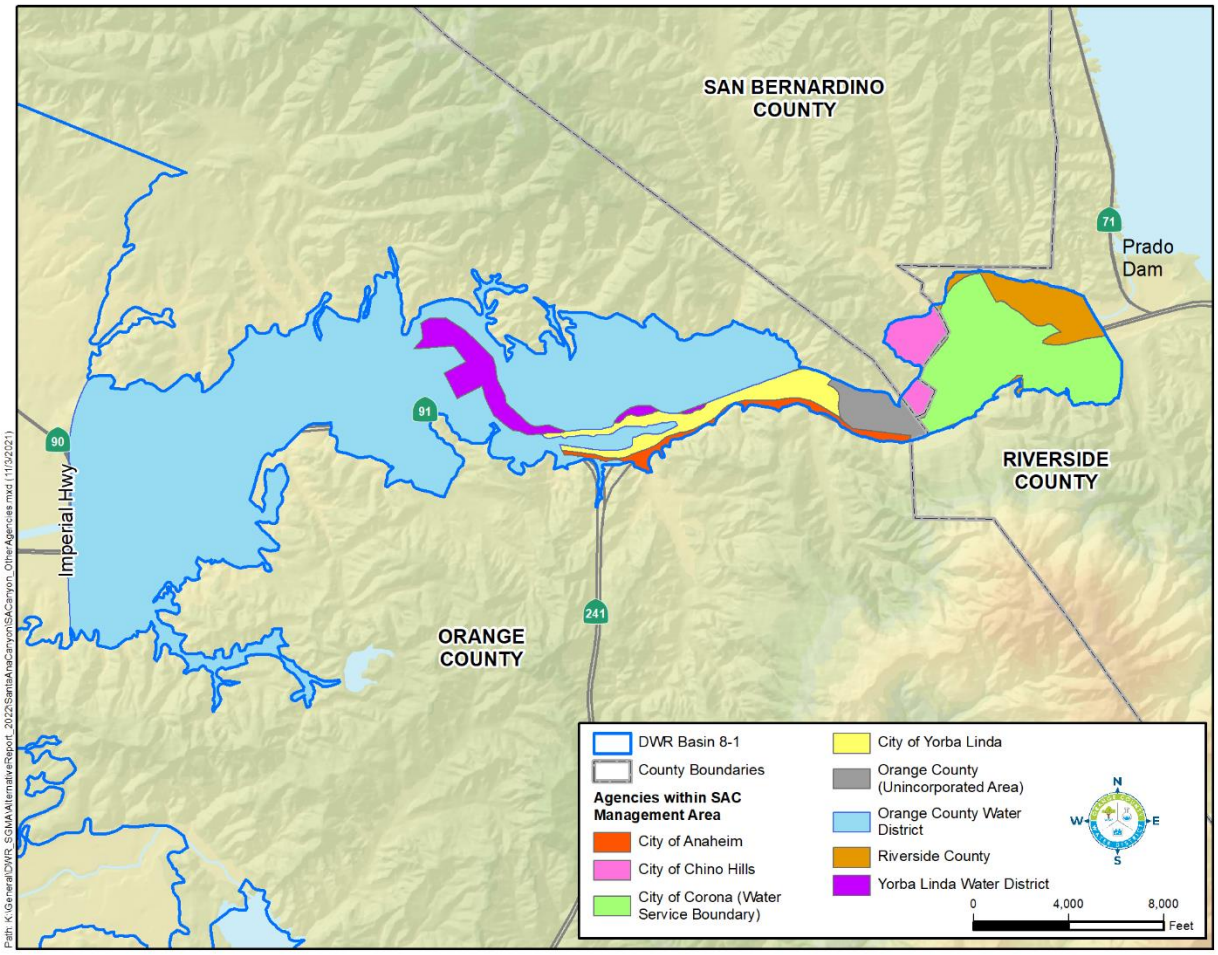



Figure 1-1: Agencies in the Santa Ana Canyon Management Area

The agencies within Basin 8-1 collaborated to prepare and submit an Alternative to a Groundwater Sustainability Plan (GSP). In accordance with Water Code §10733.6(b)(3), the Alternative presented an analysis of basin conditions that demonstrated that the Basin had operated within its sustainable yield over a period of at least 10 years. The Alternative was submitted to DWR on December 22, 2016. On July 17, 2019, DWR determined that the Alternative satisfied SGMA objectives and was therefore approved.

Agencies with approved alternatives are required to submit annual reports to DWR by April 1 of each year. Annual reports for Basin 8-1 were submitted to DWR as follows:

- Water Year 2016-17, submitted on March 29, 2018
- Water Year 2017-18, submitted on March 29, 2019
- Water Year 2018-19, submitted on March 30, 2020
- Water Year 2019-20, submitted on March 30, 2021

According to Water Code §10733.8, "At least every five years after initial submission of a plan pursuant to Section 10733.4, the department shall review any available groundwater sustainability plan or alternative submitted in accordance with Section 10733.6, and the implementation of the corresponding groundwater sustainability program for consistency with this part, including achieving the sustainability goal. The department shall issue an assessment for each basin for which a plan or alternative has been submitted in accordance with this chapter, with an emphasis on assessing progress in achieving the sustainability goal within the basin. The assessment may include recommended corrective actions to address any deficiencies identified by the department."

This document, called the 2022 Update, represents the first five-year update, which is due January 1, 2022.

**For purposes of this report, the Basin 8-1 Alternative submitted on December 22, 2016, will be referred to as the 2017 Alternative. The first five-year update will be referred to as the 2022 Update for ease of reference. The 2017 Alternative was a comprehensive document showing that Basin 8-1 had been managed sustainably for more than 10 years. For the 2022 Update, the focus is on documenting that the basin has been sustainably managed during the five years since the 2017 Alternative was submitted and to present relevant new information from the last five years. As such, the 2017 Alternative is considered a key reference document with background information that is not duplicated in the 2022 Update.**

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 produced from the alluvial aquifer is primarily used for irrigation, but some is also used for potable purposes. The volume of produced groundwater represents less than one 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 (see 2017 Alternative, Santa Ana Canyon Management Area).

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 |
| Orange County Water District |
| County of Orange |
| Riverside County |
| Yorba Linda Water District |

Table 1-2: Water Budget, 5-Year Average (2016-21)

| Flow Component | 5-Yr Avg: 2016-21 (afy) |
|---|---|
| INFLOW | |
| Santa Ana River Base Flow | 76,860 |
| Santa Ana River Storm Flow | 78,750 |
| Subsurface Inflow | 6,000 |
| TOTAL INFLOW | **161,610** |
| OUTFLOW | |
| Santa Ana River Base Flow | 76,120 |
| Santa Ana River Storm Flow | 78,750 |
| Evapotranspiration | 740 |
| Groundwater Production | 1,000 |
| Subsurface Outflow | 5,000 |
| TOTAL OUTFLOW | **161,610** |

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.

The Orange County Water District (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 groundwater levels and quality to ensure that no significant and unreasonable undesirable 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 conditions documented within the Santa Ana Canyon Management Area, it will <u>not</u> 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 expected given the high volume of Santa Ana River flow relative to the amount of groundwater production and the ability of the shallow alluvial aquifer to be recharged as a result of continuous and abundant 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. Significant loss of 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:** No vertical changes have been noted using DWR-supplied InSAR data. It is unlikely that this will occur in 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 a 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 1-1, 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 not changed since the 2017 Alternative. Table 1-1 lists the agencies and the approximate area covered by each.

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 $mi^2$.

## 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 within 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 groundwater production are the lack of demands in these areas, the relatively high mineral content 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 additional groundwater governance and management structure is needed for the areas in the Santa Ana Canyon Management Area beyond the existing monitoring program that OCWD already carries out in accordance with its authorities under the OCWD Act, in cooperation with the other jurisdictional agencies. 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 well owner 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 the existing groundwater production, level and quality data collection and reporting to DWR by OCWD per 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 County of Orange is responsible for costs associated with 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 do not incur any additional data collection costs 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 prepared 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. 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.

Detailed geologic information, including cross sections, is presented in the 2017 Alternative.

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 3-1. 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). Cross-sections presented in the 2017 Alternative using more recent data showed that the thickness of the alluvial deposits in the Santa Ana Canyon are consistent with those reported by the USGS (1964).

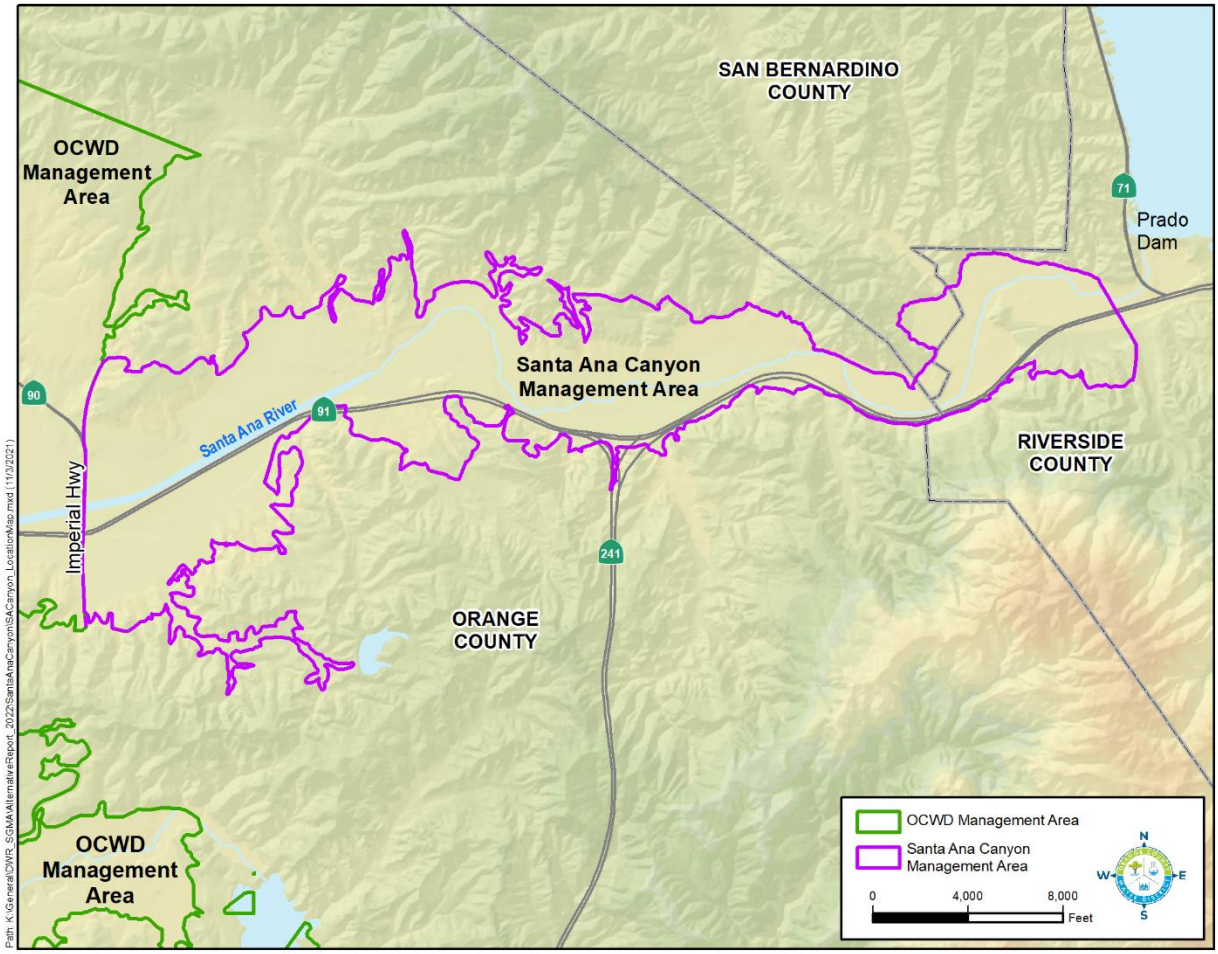



Figure 3-1: Boundary of Santa Ana Canyon Management Area

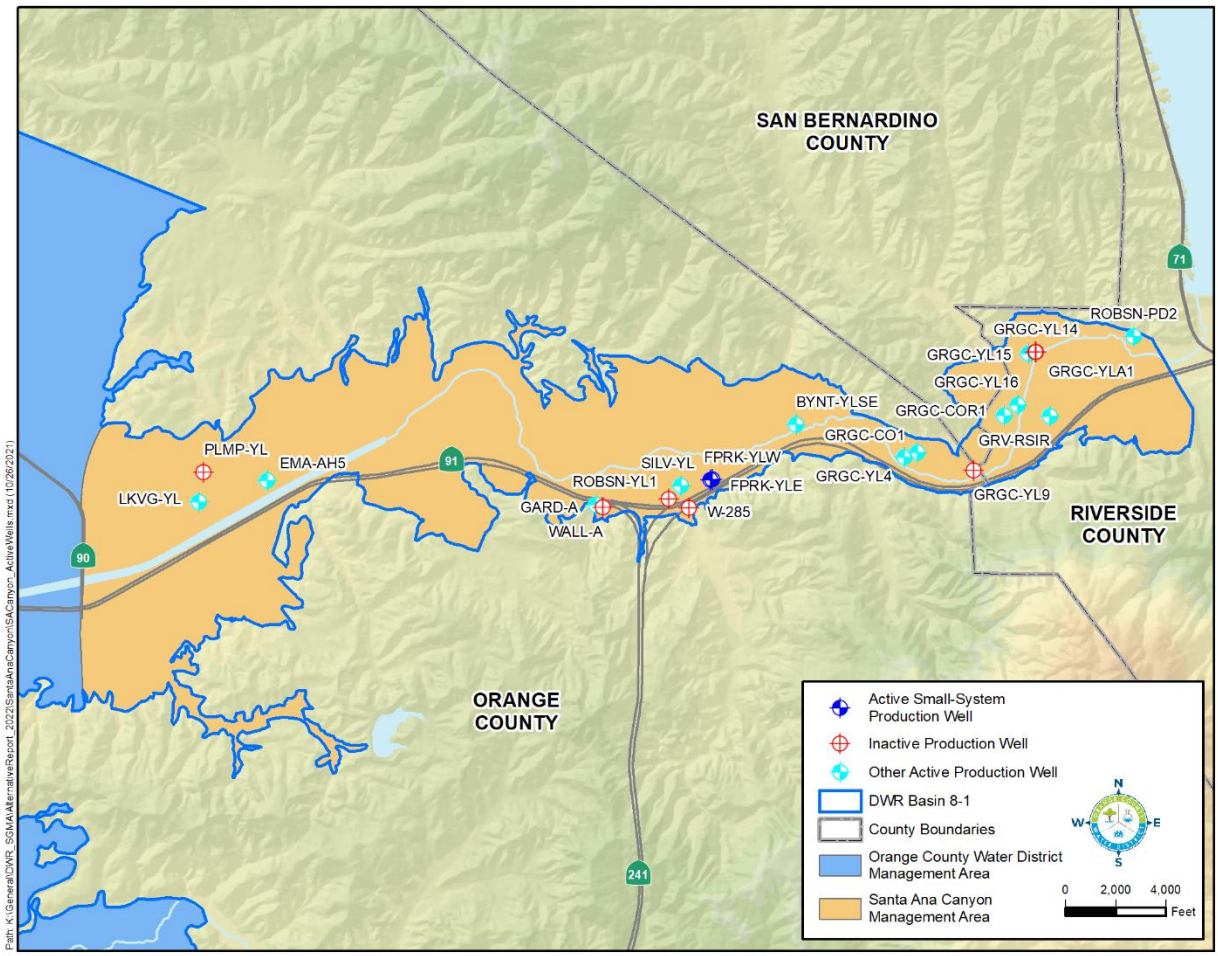



Figure 3-2: Groundwater Production Wells (Active and Inactive)

## 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 coincides with 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. Land use has remained essentially unchanged in the last five years.

## 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.

### 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 3-3. Well locations are shown on Figure 3-2 and cover the eastern (GRV-RSIR), south-central (FPRK-YLE/SILV-YL), and western (SCE-YLCS, EMA-AH5) areas of the Santa Ana Canyon Management Area.

Maximum water level elevations 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. In the vicinity of all the wells, groundwater is approximately 20 to 30 feet below ground surface. 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 shallower directly beneath the river channel where it is not covered by the river itself.

The consistent, stable nature of groundwater elevations in the Santa Ana Canyon Management Area shows that the aquifer is generally full and at equilibrium, which is consistent with the finding that here are no measurable losses of flows between Prado Dam upstream and OCWD's diversion to its recharge system just below Imperial Highway.

Within the last five years, OCWD, in cooperation with the County of Orange, began collecting groundwater elevation data at selected wells at the Green River Golf Course to complement existing groundwater elevation monitoring data. Note that wells SILV-YL and SCE-YLCS were formerly monitored for the CASGEM program. Well SCE-YLCS was destroyed and replaced by well EMA-AH5. As a result, water level data from SILV-YL and EMA-AH5 will be included in annual reports required to comply with SGMA.

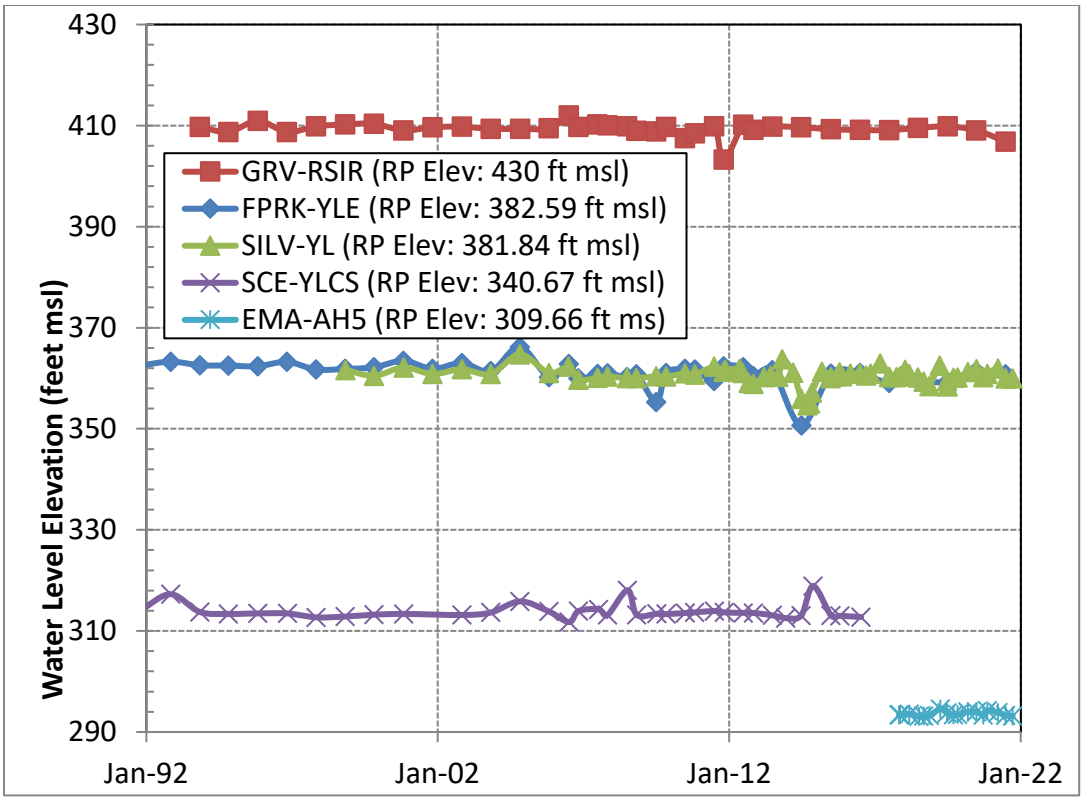



Figure 3-3: Water Level Hydrographs of Selected Wells

## 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 (e.g., inactive). At the time the 2017 Alternative was prepared, some wells, namely those owned by the County of Orange to supply irrigation water to the Green River Golf Course, were not metered. OCWD worked with the County of Orange to have all their wells metered and production reported to OCWD. Prior estimates of pumping before meters were installed was on the order of 1,000 acre-feet per year (Personal Communication, Merrie Weinstock, County of Orange). Data collected in recent years shows that total production is less, averaging just over 600 acre-feet per year.

As shown on Table 3-1, total groundwater production within the Santa Ana Canyon Management Area over the last 5 years has averaged just over 1,000 acre-feet per year. Table

3-1 lists the production wells, meter status, and 5-year average production for wells located within the Santa Ana Canyon Management Area.

Table 3-1: Production Wells, Flow-Meter Status, and 5-Year Average Production

| Well Name | Well Use | Owner | Metered | Production 5-Yr Avg 2016-21 (afy)* | Notes |
|---|---|---|---|---|---|
| BYNT-YLSE | IR | Neff Ranch, Ltd | Yes | 69.8 | |
| EMA-AH5 | IR | County Of Orange | Yes | 118.2 | SGMA monitoring well. |
| FPRK-YLE | DW/IR | Canyon RV Park | Yes | 79.5 | |
| FPRK-YLW | DW/IR | Canyon RV Park | Yes | 36.9 | |
| GARD-A | IR | Kindred Outreach Ministries | Yes | 1 | |
| GRGC-CO1 | IR | OCFCD | Yes | 82.2 | Monthly metering started Jan. 2019. Avg based on Jan. 2019-June 2021. |
| GRGC-COR1 | IR | OCFCD | Yes | 295.0 | Monthly metering started Jan. 2019. Avg based on Jan. 2019-June 2021 |
| GRGC-YL14 | IR | OCFCD | Yes | | Inactive |
| GRGC-YL15 | IR | OCFCD | No | | Inactive, only used for emergencies. |
| GRGC-YL16 | IR | OCFCD | Yes | 161.0 | Monthly metering started Jan. 2019. Avg based on Jan. 2019-June 2021 |
| GRGC-YL4 | IR | OCFCD | Yes | 75.5 | Monthly metering started Jan. 2019. Avg based on Jan. 2019-June 2021 |
| GRGC-YL9 | IR | OCFCD | Yes | | Inactive |
| GRGC-YLA1 | IR | OCFCD | Yes | | Inactive |
| GRV-RSIR | IR | Green River Village | Yes | 6.2 | |
| LKVG-YL | IR | Eastlake Village HOA | Yes | 70.8 | |
| ROBSN-PD2 | IR | Robertson Ready Mix | Yes | 5.4 | Monthly metering started Jan. 2018. Avg based on Jan. 2018-June 2021 |
| ROBSN-YL1 | IR | Robertson Ready Mix | Yes | | Inactive |
| WALL-A | DOM | Kindred Outreach Ministries | No | | Inactive |
| | | | **Total** | **1,007** | |

*Five-year average except where noted.
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. Detailed water quality information is presented in the 2017 Alternative. No substantive changes in groundwater quality have occurred within the last five years.

### 3.2.5 Land Subsidence

Land subsidence measurements derived from InSAR data provided by DWR show that land displacement in the Santa Ana Canyon Management Area from June 2015 to July 2020 is within the accuracy of the method (0 to 0.05 ft). This is not surprising 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 have not changed significantly over the last five years.

### 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 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 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.

# 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 1-2 presents the water budget for the Santa Ana Canyon Management Area for the last five years. Additional water budget information was presented in the 2017 Alternative. The 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 relative contributions of different sources in the Santa Ana Canyon Management Area.

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 shallow alluvial aquifer includes subsurface inflow and infiltrated Santa Ana River water. Outflow includes evapotranspiration, groundwater production and subsurface outflow. Table 4-1 presents the groundwater budget for the Santa Ana Canyon Management Area.

Table 4-1: Groundwater Budget, 5-Year Average (2016-21)

| Flow Component | 5-Yr Avg: 2016-21 (afy) |
|---|---|
| INFLOW | |
| Subsurface Inflow (1) | 6,000 |
| Infiltrated Santa Ana River Flow (2) | 740 |
| TOTAL INFLOW | **6,740** |
| OUTFLOW | |
| Evapotranspiration (3) | 740 |
| Groundwater Production | 1,000 |
| Subsurface Outflow to OCWD Management Area (4) | 5,000 |
| TOTAL OUTFLOW | **6,740** |
| 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 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

In the 2017 Alternative, the estimated subsurface outflow was 4,000 acre-feet per year based on the steady state groundwater flow model. More recent transient groundwater flow modeling using the period 1999 to 2017, showed that average outflow from the Santa Ana Canyon to the main basin to be approximately 5,000 acre-feet per year. As a result, the water budget tables have been updated accordingly.

Subsurface inflow is a combination of subsurface mountain front recharge, areal recharge from precipitation, and irrigation return flow. It is estimated to be approximately 6,000 acre-feet per year.

### 4.1.2 Infiltrated Santa Ana River 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 flow is the amount necessary to balance the water budget assuming subsurface inflow is 6,000 acre-feet per year. 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.

#### 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 reports that riparian vegetation consumes approximately 2 acre-feet per year per acre of vegetated area. Using this approach, the estimated evapotranspiration within the Santa Ana Canyon Management area is estimated to be 740 acre-feet per year.

### 4.1.3 Groundwater Production

As described in Section 3.2.2, there are 18 wells that can withdraw groundwater within the Santa Ana Canyon Management Area (Figure 3-2); however, some of the wells shown are not currently being used (e.g., inactive). Groundwater production from these wells is summarized in Table 3-1.

## 4.2 CHANGES IN GROUNDWATER STORAGE

As shown in Figure 3-3, groundwater levels in the Santa Ana Canyon Management Area are stable, indicating that the thin, alluvial aquifer is generally always in a near-full equilibrium 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 flow and subsurface inflow. Water budgets for wet and dry year water types are presented in the 2017 Alternative.

## 4.4 ESTIMATE OF SUSTAINABLE YIELD

As described in Table 4-1, average groundwater production over the last five years is less than one percent of the total inflow to the Santa Ana Canyon Management Area. This condition is the same as what was presented in the 2017 Alternative. It is clear 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 it is highly unlikely that groundwater demands would 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

Current water budgets are presented in presented in Tables 4-1 and 4-2. Historical and projected water budgets, including Dry and Wet Year Water Budgets, are presented in the 2017 Alternative.

# SECTION 5. WATER RESOURCE MONITORING PROGRAMS

## 5.1 OVERVIEW

This section describes OCWD's surface water 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. Within the last five years, well SCE-YLCS was destroyed and replaced in the monitoring network by well EMA-AH5. Water level data from wells SILV-YL and EMA-AH5 will be reported annually to DWR in compliance with SGMA. In addition, OCWD worked with the County of Orange to install meters on wells used to supply Green River Golf Course and to begin collecting and reporting production data. Data provided in this report utilizes metered data for all wells that pump groundwater in the Santa Ana Canyon Management area.

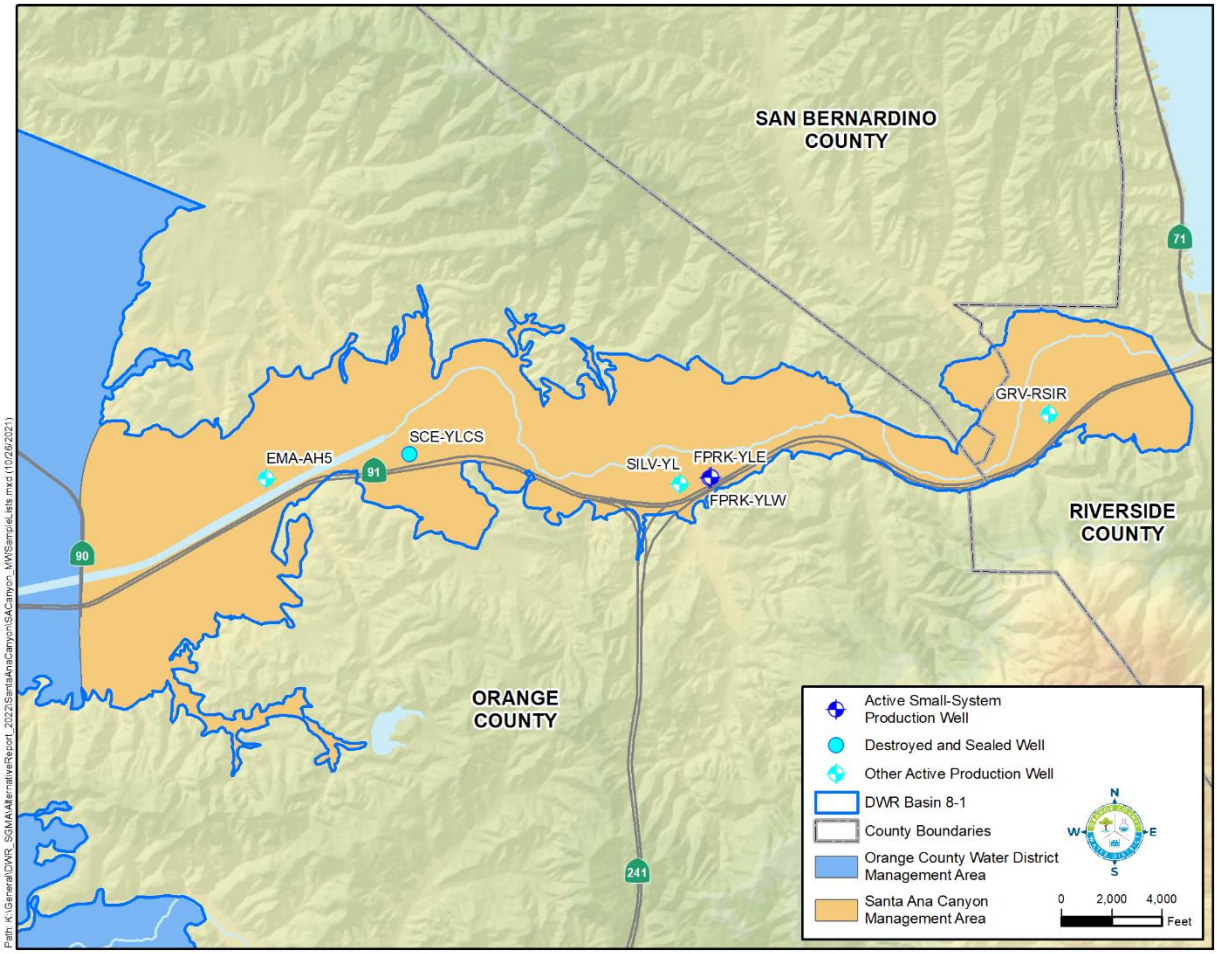



Figure 5-1: Wells Used to Monitor Groundwater Levels

For wells within OCWD's boundaries, groundwater production must be reported at a minimum frequency of every 6 months. Groundwater production volumes from the County of Orange's wells that supply the Green River Golf Course are now being collected monthly.

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 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 |
|---|---|
| IRRIGATION WELLS<br>BYNT-YLSE<br>EMA-AH5<br>GARD-A<br>GRGC-CO1<br>GRGC-COR1<br>GRGC-YL15<br>GRGC-YL16<br>GRGC-YL4<br>GRV-RSIR<br>LKVG-YL<br>ROBSN-PD2 | Annual: Volatile Organic Compounds (VOCs)<br>Every 3 yrs: General Minerals, 1,4-Dioxane, and $ClO_4$ |
| POTABLE USE WELLS<br><br><br><br>FPRK-YLE<br>FPRK-YLW | Annual: $NO_3$, $ClO_4$, 1,4-Dioxane, Mn, TDS, EC<br>Atrazine/Simazine: every 3 yrs<br>Title 22 Inorganics: every 3 yrs<br>CN: every 9 yrs<br>CrIV: every 3 yrs<br>Radioactivity: every 6 yrs (Gross Alpha, Uranium)<br>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 United States Geological Survey (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. 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. Copies of the watermaster reports can be found on OCWD's website at http://www.ocwd.com. 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 acre-feet per year; 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 acre-feet at Prado. With these cumulative credits, the required minimum base flow is 34,000 acre-feet. As a point of reference, the base flow in Water Year 2020-21 was estimated to be 76,000 acre-feet (Note that this is an OCWD estimate to be finalized in a future SAR Watermaster Report).

OCWD also closely monitors the quality of water in the Santa Ana River before it is diverted into OCWD's 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 the 2017 Alternative.

# 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
- Orange County Water District
- County of Orange
- Riverside County
- Yorba Linda Water District

On September 30, 2021, OCWD sent a letter via email to all of the Basin 8-1 agencies, including each of the agencies listed above to let them know that the 2017 Alternative was being updated and would be available for review and comment. No comments were received by any of the agencies contacted.

A draft of the 2022 Update was presented to the OCWD Board and posted on the OCWD website on November 18, 2021, to allow for public review and comment. The final 2022 Update was presented to the OCWD Board on December 15, 2021. At this board meeting, a resolution was adopted to support the submission of the 2022 Update to DWR.

# SECTION 8. SUSTAINABLE MANAGEMENT APPROACH

The approach to sustainably managing the Santa Ana Canyon Management Area is to continue monitoring conditions 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 3-3, groundwater levels in the Santa Ana Canyon Management Area have been steady over the last 20 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.

Within the last five years, several wells at the Green River Golf Course were added to the OCWD monitoring network and destroyed well SCE-YLCS was replaced in the network by well EMA-AH5.

## 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 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 started to show a consistent long-term decline, OCWD's monitoring program would be expanded to examine 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, as described in 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 have 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 showed a consistent long-term decline, OCWD's monitoring program would be expanded to examine 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 local 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 events. A similar situation 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 to consider is if the beneficial uses of the groundwater have been negatively affected and/or if water quality regulations, such as Maximum Contaminant Levels (MCLs) and other potable water quality requirements have been exceeded.

The third element that must be considered is the volume of groundwater impacted by groundwater quality degradation. If small volumes are negatively affected yet 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 within the Santa Ana Canyon Management Area 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

Recently, as part of DWR's SGMA technical assistance to provide important SGMA-relevant data to Groundwater Sustainability Agency's (GSAs) for Groundwater Sustainability Plan (GSP) development and implementation, DWR contracted with TRE ALTAMIRA, Inc. to provide vertical displacement estimates are derived from InSAR data that are collected by the European Space Agency (ESA) Sentinel-1A satellite.

This dataset represents measurements of vertical ground surface displacement in more than 200 of the high-use and populated groundwater basins across the State of California between January of 2015 and October of 2020. InSAR data coverage began in late 2014 for parts of California, and coverage for the entire study area began on June 13, 2015. Included in this dataset are point data that represent average vertical displacement values for 100 square meter areas, as well as GIS rasters that were interpolated from the point data; rasters for total vertical displacement relative to June 13, 2015, and rasters for annual vertical displacement rates with earlier coverage for some areas, both in monthly time steps. The level of accuracy is approximately 0.05 feet.

To show subsidence in Basin 8-1, OCWD used the used a layer showing the total land subsidence since the start of the InSAR data on 6/13/2015 and ending on 7/1/2020, which corresponds to the end of the OCWD water year. The GIS layer used was: https://gis.water.ca.gov/arcgisimg/rest/services/SAR/Vertical_Displacement_TRE_ALTAMIRA_v2020_Total_Since_20150613_20200701/ImageServer

Figure 13-1 shows the total land displacement in Basin 8-1 from June 2015 to July 2020. In the Santa Ana Canyon Management Area, vertical displacement is essentially unchanged and within the accuracy of the method (0 to 0.05 ft). This is not surprising given the following:

- The presence of shale and sandstone bedrock underlying the alluvial aquifer is not thought to be sufficiently compressible to cause inelastic subsidence.
- The alluvial aquifer is thin, generally less than 100 feet, and composed mainly of sand and gravel with only minor amounts of clay.
- Groundwater levels and storage volumes are stable.
- 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.

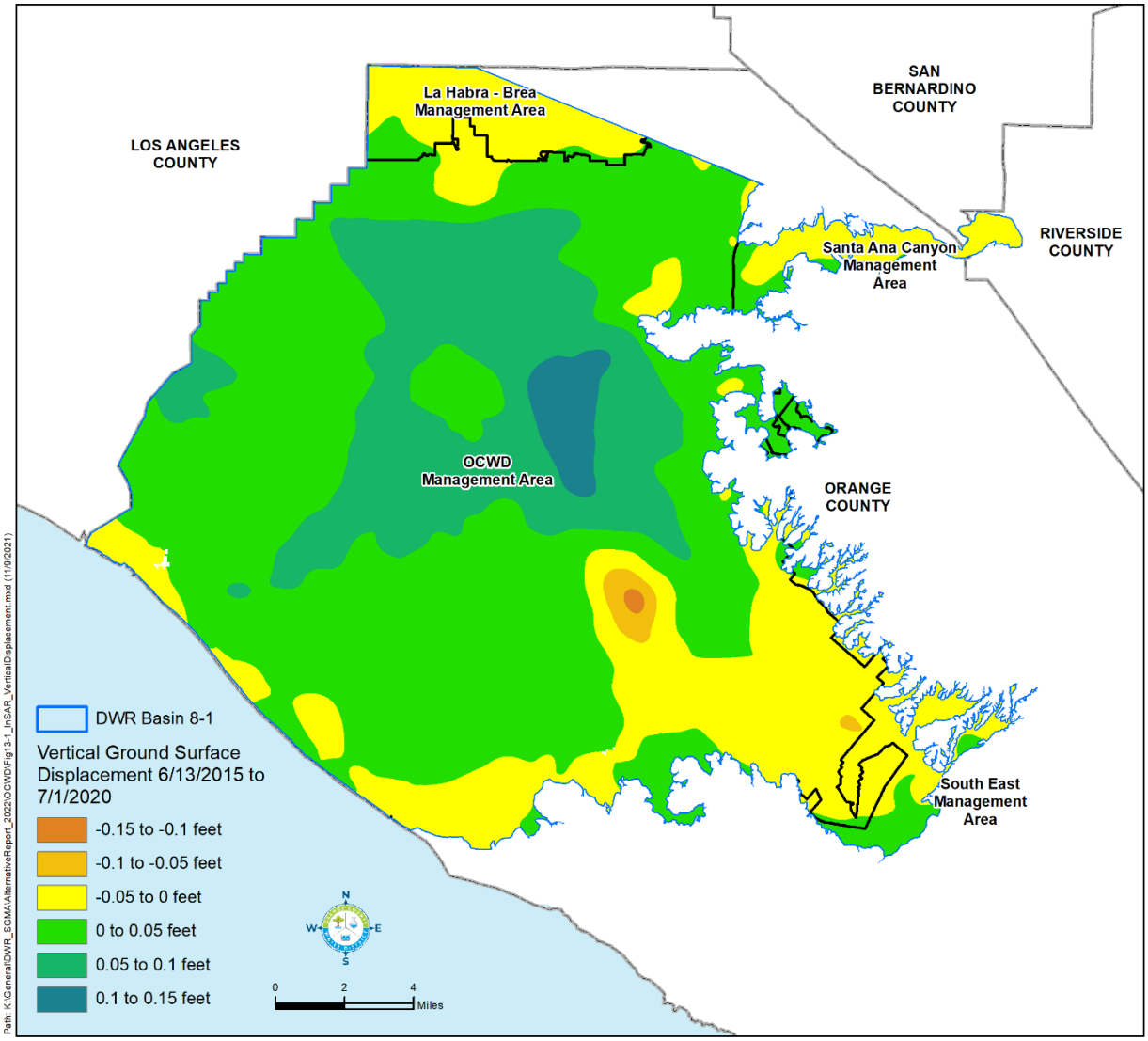



Figure 13-1: Total Vertical Ground Surface Displacement from June 2015 to July 2020

# 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. 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.

# SECTION 15. PROTOCOLS FOR MODIFYING MONITORING PROGRAMS

Protocols for modifying monitoring programs are described in the 2017 Alternative.

# 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 1

# Department of Water Resources (DWR) Comments on 2017 Alternative and Responses

**Responses to DWR Comments on Alternative Plan**

This section provides comments to DWR's Alternative Assessment Staff report, dated July 17, 2019. In addition, responses are provided for the four suggested recommended actions listed in the staff report (Section IV, B).

**OCWD Comments on DWR Alternative Assessment Staff Report, July 17, 2019.**

Page 7, Part IV, D, Basin coverage. DWR is correct in that the three agencies that collaborated in preparing the Alternative do not cover the entire basin; however, all other agencies with jurisdiction, such as the County of Orange, City of Corona, City of Yorba Linda, City of Anaheim and others were notified and offered the opportunity to be involved. No comments were received from any of the contacted agencies. It is our opinion, that through this process, OCWD, La Habra and IRWD did achieve complete coverage of Basin 8-1.

Page 14, Part V, B.2, Groundwater Conditions DWR staff mentioned that monitoring data showing that there are no depletions of interconnected surface water that will cause significant and unreasonable impacts on beneficial users of surface water is not provided, per Page 9 of the Alternative. Page 9 of the Alternative is part of the Overview of the entire report and does not contain detailed information Detailed monitoring information, including 10 years of water level data (Page 364), water budget information, etc. is presented in the Santa Ana Canyon Management Area section of the Alternative. The information presented in the Santa Ana Canyon Management Area section of the report supports the conclusion that there are no depletions of interconnected surface water that will cause significant and unreasonable impacts on beneficial users of surface water. Additional information has been provided below in response to Recommendation No. 1.

Page 16,. Part V, B.4, Management Areas. At the time the 2017 Alternative was submitted, the City of La Habra Groundwater Sustainability Agency (GSA) was contemplating preparing a GSP to be submitted in 2020. However, the City of La Habra GSA has elected to continue contributing to the Basin 8-1 Alternative.

**Response to DWR's Recommended Actions.**

Pages 32-33, Part IV, B, Recommended Actions.

> **DWR Recommended Action 1**. Staff recommend the Agencies clarify the basis for the determination that depletions of interconnected surface water in the Santa Ana Canyon Management Area are de minimis, while considering the volume of pumping, the extent of the interconnection between groundwater and surface water, and the beneficial users of the surface water.
>
> Staff recommend clarifying whether surface water bodies in the La Habra-Brea Management Area are interconnected with groundwater and whether groundwater-dependent ecosystems exist within the Santa Ana Canyon and La Habra Management Areas.

OCWD Response:

OCWD provided several lines of evidence for the determination that depletions of interconnected surface water in the Santa Ana Canyon area are insignificant (i.e., de minimis).

1. The large disparity in the supply of surface water to the Santa Ana Canyon area compared to the amount of pumping. The annual flow in the Santa Ana River is much greater than the amount of annual groundwater production. When the 2017 Alternative was prepared, some production wells in the Santa Ana Canyon were estimated, namely production wells supplying irrigation water to the Green River Golf Course. OCWD and Orange County Department of Public Works have worked together to install meters on wells supplying the Green River Golf Course. Now all production wells in the Santa Ana Canyon are metered. This effort resulted in a reduction in pumping as prior estimates were too high. For the 2022 Update, the 5-year water budget is presented in Table 1-2 in the Santa Ana Canyon section (reproduced below). This water budget is a combined surface and groundwater water budget for the Santa Ana Canyon Management Area. As shown on this table, groundwater production over this five-year period is approximately 0.6 percent of the total inflow to the canyon area.

Table1-2: Water Budget, 5-Year Average (2016-21)

| Flow Component | 5-Yr Avg: 2016-21 (afy) |
|---|---|
| INFLOW | |
| Santa Ana River Base Flow | 76,860 |
| Santa Ana River Storm Flow | 78,750 |
| Subsurface Inflow | 6,000 |
| TOTAL INFLOW | **161,610** |
| OUTFLOW | |
| Santa Ana River Base Flow | 76,120 |
| Santa Ana River Storm Flow | 78,750 |
| Evapotranspiration | 740 |
| Groundwater Production | 1,000 |
| Subsurface Outflow | 5,000 |
| TOTAL OUTFLOW | **161,610** |

2. The second line of evidence is the stability of groundwater levels as shown in Figure 3-3 in the Santa Ana Canyon section of the report. This figure is reproduced below. The consistent, stable nature of groundwater elevations in the Santa Ana Canyon Management Area shows that the aquifer is generally full and at equilibrium, which is consistent with the finding that here are no measurable losses of flows between Prado Dam upstream and OCWD's diversion to its recharge system just below Imperial Highway.
3. The third line of evidence, mentioned above, is the finding that there are no measurable losses of flows between Prado Dam and OCWD's diversion at the Imperial Rubber Dam. The location of these two measuring locations is shown in the figure below. The measuring location below Prado Dam is operated by the United States Geological Survey (USGS) and is identified as US11074000, Santa Ana R BL Prado Dam, CA. The USGS carefully reviews data from this location and publishes it annually as it is of interest to multiple stakeholders, including OCWD, the US Army Corps of Engineers, and a number of agencies upstream of Prado Dam.

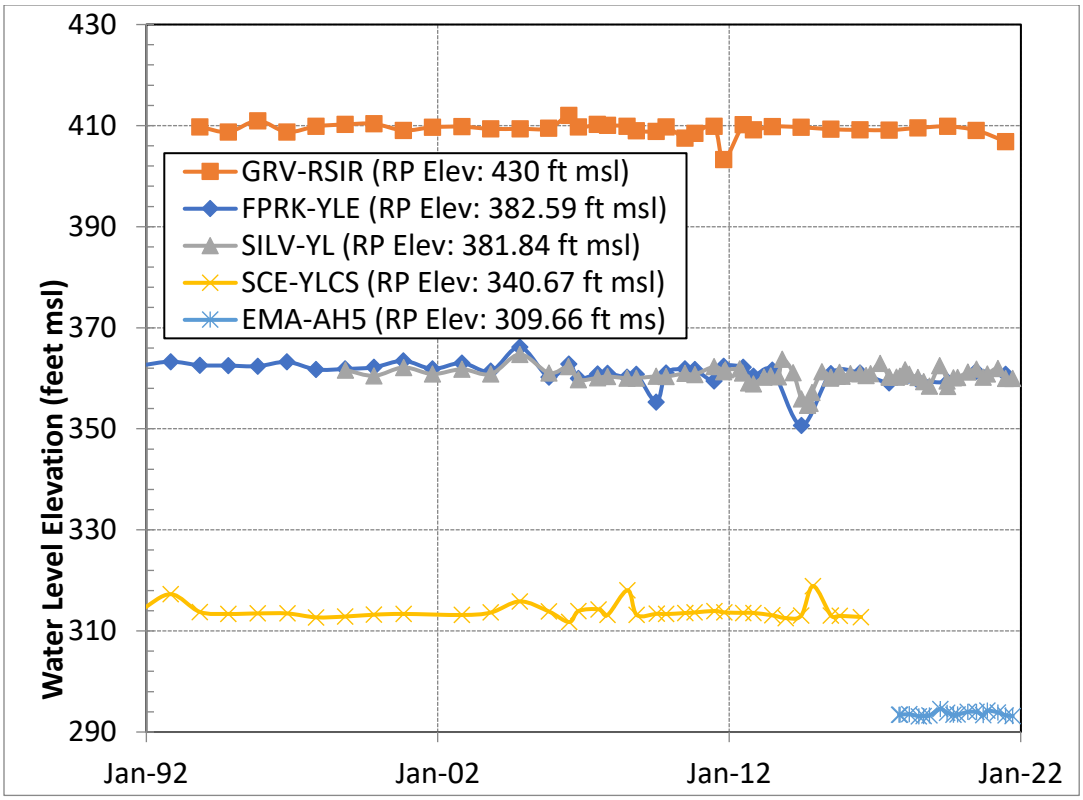
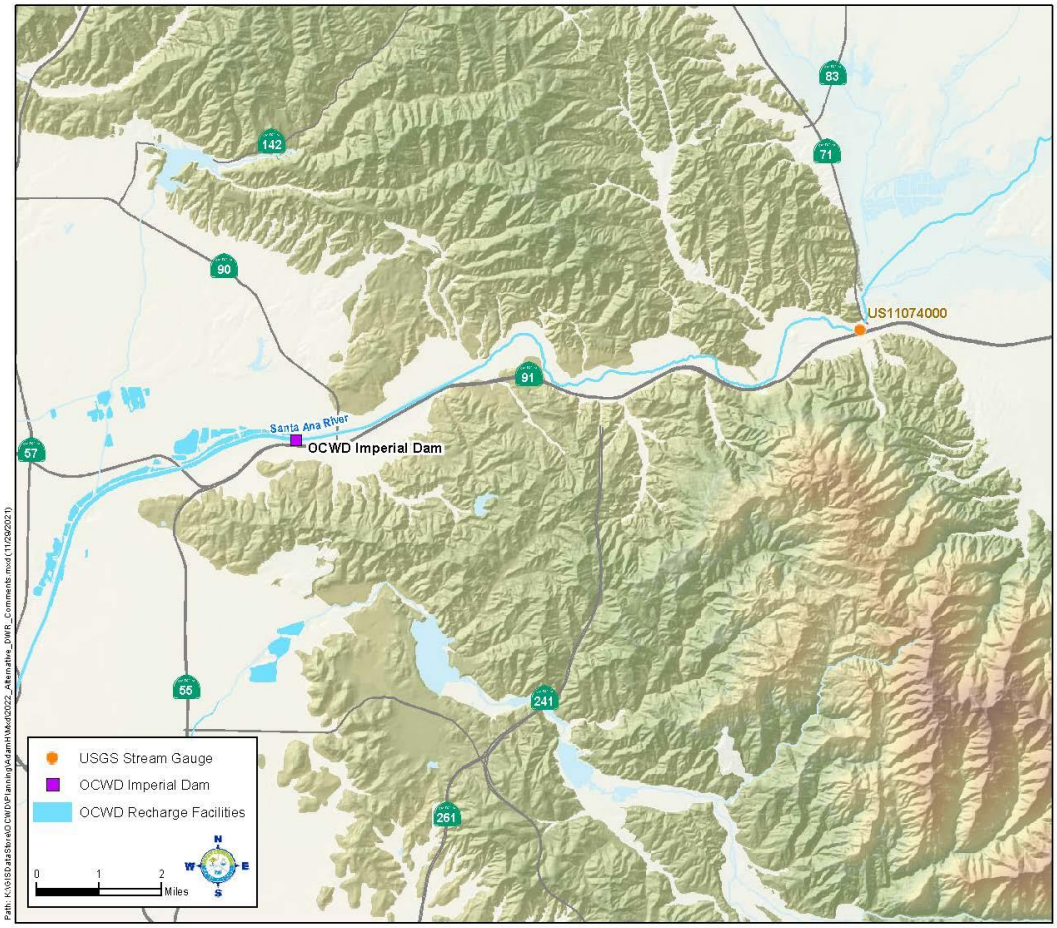



Figure 3-3: Water Level Hydrographs of Selected Wells

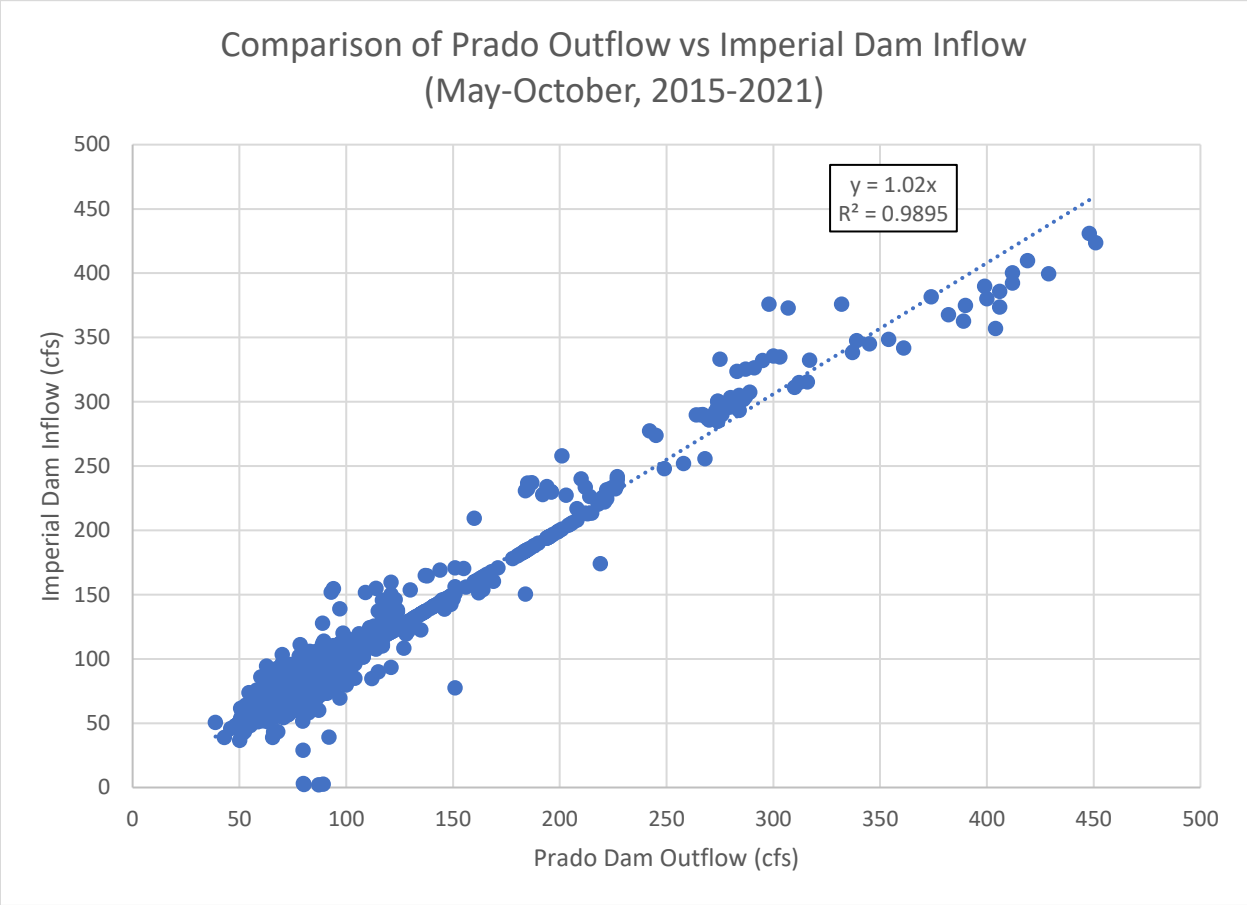



Location of USGS gauging station below Prado Dam and OCWD Imperial Rubber Dam

Inflow from the Santa Ana River to OCWD's recharge system is measured at the Imperial Rubber Dam (see figure). When flows are less than 1,000 cubic feet per second (cfs), the rubber dam remains fully inflated and all surface flows are either diverted from the river to downstream recharge basins or it is bypassed around the dam and placed back into the river channel. Flows that are diverted from the river pass through a Parshall flume, which measures the flow rate. Flows that are bypassed around the dam are measured using sonic flowmeters installed in the bypass pipelines. This arrangement ensures that all flows received by OCWD under 1,000 cfs are measured accurately. OCWD staff routinely check the accuracy of these two measuring stations. OCWD data from the Imperial Rubber Dam location provide data on total flow of the Santa Ana River on a daily basis.

OCWD compiled daily flow measurements for the USGS gauge below Prado Dam (11074000) and at OCWD's Imperial Rubber Dam for the period July 2015 to October 2021. During the winter months, there can be rainfall that occurs between Prado Dam and the Imperial Rubber Dam, resulting in ungauged inflow in this reach. To screen out these periods, the flow data for May through October is used and shown in the graph below. This graph shows there is very good agreement between the outflow at Prado Dam and what is received at the Imperial

Rubber Dam ($r^2$ =0.99). This demonstrates that there are no net losses in flow between these two locations, at least within the margin of error in the measurement accuracy. The conclusion is that the flow measurements at the two gauges are consistent with the water level data that show that the Santa Ana Canyon Management Area is in hydrologic equilibrium, and also that the volume of groundwater pumping is relatively small so as to not measurably reduce surface water volumes through the canyon.




DWR has made a dataset, called "Natural Communities Commonly Associated with Groundwater (NCCAG) Dataset" available at NC Dataset Viewer (ca.gov). This dataset shows that there is riparian vegetation located in the Santa Ana Management Area along the SAR channel. The evapotranspiration associated with the riparian vegetation was estimated to be 740 afy as shown in Table 1-2.

La Habra GSA Response:

Requested information on whether surface water bodies in the La Habra-Brea Management Area are interconnected with groundwater and whether groundwater-dependent ecosystems exist within the La Habra Management Area is included in the 2022 Update.

**DWR Recommended Action 2**. Staff recommend a basin-wide water budget utilizing inflow and outflow information from each management area or a water budget for each management area be provided in accordance with the GSP regulations (CCR 23 Section 354.18).

OWWD Response:

Over the years, OCWD has developed a comprehensive data collection system to characterize basin inflows and outflows. In an average year, approximately 80 percent of the inflow to the basin is measured and all of the groundwater production is measured and accounted for. In addition, every year, the change in groundwater storage is estimated based on water level changes in the three basin aquifers. This process defines the current storage condition in the basin and refines the net incidental (unmeasured) recharge portion of the water budget. Section 4 of the OCWD Management Area section of the Alternative describes the various elements of the water budget. The five-year water budget presented in the OCWD Management Area of the report is reproduced below.

Table 4-1: Water Budget, WY2016-17 to 2020-21 (OCWD Management Area)

| FLOW COMPONENT | 2016-17 | 2017-18 | 2018-19 | 2019-20 | 2020-21 |
|---|---|---|---|---|---|
| INFLOW | | | | | |
| Santa Ana River baseflow | 70,000 | 65,400 | 98,000 | 74,500 | 76,400 |
| Santa Ana River stormflow | 65,400 | 24,100 | 63,700 | 79,500 | 36,600 |
| Recycled Water (GWRS/Alamitos Barrier) | 98,000 | 106,400 | 97,200 | 99,700 | 101,700 |
| Imported Water | 50,400 | 66,100 | 40,300 | 18,100 | 0 |
| Net Estimated Unmeasured or Incidental Recharge* | 67,900 | 26,200 | 45,600 | 41,400 | 19,100 |
| TOTAL INFLOW: | 351,700 | 288,200 | 344,800 | 313,200 | 233,800 |
| OUTFLOW | | | | | |
| Groundwater Production | 300,700 | 237,200 | 303,800 | 277,200 | 281,800 |
| TOTAL OUTFLOW: | 300,700 | 237,200 | 303,800 | 277,200 | 281,800 |
| CHANGE IN STORAGE: | 51,000 | 51,000 | 41,000 | 36,000 | (48,000) |

The water budget presented in Table 4-1 is essentially the water budget for Basin 8-1, except for the La Habra Management Area. The water budget for the Santa Ana Canyon Management Area shows that this area provides a net source of water to the OCWD Management area that is captured in the surface

water recharge component and net estimated unmeasured recharge (via subsurface inflow). The water budget for the South East Management area is captured in the net unmeasured recharge (via subsurface inflow) minus any groundwater production in this area. Groundwater production in the South East Management area is so small, it is inconsequential in terms of the overall water budget.

Starting in April 2022, OCWD and other agencies within Basin 8-1 will be presenting the various water budget components as defined in CCR 23 Section 354.18 as part of the annual reporting process.

La Habra GSA Response:

Additional information regarding the water budget in the La Habra-Brea Management Area is included in the 2022 Update.

> **DWR Recommended Action 3**. Staff recommend that the Agencies provide the agreements among the different jurisdictions which commit the Agencies to conduct monitoring and implement the Alternative within their management areas. If no GSP is developed for the La Habra-Brea Management Area, the next Alternative update should provide additional explanation and quantification of the management approaches, sustainable management criteria, and evidence for the presence or absence of undesirable results for the La Habra-Brea Management Area.

Response:

The response to this recommended action comes in two parts. The first addresses the commitment of the Agencies to conduct monitoring and implement the Alternative within their management areas. The second addresses additional information requested for the La Habra-Brea Management Area.

Part 1: Commitment to Conduct Monitoring and Implement Alternative:

As part of the process of developing the Basin 8-1 Alternative, OCWD collaborated with the City of La Habra Groundwater Sustainability Agency and the Irvine Ranch Water District (IRWD). Both of these agencies committed resources to prepare their respective sections of the Alternative and submitted letters of support for the Alternative. The letters of support and OCWD's resolution of support were submitted to DWR along with the Alternative in December 2016. These same agencies have committed resources to updating the Alternative and OCWD has again adopted a resolution of support to submit the updated Alternative to DWR. This process demonstrates the continued commitment of the agencies to comply with SGMA and take necessary actions to continue sustainably managing Basin 8-1.

In terms of groundwater monitoring, OCWD has an extensive monitoring well network. A subset of these wells was part of the CASGEM program. As described in the 2022 Update, this well network was updated and is now part of the Monitoring Well Network (MWN), which has replaced CASGEM. Included in the MWN are two wells owned by IRWD that are located in the South East Management Area. As a result, water level data submitted twice a year by OCWD covers all of Basin 8-1 except for the La Habra-Brea Management Area. The City of La Habra GSA will be submitting water level data for their area separately.

In addition to groundwater level monitoring, the agencies are committed to continuing to conduct monitoring of water quality, groundwater production, subsidence, and any other monitoring that may be required to satisfy sustainable management criteria.

Part 2: Additional Information for La Habra-Brea Management Area

The City of La Habra GSA incorporated additional information into the La Habra-Brea Management Area section, including additional explanation and quantification of the management approaches, sustainable management criteria, and clarifying the evidence for the absence of undesirable results for the La Habra-Brea Management Area. Additionally, data gaps within the monitoring network are discussed in the 2022 Update, including steps currently being taken to address and fill the gaps.

> **DWR Recommended Action 4**. Staff recommend the Agencies explain the timeframe that the Basin can safely operate, without experiencing undesirable results, after exceeding 500,000 AF below full conditions (23 CCR Section 354.26(b)(2)) and clarify the wells used to calculate the change in groundwater in storage and the overall groundwater in storage.

Response:

It is important to reiterate that exceeding 500,000 acre-feet from full is a hypothetical situation and is not an intended action under normal basin management circumstances. Such a hypothetical situation is considered an extraordinary circumstance; for example, an extended drought that is exacerbated by a lengthy shutdown of imported water into southern California due to a catastrophic event such as a major earthquake. This hypothetical situation would not be expected to last more than one year; however, other worse hypothetical cases can be conceived. Because the cause(s) and magnitude of a hypothetical temporary storage exceedance beyond 500,000 acre-feet below full are unknown, it is difficult to quantify a precise timeframe that the Basin can operate without experiencing undesirable results. That said, a *cumulative* exceedance of no more than 200,000 acre-feet beyond 500,000 acre-feet below full conditions over five consecutive years is suggested as a general guideline. This means that the average exceedance would be no more than 40,000 acre-feet during a maximum five-year period. If the period of exceedance was two years, then the average exceedance would be 100,000 acre-feet. As a general guideline, limiting the magnitude and duration of the exceedance will lessen the potential for undesirable results, as described below:

1. The rate of inland movement of seawater intrusion with the basin at 500,000 acre-feet below full conditions and with the seawater barriers is expected to be on the order of 1-2 feet per day. Over a 5-year period, this could represent a brackish water encroachment of roughly ½ mile into some of the coastal gaps. While this encroachment could cause localized water quality degradation, it is unlikely to reach production wells which are farther inland. Once the storage exceedance ends, and the basin storage is within the established operating range, the seawater barriers' performance would be expected to recover to their design conditions and subsequently halt and reverse the brackish groundwater inland encroachment.

2. Reduction of pore pressures in and drainage of water from thick, compressible confining layers is a slow process due to the low permeability of the confining layers. Therefore, a maximum five-year period of basin storage exceeding 500,000 acre-feet from full would not be expected to cause significant inelastic land subsidence.

3. Lowering of groundwater levels could temporarily reduce or halt the production potential of an unknown number of water supply wells; however, assuming the distribution of lower groundwater levels is distributed across the Basin, the magnitude of reduced groundwater levels would be lessened, and the number of temporarily-impacted wells would likely be manageable.

Note that this discussion applies to the OCWD portion of the groundwater basin. Storage conditions in the La Habra-Brea Management Area are separate.

OCWD uses a large network of wells to obtain water levels in June every year, including:

1. OCWD owned wells (including multi-port monitoring wells)
2. Groundwater producer wells (must be turned off for 24 hours in advance)
3. Selected wells in Geotracker

The wells/monitoring points used for the June 2021 contour maps of the Shallow, Principal and Deep Aquifers are attached. For 2021, 350 wells/monitoring points were used for the Shallow Aquifer, 421 wells/monitoring points for the Principal Aquifer, and 61 wells/monitoring points for the Deep Aquifer. There may be small changes in this well/monitoring point list on an annual basis.

List of Wells/Monitoring Points Used for June 2021 Water Level Contour Map of Orange County Groundwater Basin (OCWD Management Area)

## Wells Used to Develop 2021 Groundwater Contour Maps in Orange County Groundwater Basin

**Shallow Aquifer Wells (Model Layer 1)**

| STAID1 | WELLNM | STAID | STANAME | OWNERNM | NAD83_X | NAD83_Y | GIS_SYMNM | PERF_ZONE | SHORTDATE | WLELEV_2021 |
|---|---|---|---|---|---|---|---|---|---|---|
| 19013 | CSF-1 | 19127 | CSF-1/1/WB1/MP1 | CA. STATE UNIV., FULLERTON | 6064343.084 | 2270822.497 | Multiport Monitoring Well | MP1 (132) | <Null> | <Null> |
| 1092 | FPRK-YLE | 1093 | FPRK-YLE/1 | CANYON RV PARK | 6119133.638 | 2263083.811 | Active Small-System Production Well | 60-84 | 6/29/2021 | 360.79 |
| 1090 | FPRK-YLW | 1091 | FPRK-YLW/1 | CANYON RV PARK | 6119044.248 | 2263049.927 | Active Small-System Production Well | 48-80 | 6/29/2021 | 359.55 |
| 1136 | SULY-OA4 | 1137 | SULY-OA4/1 | CHANDLER'S SAND & GRAVEL | 6094796.046 | 2243793.122 | Inactive Production Well | - | <Null> | <Null> |
| 23723 | CHEV-MW15B | 23724 | CHEV-MW15B/1 | CHEVRON MANAGEMENT COMPANY | 6072572.119 | 2277343.802 | Monitoring Well | 90-130 | <Null> | <Null> |
| 15561 | CNXT-NBES2 | 15562 | CNXT-NBES2/1 | CONEXANT SYSTEMS, INC. | 6071916.005 | 2188840.827 | Monitoring Well | 21-41 | 5/27/2021 | 21.63 |
| 15734 | CNXT-NBES3A | 15735 | CNXT-NBES3A/1 | CONEXANT SYSTEMS, INC. | 6071601.336 | 2188635.986 | Monitoring Well | 23.9-44.3 | 5/27/2021 | 21.43 |
| 15571 | CNXT-NBES4B | 15572 | CNXT-NBES4B/1 | CONEXANT SYSTEMS, INC. | 6071542.899 | 2188493.017 | Monitoring Well | 23-43 | <Null> | <Null> |
| 15569 | CNXT-NBES6 | 15570 | CNXT-NBES6/1 | CONEXANT SYSTEMS, INC. | 6071620.501 | 2188443.488 | Monitoring Well | 25-40 | <Null> | <Null> |
| 8610 | CNXT-NBMW29 | 8611 | CNXT-NBMW29/1 | CONEXANT SYSTEMS, INC. | 6071755.155 | 2189235.843 | Monitoring Well | 21-40 | <Null> | <Null> |
| 8608 | CNXT-NBMW30 | 8609 | CNXT-NBMW30/1 | CONEXANT SYSTEMS, INC. | 6071902.892 | 2189098.302 | Monitoring Well | 21-42 | <Null> | <Null> |
| 14611 | SILV-YL | 14612 | SILV-YL/1 | COUNTY OF ORANGE | 6117870.025 | 2262814.346 | Other Active Production Well | 40-66 | 6/30/2021 | 359.99 |
| 15932 | DAVI-O | 15933 | DAVI-O/1 | DAVIDSON, TOM & CINDY | 6090897.443 | 2241414.862 | Other Active Production Well | - | <Null> | <Null> |
| 23713 | DLA-GTMW04 | 23714 | DLA-GTMW04/1 | DEFENSE LOGISTICS AGENCY | 6087208.914 | 2219923.944 | Monitoring Well | 90-110 | 7/7/2021 | 48.06 |
| 4156 | OCWD-BS103 | 5213 | OCWD-BS103/1 | DEPARTMENT OF WATER RESOURCES | 6027754.184 | 2208435.987 | Monitoring Well | 43-78 | 6/29/2021 | -4.68 |
| 5218 | OCWD-BS105 | 5219 | OCWD-BS105/1 | DEPARTMENT OF WATER RESOURCES | 6022947.616 | 2207365.785 | Monitoring Well | 69-85 | 7/7/2021 | -8.97 |
| 3071 | OCWD-BS106 | 5222 | OCWD-BS106/1 | DEPARTMENT OF WATER RESOURCES | 6024891.085 | 2211245.522 | Monitoring Well | 50-92 | 6/30/2021 | -6.17 |
| 5133 | OCWD-SA10 | 5134 | OCWD-SA10/1 | DEPARTMENT OF WATER RESOURCES | 6039247.362 | 2190515.118 | Monitoring Well | 90-120 | 6/28/2021 | 3.249 |
| 5139 | OCWD-SA12 | 5140 | OCWD-SA12/1 | DEPARTMENT OF WATER RESOURCES | 6040581.662 | 2205805.671 | Monitoring Well | 86-126 | 6/30/2021 | 8.88 |
| 5115 | OCWD-SA3 | 5116 | OCWD-SA3/1 | DEPARTMENT OF WATER RESOURCES | 6034107.028 | 2196075.864 | Monitoring Well | 100-160 | 6/28/2021 | 2.631 |
| 1620 | CMIL-A | 3108 | CMIL-A/1 | FIRST INTERSTATE BANK | 6101671.628 | 2260355.691 | Destroyed and Sealed Well | 21-101 | <Null> | <Null> |
| 39 | GG-28 | 2687 | GG-28/1 | GARDEN GROVE | 6049374.528 | 2232905.514 | Inactive Production Well | 130-240 | 6/30/2021 | 59 |
| 1407 | WWGC-SAK3 | 1408 | WWGC-SAK3/1 | GARDEN GROVE | 6056974.671 | 2220835.054 | Other Active Production Well | 149-170 | 6/28/2021 | 50.85 |
| 9522 | SCWC-YLCO2 | 9523 | SCWC-YLCO2/1 | GOLDEN STATE WATER COMPANY | 6091725.912 | 2261952.552 | Inactive Production Well | 100-480 | 5/25/2021 | 254 |
| 506 | ETCH-AL2 | 507 | ETCH-AL2/1 | GOODWIN MUTUAL WATER COMPANY | 6086723.02 | 2261993.771 | Inactive Production Well | 85-185 | 6/29/2021 | 236.58 |
| 23034 | HEUL-A | 23035 | HEUL-A/1 | HEULER, BARTON | 6060159.382 | 2256110.939 | Other Active Production Well | 125-145 | <Null> | <Null> |
| 2830 | OCWD-HH2 | 2832 | OCWD-HH2/2 | HUNTINGTON HARBOUR CORPORATION | 6012383.001 | 2212193.192 | Monitoring Well | 85-95 | 6/29/2021 | -8.893 |
| 2845 | OCWD-HH3 | 2847 | OCWD-HH3/2 | HUNTINGTON HARBOUR CORPORATION | 6012242.137 | 2210674.48 | Monitoring Well | 75-85 | 6/29/2021 | -7.988 |
| 4242 | OCWD-HH5 | 4245 | OCWD-HH5/3 | HUNTINGTON HARBOUR CORPORATION | 6013929.084 | 2207761.949 | Monitoring Well | 63-73 | 6/29/2021 | -5.877 |
| 20312 | OCWD-HH6B | 20313 | OCWD-HH6B/1 | HUNTINGTON HARBOUR CORPORATION | 6011785.354 | 2213862.346 | Monitoring Well | 90-100 | 7/1/2021 | -10.411 |
| 1200 | HYNS-S2 | 1201 | HYNS-S2/1 | HYNES ESTATES, INC. | 6032783.88 | 2236398.43 | Destroyed and Sealed Well | 162-182 | <Null> | <Null> |
| 23616 | IRWD-MICH11 | 23617 | IRWD-MICH11/1 | IRVINE RANCH WATER DISTRICT | 6078141.044 | 2188888.245 | Other Active Production Well | 21-69 | <Null> | <Null> |
| 23618 | IRWD-MICH12 | 23622 | IRWD-MICH12/1 | IRVINE RANCH WATER DISTRICT | 6078209.142 | 2188963.633 | Other Active Production Well | 19-63 | <Null> | <Null> |
| 23623 | IRWD-MICH13 | 23624 | IRWD-MICH13/1 | IRVINE RANCH WATER DISTRICT | 6078263.018 | 2188904.583 | Other Active Production Well | 21-67 | <Null> | <Null> |
| 23625 | IRWD-MICH14 | 23626 | IRWD-MICH14/1 | IRVINE RANCH WATER DISTRICT | 6078303.831 | 2188587.342 | Other Active Production Well | - | <Null> | <Null> |
| 23627 | IRWD-MICH15 | 23628 | IRWD-MICH15/1 | IRVINE RANCH WATER DISTRICT | 6078219.918 | 2188672.325 | Other Active Production Well | - | <Null> | <Null> |
| 23495 | CREA-YL | 23496 | CREA-YL/1 | JOHN CREANGA | 6078734.136 | 2277902.352 | Other Active Production Well | 135-175 | 6/30/2021 | 302.223 |
| 1211 | ITO-LA | 1212 | ITO-LA/1 | JOINT FORCES TRAINING BASE LOS ALAMITOS | 6014444.094 | 2233893.201 | Other Active Production Well | 70-710 | 6/29/2021 | 14.26 |
| 432 | W-432 | 433 | W-432/1 | KATHY BONANNO | 6080325.38 | 2272580.463 | Inactive Production Well | 117-137 | 6/30/2021 | 286.993 |
| 1759 | MKAW-FV | 3235 | MKAW-FV/1 | KAWAGUCHI ENTERPRISES, LP | 6051164.175 | 2210349.133 | Other Active Production Well | 185-225 | <Null> | <Null> |
| 11544 | LAC-33Y10 | 11545 | LAC-33Y10/1 | LOS ANGELES COUNTY | 6000026.997 | 2231221.991 | Monitoring Well | 75-115 | <Null> | <Null> |
| 1160 | GHAV-GG | 1161 | GHAV-GG/1 | MAGILL, STANLEY R. | 6059608.702 | 2232220.109 | Other Active Production Well | 168-188 | 6/28/2021 | 61.3 |
| 22691 | HMW-01 | 22692 | HMW-01/1 | MANHEIM CALIFORNIA (COX ENTERPRISES) | 6078590.494 | 2262972.301 | Monitoring Well | 55-75 | <Null> | <Null> |
| 19926 | USMC-16MW11 | 19927 | USMC-16MW11/1 | MARINE CORPS AIR STATION | 6110625.131 | 2193056.413 | Monitoring Well | 160-180 | <Null> | <Null> |
| 18840 | USMC-16MW2 | 18841 | USMC-16MW2/1 | MARINE CORPS AIR STATION | 6110221.201 | 2193322.5 | Monitoring Well | 153-178 | <Null> | <Null> |
| 19957 | USMC-24EX11 | 19958 | USMC-24EX11/1 | MARINE CORPS AIR STATION | 6104523.31 | 2191224.413 | Monitoring Well | 135-180 | <Null> | <Null> |
| 19959 | USMC-24EX12A | 19960 | USMC-24EX12A/1 | MARINE CORPS AIR STATION | 6105720.54 | 2190982.863 | Monitoring Well | 115-160 | <Null> | <Null> |
| 19965 | USMC-24EX13A | 19966 | USMC-24EX13A/1 | MARINE CORPS AIR STATION | 6107553.141 | 2190629.843 | Monitoring Well | 110-160 | <Null> | <Null> |
| 19971 | USMC-24EX14 | 19972 | USMC-24EX14/1 | MARINE CORPS AIR STATION | 6104912.99 | 2191678.953 | Monitoring Well | 115-185 | <Null> | <Null> |
| 19953 | USMC-24EX9 | 19954 | USMC-24EX9/1 | MARINE CORPS AIR STATION | 6108691.53 | 2189395.353 | Monitoring Well | 120-200 | <Null> | <Null> |
| 20253 | USMC-24MW10AB | 20255 | USMC-24MW10AB/2 | MARINE CORPS AIR STATION | 6107253.063 | 2191367.404 | Monitoring Well | 130-140 | <Null> | <Null> |
| 20269 | USMC-24MW9AB | 20271 | USMC-24MW9AB/2 | MARINE CORPS AIR STATION | 6106891.198 | 2190845.415 | Monitoring Well | 140-150 | <Null> | <Null> |
| 18621 | USMC-24NEW7 | 18622 | USMC-24NEW7/1 | MARINE CORPS AIR STATION | 6108983.5 | 2190576.7 | Monitoring Well | 118-158 | <Null> | <Null> |
| 18619 | USMC-24NEW8 | 18620 | USMC-24NEW8/1 | MARINE CORPS AIR STATION | 6109711.5 | 2190269.7 | Monitoring Well | 122-162 | <Null> | <Null> |
| 13875 | USMC-MW03E | 13876 | USMC-MW03E/1 | MARINE CORPS AIR STATION | 6109510.523 | 2188847.525 | Monitoring Well | 124-164 | <Null> | <Null> |
| 13833 | USMC-MW19E | 13834 | USMC-MW19E/1 | MARINE CORPS AIR STATION | 6104580.874 | 2194499.736 | Monitoring Well | 98-138 | <Null> | <Null> |
| 14336 | USMC-MW23 | 14337 | USMC-MW23/1 | MARINE CORPS AIR STATION | 6105584.809 | 2185916.035 | Monitoring Well | 64-104 | <Null> | <Null> |
| 18586 | USMC-MW29A | 18587 | USMC-MW29A/1 | MARINE CORPS AIR STATION | 6110133.9 | 2187312.33 | Monitoring Well | 75-100 | <Null> | <Null> |
| 22910 | USMC-MW2D2 | 22911 | USMC-MW2D2/1 | MARINE CORPS AIR STATION | 6081840.685 | 2206480.568 | Monitoring Well | 76-86 | <Null> | <Null> |
| 13861 | USMC-MW31 | 13862 | USMC-MW31/1 | MARINE CORPS AIR STATION | 6107617.015 | 2189648.229 | Monitoring Well | 105-145 | <Null> | <Null> |
| 13859 | USMC-MW37 | 13860 | USMC-MW37/1 | MARINE CORPS AIR STATION | 6108153.508 | 2188707.479 | Monitoring Well | 89-130 | <Null> | <Null> |
| 22617 | USMC-MW43B | 22618 | USMC-MW43B/1 | MARINE CORPS AIR STATION | 6110701.167 | 2188814.201 | Monitoring Well | 100.41-140.91 | <Null> | <Null> |
| 13817 | USMC-MW51 | 13818 | USMC-MW51/1 | MARINE CORPS AIR STATION | 6107153.052 | 2192582.528 | Monitoring Well | 125-165 | <Null> | <Null> |
| 13877 | USMC-MW70 | 13878 | USMC-MW70/1 | MARINE CORPS AIR STATION | 6110644.542 | 2189446.258 | Monitoring Well | 125-165 | <Null> | <Null> |
| 13903 | USMC-MW73 | 13904 | USMC-MW73/1 | MARINE CORPS AIR STATION | 6109324.506 | 2187794.721 | Monitoring Well | 90-130 | <Null> | <Null> |
| 13889 | USMC-MW91 | 13890 | USMC-MW91/1 | MARINE CORPS AIR STATION | 6108291.003 | 2188258.73 | Monitoring Well | 110-150 | <Null> | <Null> |
| 7256 | USMC-PS1 | 7257 | USMC-PS1/1 | MARINE CORPS AIR STATION | 6106591.503 | 2189442.242 | Monitoring Well | 102-122 | <Null> | <Null> |
| 7258 | USMC-PS2 | 7259 | USMC-PS2/1 | MARINE CORPS AIR STATION | 6105657.052 | 2193519.226 | Monitoring Well | 103-133 | <Null> | <Null> |
| 18564 | USMC-PS3A | 18565 | USMC-PS3A/1 | MARINE CORPS AIR STATION | 6109290.87 | 2187093.49 | Monitoring Well | 70-105 | <Null> | <Null> |
| 13849 | USMC-MP06 | 14437 | USMC-MP06/1/WB1/MP1 | MARINE CORPS AIR STATION | 6100689.85 | 2194415.05 | Multiport Monitoring Well | MP1 (110) | <Null> | <Null> |
| 13851 | USMC-MP08 | 14457 | USMC-MP08/1/WB1/MP1 | MARINE CORPS AIR STATION | 6105310.575 | 2187889.19 | Multiport Monitoring Well | MP1 (70) | <Null> | <Null> |
| 13853 | USMC-MP10 | 14501 | USMC-MP10/1/WB1/MP1 | MARINE CORPS AIR STATION | 6089272.939 | 2200492.977 | Multiport Monitoring Well | MP1 (222) | <Null> | <Null> |
| 20296 | USMC-24EX20B | 20297 | USMC-24EX20B/1 | MARINE CORPS AIR STATION | 6106098.39 | 2192979.513 | Other Active Production Well | 106.8-204.8 | <Null> | <Null> |
| 20015 | USMC-SGU1 | 20016 | USMC-SGU1/1 | MARINE CORPS AIR STATION | 6109366.294 | 2188607.434 | Other Active Production Well | 96-206 | 3/9/2021 | 153.37 |
| 20090 | USMC-SGU16 | 20091 | USMC-SGU16/1 | MARINE CORPS AIR STATION | 6108500.694 | 2189851.338 | Other Active Production Well | 105-185 | 3/9/2021 | 128.4 |
| 21967 | USMC-SGU39 | 21968 | USMC-SGU39/1 | MARINE CORPS AIR STATION | 6105829.364 | 2192700.994 | Other Active Production Well | 90-190 | 3/8/2021 | 108.56 |
| 15117 | MCGN-BP1 | 15118 | MCGN-BP1/1 | MC GINNESS, BILL | 6030378.839 | 2253137.368 | Other Active Production Well | 50-255 | 6/30/2021 | 39.29 |
| 14284 | MSG-BP10L | 14285 | MSG-BP10L/1 | MCCOLL SITE GROUP | 6037931.453 | 2272258.752 | Monitoring Well | 247-257 | 6/30/2021 | 103.92 |
| 1134 | SULY-OA1 | 1135 | SULY-OA1/1 | MILAN REI, LLC | 6095028.945 | 2243462.53 | Other Active Production Well | - | 6/29/2021 | <Null> |
| 428 | W-428 | 429 | W-428/1 | MONBRI, LLC | 6074730.957 | 2271716.012 | Inactive Production Well | - | <Null> | <Null> |
| 3976 | OCWD-P10 | 3977 | OCWD-P10/1 | ORANGE COUNTY WATER DISTRICT | 6044117.886 | 2186405.599 | Destroyed and Sealed Well | 90-130 | <Null> | <Null> |
| 19007 | OCWD-BIO1 | 19008 | OCWD-BIO1/1 | ORANGE COUNTY WATER DISTRICT | 6082730.975 | 2257183.878 | Inactive Production Well | 25-115 | 7/7/2021 | 229.84 |
| 20858 | OCWD-EW2 | 20859 | OCWD-EW2/1 | ORANGE COUNTY WATER DISTRICT | 6053332.928 | 2263207.928 | Inactive Production Well | 130-196 | <Null> | <Null> |
| 20851 | OCWD-EW2A | 20852 | OCWD-EW2A/1 | ORANGE COUNTY WATER DISTRICT | 6049376.318 | 2263317.874 | Inactive Production Well | 122-188 | <Null> | <Null> |
| 22619 | OCWD-EW3A | 22620 | OCWD-EW3A/1 | ORANGE COUNTY WATER DISTRICT | 6050896.1 | 2260365.9 | Inactive Production Well | 235-290 | <Null> | <Null> |
| 21041 | OCWD-EW4 | 21042 | OCWD-EW4/1 | ORANGE COUNTY WATER DISTRICT | 6053819.546 | 2259558.892 | Inactive Production Well | 130-255 | <Null> | <Null> |
| 18056 | OCWD-I26A | 18057 | OCWD-I26A/1 | ORANGE COUNTY WATER DISTRICT | 6048813.793 | 2200416.667 | Injection Well | 60-195 | 7/6/2021 | 5.49 |
| 19465 | OCWD-I27A | 19466 | OCWD-I27A/1 | ORANGE COUNTY WATER DISTRICT | 6036244.383 | 2199722.281 | Injection Well | 78-148 | <Null> | <Null> |
| 19469 | OCWD-I28A | 19470 | OCWD-I28A/1 | ORANGE COUNTY WATER DISTRICT | 6036238.41 | 2199048.656 | Injection Well | 80-140 | 7/6/2021 | 3 |
| 19697 | OCWD-I29A | 19698 | OCWD-I29A/1 | ORANGE COUNTY WATER DISTRICT | 6034766.9 | 2200360.103 | Injection Well | 90-120 | <Null> | <Null> |
| 19701 | OCWD-I30A | 19702 | OCWD-I30A/1 | ORANGE COUNTY WATER DISTRICT | 6034047.2 | 2200278.003 | Injection Well | 95-160 | 6/28/2021 | 2.53 |
| 19711 | OCWD-I31A | 19712 | OCWD-I31A/1 | ORANGE COUNTY WATER DISTRICT | 6033586.7 | 2201013.903 | Injection Well | 90-165 | 7/6/2021 | 1.67 |
| 19707 | OCWD-I32A | 19708 | OCWD-I32A/1 | ORANGE COUNTY WATER DISTRICT | 6033114.8 | 2200599.403 | Injection Well | 90-155 | <Null> | <Null> |
| 19654 | OCWD-I33A | 19655 | OCWD-I33A/1 | ORANGE COUNTY WATER DISTRICT | 6045921.5 | 2194432.303 | Injection Well | 61-156 | 6/30/2021 | 5.16 |
| 19656 | OCWD-I34A | 19657 | OCWD-I34A/1 | ORANGE COUNTY WATER DISTRICT | 6045756.9 | 2193917.303 | Injection Well | 60-135 | <Null> | <Null> |
| 19658 | OCWD-I35A | 19659 | OCWD-I35A/1 | ORANGE COUNTY WATER DISTRICT | 6045558.2 | 2193150.603 | Injection Well | 60-115 | 6/30/2021 | 7.89 |
| 19678 | OCWD-I36A | 19679 | OCWD-I36A/1 | ORANGE COUNTY WATER DISTRICT | 6045421.1 | 2192575.403 | Injection Well | 60-110 | <Null> | <Null> |
| 1018 | AM-1 | 1019 | AM-1/1 | ORANGE COUNTY WATER DISTRICT | 6090472.39 | 2264185.952 | Monitoring Well | 97-115 | 6/30/2021 | 245.03 |

## Wells Used to Develop 2021 Groundwater Contour Maps in Orange County Groundwater Basin

**Shallow Aquifer Wells (Model Layer 1)**

| STAID1 | WELLNM | STAID | STANAME | OWNERNM | NAD83_X | NAD83_Y | GIS_SYMNM | PERF_ZONE | SHORTDATE | WLELEV_2021 |
|---|---|---|---|---|---|---|---|---|---|---|
| 545 | AM-10 | 546 | AM-10/1 | ORANGE COUNTY WATER DISTRICT | 6071304.771 | 2257813.261 | Monitoring Well | 217-235 | 7/7/2021 | 121.51 |
| 557 | AM-11 | 558 | AM-11/1 | ORANGE COUNTY WATER DISTRICT | 6072499.755 | 2255656.617 | Monitoring Well | 218-240 | 6/30/2021 | 121.98 |
| 555 | AM-12 | 556 | AM-12/1 | ORANGE COUNTY WATER DISTRICT | 6070962.221 | 2255565.488 | Monitoring Well | 210-225 | 7/7/2021 | 113.56 |
| 553 | AM-13 | 554 | AM-13/1 | ORANGE COUNTY WATER DISTRICT | 6072701.528 | 2256964.39 | Monitoring Well | 252-270 | 6/30/2021 | 128.38 |
| 2744 | AM-15A | 2745 | AM-15A/1 | ORANGE COUNTY WATER DISTRICT | 6062585.788 | 2256914.422 | Monitoring Well | 214-220 | 6/25/2021 | 89.81 |
| 2895 | AM-19A | 2896 | AM-19A/1 | ORANGE COUNTY WATER DISTRICT | 6065134.464 | 2236977.559 | Monitoring Well | 115-123 | 6/25/2021 | 77.56 |
| 1022 | AM-2 | 1023 | AM-2/1 | ORANGE COUNTY WATER DISTRICT | 6091404.587 | 2263383.522 | Monitoring Well | 87-100 | 6/30/2021 | 246.46 |
| 6515 | AM-21A | 6516 | AM-21A/1 | ORANGE COUNTY WATER DISTRICT | 6067232.542 | 2241283.088 | Monitoring Well | 157-165 | 6/25/2021 | 90.52 |
| 7011 | AM-25A | 7012 | AM-25A/1 | ORANGE COUNTY WATER DISTRICT | 6060775.248 | 2252483.682 | Monitoring Well | 188-195 | 6/25/2021 | 84.41 |
| 1020 | AM-3 | 1021 | AM-3/1 | ORANGE COUNTY WATER DISTRICT | 6090425.411 | 2261850.384 | Monitoring Well | 91-107 | 6/30/2021 | 245.62 |
| 7543 | AM-30A | 7544 | AM-30A/1 | ORANGE COUNTY WATER DISTRICT | 6046015.103 | 2255909.924 | Monitoring Well | 152-159 | 6/25/2021 | 55.16 |
| 22901 | AM-31AR | 22902 | AM-31AR/1 | ORANGE COUNTY WATER DISTRICT | 6052258.095 | 2257683 | Monitoring Well | 150-170 | 7/8/2021 | 69.05 |
| 8904 | AM-39A | 8905 | AM-39A/1 | ORANGE COUNTY WATER DISTRICT | 6057788.178 | 2260561.644 | Monitoring Well | 115-135 | 6/29/2021 | 82.15 |
| 549 | AM-4 | 550 | AM-4/1 | ORANGE COUNTY WATER DISTRICT | 6078257.417 | 2258629.141 | Monitoring Well | 187-205 | 7/7/2021 | 166.388 |
| 8908 | AM-40A | 8909 | AM-40A/1 | ORANGE COUNTY WATER DISTRICT | 6057765.028 | 2259083.041 | Monitoring Well | 145-165 | 6/25/2021 | 83.08 |
| 10147 | AM-41A | 10148 | AM-41A/1 | ORANGE COUNTY WATER DISTRICT | 6055818.758 | 2261031.665 | Monitoring Well | 156-166 | 6/30/2021 | 77.7 |
| 8232 | AM-42A | 8233 | AM-42A/1 | ORANGE COUNTY WATER DISTRICT | 6057305.512 | 2258837.864 | Monitoring Well | 115-130 | <Null> | <Null> |
| 14615 | AM-44 | 14616 | AM-44/1 | ORANGE COUNTY WATER DISTRICT | 6075009.801 | 2261947.637 | Monitoring Well | 140-160 | 6/30/2021 | 168.75 |
| 15331 | AM-45 | 15332 | AM-45/1 | ORANGE COUNTY WATER DISTRICT | 6071037.809 | 2252432.19 | Monitoring Well | 102-132 | 7/7/2021 | 104.04 |
| 15329 | AM-46 | 15330 | AM-46/1 | ORANGE COUNTY WATER DISTRICT | 6073338.847 | 2254329.24 | Monitoring Well | 94-124 | 7/7/2021 | 124.15 |
| 20711 | AM-47A | 20712 | AM-47A/1 | ORANGE COUNTY WATER DISTRICT | 6054345.1 | 2258323.2 | Monitoring Well | 160-170 | 6/25/2021 | 73.68 |
| 20703 | AM-48A | 20704 | AM-48A/1 | ORANGE COUNTY WATER DISTRICT | 6069389.1 | 2259146.8 | Monitoring Well | 116-146 | 7/8/2021 | 114.1 |
| 20760 | AM-49 | 20761 | AM-49/1 | ORANGE COUNTY WATER DISTRICT | 6068833 | 2259389.2 | Monitoring Well | 120-150 | 6/30/2021 | 112.28 |
| 22372 | AM-50 | 22373 | AM-50/1 | ORANGE COUNTY WATER DISTRICT | 6075090.3 | 2260329.2 | Monitoring Well | 140-150 | 7/1/2021 | 158.68 |
| 22714 | AM-51 | 22715 | AM-51/1 | ORANGE COUNTY WATER DISTRICT | 6078407.7 | 2256724.2 | Monitoring Well | 105-125 | 7/1/2021 | 176.413 |
| 23001 | AM-52 | 23002 | AM-52/1 | ORANGE COUNTY WATER DISTRICT | 6074643.8 | 2257784.5 | Monitoring Well | 140-150 | 7/1/2021 | 145.33 |
| 22939 | AM-53 | 22940 | AM-53/1 | ORANGE COUNTY WATER DISTRICT | 6076000.9 | 2255632.4 | Monitoring Well | 35-50 | 6/30/2021 | 199.08 |
| 23209 | AM-54A | 23210 | AM-54A/1 | ORANGE COUNTY WATER DISTRICT | 6055949.4 | 2259518.7 | Monitoring Well | 102-117 | 6/25/2021 | 77.92 |
| 2732 | AM-5A | 2733 | AM-5A/1 | ORANGE COUNTY WATER DISTRICT | 6078678.675 | 2259935.902 | Monitoring Well | 168-175 | 7/7/2021 | 166.45 |
| 551 | AM-6 | 552 | AM-6/1 | ORANGE COUNTY WATER DISTRICT | 6075037.515 | 2257301.421 | Monitoring Well | 232-250 | 7/7/2021 | 143.29 |
| 2734 | AM-7 | 2735 | AM-7/1 | ORANGE COUNTY WATER DISTRICT | 6071731.515 | 2260900.336 | Monitoring Well | 210-225 | 7/7/2021 | 131.58 |
| 2736 | AM-8 | 2737 | AM-8/1 | ORANGE COUNTY WATER DISTRICT | 6069027.597 | 2259867.528 | Monitoring Well | 268-285 | 7/7/2021 | 112.8 |
| 2738 | AM-9 | 2739 | AM-9/1 | ORANGE COUNTY WATER DISTRICT | 6068551.962 | 2256957.039 | Monitoring Well | 285-303 | 6/30/2021 | 106.16 |
| 14585 | AMD-9 | 14586 | AMD-9/1 | ORANGE COUNTY WATER DISTRICT | 6075825.081 | 2261784.701 | Monitoring Well | 200-220 | 7/1/2021 | 158.94 |
| 18333 | FM-10A | 18334 | FM-10A/1 | ORANGE COUNTY WATER DISTRICT | 6057594.391 | 2262015.979 | Monitoring Well | 151-171 | 6/29/2021 | 80.97 |
| 18337 | FM-11A | 18338 | FM-11A/1 | ORANGE COUNTY WATER DISTRICT | 6054079.666 | 2261018.177 | Monitoring Well | 134-154 | 6/30/2021 | 73.93 |
| 18341 | FM-12A | 18342 | FM-12A/1 | ORANGE COUNTY WATER DISTRICT | 6058082.287 | 2263020.488 | Monitoring Well | 135-155 | 6/29/2021 | 82.13 |
| 18345 | FM-13A | 18346 | FM-13A/1 | ORANGE COUNTY WATER DISTRICT | 6064721.254 | 2262602.268 | Monitoring Well | 140-160 | 7/1/2021 | 93.9 |
| 18349 | FM-14A | 18350 | FM-14A/1 | ORANGE COUNTY WATER DISTRICT | 6064616.249 | 2263074.072 | Monitoring Well | 147-167 | 7/2/2021 | 93.36 |
| 18353 | FM-15A | 18354 | FM-15A/1 | ORANGE COUNTY WATER DISTRICT | 6054101.553 | 2262617.193 | Monitoring Well | 120-140 | 6/29/2021 | 71.92 |
| 18414 | FM-16A | 18415 | FM-16A/1 | ORANGE COUNTY WATER DISTRICT | 6063638.746 | 2262326.768 | Monitoring Well | 125-145 | 7/3/2021 | 91.85 |
| 19614 | FM-18A | 19615 | FM-18A/1 | ORANGE COUNTY WATER DISTRICT | 6049386.482 | 2263643.669 | Monitoring Well | 120.5-150.5 | 6/29/2021 | 63.93 |
| 19618 | FM-19A | 19619 | FM-19A/1 | ORANGE COUNTY WATER DISTRICT | 6051553.311 | 2262443.484 | Monitoring Well | 115-135 | 6/29/2021 | 68.63 |
| 7019 | FM-1A | 7020 | FM-1A/1 | ORANGE COUNTY WATER DISTRICT | 6053145.617 | 2258731.83 | Monitoring Well | 164-172 | 6/25/2021 | 71.88 |
| 20764 | FM-20A | 20765 | FM-20A/1 | ORANGE COUNTY WATER DISTRICT | 6053785.7 | 2263876.3 | Monitoring Well | 130-150 | 6/29/2021 | 72.54 |
| 20768 | FM-21A | 20769 | FM-21A/1 | ORANGE COUNTY WATER DISTRICT | 6047768.5 | 2262675.5 | Monitoring Well | 140-160 | 6/29/2021 | 60.141 |
| 20753 | FM-22A | 20754 | FM-22A/1 | ORANGE COUNTY WATER DISTRICT | 6051124.3 | 2260372.1 | Monitoring Well | 150-170 | 6/25/2021 | 67.28 |
| 20884 | FM-23A | 20885 | FM-23A/1 | ORANGE COUNTY WATER DISTRICT | 6054153.6 | 2260625.1 | Monitoring Well | 128-143 | 6/29/2021 | 74.3 |
| 20701 | FM-24A | 20702 | FM-24A/1 | ORANGE COUNTY WATER DISTRICT | 6051431.3 | 2258787.9 | Monitoring Well | 154-174 | 6/25/2021 | 67.61 |
| 20316 | FM-25 | 20317 | FM-25/1 | ORANGE COUNTY WATER DISTRICT | 6068593.3 | 2262774.2 | Monitoring Well | 132-152 | 6/30/2021 | 110.53 |
| 20878 | FM-26 | 20879 | FM-26/1 | ORANGE COUNTY WATER DISTRICT | 6053369.5 | 2263220 | Monitoring Well | 145-155 | <Null> | <Null> |
| 20894 | FM-27 | 20895 | FM-27/1 | ORANGE COUNTY WATER DISTRICT | 6054575.1 | 2263550.9 | Monitoring Well | 105-125 | 6/29/2021 | 74.86 |
| 23221 | FM-29A | 23222 | FM-29A/1 | ORANGE COUNTY WATER DISTRICT | 6048986.6 | 2262406 | Monitoring Well | 150-170 | 6/29/2021 | 62.36 |
| 23571 | FM-30A | 23572 | FM-30A/1 | ORANGE COUNTY WATER DISTRICT | 6061066.47 | 2263552.561 | Monitoring Well | 106-126 | 6/29/2021 | 86.65 |
| 23227 | FM-31A | 23228 | FM-31A/1 | ORANGE COUNTY WATER DISTRICT | 6054066.6 | 2261852.6 | Monitoring Well | 122-137 | 6/29/2021 | 73.97 |
| 23231 | FM-32A | 23232 | FM-32A/1 | ORANGE COUNTY WATER DISTRICT | 6045296.9 | 2263968.8 | Monitoring Well | 135-155 | 6/29/2021 | 56.56 |
| 23483 | FM-33A | 23484 | FM-33A/1 | ORANGE COUNTY WATER DISTRICT | 6052364.7 | 2264780 | Monitoring Well | 135-155 | 6/29/2021 | 69.67 |
| 23575 | FM-34A | 23576 | FM-34A/1 | ORANGE COUNTY WATER DISTRICT | 6057208.2 | 2265369.9 | Monitoring Well | 114-124 | 7/8/2021 | 81.62 |
| 23894 | FM-35A | 23895 | FM-35A/1 | ORANGE COUNTY WATER DISTRICT | 6062993.381 | 2262539.528 | Monitoring Well | 180.1-195.1 | 7/6/2021 | 89.8 |
| 7521 | FM-4A | 7522 | FM-4A/1 | ORANGE COUNTY WATER DISTRICT | 6048400.799 | 2258801.821 | Monitoring Well | 142-160 | 6/25/2021 | 60.89 |
| 7932 | FM-5 | 7933 | FM-5/1 | ORANGE COUNTY WATER DISTRICT | 6059389.1 | 2261084.6 | Monitoring Well | 121-141 | 6/29/2021 | 85 |
| 9947 | FM-6 | 9948 | FM-6/1 | ORANGE COUNTY WATER DISTRICT | 6053264.065 | 2274113.568 | Monitoring Well | 150-310 | 6/30/2021 | 175.28 |
| 10145 | FM-7A | 10146 | FM-7A/1 | ORANGE COUNTY WATER DISTRICT | 6054314.136 | 2259267.565 | Monitoring Well | 160-170 | 6/25/2021 | 74.11 |
| 18325 | FM-8 | 18326 | FM-8/1 | ORANGE COUNTY WATER DISTRICT | 6059585.097 | 2263564.489 | Monitoring Well | 114-134 | 6/29/2021 | 84.74 |
| 18329 | FM-9A | 18330 | FM-9A/1 | ORANGE COUNTY WATER DISTRICT | 6063388.839 | 2262959.974 | Monitoring Well | 166-186 | 6/30/2021 | 89 |
| 19009 | IDM-3 | 19010 | IDM-3/1 | ORANGE COUNTY WATER DISTRICT | 6099726.882 | 2201438.084 | Monitoring Well | 174-194 | 6/28/2021 | 94.682 |
| 19404 | IDM-4 | 19405 | IDM-4/1 | ORANGE COUNTY WATER DISTRICT | 6103585.541 | 2200230.218 | Monitoring Well | 136-156 | 6/28/2021 | 107.205 |
| 19478 | IDP-2R | 19479 | IDP-2R/1 | ORANGE COUNTY WATER DISTRICT | 6106015.21 | 2193086.752 | Monitoring Well | 155-195 | 6/28/2021 | 115.845 |
| 721 | KBS-1 | 998 | KBS-1/1 | ORANGE COUNTY WATER DISTRICT | 6074374.124 | 2260345.831 | Monitoring Well | 209-219 | 7/1/2021 | 154.21 |
| 14600 | KBS-4 | 14601 | KBS-4/1 | ORANGE COUNTY WATER DISTRICT | 6073595.666 | 2262004.207 | Monitoring Well | 138-158 | 7/7/2021 | 154.88 |
| 1360 | MCAS-4 | 1361 | MCAS-4/1 | ORANGE COUNTY WATER DISTRICT | 6098189.884 | 2189446.916 | Monitoring Well | 181-238 | 6/28/2021 | 95.46 |
| 10217 | MCAS-5A | 10218 | MCAS-5A/1 | ORANGE COUNTY WATER DISTRICT | 6101340.027 | 2187474.726 | Monitoring Well | 120-130 | 6/28/2021 | 118.26 |
| 21062 | OCWD-34X40 | 21063 | OCWD-34X40/1 | ORANGE COUNTY WATER DISTRICT | 6005285 | 2228276.5 | Monitoring Well | 88-113 | <Null> | <Null> |
| 23057 | OCWD-34Y01 | 23058 | OCWD-34Y01/1 | ORANGE COUNTY WATER DISTRICT | 6001790.9 | 2226024.1 | Monitoring Well | 60-80 | 7/6/2021 | 2.734 |
| 5410 | OCWD-35H11 | 5413 | OCWD-35H11/1 | ORANGE COUNTY WATER DISTRICT | 6002891.562 | 2224892.037 | Monitoring Well | 44-77 | 7/6/2021 | -1.064 |
| 5414 | OCWD-35N01 | 5416 | OCWD-35N01/1 | ORANGE COUNTY WATER DISTRICT | 6001915.345 | 2223579.533 | Monitoring Well | 39-79 | <Null> | <Null> |
| 2859 | OCWD-AIR1 | 2860 | OCWD-AIR1/1 | ORANGE COUNTY WATER DISTRICT | 6037614.933 | 2265072.135 | Monitoring Well | 200-250 | 6/29/2021 | 39.807 |
| 3327 | OCWD-AN2 | 3328 | OCWD-AN2/1 | ORANGE COUNTY WATER DISTRICT | 6078166.807 | 2262263.165 | Monitoring Well | 35-115 | 6/28/2021 | 174.34 |
| 3317 | OCWD-BP3 | 3318 | OCWD-BP3/1 | ORANGE COUNTY WATER DISTRICT | 6069054.595 | 2245231.281 | Monitoring Well | 185-205 | 7/7/2021 | 97.415 |
| 3311 | OCWD-BP4 | 3312 | OCWD-BP4/1 | ORANGE COUNTY WATER DISTRICT | 6070719.841 | 2250468.164 | Monitoring Well | 140-180 | 7/7/2021 | 91.57 |
| 20224 | OCWD-BP5 | 20226 | OCWD-BP5/2 | ORANGE COUNTY WATER DISTRICT | 6069894.721 | 2249887.593 | Monitoring Well | 146.5-166.5 | 7/7/2021 | 125.41 |
| 20227 | OCWD-BP6 | 20228 | OCWD-BP6/1 | ORANGE COUNTY WATER DISTRICT | 6069328.8 | 2249065.103 | Monitoring Well | 148-168 | 7/7/2021 | 102.79 |
| 20229 | OCWD-BP7 | 20231 | OCWD-BP7/2 | ORANGE COUNTY WATER DISTRICT | 6069218.53 | 2247697.383 | Monitoring Well | 148-168 | 7/7/2021 | 101.76 |
| 22323 | OCWD-BS10 | 22324 | OCWD-BS10/1 | ORANGE COUNTY WATER DISTRICT | 6013179.752 | 2219396.307 | Monitoring Well | 100-110 | 7/1/2021 | -13.06 |
| 22330 | OCWD-BS11 | 22331 | OCWD-BS11/1 | ORANGE COUNTY WATER DISTRICT | 6008506.1 | 2221300 | Monitoring Well | 95-115 | 7/1/2021 | -9.453 |
| 22774 | OCWD-BS12 | 22968 | OCWD-BS12/1 | ORANGE COUNTY WATER DISTRICT | 6015660.3 | 2214181.8 | Monitoring Well | 115-125 | 7/1/2021 | -12.659 |
| 23682 | OCWD-BS13A | 23683 | OCWD-BS13A/1 | ORANGE COUNTY WATER DISTRICT | 6009763.8 | 2214240.5 | Monitoring Well | 127-132 | 7/1/2021 | -10.876 |
| 22776 | OCWD-BS14 | 22912 | OCWD-BS14/1 | ORANGE COUNTY WATER DISTRICT | 6003965.9 | 2221842.9 | Monitoring Well | 75-85 | 7/1/2021 | -4.65 |
| 19673 | OCWD-BS16 | 19674 | OCWD-BS16/1 | ORANGE COUNTY WATER DISTRICT | 6021997.663 | 2201854.703 | Monitoring Well | 60-80 | 7/1/2021 | -9.627 |
| 19675 | OCWD-BS18 | 19676 | OCWD-BS18/1 | ORANGE COUNTY WATER DISTRICT | 6018119.189 | 2205526.66 | Monitoring Well | 72-82 | 7/1/2021 | -11.001 |
| 22899 | OCWD-BS18B | 22900 | OCWD-BS18B/1 | ORANGE COUNTY WATER DISTRICT | 6018114.308 | 2205521.438 | Monitoring Well | 52-62 | 7/1/2021 | -11.192 |
| 19854 | OCWD-BS19 | 19855 | OCWD-BS19/1 | ORANGE COUNTY WATER DISTRICT | 6019002.9 | 2203605.503 | Monitoring Well | 62.5-82.5 | 7/1/2021 | -9.346 |
| 20140 | OCWD-BS20B | 20141 | OCWD-BS20B/1 | ORANGE COUNTY WATER DISTRICT | 6018514.448 | 2207922.493 | Monitoring Well | 70.8-80.8 | 6/24/2021 | -9.28 |
| 22778 | OCWD-BS21 | 22895 | OCWD-BS21/1 | ORANGE COUNTY WATER DISTRICT | 6004262.7 | 2223732.4 | Monitoring Well | 65-85 | 6/29/2021 | -2.96 |
| 23498 | OCWD-BS24A | 23500 | OCWD-BS24A/1 | ORANGE COUNTY WATER DISTRICT | 6005236.2 | 2219558.6 | Monitoring Well | 87.5-92.5 | 7/1/2021 | -8.055 |
| 2867 | OCWD-CTG1 | 2868 | OCWD-CTG1/1 | ORANGE COUNTY WATER DISTRICT | 6061970.346 | 2206073.478 | Monitoring Well | 160-260 | 6/30/2021 | 32.73 |
| 3309 | OCWD-FC2 | 3310 | OCWD-FC2/1 | ORANGE COUNTY WATER DISTRICT | 6072303.404 | 2252609.097 | Monitoring Well | 95-115 | 7/7/2021 | 105.49 |
| 3305 | OCWD-FH1 | 3306 | OCWD-FH1/1 | ORANGE COUNTY WATER DISTRICT | 6081695.772 | 2257027.264 | Monitoring Well | 120-140 | 7/7/2021 | 213.83 |

**Wells Used to Develop 2021 Groundwater Contour Maps in Orange County Groundwater Basin**

**Shallow Aquifer Wells (Model Layer 1)**

| STAID1 | WELLNM | STAID | STANAME | OWNERNM | NAD83_X | NAD83_Y | GIS_SYMNM | PERF_ZONE | SHORTDATE | WLELEV_2021 |
|---|---|---|---|---|---|---|---|---|---|---|
| 7056 | OCWD-GA2 | 7057 | OCWD-GA2/1 | ORANGE COUNTY WATER DISTRICT | 6024924.606 | 2202223.668 | Monitoring Well | 30-40 | 6/24/2021 | -4.615 |
| 23477 | OCWD-HG2 | 23478 | OCWD-HG2/1 | ORANGE COUNTY WATER DISTRICT | 6090811.6 | 2258833 | Monitoring Well | 43-48 | 7/7/2021 | 258.38 |
| 543 | OCWD-KB1 | 544 | OCWD-KB1/1 | ORANGE COUNTY WATER DISTRICT | 6073294.322 | 2259903.951 | Monitoring Well | 180-200 | 7/7/2021 | 141.77 |
| 20232 | OCWD-LB1 | 20234 | OCWD-LB1/2 | ORANGE COUNTY WATER DISTRICT | 6070964.86 | 2251336.473 | Monitoring Well | 148-168 | 7/7/2021 | 97.07 |
| 20237 | OCWD-LB3 | 20239 | OCWD-LB3/2 | ORANGE COUNTY WATER DISTRICT | 6071277.961 | 2250678.833 | Monitoring Well | 145-165 | 7/7/2021 | 93.26 |
| 21196 | OCWD-LB4 | 21198 | OCWD-LB4/2 | ORANGE COUNTY WATER DISTRICT | 6070798.52 | 2250812.078 | Monitoring Well | 78-88 | 7/7/2021 | 121.19 |
| 3303 | OCWD-LV1 | 3304 | OCWD-LV1/1 | ORANGE COUNTY WATER DISTRICT | 6085675.722 | 2259327.385 | Monitoring Well | 135-155 | 7/7/2021 | 237.5 |
| 3020 | OCWD-M1 | 3021 | OCWD-M1/1 | ORANGE COUNTY WATER DISTRICT | 6042016.978 | 2187264.062 | Monitoring Well | 75-110 | 6/30/2021 | 2.55 |
| 2906 | OCWD-M10 | 2907 | OCWD-M10/1 | ORANGE COUNTY WATER DISTRICT | 6038138.474 | 2201788.445 | Monitoring Well | 80-160 | 6/29/2021 | 2.175 |
| 2911 | OCWD-M11 | 2912 | OCWD-M11/1 | ORANGE COUNTY WATER DISTRICT | 6040661.307 | 2201457.181 | Monitoring Well | 70-105 | 6/30/2021 | 3.83 |
| 2924 | OCWD-M12 | 2925 | OCWD-M12/1 | ORANGE COUNTY WATER DISTRICT | 6043375.718 | 2201517.376 | Monitoring Well | 70-110 | 6/30/2021 | 5.775 |
| 2929 | OCWD-M13 | 2930 | OCWD-M13/1 | ORANGE COUNTY WATER DISTRICT | 6045991.781 | 2201410.369 | Monitoring Well | 65-95 | 6/30/2021 | 10.798 |
| 2947 | OCWD-M14A | 2948 | OCWD-M14A/1 | ORANGE COUNTY WATER DISTRICT | 6046612.239 | 2200062.034 | Monitoring Well | 60-90 | 6/28/2021 | 7.94 |
| 2954 | OCWD-M15A | 2955 | OCWD-M15A/1 | ORANGE COUNTY WATER DISTRICT | 6046620.011 | 2199773.098 | Monitoring Well | 60-85 | 6/28/2021 | 6.96 |
| 2961 | OCWD-M16 | 2962 | OCWD-M16/1 | ORANGE COUNTY WATER DISTRICT | 6046615.518 | 2199268.584 | Monitoring Well | 65-90 | 6/28/2021 | 4.264 |
| 2966 | OCWD-M17A | 2967 | OCWD-M17A/1 | ORANGE COUNTY WATER DISTRICT | 6046331.102 | 2200365.515 | Monitoring Well | 60-95 | 6/28/2021 | 7.867 |
| 2934 | OCWD-M19 | 2935 | OCWD-M19/1 | ORANGE COUNTY WATER DISTRICT | 6046001.209 | 2200836.043 | Monitoring Well | 60-110 | 6/30/2021 | 8.575 |
| 3022 | OCWD-M2 | 3023 | OCWD-M2/1 | ORANGE COUNTY WATER DISTRICT | 6039248.099 | 2187144.76 | Monitoring Well | 85-150 | 6/28/2021 | 4.202 |
| 2938 | OCWD-M20 | 2939 | OCWD-M20/1 | ORANGE COUNTY WATER DISTRICT | 6045975.835 | 2200531.536 | Monitoring Well | 60-105 | 6/30/2021 | 8.088 |
| 4395 | OCWD-M21 | 4398 | OCWD-M21/1 | ORANGE COUNTY WATER DISTRICT | 6046004.999 | 2200239.171 | Monitoring Well | 65-100 | 6/30/2021 | 7.39 |
| 2976 | OCWD-M22 | 2977 | OCWD-M22/1 | ORANGE COUNTY WATER DISTRICT | 6046004.496 | 2199936.42 | Monitoring Well | 70-105 | 6/30/2021 | 7.525 |
| 2987 | OCWD-M24 | 2988 | OCWD-M24/1 | ORANGE COUNTY WATER DISTRICT | 6045442.857 | 2199803.456 | Monitoring Well | 70-95 | 6/24/2021 | 6.605 |
| 3026 | OCWD-M25 | 3027 | OCWD-M25/1 | ORANGE COUNTY WATER DISTRICT | 6033478.884 | 2192672.122 | Monitoring Well | 65-185 | 6/30/2021 | 4.323 |
| 3014 | OCWD-M26 | 3015 | OCWD-M26/1 | ORANGE COUNTY WATER DISTRICT | 6040602.649 | 2193477.553 | Monitoring Well | 70-135 | 7/1/2021 | 3.386 |
| 3016 | OCWD-M27 | 3017 | OCWD-M27/1 | ORANGE COUNTY WATER DISTRICT | 6043039.524 | 2189845.444 | Monitoring Well | 60-110 | 6/30/2021 | 3.357 |
| 3030 | OCWD-M28 | 3031 | OCWD-M28/1 | ORANGE COUNTY WATER DISTRICT | 6040384.981 | 2184652.638 | Monitoring Well | 80-145 | 6/30/2021 | 3.808 |
| 3018 | OCWD-M30 | 3019 | OCWD-M30/1 | ORANGE COUNTY WATER DISTRICT | 6043301.989 | 2183249.013 | Monitoring Well | 90-110 | 6/28/2021 | 3.325 |
| 3024 | OCWD-M31 | 3025 | OCWD-M31/1 | ORANGE COUNTY WATER DISTRICT | 6040492.197 | 2179496.985 | Monitoring Well | 82-162 | 6/28/2021 | 4.918 |
| 11859 | OCWD-M36 | 11860 | OCWD-M36/1 | ORANGE COUNTY WATER DISTRICT | 6035356.833 | 2200840.246 | Monitoring Well | 80-90 | 6/28/2021 | 2.46 |
| 14515 | OCWD-M37 | 14516 | OCWD-M37/1 | ORANGE COUNTY WATER DISTRICT | 6035034.164 | 2201302.677 | Monitoring Well | 120-130 | 6/28/2021 | 1.78 |
| 15127 | OCWD-M38 | 15128 | OCWD-M38/1 | ORANGE COUNTY WATER DISTRICT | 6030736.262 | 2198146.213 | Monitoring Well | 94-104 | 6/30/2021 | 0.234 |
| 2992 | OCWD-M4 | 2993 | OCWD-M4/1 | ORANGE COUNTY WATER DISTRICT | 6049340.682 | 2199524.535 | Monitoring Well | 80-120 | 6/28/2021 | 3.04 |
| 16654 | OCWD-M40 | 16655 | OCWD-M40/1 | ORANGE COUNTY WATER DISTRICT | 6051222.286 | 2195005.215 | Monitoring Well | 85-105 | 6/28/2021 | 0.72 |
| 18425 | OCWD-M41 | 18427 | OCWD-M41/2 | ORANGE COUNTY WATER DISTRICT | 6031312.152 | 2196141.497 | Monitoring Well | 95-105 | 6/30/2021 | 1.256 |
| 18418 | OCWD-M42 | 18419 | OCWD-M42/1 | ORANGE COUNTY WATER DISTRICT | 6030956.495 | 2201880.558 | Monitoring Well | 100-120 | 6/24/2021 | -1.085 |
| 23769 | OCWD-M43R | 23770 | OCWD-M43R/1 | ORANGE COUNTY WATER DISTRICT | 6056258.4 | 2193225.9 | Monitoring Well | 75-95 | 6/28/2021 | -10.84 |
| 20371 | OCWD-M44 | 20372 | OCWD-M44/1 | ORANGE COUNTY WATER DISTRICT | 6048200.8 | 2193011.3 | Monitoring Well | 50-60 | 6/28/2021 | 5.089 |
| 19640 | OCWD-M45 | 19641 | OCWD-M45/1 | ORANGE COUNTY WATER DISTRICT | 6040339.8 | 2203350.603 | Monitoring Well | 195-205 | 6/30/2021 | 1.11 |
| 18766 | OCWD-M48 | 18767 | OCWD-M48/1 | ORANGE COUNTY WATER DISTRICT | 6059972.844 | 2188953.882 | Monitoring Well | 80-100 | 6/28/2021 | -25.796 |
| 2942 | OCWD-M5 | 2943 | OCWD-M5/1 | ORANGE COUNTY WATER DISTRICT | 6046006.801 | 2199404.116 | Monitoring Well | 65-95 | 6/30/2021 | 6.035 |
| 22780 | OCWD-M51A | 22847 | OCWD-M51A/1 | ORANGE COUNTY WATER DISTRICT | 6065086.6 | 2189052.9 | Monitoring Well | 28-38 | 6/24/2021 | 6.643 |
| 22782 | OCWD-M52A | 22845 | OCWD-M52A/1 | ORANGE COUNTY WATER DISTRICT | 6067063.8 | 2192832.5 | Monitoring Well | 46-56 | 6/24/2021 | 14.66 |
| 22783 | OCWD-M53A | 22849 | OCWD-M53A/1 | ORANGE COUNTY WATER DISTRICT | 6070492.9 | 2196785 | Monitoring Well | 21.5-31.5 | 7/27/2021 | 21.502 |
| 22785 | OCWD-M54A | 22852 | OCWD-M54A/1 | ORANGE COUNTY WATER DISTRICT | 6074213.9 | 2188681.7 | Monitoring Well | 38-43 | 6/24/2021 | -18.326 |
| 23136 | OCWD-M55B | 23137 | OCWD-M55B/1 | ORANGE COUNTY WATER DISTRICT | 6073271.8 | 2195029.2 | Monitoring Well | 57-67 | 6/24/2021 | 24.195 |
| 23138 | OCWD-M56 | 23139 | OCWD-M56/1 | ORANGE COUNTY WATER DISTRICT | 6076007.2 | 2194374.4 | Monitoring Well | 106-116 | 6/24/2021 | 12.115 |
| 23819 | OCWD-M57 | 23820 | OCWD-M57/1 | ORANGE COUNTY WATER DISTRICT | 6043815.8 | 2186794.1 | Monitoring Well | 80-130 | 6/28/2021 | 3.257 |
| 23888 | OCWD-M58A | 23889 | OCWD-M58A/1 | ORANGE COUNTY WATER DISTRICT | 6038939.075 | 2198039.987 | Monitoring Well | 80-90 | 6/28/2021 | 2.69 |
| 2997 | OCWD-M6A | 2998 | OCWD-M6A/1 | ORANGE COUNTY WATER DISTRICT | 6043358.318 | 2199431.427 | Monitoring Well | 65-125 | 6/30/2021 | 5.345 |
| 2916 | OCWD-M7A | 2917 | OCWD-M7A/1 | ORANGE COUNTY WATER DISTRICT | 6040722.972 | 2199455.757 | Monitoring Well | 70-135 | 7/1/2021 | 4.75 |
| 3004 | OCWD-M8 | 3005 | OCWD-M8/1 | ORANGE COUNTY WATER DISTRICT | 6036253.121 | 2199205.112 | Monitoring Well | 50-150 | 6/24/2021 | 4.403 |
| 3009 | OCWD-M9 | 3011 | OCWD-M9/2 | ORANGE COUNTY WATER DISTRICT | 6033874.971 | 2200507.549 | Monitoring Well | 135-155 | 6/30/2021 | 2.905 |
| 22659 | OCWD-SA22R | 22661 | OCWD-SA22R/2 | ORANGE COUNTY WATER DISTRICT | 6036740.5 | 2194795.1 | Monitoring Well | 100-130 | 6/30/2021 | 2.618 |
| 3978 | OCWD-T2 | 3980 | OCWD-T2/2 | ORANGE COUNTY WATER DISTRICT | 6035679.306 | 2192640.337 | Monitoring Well | 70-170 | 6/24/2021 | 3.624 |
| 4804 | OCWD-T3 | 4805 | OCWD-T3/1 | ORANGE COUNTY WATER DISTRICT | 6035928.37 | 2192634.905 | Monitoring Well | 65-85 | 6/30/2021 | 2.581 |
| 3985 | OCWD-T4 | 4846 | OCWD-T4/1 | ORANGE COUNTY WATER DISTRICT | 6036181.511 | 2192629.058 | Monitoring Well | 68-168 | 6/30/2021 | 3.314 |
| 3982 | OCWD-T5 | 3983 | OCWD-T5/1 | ORANGE COUNTY WATER DISTRICT | 6035375.819 | 2190450.423 | Monitoring Well | 110-190 | 6/30/2021 | 4.479 |
| 20892 | OCWD-YLR3 | 20893 | OCWD-YLR3/1 | ORANGE COUNTY WATER DISTRICT | 6087613.912 | 2264061.986 | Monitoring Well | 31-36 | 6/30/2021 | 237.2 |
| 1052 | OM-2A | 1053 | OM-2A/1 | ORANGE COUNTY WATER DISTRICT | 6064189.6 | 2231238.364 | Monitoring Well | 118-125 | 6/25/2021 | 63.638 |
| 1039 | OM-4A | 1040 | OM-4A/1 | ORANGE COUNTY WATER DISTRICT | 6066713.864 | 2235618.971 | Monitoring Well | 112-117 | 6/23/2021 | 76.25 |
| 6519 | OM-8A | 6520 | OM-8A/1 | ORANGE COUNTY WATER DISTRICT | 6068864.508 | 2240692.482 | Monitoring Well | 156-164 | 6/25/2021 | 89.55 |
| 20962 | SAM-1 | 20964 | SAM-1/2 | ORANGE COUNTY WATER DISTRICT | 6074659.6 | 2209328.2 | Monitoring Well | 132-147 | 6/30/2021 | 40.67 |
| 23285 | SAM-10C | 23286 | SAM-10C/1 | ORANGE COUNTY WATER DISTRICT | 6075362.1 | 2201059 | Monitoring Well | 77.5-82.5 | 7/1/2021 | 31.8 |
| 23291 | SAM-11D | 23292 | SAM-11D/1 | ORANGE COUNTY WATER DISTRICT | 6076595.5 | 2202810.9 | Monitoring Well | 90-100 | 6/30/2021 | 34.47 |
| 23297 | SAM-13D | 23298 | SAM-13D/1 | ORANGE COUNTY WATER DISTRICT | 6073031.3 | 2202354.5 | Monitoring Well | 91.5-101.5 | 6/30/2021 | 32.14 |
| 20984 | SAM-2 | 20986 | SAM-2/2 | ORANGE COUNTY WATER DISTRICT | 6072812.2 | 2208121.4 | Monitoring Well | 121-131 | 6/30/2021 | 39.83 |
| 20958 | SAM-3 | 20960 | SAM-3/2 | ORANGE COUNTY WATER DISTRICT | 6074219.9 | 2207608.9 | Monitoring Well | 122-142 | 6/30/2021 | 39.53 |
| 20970 | SAM-4 | 20972 | SAM-4/2 | ORANGE COUNTY WATER DISTRICT | 6072905.5 | 2206698.6 | Monitoring Well | 120-135 | 6/30/2021 | 38.16 |
| 20966 | SAM-5 | 20968 | SAM-5/2 | ORANGE COUNTY WATER DISTRICT | 6072894 | 2205886.2 | Monitoring Well | 115-130 | 6/30/2021 | 37.31 |
| 20948 | SAM-6 | 20950 | SAM-6/2 | ORANGE COUNTY WATER DISTRICT | 6075457.3 | 2205983.5 | Monitoring Well | 114-134 | <Null> | <Null> |
| 23263 | SAM-7C | 23264 | SAM-7C/1 | ORANGE COUNTY WATER DISTRICT | 6070824 | 2202542.5 | Monitoring Well | 106-111 | 7/1/2021 | 31.32 |
| 23301 | SAM-8C | 23302 | SAM-8C/1 | ORANGE COUNTY WATER DISTRICT | 6072805.6 | 2199933 | Monitoring Well | 65.5-75.5 | 6/30/2021 | 28.61 |
| 23275 | SAM-9C | 23276 | SAM-9C/1 | ORANGE COUNTY WATER DISTRICT | 6074482.7 | 2198350.3 | Monitoring Well | 58.5-63.5 | 6/30/2021 | 26.56 |
| 23824 | SAR-14B | 23825 | SAR-14B/1 | ORANGE COUNTY WATER DISTRICT | 6099053.012 | 2261319.993 | Monitoring Well | 37-42 | <Null> | <Null> |
| 20926 | SCS-11 | 20927 | SCS-11/1 | ORANGE COUNTY WATER DISTRICT | 6070448.4 | 2228003 | Monitoring Well | 156-166 | 7/8/2021 | 48.71 |
| 20929 | SCS-12 | 20930 | SCS-12/1 | ORANGE COUNTY WATER DISTRICT | 6067610.6 | 2228198.9 | Monitoring Well | 170-180 | 7/8/2021 | 60.2 |
| 15392 | SCS-6 | 15394 | SCS-6/2 | ORANGE COUNTY WATER DISTRICT | 6081489.879 | 2232585.107 | Monitoring Well | 147-152.5 | 7/8/2021 | 85.86 |
| 15395 | SCS-7 | 15397 | SCS-7/2 | ORANGE COUNTY WATER DISTRICT | 6080943.41 | 2232168.833 | Monitoring Well | 125-140.5 | 7/8/2021 | 93.62 |
| 15398 | SCS-8 | 15399 | SCS-8/1 | ORANGE COUNTY WATER DISTRICT | 6081887.799 | 2233776.982 | Monitoring Well | 108-128.5 | 7/8/2021 | 120.23 |
| 18179 | SCS-9 | 18180 | SCS-9/1 | ORANGE COUNTY WATER DISTRICT | 6082464.896 | 2233574.788 | Monitoring Well | 153-173 | 7/8/2021 | 76 |
| 997 | ABS-1 | 22665 | ABS-1/1/WB2/MP3 | ORANGE COUNTY WATER DISTRICT | 6076226.851 | 2262977.612 | Multiport Monitoring Well | MP3 (257) | 7/7/2021 | 158.375 |
| 547 | AMD-1 | 21135 | AMD-1/1/WB2/MP3 | ORANGE COUNTY WATER DISTRICT | 6073916.932 | 2258572.091 | Multiport Monitoring Well | MP3 (182) | 6/30/2021 | 144.17 |
| 565 | AMD-2 | 22202 | AMD-2/1/WB2/MP1 | ORANGE COUNTY WATER DISTRICT | 6066705.21 | 2254540.618 | Multiport Monitoring Well | MP1 (157) | 6/29/2021 | 99.56 |
| 6410 | AMD-3 | 6433 | AMD-3/1/WB1/MP2 | ORANGE COUNTY WATER DISTRICT | 6057347.584 | 2256481.116 | Multiport Monitoring Well | MP2 (135) | <Null> | <Null> |
| 7295 | AMD-5 | 7315 | AMD-5/1/WB1/MP2 | ORANGE COUNTY WATER DISTRICT | 6060070.244 | 2248962.576 | Multiport Monitoring Well | MP2 (201) | 6/28/2021 | 81.17 |
| 7293 | AMD-6 | 7477 | AMD-6/1/WB1/MP2 | ORANGE COUNTY WATER DISTRICT | 6057374.729 | 2241092.645 | Multiport Monitoring Well | MP2 (152) | 6/28/2021 | 69.17 |
| 8596 | AMD-7 | 8748 | AMD-7/1/WB1/MP1 | ORANGE COUNTY WATER DISTRICT | 6049188.026 | 2247218.215 | Multiport Monitoring Well | MP1 (121) | 6/28/2021 | 59.63 |
| 9682 | AMD-8 | 9903 | AMD-8/1/WB1/MP2 | ORANGE COUNTY WATER DISTRICT | 6033488.697 | 2249624.328 | Multiport Monitoring Well | MP2 (180) | 7/12/2021 | 44.575 |
| 9831 | BPM-1 | 9980 | BPM-1/1/WB1/MP1 | ORANGE COUNTY WATER DISTRICT | 6022348.508 | 2259541.566 | Multiport Monitoring Well | MP1 (129) | 7/12/2021 | 26.87 |
| 9832 | BPM-2 | 10174 | BPM-2/1/WB1/MP1 | ORANGE COUNTY WATER DISTRICT | 6025195.413 | 2246739.597 | Multiport Monitoring Well | MP1 (181) | 7/12/2021 | 35.65 |
| 685 | CB-1 | 8787 | CB-1/1/WB2/MP2 | ORANGE COUNTY WATER DISTRICT | 6044695.232 | 2253837.186 | Multiport Monitoring Well | MP2 (143) | 7/6/2021 | 53.15 |
| 5155 | COSM-1 | 7143 | COSM-1/1/WB1/MP1 | ORANGE COUNTY WATER DISTRICT | 6055253.401 | 2197825.036 | Multiport Monitoring Well | MP1 (92) | 6/30/2021 | 2.01 |
| 18846 | COSM-2 | 18860 | COSM-2/1/WB1/MP2 | ORANGE COUNTY WATER DISTRICT | 6052266.414 | 2199776.431 | Multiport Monitoring Well | MP2 (115) | 6/30/2021 | 8.62 |
| 719 | FFS-1 | 14241 | FFS-1/1/WB2/MP1 | ORANGE COUNTY WATER DISTRICT | 6061436.461 | 2262022.62 | Multiport Monitoring Well | MP1 (181) | 7/6/2021 | 88.13 |
| 1291 | FVM-1 | 15685 | FVM-1/1/WB2/MP2 | ORANGE COUNTY WATER DISTRICT | 6047178.815 | 2210990.613 | Multiport Monitoring Well | MP2 (173) | 6/22/2021 | 28.21 |
| 7297 | GGM-1 | 10021 | GGM-1/1/WB1/MP1 | ORANGE COUNTY WATER DISTRICT | 6045688.299 | 2230864.24 | Multiport Monitoring Well | MP1 (150) | 7/8/2021 | 51.65 |
| 8923 | GGM-2 | 9045 | GGM-2/1/WB1/MP1 | ORANGE COUNTY WATER DISTRICT | 6026525.607 | 2230233.156 | Multiport Monitoring Well | MP1 (213) | 6/22/2021 | 26.83 |
| 8592 | GGM-3 | 8661 | GGM-3/1/WB1/MP1 | ORANGE COUNTY WATER DISTRICT | 6037298.069 | 2237458.988 | Multiport Monitoring Well | MP1 (197) | 7/8/2021 | 43.98 |

**Wells Used to Develop 2021 Groundwater Contour Maps in Orange County Groundwater Basin**

**Shallow Aquifer Wells (Model Layer 1)**

| STAID1 | WELLNM | STAID | STANAME | OWNERNM | NAD83_X | NAD83_Y | GIS_SYMNM | PERF_ZONE | SHORTDATE | WLELEV_2021 |
|---|---|---|---|---|---|---|---|---|---|---|
| 7178 | HBM-1 | 8433 | HBM-1/1/WB1/MP1 | ORANGE COUNTY WATER DISTRICT | 6031700.722 | 2216385.252 | Multiport Monitoring Well | MP1 (91) | 7/2/2021 | 24.52 |
| 7086 | HBM-2 | 7218 | HBM-2/1/WB1/MP1 | ORANGE COUNTY WATER DISTRICT | 6036228.737 | 2196532.383 | Multiport Monitoring Well | MP1 (112) | 7/2/2021 | 3.49 |
| 9200 | HBM-4 | 9219 | HBM-4/1/WB1/MP2 | ORANGE COUNTY WATER DISTRICT | 6034095.825 | 2197123.319 | Multiport Monitoring Well | MP2 (120) | 7/2/2021 | 2.99 |
| 9688 | HBM-5 | 9873 | HBM-5/1/WB1/MP2 | ORANGE COUNTY WATER DISTRICT | 6045744.869 | 2193971.856 | Multiport Monitoring Well | MP2 (76) | 7/2/2021 | 9.36 |
| 15088 | HBM-6 | 15239 | HBM-6/1/WB1/MP1 | ORANGE COUNTY WATER DISTRICT | 6025106.578 | 2204548.969 | Multiport Monitoring Well | MP1 (53) | 7/2/2021 | -6.84 |
| 720 | IDM-1 | 18976 | IDM-1/1/WB2/MP1 | ORANGE COUNTY WATER DISTRICT | 6099572.243 | 2207081.537 | Multiport Monitoring Well | MP1 (86) | 7/7/2021 | 92.85 |
| 9830 | IDM-2 | 10059 | IDM-2/1/WB1/MP1 | ORANGE COUNTY WATER DISTRICT | 6080705.598 | 2209836.046 | Multiport Monitoring Well | MP1 (129) | 7/7/2021 | 48.9 |
| 541 | KBS-2 | 10226 | KBS-2/1/WB1/MP2 | ORANGE COUNTY WATER DISTRICT | 6073053.762 | 2260992.439 | Multiport Monitoring Well | MP2 (214) | 6/21/2021 | 144.53 |
| 11949 | LAM-1 | 12020 | LAM-1/1/WB1/MP1 | ORANGE COUNTY WATER DISTRICT | 6009581.587 | 2238043.705 | Multiport Monitoring Well | MP1 (72) | 6/15/2021 | 13.07 |
| 1345 | MCAS-1 | 5841 | MCAS-1/1/WB2/MP2 | ORANGE COUNTY WATER DISTRICT | 6098255.481 | 2192973.357 | Multiport Monitoring Well | MP2 (155) | 7/6/2021 | 97.79 |
| 759 | MCAS-2 | 5926 | MCAS-2/1/WB2/MP2 | ORANGE COUNTY WATER DISTRICT | 6100360.442 | 2191167.958 | Multiport Monitoring Well | MP2 (135) | 7/6/2021 | 106.75 |
| 1339 | MCAS-3 | 5882 | MCAS-3/1/WB2/MP2 | ORANGE COUNTY WATER DISTRICT | 6104434.428 | 2191276.758 | Multiport Monitoring Well | MP2 (166) | 7/6/2021 | 114.92 |
| 758 | MCAS-7 | 11826 | MCAS-7/1/WB3/MP1 | ORANGE COUNTY WATER DISTRICT | 6093900.827 | 2194418.586 | Multiport Monitoring Well | MP1 (92) | 7/7/2021 | 83.2 |
| 756 | SAR-1 | 9257 | SAR-1/1/WB2/MP1 | ORANGE COUNTY WATER DISTRICT | 6070684.206 | 2250425.314 | Multiport Monitoring Well | MP1 (162) | 6/29/2021 | 92.52 |
| 761 | SAR-2 | 11984 | SAR-2/1/WB2/MP1 | ORANGE COUNTY WATER DISTRICT | 6069096.008 | 2245410.807 | Multiport Monitoring Well | MP1 (141) | 6/29/2021 | 99.88 |
| 762 | SAR-3 | 9461 | SAR-3/1/WB2/MP1 | ORANGE COUNTY WATER DISTRICT | 6066892.02 | 2238409.284 | Multiport Monitoring Well | MP1 (164) | 6/24/2021 | 81.47 |
| 763 | SAR-4 | 14628 | SAR-4/1/WB2/MP1 | ORANGE COUNTY WATER DISTRICT | 6065370.966 | 2233375.154 | Multiport Monitoring Well | MP1 (123) | 6/29/2021 | 70.47 |
| 1289 | SAR-5 | 21217 | SAR-5/1/WB3/MP2 | ORANGE COUNTY WATER DISTRICT | 6062597.607 | 2227874.211 | Multiport Monitoring Well | MP2 (172) | 6/30/2021 | 58.48 |
| 996 | SAR-7 | 19998 | SAR-7/1/WB2/MP2 | ORANGE COUNTY WATER DISTRICT | 6078049.17 | 2256383.048 | Multiport Monitoring Well | MP2 (171) | 6/21/2021 | 183.21 |
| 559 | SAR-8 | 22591 | SAR-8/1/WB2/MP3 | ORANGE COUNTY WATER DISTRICT | 6076100.201 | 2255671.218 | Multiport Monitoring Well | MP3 (161) | 6/21/2021 | 204.32 |
| 7181 | SAR-9 | 9796 | SAR-9/1/WB1/MP1 | ORANGE COUNTY WATER DISTRICT | 6058380.802 | 2221450.982 | Multiport Monitoring Well | MP1 (150) | 6/30/2021 | 49.087 |
| 9686 | SBM-1 | 9723 | SBM-1/1/WB1/MP1 | ORANGE COUNTY WATER DISTRICT | 6016566.11 | 2224523.54 | Multiport Monitoring Well | MP1 (79) | 6/15/2021 | 8.535 |
| 1000 | SC-1 | 21651 | SC-1/1/WB2/MP1 | ORANGE COUNTY WATER DISTRICT | 6089555.444 | 2242038.806 | Multiport Monitoring Well | MP1 (47) | <Null> | <Null> |
| 1001 | SC-2 | 18744 | SC-2/1/WB2/MP3 | ORANGE COUNTY WATER DISTRICT | 6086489.295 | 2237887.557 | Multiport Monitoring Well | MP3 (148) | <Null> | <Null> |
| 2888 | SC-4 | 6293 | SC-4/1/WB1/MP1 | ORANGE COUNTY WATER DISTRICT | 6082605.785 | 2235080.546 | Multiport Monitoring Well | MP1 (102) | 3/10/2021 | 164.02 |
| 2854 | SC-5 | 6327 | SC-5/1/WB1/MP1 | ORANGE COUNTY WATER DISTRICT | 6077454.866 | 2225543.458 | Multiport Monitoring Well | MP1 (124) | 7/1/2021 | 59.96 |
| 9684 | SC-6 | 9754 | SC-6/1/WB1/MP2 | ORANGE COUNTY WATER DISTRICT | 6066813.288 | 2216032.113 | Multiport Monitoring Well | MP2 (202) | 7/7/2021 | 47.93 |
| 1016 | SCS-1 | 8863 | SCS-1/1/WB1/MP2 | ORANGE COUNTY WATER DISTRICT | 6088950.708 | 2237855.374 | Multiport Monitoring Well | MP2 (94) | <Null> | <Null> |
| 1014 | SCS-2 | 22649 | SCS-2/1/WB2/MP1 | ORANGE COUNTY WATER DISTRICT | 6088207.123 | 2239962.183 | Multiport Monitoring Well | MP1 (139) | <Null> | <Null> |
| 1008 | WBS-2A | 10234 | WBS-2A/1/WB1/MP2 | ORANGE COUNTY WATER DISTRICT | 6082321.431 | 2259606.923 | Multiport Monitoring Well | MP2 (94) | 6/21/2021 | 208.44 |
| 1011 | WBS-4 | 19982 | WBS-4/1/WB2/MP2 | ORANGE COUNTY WATER DISTRICT | 6080099.39 | 2256910.089 | Multiport Monitoring Well | MP2 (122) | 6/21/2021 | 193.21 |
| 1293 | WMM-1 | 19877 | WMM-1/1/WB2/MP1 | ORANGE COUNTY WATER DISTRICT | 6038251.554 | 2221751.195 | Multiport Monitoring Well | MP1 (111) | 7/8/2021 | 35.73 |
| 1124 | OCWD-BESS | 1152 | OCWD-BESS/1 | ORANGE COUNTY WATER DISTRICT | 6080158.417 | 2258062.783 | Other Active Production Well | 172-189 | 7/7/2021 | 171.45 |
| 1399 | OWOD-GG | 1400 | OWOD-GG/1 | ORANGEWOOD ACADEMY | 6057015.043 | 2226104.239 | Other Active Production Well | 159-179 | 6/28/2021 | 57.78 |
| 2268 | W-2268 | 2270 | W-2268/1 | PRIVATE | 6055379.538 | 2239905.999 | Inactive Production Well | 140-190 | 6/28/2021 | 65.1 |
| 2447 | W-2447 | 2448 | W-2447/1 | PRIVATE | 6039781.004 | 2230376.471 | Inactive Production Well | 157-178 | 6/30/2021 | 45.52 |
| 7046 | W-7046 | 7047 | W-7046/1 | PRIVATE | 6078609.174 | 2244437.793 | Inactive Production Well | - | 7/8/2021 | 83.04 |
| 23777 | PRUD-MW49 | 23778 | PRUD-MW49/1 | PRUDENTIAL REALTY CORPORATION | 6075571.865 | 2190248.213 | Monitoring Well | 22-32 | <Null> | <Null> |
| 23783 | PRUD-TP07 | 23784 | PRUD-TP07/1 | PRUDENTIAL REALTY CORPORATION | 6075439.364 | 2190268.695 | Monitoring Well | 22-32 | <Null> | <Null> |
| 23785 | PRUD-TP10 | 23786 | PRUD-TP10/1 | PRUDENTIAL REALTY CORPORATION | 6075138.851 | 2190153.723 | Monitoring Well | 35-45 | <Null> | <Null> |
| 22761 | RAY-P07 | 22762 | RAY-P07/1 | RAYTHEON TECHNOLOGIES CORPORATION | 6042051.6 | 2268371.59 | Monitoring Well | 107.7-129.6 | 6/30/2021 | 56.01 |
| 22763 | RAY-P09 | 22764 | RAY-P09/1 | RAYTHEON TECHNOLOGIES CORPORATION | 6042223.4 | 2268769.56 | Monitoring Well | 109.6-129.6 | 6/30/2021 | 68.63 |
| 1194 | SANZ-C | 1195 | SANZ-C/1 | SANCHEZ, AMELIA | 6023494.753 | 2248016.248 | Other Active Production Well | 76-83 | 6/28/2021 | 42.58 |
| 1164 | RODE-A | 1165 | RODE-A/1 | SILICON SALVAGE | 6035121.635 | 2259930.623 | Other Active Production Well | 178-208 | 6/28/2021 | 40.77 |
| 3743 | TIC-127 | 3744 | TIC-127/1 | SOUTHERN CALIFORNIA EDISON | 6098420.447 | 2188499.752 | Monitoring Well | - | <Null> | <Null> |
| 19683 | BOE-MW31S | 19684 | BOE-MW31S/1 | THE BOEING COMPANY | 6017036.97 | 2217640.872 | Monitoring Well | 78-88 | 6/7/2021 | -3.481 |
| 20244 | BOE-EW102 | 20245 | BOE-EW102/1 | THE BOEING COMPANY | 6017705 | 2219232.003 | Other Active Production Well | 62-81.7 | <Null> | <Null> |
| 1128 | TMIX-O | 1129 | TMIX-O/1 | TRANSIT MIXED CONCRETE COMPANY | 6069953.158 | 2244552.046 | Abandoned Well | 76-288 | 6/29/2021 | 107.06 |
| 1370 | T-NEWP | 1371 | T-NEWP/1 | TUSTIN | 6087882.616 | 2220782.263 | Active Large-System Production Well | 234-267 | 7/1/2021 | 31.06 |
| 21187 | WRD-SEALBEACH-1 | 21188 | WRD-SEALBEACH-1/1 | WATER REPLENISHMENT DISTRICT | 6002807.228 | 2229796.158 | Monitoring Well | 60-70 | 6/7/2021 | -0.287 |
| 23796 | XER-MW3 | 23797 | XER-MW3/1 | XEROX CORPORATION | 6074925.4 | 2191231.3 | Destroyed and Sealed Well | 29-34 | <Null> | <Null> |
| 23801 | XER-MW5 | 23802 | XER-MW5/1 | XEROX CORPORATION | 6076231.9 | 2191234.6 | Monitoring Well | 34.5-39.5 | <Null> | <Null> |
| 23803 | XER-OW50 | 23804 | XER-OW50/1 | XEROX CORPORATION | 6074926.467 | 2191241.45 | Monitoring Well | 35-47 | <Null> | <Null> |
| 7027 | YLWD-16 | 7028 | YLWD-16/1 | YORBA LINDA WATER DISTRICT | 6123141.996 | 2265497.536 | Destroyed and Sealed Well | 40-60 | <Null> | <Null> |
| 7529 | YLWD-17 | 7530 | YLWD-17/1 | YORBA LINDA WATER DISTRICT | 6123146.156 | 2265420.578 | Destroyed and Sealed Well | 42-82 | <Null> | <Null> |
| 1520 | YLWD-15 | 1521 | YLWD-15/1 | YORBA LINDA WATER DISTRICT | 6085437.359 | 2260363.815 | Standby Large-System Production Well | 133-198 | <Null> | <Null> |

**Wells Used to Develop 2021 Groundwater Contour Maps in Orange County Groundwater Basin**

**Principal Aquifer Wells (Model Layer 2)**

| STAID1 | WELLNM | STAID | STANAME | OWNERNM | GIS_SYMNM | NAD83_X | NAD83_Y | PERF_ZONE | SHORTDATE | WLELEV_2021 | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 15484 | AVCC-P2 | 15485 | AVCC-P2/1 | ALTA VISTA COUNTRY CLUB | Other Active Production Well | 6075388.705 | 2267012.656 | 210-770 | 6/29/2021 | 83.575 | <Null> |
| 903 | A-39 | 904 | A-39/1 | ANAHEIM | Active Large-System Production Well | 6029597.629 | 2248076.493 | 540-1280 | 6/24/2021 | 0.95 | <Null> |
| 8 | A-40 | 109 | A-40/1 | ANAHEIM | Active Large-System Production Well | 6042665.936 | 2241510.291 | 505-1220 | 6/25/2021 | 0.99 | <Null> |
| 2 | A-42 | 102 | A-42/1 | ANAHEIM | Active Large-System Production Well | 6076410.19 | 2260884.14 | 430-1180 | 6/24/2021 | 158.27 | <Null> |
| 3 | A-44 | 106 | A-44/1 | ANAHEIM | Active Large-System Production Well | 6075745.03 | 2262067.192 | 450-1130 | 6/24/2021 | 149.51 | <Null> |
| 18323 | A-45 | 18324 | A-45/1 | ANAHEIM | Active Large-System Production Well | 6064928.908 | 2240047.749 | 455-1410 | 6/24/2021 | 70.25 | <Null> |
| 9029 | A-46 | 9030 | A-46/1 | ANAHEIM | Active Large-System Production Well | 6063620.6 | 2247980.932 | 599-1529 | 6/24/2021 | 78.27 | <Null> |
| 3296 | A-47 | 3297 | A-47/1 | ANAHEIM | Active Large-System Production Well | 6043274.016 | 2253508.899 | 482-1375 | 6/25/2021 | 6.94 | <Null> |
| 20128 | A-48 | 20129 | A-48/1 | ANAHEIM | Active Large-System Production Well | 6039676.184 | 2252635.146 | 932-1344 | 6/25/2021 | -8 | <Null> |
| 7175 | A-49 | 7176 | A-49/1 | ANAHEIM | Active Large-System Production Well | 6051692.012 | 2255804.997 | 580-1450 | 6/24/2021 | 42.3 | <Null> |
| 18380 | A-51 | 18381 | A-51/1 | ANAHEIM | Active Large-System Production Well | 6033547.226 | 2249423.825 | 525-965 | 6/25/2021 | -13.82 | <Null> |
| 19546 | A-52 | 19547 | A-52/1 | ANAHEIM | Active Large-System Production Well | 6077704.821 | 2261093.873 | 570-1066 | 6/24/2021 | 169.8 | <Null> |
| 19371 | A-53 | 19372 | A-53/1 | ANAHEIM | Active Large-System Production Well | 6037376.558 | 2245173.272 | 945-1270 | 6/25/2021 | -15 | <Null> |
| 20130 | A-54 | 20131 | A-54/1 | ANAHEIM | Active Large-System Production Well | 6057250.4 | 2249808.49 | 680-1480 | 6/24/2021 | 37.5 | <Null> |
| 15155 | A-55 | 15156 | A-55/1 | ANAHEIM | Active Large-System Production Well | 6057199.693 | 2240917.141 | 370-1300 | 6/24/2021 | 24.82 | <Null> |
| 20814 | A-56 | 20815 | A-56/1 | ANAHEIM | Active Large-System Production Well | 6049068.109 | 2246784.849 | 725-1300 | 6/24/2021 | 11 | <Null> |
| 22689 | A-58 | 22690 | A-58/1 | ANAHEIM | Active Large-System Production Well | 6076957.97 | 2260975.182 | 400-930 | 6/24/2021 | 157 | <Null> |
| 23093 | A-59 | 23094 | A-59/1 | ANAHEIM | Active Large-System Production Well | 6050447.318 | 2241983.774 | 740-1270 | 6/24/2021 | 18 | <Null> |
| 9 | A-41 | 112 | A-41/1 | ANAHEIM | Inactive Production Well | 6053236.333 | 2238146.843 | 437-1450 | 6/29/2021 | 17.41 | <Null> |
| 1 | A-43 | 101 | A-43/1 | ANAHEIM | Inactive Production Well | 6075927.929 | 2261453.161 | 530-1210 | 6/24/2021 | 155.86 | <Null> |
| 882 | A-DMGC | 883 | A-DMGC/1 | ANAHEIM | Other Active Production Well | 6039662.685 | 2252561.822 | 430-482 | 6/25/2021 | 3 | <Null> |
| 11918 | BP-BALL | 11919 | BP-BALL/1 | BUENA PARK | Active Large-System Production Well | 6022213.798 | 2245381.375 | 260-870 | 6/28/2021 | -8.9 | <Null> |
| 11890 | BP-BOIS | 11891 | BP-BOIS/1 | BUENA PARK | Active Large-System Production Well | 6035674.646 | 2258374.859 | 475-1355 | 6/30/2021 | 14.03 | <Null> |
| 6 | BP-CABA | 110 | BP-CABA/1 | BUENA PARK | Active Large-System Production Well | 6024286.125 | 2262965.786 | 250-1010 | 6/28/2021 | -24.6 | <Null> |
| 394 | BP-FREE | 901 | BP-FREE/1 | BUENA PARK | Active Large-System Production Well | 6026742.413 | 2259834.394 | 260-1000 | 6/28/2021 | -24.5 | <Null> |
| 13 | BP-HOLD | 103 | BP-HOLD/1 | BUENA PARK | Active Large-System Production Well | 6024539.646 | 2250081.536 | 250-1000 | 7/1/2021 | -6.4 | <Null> |
| 205 | BP-KNOT | 206 | BP-KNOT/1 | BUENA PARK | Active Large-System Production Well | 6026889.096 | 2263326.166 | 260-1000 | 6/28/2021 | -22.7 | <Null> |
| 19624 | BP-LIND | 19625 | BP-LIND/1 | BUENA PARK | Active Large-System Production Well | 6033483.531 | 2254059.483 | 470-1221 | 7/1/2021 | -11.5 | <Null> |
| 4 | BP-SM | 107 | BP-SM/1 | BUENA PARK | Active Large-System Production Well | 6033035.282 | 2270048.001 | 308-1038 | 6/29/2021 | 60.3 | <Null> |
| 19013 | CSF-1 | 19130 | CSF-1/1/WB1/MP4 | CA. STATE UNIV., FULLERTON | Multiport Monitoring Well | 6064343.084 | 2270822.497 | MP4 (454) | 7/6/2021 | 95.19 | <Null> |
| 5133 | OCWD-SA10 | 5136 | OCWD-SA10/3 | DEPARTMENT OF WATER RESOURCES | Monitoring Well | 6039247.362 | 2190515.118 | 300-330 | 6/28/2021 | -27.73 | <Null> |
| 75 | EOCW-E | 2624 | EOCW-E/1 | EAST ORANGE COUNTY WATER DISTRICT | Active Large-System Production Well | 6084070.661 | 2234506.703 | 324-450 | 6/9/2021 | 40.6 | <Null> |
| 74 | EOCW-W | 2623 | EOCW-W/1 | EAST ORANGE COUNTY WATER DISTRICT | Active Large-System Production Well | 6084006.305 | 2234482.779 | 315-450 | 6/9/2021 | 42.5 | <Null> |
| 1636 | ANDR-A | 3116 | ANDR-A/1 | ELTISTE, JAMIE | Other Active Production Well | 6089089.85 | 2256920.388 | - | 6/29/2021 | 266.7 | <Null> |
| 2151 | FV-10 | 2152 | FV-10/1 | FOUNTAIN VALLEY | Active Large-System Production Well | 6050675.518 | 2207799.966 | 460-980 | 3/28/2021 | -32.08 | <Null> |
| 2218 | FV-11 | 2219 | FV-11/1 | FOUNTAIN VALLEY | Active Large-System Production Well | 6043548.905 | 2210280.198 | 440-950 | 6/28/2021 | -13.22 | <Null> |
| 15548 | FV-12 | 15549 | FV-12/1 | FOUNTAIN VALLEY | Active Large-System Production Well | 6048362.825 | 2212580.442 | 340-1070 | 6/28/2021 | -19.8 | <Null> |
| 643 | FV-6 | 1228 | FV-6/1 | FOUNTAIN VALLEY | Active Large-System Production Well | 6052471.003 | 2208423.32 | 370-1110 | 6/27/2021 | -57.6 | <Null> |
| 989 | FV-8 | 990 | FV-8/1 | FOUNTAIN VALLEY | Active Large-System Production Well | 6052244.232 | 2213617.679 | 312-844 | 6/23/2021 | -22.77 | <Null> |
| 21043 | FV-9 | 21044 | FV-9/1 | FOUNTAIN VALLEY | Active Large-System Production Well | 6039667.163 | 2210310.989 | 415-1070 | 7/3/2021 | -39.2 | <Null> |
| 6999 | F-10 | 7000 | F-10/1 | FULLERTON | Active Large-System Production Well | 6062173.417 | 2262322.138 | 460-1290 | 6/30/2021 | 78.92 | <Null> |
| 62 | F-4 | 1066 | F-4/1 | FULLERTON | Active Large-System Production Well | 6053113.41 | 2256243.518 | 315-405 | <Null> | <Null> | No static water level |
| 60 | F-5 | 1064 | F-5/1 | FULLERTON | Active Large-System Production Well | 6052548.597 | 2256107.709 | 350-400 | 6/30/2021 | 73.32 | <Null> |
| 61 | F-6 | 1065 | F-6/1 | FULLERTON | Active Large-System Production Well | 6052747.388 | 2256082.222 | 340-401 | <Null> | <Null> | No static water level |
| 58 | F-8 | 1062 | F-8/1 | FULLERTON | Active Large-System Production Well | 6052703.232 | 2256195.873 | 324-402 | 6/30/2021 | 53.02 | <Null> |
| 7 | F-AIRP | 111 | F-AIRP/1 | FULLERTON | Active Large-System Production Well | 6036730.867 | 2265796.644 | 435-1080 | 6/30/2021 | -0.98 | <Null> |
| 8250 | F-CHRI2 | 8251 | F-CHRI2/1 | FULLERTON | Active Large-System Production Well | 6043423.817 | 2259590.954 | 520-1330 | 6/30/2021 | 11 | <Null> |
| 18605 | F-KIM1A | 18606 | F-KIM1A/1 | FULLERTON | Active Large-System Production Well | 6059437.543 | 2261596.705 | 500-1225 | <Null> | <Null> | No static water level |
| 2614 | F-KIM2 | 2615 | F-KIM2/1 | FULLERTON | Active Large-System Production Well | 6062988.653 | 2261590.596 | 320-626 | 6/30/2021 | 83.02 | <Null> |
| 14527 | F-3A | 14528 | F-3A/1 | FULLERTON | Inactive Production Well | 6052567.9 | 2256330.735 | 580-1280 | 6/30/2021 | 43.62 | <Null> |
| 8556 | F-COYO2 | 8557 | F-COYO2/1 | FULLERTON | Inactive Production Well | 6040365.852 | 2271034.694 | 309-919 | 6/30/2021 | 85.12 | <Null> |
| 16 | GG-16 | 120 | GG-16/1 | GARDEN GROVE | Active Large-System Production Well | 6018579.01 | 2232461.498 | 304-864 | 6/30/2021 | -17.92 | <Null> |
| 24 | GG-20 | 126 | GG-20/1 | GARDEN GROVE | Active Large-System Production Well | 6038073.339 | 2227032.571 | 360-912 | 7/2/2021 | -3 | <Null> |
| 395 | GG-22 | 929 | GG-22/1 | GARDEN GROVE | Active Large-System Production Well | 6026676.395 | 2235110.939 | 416-1020 | 6/28/2021 | -8 | <Null> |
| 970 | GG-25 | 971 | GG-25/1 | GARDEN GROVE | Active Large-System Production Well | 6047504.135 | 2225582.455 | 442-850 | 7/4/2021 | -4 | <Null> |
| 968 | GG-26 | 969 | GG-26/1 | GARDEN GROVE | Active Large-System Production Well | 6055989.26 | 2226872.674 | 470-1060 | 6/27/2021 | -7.5 | <Null> |
| 899 | GG-27 | 900 | GG-27/1 | GARDEN GROVE | Active Large-System Production Well | 6037663.073 | 2237687.515 | 520-1160 | 7/6/2021 | -2 | <Null> |
| 21518 | GG-31 | 21519 | GG-31/1 | GARDEN GROVE | Active Large-System Production Well | 6049303.952 | 2233106.343 | 739-1373 | 7/7/2021 | -12 | <Null> |
| 43 | GG-19 | 2673 | GG-19/1 | GARDEN GROVE | Inactive Production Well | 6046486.765 | 2237386.406 | 818-892 | 6/30/2021 | 12.66 | <Null> |
| 10 | GG-21 | 113 | GG-21/1 | GARDEN GROVE | Inactive Production Well | 6053483.401 | 2233322.843 | 428-1080 | 6/28/2021 | 10 | <Null> |
| 40 | GG-23 | 2683 | GG-23/1 | GARDEN GROVE | Inactive Production Well | 6049380.377 | 2233107.081 | 474-835 | 6/30/2021 | 21 | <Null> |
| 11910 | GG-29 | 11911 | GG-29/1 | GARDEN GROVE | Standby Large-System Production Well | 6058221.696 | 2231433.99 | 465-1110 | 6/28/2021 | -8 | <Null> |
| 19548 | GG-30 | 19549 | GG-30/1 | GARDEN GROVE | Standby Large-System Production Well | 6058357.807 | 2234214.139 | 390-1146 | 6/28/2021 | 19.2 | <Null> |
| 23833 | GSWC-CHF3 | 23834 | GSWC-CHF3/1 | GOLDEN STATE WATER COMPANY | Active Large-System Production Well | 6080817.993 | 2228562.283 | 415-825 | 6/1/2021 | 2.66 | <Null> |
| 20695 | GSWC-POR1 | 20696 | GSWC-POR1/1 | GOLDEN STATE WATER COMPANY | Active Large-System Production Well | 6079506.635 | 2263540.675 | 350-895 | <Null> | <Null> | No static water level |
| 21249 | GSWC-SCL5 | 21250 | GSWC-SCL5/1 | GOLDEN STATE WATER COMPANY | Active Large-System Production Well | 6033365.183 | 2242754.29 | 915-1280 | 6/26/2021 | -14 | <Null> |
| 913 | SCWC-CBAL | 914 | SCWC-CBAL/1 | GOLDEN STATE WATER COMPANY | Active Large-System Production Well | 6020255.615 | 2245432.308 | 200-770 | 6/26/2021 | -16.3 | <Null> |
| 905 | SCWC-CSC | 906 | SCWC-CSC/1 | GOLDEN STATE WATER COMPANY | Active Large-System Production Well | 6019058.295 | 2249273.52 | 526-556 | 6/29/2021 | -16 | <Null> |
| 15059 | SCWC-LABL2 | 15060 | SCWC-LABL2/1 | GOLDEN STATE WATER COMPANY | Active Large-System Production Well | 6010813.626 | 2245084.513 | 460-690 | 6/25/2021 | -45 | <Null> |
| 909 | SCWC-LAC3 | 910 | SCWC-LAC3/1 | GOLDEN STATE WATER COMPANY | Active Large-System Production Well | 6009351.523 | 2240861.379 | 346-593 | 6/2/2021 | -39.28 | <Null> |
| 2890 | SCWC-LAFL | 2891 | SCWC-LAFL/1 | GOLDEN STATE WATER COMPANY | Active Large-System Production Well | 6009761.621 | 2241392.543 | 300-680 | 6/2/2021 | -44.7 | <Null> |
| 932 | SCWC-LAHO | 933 | SCWC-LAHO/1 | GOLDEN STATE WATER COMPANY | Active Large-System Production Well | 6013044.186 | 2239882.249 | 386-486 | 6/26/2021 | -22.15 | <Null> |
| 938 | SCWC-LAYT | 939 | SCWC-LAYT/1 | GOLDEN STATE WATER COMPANY | Active Large-System Production Well | 6006632.572 | 2231013.121 | 250-800 | 6/29/2021 | -47.42 | <Null> |
| 83 | SCWC-PBF4 | 1075 | SCWC-PBF4/1 | GOLDEN STATE WATER COMPANY | Active Large-System Production Well | 6069384.796 | 2263342.45 | 275-520 | 5/25/2021 | 119 | <Null> |
| 66 | SCWC-PLJ2 | 1070 | SCWC-PLJ2/1 | GOLDEN STATE WATER COMPANY | Active Large-System Production Well | 6067609.83 | 2260053.948 | 402-492 | 6/25/2021 | 106 | <Null> |
| 15488 | SCWC-PRU | 15489 | SCWC-PRU/1 | GOLDEN STATE WATER COMPANY | Active Large-System Production Well | 6069096.18 | 2266983.102 | 430-790 | 6/30/2021 | 98 | <Null> |
| 940 | SCWC-SBCH | 941 | SCWC-SBCH/1 | GOLDEN STATE WATER COMPANY | Active Large-System Production Well | 6031904.764 | 2233300.581 | 200-570 | <Null> | <Null> | Well in exclusion list |
| 925 | SCWC-SDAL | 926 | SCWC-SDAL/1 | GOLDEN STATE WATER COMPANY | Active Large-System Production Well | 6034900.671 | 2235490.72 | 500-542 | 6/28/2021 | -1 | <Null> |
| 1530 | SCWC-SLON | 1531 | SCWC-SLON/1 | GOLDEN STATE WATER COMPANY | Active Large-System Production Well | 6028180.861 | 2242547.915 | - | 6/26/2021 | 1 | <Null> |
| 927 | SCWC-SORG | 928 | SCWC-SORG/1 | GOLDEN STATE WATER COMPANY | Active Large-System Production Well | 6031153.704 | 2237527.217 | 242-286 | <Null> | <Null> | Well in exclusion list |
| 919 | SCWC-SSHR | 920 | SCWC-SSHR/1 | GOLDEN STATE WATER COMPANY | Active Large-System Production Well | 6036356.964 | 2241844.025 | 520-580 | 6/29/2021 | 14 | <Null> |
| 942 | SCWC-SSYC | 943 | SCWC-SSYC/1 | GOLDEN STATE WATER COMPANY | Active Large-System Production Well | 6033362.684 | 2230788.849 | 500-546 | 6/16/2021 | -5 | <Null> |
| 18790 | RHWC-W2 | 18791 | RHWC-W2/1 | GOLDEN STATE WATER COMPANY | Inactive Production Well | 6080901.573 | 2228585.131 | 474-753 | 6/1/2021 | -4.2 | <Null> |
| 19579 | SCWC-CVV2 | 19580 | SCWC-CVV2/1 | GOLDEN STATE WATER COMPANY | Inactive Production Well | 6021484.347 | 2249526.359 | 480-981 | 6/29/2021 | -16 | <Null> |
| 2616 | SCWC-PBF3 | 2617 | SCWC-PBF3/1 | GOLDEN STATE WATER COMPANY | Inactive Production Well | 6069378.014 | 2263398.289 | 220-475 | 5/25/2021 | 117 | <Null> |
| 9522 | SCWC-YLCO2 | 9523 | SCWC-YLCO2/1 | GOLDEN STATE WATER COMPANY | Inactive Production Well | 6091725.912 | 2261952.552 | 100-480 | 5/25/2021 | 254 | <Null> |
| 1147 | HOLY-A | 1148 | HOLY-A/1 | HOLY SEPULCHER CEMETERY | Other Active Production Well | 6047567.386 | 2247438.547 | 334-364 | 6/28/2021 | 23.43 | <Null> |
| 1244 | HB-10 | 1245 | HB-10/1 | HUNTINGTON BEACH | Active Large-System Production Well | 6031343.851 | 2212699.814 | 232-942 | 6/30/2021 | -39.55 | <Null> |
| 18384 | HB-13 | 18385 | HB-13/1 | HUNTINGTON BEACH | Active Large-System Production Well | 6021661.742 | 2221160.513 | 280-810 | 6/14/2021 | -44.54 | <Null> |
| 23201 | HB-1A | 23202 | HB-1A/1 | HUNTINGTON BEACH | Active Large-System Production Well | 6023131.185 | 2218817.882 | 410-805 | 4/29/2021 | -42.324 | <Null> |
| 10208 | HB-3A | 10209 | HB-3A/1 | HUNTINGTON BEACH | Active Large-System Production Well | 6031590.226 | 2208300.41 | 370-640 | 6/28/2021 | -41.53 | <Null> |
| 27 | HB-4 | 130 | HB-4/1 | HUNTINGTON BEACH | Active Large-System Production Well | 6021540.371 | 2221406.93 | 252-804 | 6/28/2021 | -30.04 | <Null> |
| 1252 | HB-5 | 1253 | HB-5/1 | HUNTINGTON BEACH | Active Large-System Production Well | 6036338.835 | 2208549.742 | 223-800 | 6/29/2021 | -39.24 | <Null> |
| 1246 | HB-6 | 1247 | HB-6/1 | HUNTINGTON BEACH | Active Large-System Production Well | 6029305.314 | 2212450.473 | 246-810 | 6/15/2021 | -44.55 | <Null> |
| 1261 | HB-7 | 1262 | HB-7/1 | HUNTINGTON BEACH | Active Large-System Production Well | 6022149.127 | 2221238.007 | 263-879 | 6/21/2021 | -37.74 | <Null> |
| 28 | HB-9 | 129 | HB-9/1 | HUNTINGTON BEACH | Active Large-System Production Well | 6037364.908 | 2208498.213 | 556-996 | 6/30/2021 | -55.58 | <Null> |
| 1248 | HB-8 | 1249 | HB-8/1 | HUNTINGTON BEACH | Inactive Production Well | 6027670.035 | 2209264.856 | 256-704 | 6/15/2021 | -45.53 | <Null> |
| 1457 | HB-MEA2 | 1458 | HB-MEA2/1 | HUNTINGTON BEACH | Other Active Production Well | 6020702.13 | 2209754.143 | 480-510 | 6/29/2021 | -44.67 | <Null> |
| 1643 | TAOR-A | 3123 | TAOR-A/1 | HUYNH, TUAN | Inactive Production Well | 6067751.89 | 2255475.782 | - | 6/28/2021 | 90.52 | <Null> |
| 22 | IRWD-1 | 124 | IRWD-1/1 | IRVINE RANCH WATER DISTRICT | Active Large-System Production Well | 6061580.041 | 2205422.106 | 410-860 | 6/23/2021 | -85.8 | <Null> |
| 11476 | IRWD-10 | 11477 | IRWD-10/1 | IRVINE RANCH WATER DISTRICT | Active Large-System Production Well | 6055993.429 | 2207529.468 | 419.07-939.6 | <Null> | <Null> | No static water level |
| 22342 | IRWD-107R | 22343 | IRWD-107R/1 | IRVINE RANCH WATER DISTRICT | Active Large-System Production Well | 6095711.53 | 2205898.451 | 275-1000 | <Null> | <Null> | No static water level |
| 393 | IRWD-11 | 1224 | IRWD-11/1 | IRVINE RANCH WATER DISTRICT | Active Large-System Production Well | 6059766.912 | 2205005.285 | 410-870 | 6/23/2021 | -98.3 | <Null> |
| 19366 | IRWD-110 | 19367 | IRWD-110/1 | IRVINE RANCH WATER DISTRICT | Active Large-System Production Well | 6100371.561 | 2196315.961 | 555-1015 | <Null> | <Null> | No static water level |
| 22856 | IRWD-115R | 22857 | IRWD-115R/1 | IRVINE RANCH WATER DISTRICT | Active Large-System Production Well | 6093475.865 | 2207945.022 | 290-1080 | <Null> | <Null> | No static water level |
| 397 | IRWD-12 | 991 | IRWD-12/1 | IRVINE RANCH WATER DISTRICT | Active Large-System Production Well | 6057023.616 | 2209371.259 | 580-1040 | 5/26/2021 | -67.4 | <Null> |

**Wells Used to Develop 2021 Groundwater Contour Maps in Orange County Groundwater Basin**

**Principal Aquifer Wells (Model Layer 2)**

| STAID1 | WELLNM | STAID | STANAME | OWNERNM | GIS_SYMNM | NAD83_X | NAD83_Y | PERF_ZONE | SHORTDATE | WLELEV_2021 | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 392 | IRWD-13 | 1227 | IRWD-13/1 | IRVINE RANCH WATER DISTRICT | Active Large-System Production Well | 6056862.056 | 2205734.981 | 410-980 | 6/30/2021 | -76 | <Null> |
| 1225 | IRWD-14 | 1226 | IRWD-14/1 | IRVINE RANCH WATER DISTRICT | Active Large-System Production Well | 6057193.114 | 2207516.401 | 470-970 | 6/30/2021 | -90.2 | <Null> |
| 7082 | IRWD-15 | 7083 | IRWD-15/1 | IRVINE RANCH WATER DISTRICT | Active Large-System Production Well | 6058994.6 | 2207797.409 | 470-990 | 4/21/2021 | -62.1 | <Null> |
| 14827 | IRWD-16 | 14828 | IRWD-16/1 | IRVINE RANCH WATER DISTRICT | Active Large-System Production Well | 6055756.572 | 2207045.785 | 406.03-806.73 | 6/30/2021 | -75.3 | <Null> |
| 11478 | IRWD-17 | 11479 | IRWD-17/1 | IRVINE RANCH WATER DISTRICT | Active Large-System Production Well | 6056285.662 | 2208810.875 | 504.06-959.62 | 4/21/2021 | -52.2 | <Null> |
| 21 | IRWD-18 | 115 | IRWD-18/1 | IRVINE RANCH WATER DISTRICT | Active Large-System Production Well | 6060643.784 | 2208050.14 | 390-1080 | <Null> | <Null> | No static water level |
| 994 | IRWD-2 | 995 | IRWD-2/1 | IRVINE RANCH WATER DISTRICT | Active Large-System Production Well | 6067589.167 | 2204114.565 | 385-855 | 4/21/2021 | -75.9 | <Null> |
| 8372 | IRWD-21 | 8373 | IRWD-21/1 | IRVINE RANCH WATER DISTRICT | Active Large-System Production Well | 6083385.042 | 2214485.399 | 290-970 | 6/29/2021 | 2.41 | <Null> |
| 8370 | IRWD-22 | 8371 | IRWD-22/1 | IRVINE RANCH WATER DISTRICT | Active Large-System Production Well | 6083876.226 | 2214049.348 | 300-970 | <Null> | <Null> | No static water level |
| 11474 | IRWD-3 | 11475 | IRWD-3/1 | IRVINE RANCH WATER DISTRICT | Active Large-System Production Well | 6072630.329 | 2206528.469 | 483.53-1249.9 | 6/23/2021 | -64.9 | <Null> |
| 672 | IRWD-4 | 993 | IRWD-4/1 | IRVINE RANCH WATER DISTRICT | Active Large-System Production Well | 6065784.295 | 2205666.545 | 440-910 | <Null> | <Null> | No static water level |
| 15490 | IRWD-5 | 15491 | IRWD-5/1 | IRVINE RANCH WATER DISTRICT | Active Large-System Production Well | 6070026.423 | 2205985.727 | 554.42-1028.47 | <Null> | <Null> | No static water level |
| 8558 | IRWD-6 | 8559 | IRWD-6/1 | IRVINE RANCH WATER DISTRICT | Active Large-System Production Well | 6067126.622 | 2207312.356 | 499-1124 | 3/23/2021 | -51.4 | <Null> |
| 8560 | IRWD-7 | 8561 | IRWD-7/1 | IRVINE RANCH WATER DISTRICT | Active Large-System Production Well | 6057958.676 | 2203766.228 | 359-660 | 6/23/2021 | -86.8 | <Null> |
| 19412 | IRWD-76 | 19413 | IRWD-76/1 | IRVINE RANCH WATER DISTRICT | Active Large-System Production Well | 6097532.587 | 2201980.705 | 450-900 | <Null> | <Null> | No static water level |
| 19414 | IRWD-77 | 19415 | IRWD-77/1 | IRVINE RANCH WATER DISTRICT | Active Large-System Production Well | 6095951.099 | 2203527.216 | 330-980 | <Null> | <Null> | No static water level |
| 18510 | IRWD-C8 | 18511 | IRWD-C8/1 | IRVINE RANCH WATER DISTRICT | Active Large-System Production Well | 6062825.396 | 2204153.762 | 1080-1982 | <Null> | <Null> | Well in exclusion list |
| 18512 | IRWD-C9 | 18513 | IRWD-C9/1 | IRVINE RANCH WATER DISTRICT | Active Large-System Production Well | 6062422.93 | 2205055.852 | 1055-1930 | <Null> | <Null> | Well in exclusion list |
| 8929 | IRWD-51 | 8930 | IRWD-51/1 | IRVINE RANCH WATER DISTRICT | Inactive Production Well | 6072287.787 | 2201236.375 | 310-880 | 6/29/2021 | -51.7 | <Null> |
| 22065 | IRWD-52 | 22066 | IRWD-52/1 | IRVINE RANCH WATER DISTRICT | Inactive Production Well | 6073545.847 | 2203710.984 | 635-1290 | 6/29/2021 | -62.3 | <Null> |
| 1503 | IRWD-98 | 1504 | IRWD-98/1 | IRVINE RANCH WATER DISTRICT | Inactive Production Well | 6080266.015 | 2190031.269 | 115-343 | 6/29/2021 | -54.42 | <Null> |
| 22710 | IRWD-OPA1 | 22711 | IRWD-OPA1/1 | IRVINE RANCH WATER DISTRICT | Inactive Production Well | 6086291.17 | 2237727.918 | 390-750 | 6/28/2021 | 41.5 | <Null> |
| 1379 | TIC-109 | 1380 | TIC-109/1 | IRVINE RANCH WATER DISTRICT | Inactive Production Well | 6093513 | 2212849.72 | 240-1120 | 6/29/2021 | 16.9 | <Null> |
| 1381 | TIC-112 | 1382 | TIC-112/1 | IRVINE RANCH WATER DISTRICT | Inactive Production Well | 6092052.48 | 2212026.724 | 240-1100 | 6/29/2021 | 15.23 | <Null> |
| 1377 | TIC-114 | 1378 | TIC-114/1 | IRVINE RANCH WATER DISTRICT | Inactive Production Well | 6094747.508 | 2212848.22 | 300-960 | 6/29/2021 | 19.88 | <Null> |
| 1941 | TIC-82 | 1942 | TIC-82/1 | IRVINE RANCH WATER DISTRICT | Monitoring Well | 6090541.059 | 2199639.983 | 410-1002 | 6/29/2021 | -8.83 | <Null> |
| 1343 | IRWD-72 | 1344 | IRWD-72/1 | IRVINE RANCH WATER DISTRICT | Other Active Production Well | 6090498.014 | 2215406.267 | 254-1151 | 6/29/2021 | 9.9 | <Null> |
| 1389 | TIC-106 | 1390 | TIC-106/1 | IRVINE RANCH WATER DISTRICT | Other Active Production Well | 6084967 | 2197177.989 | 405-715 | 3/23/2021 | -45.1 | <Null> |
| 432 | W-432 | 433 | W-432/1 | KATHY BONANNO | Inactive Production Well | 6080325.38 | 2272580.463 | 117-137 | 6/30/2021 | 286.97 | <Null> |
| 1176 | KNOT-BPBS | 1515 | KNOT-BPBS/1 | KNOTT'S BERRY FARM | Active Small-System Production Well | 6029633.814 | 2254234.979 | 430-630 | 6/29/2021 | 8.14 | <Null> |
| 12 | LP-CITY | 105 | LP-CITY/1 | LA PALMA | Active Large-System Production Well | 6015567.916 | 2254199.963 | 290-1415 | 6/29/2021 | -72.67 | <Null> |
| 5 | LP-WALK | 108 | LP-WALK/1 | LA PALMA | Active Large-System Production Well | 6019189.082 | 2262316.73 | 489-919 | 6/25/2021 | -25.45 | <Null> |
| 14284 | MSG-BP10L | 14285 | MSG-BP10L/1 | MCCOLL SITE GROUP | Monitoring Well | 6037931.453 | 2272258.752 | 247-257 | 6/30/2021 | 103.92 | <Null> |
| 1505 | MVCC-COSD2 | 1506 | MVCC-COSD2/1 | MESA VERDE COUNTRY CLUB | Other Active Production Well | 6049566.742 | 2197240.664 | 200-450 | 6/30/2021 | -65.825 | <Null> |
| 15780 | MCWD-11 | 15781 | MCWD-11/1 | MESA WATER DISTRICT | Active Large-System Production Well | 6055237.67 | 2197733.913 | 330-1000 | 7/7/2021 | -86.57 | <Null> |
| 10138 | MCWD-1B | 10139 | MCWD-1B/1 | MESA WATER DISTRICT | Active Large-System Production Well | 6058120.94 | 2200970.067 | 305-580 | <Null> | <Null> | No static water level |
| 31 | MCWD-3B | 2892 | MCWD-3B/1 | MESA WATER DISTRICT | Active Large-System Production Well | 6053761.218 | 2202557.912 | 242-572 | <Null> | <Null> | Well in exclusion list |
| 1231 | MCWD-5 | 1232 | MCWD-5/1 | MESA WATER DISTRICT | Active Large-System Production Well | 6051212.891 | 2202686.998 | 400-940 | <Null> | <Null> | No static water level |
| 2135 | MCWD-6 | 2136 | MCWD-6/1 | MESA WATER DISTRICT | Active Large-System Production Well | 6055652.152 | 2197722.22 | 310-1025 | <Null> | <Null> | No static water level |
| 1233 | MCWD-7 | 1234 | MCWD-7/1 | MESA WATER DISTRICT | Active Large-System Production Well | 6053044.669 | 2200013.913 | 363-753 | <Null> | <Null> | No static water level |
| 23121 | MESA-9B | 23122 | MESA-9B/1 | MESA WATER DISTRICT | Active Large-System Production Well | 6055224.568 | 2200729.295 | 350-580 | <Null> | <Null> | No static water level |
| 23 | MCWD-2 | 125 | MCWD-2/1 | MESA WATER DISTRICT | Monitoring Well | 6060220.541 | 2200931.5 | 300-650 | 7/7/2021 | -88.14 | <Null> |
| 7747 | MCWD-3BM | 7748 | MCWD-3BM/1 | MESA WATER DISTRICT | Monitoring Well | 6053810.232 | 2202578.466 | 530-570 | 7/7/2021 | -67.5 | <Null> |
| 14833 | NB-DOLD | 14834 | NB-DOLD/1 | NEWPORT BEACH | Active Large-System Production Well | 6041557.515 | 2205737.495 | 399-729 | 6/30/2021 | -41.75 | <Null> |
| 14835 | NB-DOLS | 14836 | NB-DOLS/1 | NEWPORT BEACH | Active Large-System Production Well | 6041637.348 | 2205746.699 | 201-356 | <Null> | <Null> | Well in exclusion list |
| 14837 | NB-TAMD | 14838 | NB-TAMD/1 | NEWPORT BEACH | Active Large-System Production Well | 6037391.886 | 2206329.916 | 395-690 | 6/29/2021 | -42.79 | <Null> |
| 14839 | NB-TAMS | 14840 | NB-TAMS/1 | NEWPORT BEACH | Active Large-System Production Well | 6037391.924 | 2206247.365 | 170-360 | <Null> | <Null> | Well in exclusion list |
| 71 | O-18 | 2625 | O-18/1 | ORANGE | Active Large-System Production Well | 6073004.258 | 2233669.343 | 372-574 | 6/28/2021 | 44.64 | <Null> |
| 79 | O-19 | 2618 | O-19/1 | ORANGE | Active Large-System Production Well | 6072211.218 | 2241094.476 | 444-1014 | 6/28/2021 | 105.35 | <Null> |
| 2694 | O-20 | 2696 | O-20/1 | ORANGE | Active Large-System Production Well | 6065992.895 | 2234093.189 | 400-1130 | 6/28/2021 | 13.83 | <Null> |
| 81 | O-21 | 1073 | O-21/1 | ORANGE | Active Large-System Production Well | 6075241.088 | 2245598.993 | 482-1252 | 6/28/2021 | 90.16 | <Null> |
| 2921 | O-22 | 3295 | O-22/1 | ORANGE | Active Large-System Production Well | 6077271.09 | 2239348.179 | 342-802 | 6/28/2021 | 53.77 | <Null> |
| 7173 | O-23 | 7174 | O-23/1 | ORANGE | Active Large-System Production Well | 6084469.321 | 2236564.181 | 370-640 | 6/28/2021 | 23.32 | <Null> |
| 10140 | O-24 | 10141 | O-24/1 | ORANGE | Active Large-System Production Well | 6084080.037 | 2238925.34 | 420-800 | 6/28/2021 | 42.65 | <Null> |
| 15474 | O-25 | 15475 | O-25/1 | ORANGE | Active Large-System Production Well | 6078385.795 | 2233068.736 | 430-885 | 6/28/2021 | -9.78 | <Null> |
| 18435 | O-26 | 18436 | O-26/1 | ORANGE | Active Large-System Production Well | 6061791.146 | 2233358.136 | 460-1170 | 6/28/2021 | -2.58 | <Null> |
| 22860 | O-27 | 22861 | O-27/1 | ORANGE | Active Large-System Production Well | 6078303.303 | 2233680.531 | 425-890 | 6/28/2021 | -45 | <Null> |
| 47 | O-8 | 2652 | O-8/1 | ORANGE | Active Large-System Production Well | 6069397.223 | 2240803.328 | 570-850 | 4/5/2021 | 53.07 | <Null> |
| 46 | O-9 | 2656 | O-9/1 | ORANGE | Active Large-System Production Well | 6069440.354 | 2241135.949 | 546-888 | <Null> | <Null> | No static water level |
| 22370 | MBI-1 | 22371 | MBI-1/1 | ORANGE COUNTY WATER DISTRICT | Injection Well | 6055132.435 | 2212498.453 | 530-1190 | 7/1/2021 | -38.54 | <Null> |
| 23015 | MBI-2 | 23016 | MBI-2/1 | ORANGE COUNTY WATER DISTRICT | Injection Well | 6056141.1 | 2211006.5 | 646-1085 | 6/29/2021 | -55.78 | <Null> |
| 23017 | MBI-3 | 23018 | MBI-3/1 | ORANGE COUNTY WATER DISTRICT | Injection Well | 6056123.8 | 2212200.9 | 654-1114 | 6/29/2021 | -42.47 | <Null> |
| 23019 | MBI-4 | 23020 | MBI-4/1 | ORANGE COUNTY WATER DISTRICT | Injection Well | 6057084.9 | 2212185.2 | 650-1089 | 6/29/2021 | -47.65 | <Null> |
| 23021 | MBI-5 | 23022 | MBI-5/1 | ORANGE COUNTY WATER DISTRICT | Injection Well | 6057622.7 | 2211477.6 | 609-1059 | 6/29/2021 | -53.62 | <Null> |
| 15492 | OCWD-I24 | 15494 | OCWD-I24/2 | ORANGE COUNTY WATER DISTRICT | Injection Well | 6046615.244 | 2199848.75 | 420-605 | 7/6/2021 | -59.31 | <Null> |
| 18060 | OCWD-I26C | 18061 | OCWD-I26C/1 | ORANGE COUNTY WATER DISTRICT | Injection Well | 6048796.348 | 2200397.494 | 476-660 | 7/6/2021 | -65.21 | <Null> |
| 19463 | OCWD-I28C | 19464 | OCWD-I28C/1 | ORANGE COUNTY WATER DISTRICT | Injection Well | 6036240.299 | 2199039.947 | 360-460 | 7/6/2021 | -22.14 | <Null> |
| 19648 | OCWD-I30C | 19649 | OCWD-I30C/1 | ORANGE COUNTY WATER DISTRICT | Injection Well | 6034047 | 2200300.103 | 425-650 | 6/28/2021 | -18.35 | <Null> |
| 19650 | OCWD-I31C | 19651 | OCWD-I31C/1 | ORANGE COUNTY WATER DISTRICT | Injection Well | 6033606.9 | 2201013.303 | 440-590 | 7/6/2021 | -22.46 | <Null> |
| 1018 | AM-1 | 1019 | AM-1/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6090472.39 | 2264185.952 | 97-115 | 6/30/2021 | 245.03 | <Null> |
| 545 | AM-10 | 546 | AM-10/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6071304.771 | 2257813.261 | 217-235 | 7/7/2021 | 121.51 | <Null> |
| 557 | AM-11 | 558 | AM-11/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6072499.755 | 2255656.617 | 218-240 | 6/30/2021 | 121.98 | <Null> |
| 555 | AM-12 | 556 | AM-12/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6070962.221 | 2255565.488 | 210-225 | 7/7/2021 | 113.56 | <Null> |
| 553 | AM-13 | 554 | AM-13/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6072701.528 | 2256964.39 | 252-270 | 6/30/2021 | 128.38 | <Null> |
| 2740 | AM-14 | 2741 | AM-14/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6065935.798 | 2256505.388 | 297-315 | 6/30/2021 | 96.56 | <Null> |
| 2742 | AM-15 | 2743 | AM-15/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6062582.08 | 2256912.924 | 300-317 | 6/25/2021 | 86.54 | <Null> |
| 2746 | AM-16 | 2747 | AM-16/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6057468.185 | 2255986.324 | 300-315 | 7/1/2021 | 70.09 | <Null> |
| 2750 | AM-17 | 2751 | AM-17/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6056078.923 | 2256637.855 | 290-308 | 6/25/2021 | 67.03 | <Null> |
| 2752 | AM-18 | 2753 | AM-18/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6054337.392 | 2256704.097 | 291-309 | 7/1/2021 | 60.89 | <Null> |
| 1022 | AM-2 | 1023 | AM-2/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6091404.587 | 2263383.522 | 87-100 | 6/30/2021 | 246.46 | <Null> |
| 7535 | AM-20 | 7536 | AM-20/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6054209.307 | 2247063.369 | 361-379 | 6/25/2021 | 34.97 | <Null> |
| 7001 | AM-22 | 7002 | AM-22/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6059519.306 | 2254484.798 | 339-353 | 6/25/2021 | 72.1 | <Null> |
| 7003 | AM-23 | 7004 | AM-23/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6062009.413 | 2254628.535 | 330-347 | 6/25/2021 | 83.21 | <Null> |
| 7005 | AM-24 | 7006 | AM-24/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6058556.647 | 2251960.234 | 335-350 | 6/25/2021 | 69.28 | <Null> |
| 7009 | AM-25 | 7010 | AM-25/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6060774.466 | 2252487.982 | 340-358 | 6/25/2021 | 74.37 | <Null> |
| 7533 | AM-26 | 7534 | AM-26/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6051909.723 | 2244283.122 | 377-383 | 7/1/2021 | 29.21 | <Null> |
| 7013 | AM-27 | 7014 | AM-27/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6064651.178 | 2249603.126 | 287-305 | 6/25/2021 | 82.55 | <Null> |
| 7015 | AM-29 | 7016 | AM-29/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6062902.901 | 2259184.123 | 340-358 | 6/30/2021 | 88.5 | <Null> |
| 1020 | AM-3 | 1021 | AM-3/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6090425.411 | 2261850.384 | 91-107 | 6/30/2021 | 245.62 | <Null> |
| 7541 | AM-30 | 7542 | AM-30/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6046016.856 | 2255914.15 | 349-367 | 6/25/2021 | 41.38 | <Null> |
| 8919 | AM-31 | 8920 | AM-31/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6052262.726 | 2257664.465 | 335-353 | 6/25/2021 | 57.41 | <Null> |
| 7753 | AM-32 | 7754 | AM-32/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6052527.256 | 2252384.43 | 335-353 | 6/25/2021 | 50.68 | <Null> |
| 7523 | AM-33 | 7524 | AM-33/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6055430.54 | 2253987.665 | 354-372 | 6/25/2021 | 61.86 | <Null> |
| 7527 | AM-34 | 7528 | AM-34/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6049928.243 | 2250310.571 | 317-335 | 6/25/2021 | 39.01 | <Null> |
| 7755 | AM-35 | 7756 | AM-35/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6044316.748 | 2249355.364 | 332-350 | 6/25/2021 | 28.86 | <Null> |
| 7759 | AM-37 | 7760 | AM-37/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6054347.18 | 2250152.867 | 349-367 | 6/25/2021 | 46.31 | <Null> |
| 7761 | AM-38 | 7762 | AM-38/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6058042.463 | 2246387.411 | 316-334 | 6/25/2021 | 35.25 | <Null> |
| 549 | AM-4 | 550 | AM-4/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6078257.417 | 2258629.141 | 187-205 | 7/7/2021 | 166.16 | <Null> |
| 20709 | AM-47 | 20710 | AM-47/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6054333.5 | 2258316.7 | 227-242 | 6/25/2021 | 64.05 | <Null> |
| 20705 | AM-48 | 20706 | AM-48/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6069379.3 | 2259143.9 | 270-300 | 7/8/2021 | 113.68 | <Null> |
| 1024 | AM-5 | 1025 | AM-5/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6078674.697 | 2259936.321 | 230-245 | 7/7/2021 | 156.58 | <Null> |
| 23213 | AM-54C | 23214 | AM-54C/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6055965.303 | 2259518 | 280-295 | 6/25/2021 | 69.46 | <Null> |
| 23563 | AM-55B | 23564 | AM-55B/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6054292.1 | 2256036.6 | 375-395 | 7/8/2021 | 59.8 | <Null> |
| 23567 | AM-56B | 23569 | AM-56B/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6053578.9 | 2256950.9 | 380-400 | 7/8/2021 | 58.82 | <Null> |
| 551 | AM-6 | 552 | AM-6/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6075037.515 | 2257301.421 | 232-250 | 7/7/2021 | 143.29 | <Null> |
| 2734 | AM-7 | 2735 | AM-7/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6071731.515 | 2260900.336 | 210-225 | 7/7/2021 | 131.58 | <Null> |

**Wells Used to Develop 2021 Groundwater Contour Maps in Orange County Groundwater Basin**

**Principal Aquifer Wells (Model Layer 2)**

| STAID1 | WELLNM | STAID | STANAME | OWNERNM | GIS_SYMNM | NAD83_X | NAD83_Y | PERF_ZONE | SHORTDATE | WLELEV_2021 | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2736 | AM-8 | 2737 | AM-8/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6069027.597 | 2259867.528 | 268-285 | 7/7/2021 | 112.8 | <Null> |
| 15043 | AMD-10 | 15045 | AMD-10/2 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6072825.077 | 2260900.884 | 440-460 | 7/7/2021 | 135.71 | <Null> |
| 15053 | AMD-11 | 15056 | AMD-11/3 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6070695.395 | 2257252.242 | 600-620 | 6/30/2021 | 117.07 | <Null> |
| 19507 | AMD-12 | 19510 | AMD-12/3 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6071323.1 | 2260657.003 | 595-615 | 6/30/2021 | 126.14 | <Null> |
| 14585 | AMD-9 | 14587 | AMD-9/2 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6075825.081 | 2261784.701 | 450-470 | 7/7/2021 | 151.35 | <Null> |
| 7017 | FM-1 | 7018 | FM-1/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6053154.441 | 2258736.246 | 348-356 | 6/25/2021 | 60.62 | <Null> |
| 18331 | FM-10 | 18332 | FM-10/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6057584.791 | 2262009.679 | 215-235 | 6/29/2021 | 79.5 | <Null> |
| 18335 | FM-11 | 18336 | FM-11/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6054079.466 | 2261009.777 | 236-256 | 6/30/2021 | 69.03 | <Null> |
| 18339 | FM-12 | 18340 | FM-12/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6058076.487 | 2263025.088 | 206-226 | 6/29/2021 | 82.04 | <Null> |
| 18343 | FM-13 | 18344 | FM-13/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6064730.854 | 2262602.368 | 210-230 | 6/30/2021 | 93.15 | <Null> |
| 18347 | FM-14 | 18348 | FM-14/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6064606.249 | 2263073.772 | 234-254 | 7/1/2021 | 93.13 | <Null> |
| 18351 | FM-15 | 18352 | FM-15/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6054099.553 | 2262606.493 | 218-238 | 6/29/2021 | 73.72 | <Null> |
| 18412 | FM-16 | 18413 | FM-16/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6063630.746 | 2262324.068 | 248-268 | 6/30/2021 | 88.76 | <Null> |
| 19626 | FM-17 | 19627 | FM-17/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6061492.436 | 2262019.765 | 250-270 | 6/30/2021 | 84.02 | <Null> |
| 19612 | FM-18 | 19613 | FM-18/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6049362.557 | 2263643.539 | 224-244 | 6/29/2021 | 62.44 | <Null> |
| 19622 | FM-19C | 19623 | FM-19C/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6051551.893 | 2262403.786 | 365-385 | 6/29/2021 | 57.84 | <Null> |
| 23462 | FM-19D | 23463 | FM-19D/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6051660.8 | 2262458.6 | 435-455 | 6/29/2021 | 59.85 | <Null> |
| 7021 | FM-2 | 7022 | FM-2/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6058816.966 | 2258623.398 | 320-338 | 6/25/2021 | 76.61 | <Null> |
| 20762 | FM-20 | 20763 | FM-20/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6053785.7 | 2263886.1 | 221-241 | 6/29/2021 | 72.51 | <Null> |
| 20766 | FM-21 | 20767 | FM-21/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6047750.6 | 2262684.3 | 260-270 | 6/29/2021 | 58.02 | <Null> |
| 20751 | FM-22 | 20752 | FM-22/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6051135 | 2260372.1 | 242-262 | 7/8/2021 | 60.23 | <Null> |
| 23217 | FM-22B | 23218 | FM-22B/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6051128.1 | 2260379.8 | 326-346 | 6/25/2021 | 56.32 | <Null> |
| 20882 | FM-23 | 20883 | FM-23/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6054166.9 | 2260625 | 234-249 | 6/29/2021 | 69.17 | <Null> |
| 20699 | FM-24 | 20700 | FM-24/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6051441.4 | 2258786 | 271-291 | 6/25/2021 | 57 | <Null> |
| 23219 | FM-24B | 23220 | FM-24B/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6051418.9 | 2258788.7 | 338-358 | 6/25/2021 | 55.89 | <Null> |
| 23225 | FM-29C | 23226 | FM-29C/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6049003.993 | 2262397.371 | 340-360 | 6/29/2021 | 49.19 | <Null> |
| 7025 | FM-3 | 7026 | FM-3/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6061451.851 | 2259514.599 | 257-263 | 6/30/2021 | 84.27 | <Null> |
| 23573 | FM-30B | 23574 | FM-30B/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6061056.8 | 2263552.8 | 370-390 | 6/29/2021 | 83.12 | <Null> |
| 23229 | FM-31B | 23230 | FM-31B/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6054065.947 | 2261842.665 | 230-250 | 6/29/2021 | 70.23 | <Null> |
| 23449 | FM-32B | 23452 | FM-32B/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6045316.1 | 2263964.1 | 220-230 | 6/29/2021 | 56.28 | <Null> |
| 23577 | FM-34B | 23578 | FM-34B/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6057207.6 | 2265354.1 | 377-397 | 7/8/2021 | 66.54 | <Null> |
| 23898 | FM-35C | 23899 | FM-35C/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6062992.887 | 2262505.466 | 460.5-480.5 | 7/6/2021 | 85.12 | <Null> |
| 7519 | FM-4 | 7520 | FM-4/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6048406.619 | 2258792.993 | 327-345 | 6/25/2021 | 49.86 | <Null> |
| 9947 | FM-6 | 9948 | FM-6/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6053264.065 | 2274113.568 | 150-310 | 6/30/2021 | 175.2 | <Null> |
| 23215 | FM-7B | 23216 | FM-7B/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6054304.1 | 2259270.6 | 329.5-344.5 | 6/25/2021 | 64.28 | <Null> |
| 18327 | FM-9 | 18328 | FM-9/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6063377.138 | 2262960.474 | 220-240 | 6/30/2021 | 88.97 | <Null> |
| 19009 | IDM-3 | 19012 | IDM-3/3 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6099726.882 | 2201438.084 | 652-672 | 6/28/2021 | 8.37 | <Null> |
| 19404 | IDM-4 | 19407 | IDM-4/3 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6103585.541 | 2200230.218 | 654-674 | 6/28/2021 | 51.87 | <Null> |
| 19478 | IDP-2R | 19480 | IDP-2R/2 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6106015.21 | 2193086.752 | 300-340 | 6/28/2021 | 108.257 | <Null> |
| 721 | KBS-1 | 998 | KBS-1/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6074374.124 | 2260345.831 | 209-219 | 7/1/2021 | 154.21 | <Null> |
| 1285 | MCAS-10 | 1286 | MCAS-10/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6096082.894 | 2198174.236 | 347-377 | 6/28/2021 | 9.88 | <Null> |
| 1360 | MCAS-4 | 1361 | MCAS-4/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6098189.884 | 2189446.916 | 181-238 | 6/28/2021 | 95.46 | <Null> |
| 10217 | MCAS-5A | 10218 | MCAS-5A/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6101340.027 | 2187474.726 | 120-130 | 6/28/2021 | 118.26 | <Null> |
| 1355 | MCAS-8 | 1356 | MCAS-8/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6088737.288 | 2194284.922 | 392-410 | 6/28/2021 | -63.35 | <Null> |
| 1287 | MCAS-9 | 1288 | MCAS-9/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6092651.761 | 2198312.255 | 372-445 | 6/28/2021 | 2.18 | <Null> |
| 23057 | OCWD-34Y01 | 23061 | OCWD-34Y01/4 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6001790.9 | 2226024.1 | 400-420 | 7/6/2021 | -43.1 | <Null> |
| 11700 | OCWD-36FP1Z | 11701 | OCWD-36FP1Z/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6001815.979 | 2221372.331 | 504-514 | 7/1/2021 | -42.84 | <Null> |
| 2859 | OCWD-AIR1 | 2861 | OCWD-AIR1/2 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6037614.933 | 2265072.135 | 410-510 | 6/29/2021 | -7.44 | <Null> |
| 22323 | OCWD-BS10 | 22329 | OCWD-BS10/6 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6013179.752 | 2219396.307 | 595-605 | 7/1/2021 | -46.87 | <Null> |
| 22330 | OCWD-BS11 | 22336 | OCWD-BS11/6 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6008506.1 | 2221300 | 580-590 | 7/1/2021 | -47.03 | <Null> |
| 22774 | OCWD-BS12 | 22973 | OCWD-BS12/6 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6015660.3 | 2214181.8 | 585-605 | 7/1/2021 | -49.9 | <Null> |
| 23692 | OCWD-BS13F | 23693 | OCWD-BS13F/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6009690 | 2214241.6 | 575-595 | 7/1/2021 | -44.86 | <Null> |
| 22776 | OCWD-BS14 | 22916 | OCWD-BS14/5 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6003965.9 | 2221842.9 | 490-510 | 7/1/2021 | -43.9 | <Null> |
| 23550 | OCWD-BS24F | 23554 | OCWD-BS24F/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6005185.3 | 2219560 | 500-520 | 7/1/2021 | -41.91 | <Null> |
| 2867 | OCWD-CTG1 | 2869 | OCWD-CTG1/2 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6061970.346 | 2206073.478 | 420-720 | 6/30/2021 | -85.71 | <Null> |
| 2872 | OCWD-CTG5 | 2873 | OCWD-CTG5/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6062530.714 | 2206394.591 | 420-620 | 8/4/2021 | -81.04 | <Null> |
| 2876 | OCWD-CTK1 | 2878 | OCWD-CTK1/2 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6062486.259 | 2205158.852 | 780-1015 | 6/30/2021 | -81.99 | <Null> |
| 3307 | OCWD-FC1 | 3308 | OCWD-FC1/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6072297.077 | 2252615.883 | 165-185 | 7/7/2021 | 104.96 | <Null> |
| 3305 | OCWD-FH1 | 3306 | OCWD-FH1/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6081695.772 | 2257027.264 | 120-140 | 7/7/2021 | 213.83 | <Null> |
| 3303 | OCWD-LV1 | 3304 | OCWD-LV1/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6085675.722 | 2259327.385 | 135-155 | 7/7/2021 | 237.5 | <Null> |
| 15127 | OCWD-M38 | 15131 | OCWD-M38/4 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6030736.262 | 2198146.213 | 336-346 | 6/30/2021 | -27.7 | <Null> |
| 16021 | OCWD-M39 | 16026 | OCWD-M39/5 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6048139.112 | 2190636.716 | 250-270 | 6/28/2021 | -16.46 | <Null> |
| 16654 | OCWD-M40 | 16658 | OCWD-M40/4 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6051222.286 | 2195005.215 | 330-520 | 6/28/2021 | -81.04 | <Null> |
| 18425 | OCWD-M41 | 18430 | OCWD-M41/5 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6031312.152 | 2196141.497 | 370-390 | 6/30/2021 | -27.74 | <Null> |
| 18418 | OCWD-M42 | 18423 | OCWD-M42/5 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6030956.495 | 2201880.558 | 500-520 | 6/24/2021 | -30.94 | <Null> |
| 23769 | OCWD-M43R | 23774 | OCWD-M43R/5 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6056258.4 | 2193225.9 | 530-550 | 6/28/2021 | -82.54 | <Null> |
| 20371 | OCWD-M44 | 20376 | OCWD-M44/5 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6048200.8 | 2193011.3 | 295-305 | 6/28/2021 | -58.37 | <Null> |
| 19640 | OCWD-M45 | 19645 | OCWD-M45/5 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6040339.8 | 2203350.603 | 780-790 | 6/30/2021 | -56.92 | <Null> |
| 19482 | OCWD-M46 | 19487 | OCWD-M46/5 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6049299 | 2201186.803 | 890-910 | 6/28/2021 | -61.24 | <Null> |
| 19634 | OCWD-M47 | 19639 | OCWD-M47/5 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6049915.7 | 2202379.503 | 940-960 | 6/28/2021 | -61.7 | <Null> |
| 18766 | OCWD-M48 | 18768 | OCWD-M48/2 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6059972.844 | 2188953.882 | 175-195 | 6/28/2021 | -73.7 | <Null> |
| 22842 | OCWD-M52C | 22843 | OCWD-M52C/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6067045.9 | 2192841.2 | 210-230 | 6/24/2021 | -69.15 | <Null> |
| 22786 | OCWD-MRSH | 22854 | OCWD-MRSH/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6074220 | 2188672.3 | 199-219 | 6/29/2021 | -28.15 | <Null> |
| 22659 | OCWD-SA22R | 22663 | OCWD-SA22R/4 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6036740.5 | 2194795.1 | 310-330 | 6/30/2021 | -28.24 | <Null> |
| 3978 | OCWD-T2 | 3981 | OCWD-T2/3 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6035679.306 | 2192640.337 | 300-360 | 6/24/2021 | -27.11 | <Null> |
| 315 | OCWD-W1 | 316 | OCWD-W1/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6081387.171 | 2258988.611 | - | 7/7/2021 | 174.34 | <Null> |
| 22347 | SAR-10 | 22351 | SAR-10/4 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6055179.3 | 2212421.7 | 1100-1115 | 7/1/2021 | -51.98 | <Null> |
| 22061 | SAR-11 | 22064 | SAR-11/3 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6055349.4 | 2211898 | 1100-1110 | 7/1/2021 | -54.34 | <Null> |
| 23010 | SAR-12 | 23014 | SAR-12/4 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6056736.8 | 2210170.5 | 1045-1055 | 6/30/2021 | -67.896 | <Null> |
| 23203 | SAR-13 | 23207 | SAR-13/4 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6057504.8 | 2210763.1 | 1045-1055 | 6/30/2021 | -63.83 | <Null> |
| 1851 | TIC-67 | 1852 | TIC-67/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6100937.109 | 2211418.256 | 245-900 | 6/29/2021 | 73.58 | <Null> |
| 997 | ABS-1 | 22665 | ABS-1/1/WB2/MP3 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6076226.851 | 2262977.612 | MP3 (257) | 7/7/2021 | 158.375 | <Null> |
| 547 | AMD-1 | 21137 | AMD-1/1/WB2/MP5 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6073916.932 | 2258572.091 | MP5 (331) | 6/21/2021 | 143.45 | <Null> |
| 565 | AMD-2 | 22205 | AMD-2/1/WB2/MP4 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6066705.21 | 2254540.618 | MP4 (512) | 6/29/2021 | 99.11 | <Null> |
| 7031 | AMD-4 | 7104 | AMD-4/1/WB1/MP4 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6050716.117 | 2255097.562 | MP4 (561) | 6/28/2021 | 43.82 | <Null> |
| 7295 | AMD-5 | 7320 | AMD-5/1/WB1/MP7 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6060070.244 | 2248962.576 | MP7 (754) | 6/28/2021 | 69.39 | <Null> |
| 7293 | AMD-6 | 7482 | AMD-6/1/WB1/MP7 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6057374.729 | 2241092.645 | MP7 (622) | 6/28/2021 | 15.03 | <Null> |
| 8596 | AMD-7 | 8754 | AMD-7/1/WB1/MP7 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6049188.026 | 2247218.215 | MP7 (580) | 6/28/2021 | 15.36 | <Null> |
| 9682 | AMD-8 | 9906 | AMD-8/1/WB1/MP5 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6033488.697 | 2249624.328 | MP5 (662) | 7/12/2021 | -8.705 | <Null> |
| 9831 | BPM-1 | 9985 | BPM-1/1/WB1/MP6 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6022348.508 | 2259541.566 | MP6 (890) | 7/12/2021 | -42.1 | <Null> |
| 9832 | BPM-2 | 10178 | BPM-2/1/WB1/MP5 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6025195.413 | 2246739.597 | MP5 (778) | 7/12/2021 | -11.49 | <Null> |
| 685 | CB-1 | 8788 | CB-1/1/WB2/MP3 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6044695.232 | 2253837.186 | MP3 (443) | 7/6/2021 | 30.09 | <Null> |
| 5155 | COSM-1 | 7147 | COSM-1/1/WB1/MP5 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6055253.401 | 2197825.036 | MP5 (451) | 6/30/2021 | -87.65 | <Null> |
| 18846 | COSM-2 | 18866 | COSM-2/1/WB1/MP8 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6052266.414 | 2199776.431 | MP8 (763) | 6/30/2021 | -80.87 | <Null> |
| 719 | FFS-1 | 14243 | FFS-1/1/WB2/MP3 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6061436.461 | 2262022.62 | MP3 (530) | 7/6/2021 | 81.44 | <Null> |
| 1291 | FVM-1 | 15692 | FVM-1/1/WB2/MP9 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6047178.815 | 2210990.613 | MP9 (814) | 6/22/2021 | -47.21 | <Null> |
| 7297 | GGM-1 | 10028 | GGM-1/1/WB1/MP8 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6045688.299 | 2230864.24 | MP8 (1074) | 7/8/2021 | -22.44 | <Null> |
| 8923 | GGM-2 | 9049 | GGM-2/1/WB1/MP5 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6026525.607 | 2230233.156 | MP5 (954) | 6/22/2021 | -30.46 | <Null> |
| 8592 | GGM-3 | 8666 | GGM-3/1/WB1/MP6 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6037298.069 | 2237458.988 | MP6 (1007) | 7/8/2021 | -17.34 | <Null> |
| 7178 | HBM-1 | 8439 | HBM-1/1/WB1/MP7 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6031700.722 | 2216385.252 | MP7 (924) | 7/2/2021 | -43.89 | <Null> |
| 7086 | HBM-2 | 7223 | HBM-2/1/WB1/MP6 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6036228.737 | 2196532.383 | MP6 (447) | 7/2/2021 | -25.01 | <Null> |
| 9200 | HBM-4 | 9225 | HBM-4/1/WB1/MP8 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6034095.825 | 2197123.319 | MP8 (551) | 7/2/2021 | -20.86 | <Null> |
| 9688 | HBM-5 | 9879 | HBM-5/1/WB1/MP8 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6045744.869 | 2193971.856 | MP8 (273) | 7/2/2021 | -52.65 | <Null> |
| 15088 | HBM-6 | 15245 | HBM-6/1/WB1/MP7 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6025106.578 | 2204548.969 | MP7 (508) | 7/2/2021 | -37.1 | <Null> |
| 720 | IDM-1 | 18979 | IDM-1/1/WB2/MP4 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6099572.243 | 2207081.537 | MP4 (436) | 7/7/2021 | 28.49 | <Null> |
| 9830 | IDM-2 | 10064 | IDM-2/1/WB1/MP6 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6080705.598 | 2209836.046 | MP6 (613) | 7/7/2021 | -71.94 | <Null> |

**Wells Used to Develop 2021 Groundwater Contour Maps in Orange County Groundwater Basin**

**Principal Aquifer Wells (Model Layer 2)**

| STAID1 | WELLNM | STAID | STANAME | OWNERNM | GIS_SYMNM | NAD83_X | NAD83_Y | PERF_ZONE | SHORTDATE | WLELEV_2021 | NOTES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 541 | KBS-2 | 10226 | KBS-2/1/WB1/MP2 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6073053.762 | 2260992.439 | MP2 (214) | 6/21/2021 | 144.53 | <Null> |
| 11949 | LAM-1 | 12028 | LAM-1/1/WB1/MP9 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6009581.587 | 2238043.705 | MP9 (1153) | 6/15/2021 | -56.23 | <Null> |
| 1345 | MCAS-1 | 5853 | MCAS-1/1/WB2/MP6 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6098255.481 | 2192973.357 | MP6 (455) | 7/6/2021 | 36.17 | <Null> |
| 759 | MCAS-2 | 5935 | MCAS-2/1/WB2/MP5 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6100360.442 | 2191167.958 | MP5 (425) | 7/6/2021 | 62.46 | <Null> |
| 1339 | MCAS-3 | 5891 | MCAS-3/1/WB2/MP5 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6104434.428 | 2191276.758 | MP5 (426) | 7/6/2021 | 89.45 | <Null> |
| 758 | MCAS-7 | 11829 | MCAS-7/1/WB3/MP4 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6093900.827 | 2194418.586 | MP4 (442) | 7/7/2021 | -23.9 | <Null> |
| 756 | SAR-1 | 9261 | SAR-1/1/WB2/MP5 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6070684.206 | 2250425.314 | MP5 (519) | 6/29/2021 | 88.12 | <Null> |
| 761 | SAR-2 | 11989 | SAR-2/1/WB2/MP6 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6069096.008 | 2245410.807 | MP6 (741) | 6/29/2021 | 71.42 | <Null> |
| 762 | SAR-3 | 9466 | SAR-3/1/WB2/MP6 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6066892.02 | 2238409.284 | MP6 (774) | 6/24/2021 | 54.27 | <Null> |
| 763 | SAR-4 | 14633 | SAR-4/1/WB2/MP6 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6065370.966 | 2233375.154 | MP6 (868) | 6/29/2021 | 31.58 | <Null> |
| 1289 | SAR-5 | 21220 | SAR-5/1/WB3/MP5 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6062597.607 | 2227874.211 | MP5 (766) | 6/30/2021 | -16.37 | <Null> |
| 561 | SAR-6 | 10113 | SAR-6/1/WB2/MP4 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6073313.538 | 2254365.369 | MP4 (581) | 6/21/2021 | 142.26 | <Null> |
| 996 | SAR-7 | 20000 | SAR-7/1/WB2/MP4 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6078049.17 | 2256383.048 | MP4 (440) | 6/21/2021 | 192.2 | <Null> |
| 7181 | SAR-9 | 9802 | SAR-9/1/WB1/MP7 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6058380.802 | 2221450.982 | MP7 (877) | 6/30/2021 | -40.723 | <Null> |
| 9686 | SBM-1 | 9729 | SBM-1/1/WB1/MP7 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6016566.11 | 2224523.54 | MP7 (916) | 6/15/2021 | -47.295 | <Null> |
| 1000 | SC-1 | 21654 | SC-1/1/WB2/MP4 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6089555.444 | 2242038.806 | MP4 (197) | 7/1/2021 | 213.44 | <Null> |
| 1001 | SC-2 | 18747 | SC-2/1/WB2/MP6 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6086489.295 | 2237887.557 | MP6 (303) | 7/1/2021 | 112.45 | <Null> |
| 1005 | SC-3 | 8839 | SC-3/1/WB2/MP3 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6081074.85 | 2229940.413 | MP3 (577) | 7/1/2021 | 29.49 | <Null> |
| 2888 | SC-4 | 6296 | SC-4/1/WB1/MP4 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6082605.785 | 2235080.546 | MP4 (393) | 7/1/2021 | 46.59 | <Null> |
| 2854 | SC-5 | 6331 | SC-5/1/WB1/MP5 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6077454.866 | 2225543.458 | MP5 (670) | 7/1/2021 | 4.73 | <Null> |
| 9684 | SC-6 | 9758 | SC-6/1/WB1/MP6 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6066813.288 | 2216032.113 | MP6 (964) | 7/7/2021 | -60.78 | <Null> |
| 1016 | SCS-1 | 8867 | SCS-1/1/WB1/MP6 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6088950.708 | 2237855.374 | MP6 (298) | 7/1/2021 | 89.68 | <Null> |
| 1014 | SCS-2 | 22653 | SCS-2/1/WB2/MP5 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6088207.123 | 2239962.183 | MP5 (329) | 7/1/2021 | 72.99 | <Null> |
| 1011 | WBS-4 | 19983 | WBS-4/1/WB2/MP3 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6080099.39 | 2256910.089 | MP3 (212) | 6/21/2021 | 206.6 | <Null> |
| 1293 | WMM-1 | 19884 | WMM-1/1/WB2/MP8 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6038251.554 | 2221751.195 | MP8 (985) | 7/8/2021 | -24.03 | <Null> |
| 1423 | OCWD-D1 | 1424 | OCWD-D1/1 | ORANGE COUNTY WATER DISTRICT | Other Active Production Well | 6046612.36 | 2200327.641 | 780-880 | 6/23/2021 | -60.642 | <Null> |
| 1412 | OCWD-D3 | 1413 | OCWD-D3/1 | ORANGE COUNTY WATER DISTRICT | Other Active Production Well | 6046034.602 | 2201849.851 | 560-1000 | 6/23/2021 | -58.66 | <Null> |
| 3797 | OCWD-D4 | 3798 | OCWD-D4/1 | ORANGE COUNTY WATER DISTRICT | Other Active Production Well | 6047147.793 | 2201759.429 | 531-979 | 6/23/2021 | -61.08 | <Null> |
| 1798 | NVLW-SB3 | 3275 | NVLW-SB3/1 | PURSCHE, ROY | Other Active Production Well | 6011353.936 | 2219409.749 | - | 6/29/2021 | -51.1 | <Null> |
| 1126 | NOBL-O | 1127 | NOBL-O/1 | R.J. NOBLE COMPANY | Other Active Production Well | 6072535.517 | 2251285.626 | 290-474 | 6/29/2021 | 91.85 | <Null> |
| 22874 | RAY-MW06 | 22875 | RAY-MW06/1 | RAYTHEON TECHNOLOGIES CORPORATION | Monitoring Well | 6042228.1 | 2268828.8 | 149.6-189.6 | 6/30/2021 | 33.58 | <Null> |
| 22408 | RAY-MW32 | 22410 | RAY-MW32/2 | RAYTHEON TECHNOLOGIES CORPORATION | Monitoring Well | 6039287.583 | 2267257.657 | 969-999 | 6/30/2021 | 17.47 | <Null> |
| 22416 | RAY-MW34B | 22417 | RAY-MW34B/1 | RAYTHEON TECHNOLOGIES CORPORATION | Monitoring Well | 6039046.07 | 2268346.15 | 486-536 | 6/30/2021 | 18.29 | <Null> |
| 22420 | RAY-MW35 | 22423 | RAY-MW35/3 | RAYTHEON TECHNOLOGIES CORPORATION | Monitoring Well | 6039878.34 | 2265861.26 | 990-1040 | 6/30/2021 | 12.69 | <Null> |
| 22757 | RAY-MW39 | 22758 | RAY-MW39/1 | RAYTHEON TECHNOLOGIES CORPORATION | Monitoring Well | 6034604.76 | 2267260.25 | 982-1012 | 6/30/2021 | 14.6 | <Null> |
| 22759 | RAY-MW40 | 22760 | RAY-MW40/1 | RAYTHEON TECHNOLOGIES CORPORATION | Monitoring Well | 6042465.71 | 2267070.62 | 930-970 | 6/30/2021 | 20.33 | <Null> |
| 975 | SA-16 | 976 | SA-16/1 | SANTA ANA | Active Large-System Production Well | 6066775.852 | 2220474.597 | 305-950 | <Null> | <Null> | Well in exclusion list |
| 964 | SA-18 | 965 | SA-18/1 | SANTA ANA | Active Large-System Production Well | 6065423.295 | 2227343.923 | 245-623 | 6/30/2021 | 6.21 | <Null> |
| 983 | SA-20 | 984 | SA-20/1 | SANTA ANA | Active Large-System Production Well | 6051943.524 | 2218208.729 | 390-940 | 6/29/2021 | -18.5 | <Null> |
| 981 | SA-21 | 982 | SA-21/1 | SANTA ANA | Active Large-System Production Well | 6051992.474 | 2218775.287 | 400-960 | 6/29/2021 | -17.7 | <Null> |
| 966 | SA-24 | 967 | SA-24/1 | SANTA ANA | Active Large-System Production Well | 6062495.013 | 2226820.521 | 352-654 | 6/30/2021 | -4.27 | <Null> |
| 19 | SA-29 | 117 | SA-29/1 | SANTA ANA | Active Large-System Production Well | 6067350.619 | 2218664.363 | 450-1050 | 7/1/2021 | -48.19 | <Null> |
| 985 | SA-30 | 986 | SA-30/1 | SANTA ANA | Active Large-System Production Well | 6051988.27 | 2217594.374 | 440-900 | 6/29/2021 | -22.8 | <Null> |
| 979 | SA-33 | 980 | SA-33/1 | SANTA ANA | Active Large-System Production Well | 6067018.394 | 2218472.227 | 425-935 | 7/1/2021 | -47.2 | <Null> |
| 3322 | SA-34 | 3323 | SA-34/1 | SANTA ANA | Active Large-System Production Well | 6062544.736 | 2203955.867 | 370-520 | 7/2/2021 | -83 | <Null> |
| 8823 | SA-35 | 8824 | SA-35/1 | SANTA ANA | Active Large-System Production Well | 6058367.7 | 2224408.129 | 429.2-1480 | 5/24/2021 | -29 | <Null> |
| 1993 | SA-36 | 1994 | SA-36/1 | SANTA ANA | Active Large-System Production Well | 6064973.942 | 2227415.821 | 570-1290 | 6/30/2021 | -21.75 | <Null> |
| 8825 | SA-37 | 8826 | SA-37/1 | SANTA ANA | Active Large-System Production Well | 6061211.41 | 2214947.524 | 348-1480 | 5/24/2021 | -48 | <Null> |
| 18391 | SA-39 | 18393 | SA-39/1 | SANTA ANA | Active Large-System Production Well | 6064925.485 | 2227035.79 | 590-1290 | 6/30/2021 | -26.3 | <Null> |
| 19552 | SA-41 | 19553 | SA-41/1 | SANTA ANA | Active Large-System Production Well | 6067142.505 | 2220423.372 | 525-978 | 5/25/2021 | -40.58 | <Null> |
| 956 | SA-26 | 957 | SA-26/1 | SANTA ANA | Standby Large-System Production Well | 6073873.971 | 2210851.779 | 330-1140 | 7/2/2021 | -58.82 | <Null> |
| 532 | SA-27 | 533 | SA-27/1 | SANTA ANA | Standby Large-System Production Well | 6072868.882 | 2229547.215 | 396-1140 | 6/30/2021 | -6.9 | <Null> |
| 70 | SA-28 | 2629 | SA-28/1 | SANTA ANA | Standby Large-System Production Well | 6073394.893 | 2229877.64 | 250-980 | 6/30/2021 | 11.5 | <Null> |
| 18 | SA-31 | 118 | SA-31/1 | SANTA ANA | Standby Large-System Production Well | 6078121.42 | 2217676.874 | 465-1240 | 6/22/2021 | -11.32 | <Null> |
| 8817 | SA-38 | 8818 | SA-38/1 | SANTA ANA | Standby Large-System Production Well | 6077082.488 | 2229427.758 | 400-1270 | 6/30/2021 | 27 | <Null> |
| 19550 | SA-40 | 19551 | SA-40/1 | SANTA ANA | Standby Large-System Production Well | 6077600.85 | 2221373.519 | 550-1305 | 6/30/2021 | -50.75 | <Null> |
| 1513 | SACC-SA | 1514 | SACC-SA/1 | SANTA ANA COUNTRY CLUB | Other Active Production Well | 6062143.936 | 2190413.821 | 205-406 | 6/30/2021 | -80.85 | <Null> |
| 26 | SB-BC | 123 | SB-BC/1 | SEAL BEACH | Active Large-System Production Well | 6016910.323 | 2228579.652 | 370-1020 | 6/29/2021 | -62 | <Null> |
| 1282 | SB-BEV | 1283 | SB-BEV/1 | SEAL BEACH | Active Large-System Production Well | 6006691.531 | 2229990.738 | 400-800 | 5/26/2021 | -58.14 | <Null> |
| 21089 | SB-LAM | 21090 | SB-LAM/1 | SEAL BEACH | Active Large-System Production Well | 6012636.62 | 2232616.404 | 360-1170 | 6/29/2021 | -50 | <Null> |
| 78 | SID-3 | 2619 | SID-3/1 | SERRANO WATER DISTRICT | Active Large-System Production Well | 6085523.367 | 2241664.186 | 296-584 | 6/30/2021 | 49 | <Null> |
| 7036 | SID-4 | 7037 | SID-4/1 | SERRANO WATER DISTRICT | Active Large-System Production Well | 6088277.371 | 2242027.33 | 290-520 | <Null> | <Null> | No static water level |
| 15486 | SWD-5 | 15487 | SWD-5/1 | SERRANO WATER DISTRICT | Active Large-System Production Well | 6085860.482 | 2241857.866 | 310-720 | 6/30/2021 | 53 | <Null> |
| 3801 | W-3801 | 3802 | W-3801/1 | STATE OF CALIFORNIA | Inactive Production Well | 6061820.651 | 2190918.886 | 254-407 | 6/30/2021 | -80.36 | <Null> |
| 1927 | TIC-194 | 1931 | TIC-194/1 | THE IRVINE COMPANY | Monitoring Well | 6085062.044 | 2200644.721 | 562-726 | 6/29/2021 | -62.48 | <Null> |
| 3524 | TIC-25 | 3525 | TIC-25/1 | THE IRVINE COMPANY | Monitoring Well | 6082128.447 | 2194002.252 | 666-760 | 6/29/2021 | -62.21 | <Null> |
| 1829 | TIC-50 | 1830 | TIC-50/1 | THE IRVINE COMPANY | Monitoring Well | 6089719.969 | 2212322.221 | 475-1070 | 6/29/2021 | 19.34 | <Null> |
| 1331 | TIC-99 | 1332 | TIC-99/1 | THE IRVINE COMPANY | Monitoring Well | 6094081.516 | 2213753.527 | 346-650 | 6/29/2021 | 10.69 | <Null> |
| 18770 | T-17S4 | 18771 | T-17S4/1 | TUSTIN | Active Large-System Production Well | 6087962.147 | 2223505.698 | 200-480 | 7/1/2021 | 22 | <Null> |
| 950 | T-COLU | 951 | T-COLU/1 | TUSTIN | Active Large-System Production Well | 6083806.737 | 2220457.042 | 560-1160 | 6/30/2021 | -16 | <Null> |
| 22699 | T-ED | 22700 | T-ED/1 | TUSTIN | Active Large-System Production Well | 6079918.435 | 2211393.25 | 500-840 | 7/1/2021 | -58 | <Null> |
| 954 | T-MS3 | 955 | T-MS3/1 | TUSTIN | Active Large-System Production Well | 6083758.623 | 2217438.721 | 300-630 | 6/30/2021 | 32 | <Null> |
| 15470 | T-MS4 | 15471 | T-MS4/1 | TUSTIN | Active Large-System Production Well | 6084025.072 | 2217344.269 | 330-880 | 6/30/2021 | 9 | <Null> |
| 1370 | T-NEWP | 1371 | T-NEWP/1 | TUSTIN | Active Large-System Production Well | 6087882.616 | 2220782.263 | 234-267 | 7/1/2021 | 31 | <Null> |
| 20304 | T-PAS | 20305 | T-PAS/1 | TUSTIN | Active Large-System Production Well | 6080513.128 | 2217850.37 | 440-1225 | 6/30/2021 | -11 | <Null> |
| 9204 | T-VNBG | 9205 | T-VNBG/1 | TUSTIN | Active Large-System Production Well | 6083087.233 | 2223256.938 | 480-900 | <Null> | <Null> | No static water level |
| 958 | T-WALN | 959 | T-WALN/1 | TUSTIN | Active Large-System Production Well | 6084028.458 | 2212002.398 | 397-995 | 7/2/2021 | -40 | <Null> |
| 948 | T-LIVI | 949 | T-LIVI/1 | TUSTIN | Inactive Production Well | 6085117.397 | 2221039.77 | 300-617 | 6/30/2021 | 21 | <Null> |
| 960 | T-PANK | 961 | T-PANK/1 | TUSTIN | Inactive Production Well | 6087674.762 | 2213340.094 | 323-614 | 6/30/2021 | 10.88 | <Null> |
| 946 | T-TUST | 947 | T-TUST/1 | TUSTIN | Inactive Production Well | 6079841.655 | 2224465.712 | 306-776 | 5/10/2021 | 0 | <Null> |
| 33 | T-YORB | 2898 | T-YORB/1 | TUSTIN | Inactive Production Well | 6082254.093 | 2227714.437 | 385-850 | 6/30/2021 | 12 | <Null> |
| 2139 | COS-PLAZ | 3551 | COS-PLAZ/1 | UNKNOWN | Monitoring Well | 6062779.265 | 2200089.756 | - | 6/30/2021 | -82.38 | <Null> |
| 21187 | WRD-SEALBEACH-1 | 21191 | WRD-SEALBEACH-1/4 | WATER REPLENISHMENT DISTRICT | Monitoring Well | 6002807.228 | 2229796.158 | 775-795 | 6/7/2021 | -61.51 | <Null> |
| 20132 | WM-107A | 20133 | WM-107A/1 | WESTMINSTER | Active Large-System Production Well | 6036756.169 | 2221201.688 | 350-980 | 6/23/2021 | -3.71 | <Null> |
| 18462 | WM-11 | 18463 | WM-11/1 | WESTMINSTER | Active Large-System Production Well | 6030376.492 | 2221521.749 | 325-790 | 6/28/2021 | -16 | <Null> |
| 15462 | WM-125 | 15463 | WM-125/1 | WESTMINSTER | Active Large-System Production Well | 6019490.522 | 2226357.926 | 374-860 | 6/29/2021 | -35 | <Null> |
| 1250 | WM-3 | 1251 | WM-3/1 | WESTMINSTER | Active Large-System Production Well | 6035334.153 | 2212273.162 | 285-365 | <Null> | <Null> | Well in exclusion list |
| 987 | WM-4 | 988 | WM-4/1 | WESTMINSTER | Active Large-System Production Well | 6041811.441 | 2216473.787 | 345-1125 | 6/30/2021 | -10 | <Null> |
| 973 | WM-6 | 974 | WM-6/1 | WESTMINSTER | Active Large-System Production Well | 6040452.837 | 2221186.654 | 176-660 | <Null> | <Null> | Well in exclusion list |
| 19581 | WM-75A | 19582 | WM-75A/1 | WESTMINSTER | Active Large-System Production Well | 6027529.048 | 2227543.038 | 410-996 | 7/1/2021 | -18.75 | <Null> |
| 2351 | WM-RES1 | 2352 | WM-RES1/1 | WESTMINSTER | Active Large-System Production Well | 6034195.466 | 2226587.136 | 390-880 | 6/29/2021 | -13.33 | <Null> |
| 25 | WM-RES2 | 127 | WM-RES2/1 | WESTMINSTER | Active Large-System Production Well | 6022510.924 | 2225649.817 | 340-937 | 6/28/2021 | -36 | <Null> |
| 1549 | WM-SC4 | 1550 | WM-SC4/1 | WESTMINSTER | Active Large-System Production Well | 6024891.234 | 2228376.544 | 425-454 | 6/28/2021 | -13 | <Null> |
| 1501 | WOOD-INLK | 1502 | WOOD-INLK/1 | WOODBRIDGE VILL HOMEOWNER ASSN | Inactive Production Well | 6090903.001 | 2195025.511 | 370-890 | 6/28/2021 | -33.24 | <Null> |
| 2602 | YLWD-1 | 2603 | YLWD-1/1 | YORBA LINDA WATER DISTRICT | Standby Large-System Production Well | 6083180.423 | 2261475.297 | 90-340 | 6/24/2021 | 201.25 | <Null> |
| 2600 | YLWD-10 | 2601 | YLWD-10/1 | YORBA LINDA WATER DISTRICT | Standby Large-System Production Well | 6082573.916 | 2261063.226 | 90-406 | 6/24/2021 | 199.95 | <Null> |
| 2598 | YLWD-12 | 2599 | YLWD-12/1 | YORBA LINDA WATER DISTRICT | Standby Large-System Production Well | 6082579.233 | 2261460.266 | 80-498 | 6/24/2021 | 194.75 | <Null> |
| 18764 | YLWD-18 | 18765 | YLWD-18/1 | YORBA LINDA WATER DISTRICT | Standby Large-System Production Well | 6082572.851 | 2261290.355 | 250-570 | 6/24/2021 | 202 | <Null> |
| 19554 | YLWD-19 | 19555 | YLWD-19/1 | YORBA LINDA WATER DISTRICT | Standby Large-System Production Well | 6082841.553 | 2261300.166 | 280-581 | 6/24/2021 | 200.7 | <Null> |
| 21243 | YLWD-20 | 21244 | YLWD-20/1 | YORBA LINDA WATER DISTRICT | Standby Large-System Production Well | 6083164.301 | 2258232.562 | 225-570 | 6/24/2021 | 227.32 | <Null> |
| 22794 | YLWD-21 | 22795 | YLWD-21/1 | YORBA LINDA WATER DISTRICT | Standby Large-System Production Well | 6082500.179 | 2259535.434 | 210-510 | 6/24/2021 | 211.25 | <Null> |
| 2592 | YLWD-5 | 2593 | YLWD-5/1 | YORBA LINDA WATER DISTRICT | Standby Large-System Production Well | 6083146.35 | 2261304.493 | 90-340 | 6/24/2021 | 200.5 | <Null> |
| 2596 | YLWD-7 | 2597 | YLWD-7/1 | YORBA LINDA WATER DISTRICT | Standby Large-System Production Well | 6082874.48 | 2261508.045 | 137-259 | 6/24/2021 | 197.25 | <Null> |

**Wells Used to Develop 2021 Groundwater Contour Maps in Orange County Groundwater Basin**

**Deep Aquifer Wells (Model Layer 3)**

| STAID1 | WELLNM | STAID | STANAME | OWNERNM | GIS_SYMNM | NAD83_X | NAD83_Y | PERF_ZONE | SHORTDATE | WLELEV | NAD83_X | NAD83_Y |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 19013 | CSF-1 | 19132 | CSF-1/1/WB1/MP6 | CA. STATE UNIV., FULLERTON | Multiport Monitoring Well | 6064343.084 | 2270822.497 | MP6 (718) | 7/6/2021 | 108.52 | 6064343.084 | 2270822.497 |
| 8556 | F-COYO2 | 8557 | F-COYO2/1 | FULLERTON | Inactive Production Well | 6040365.852 | 2271034.694 | 309-919 | 6/30/2021 | 85.12 | 6040365.852 | 2271034.694 |
| 1387 | SNDR-SA | 1388 | SNDR-SA/1 | I & G 4 HUTTON LLC-ASSOC. | Other Active Production Well | 6070727.949 | 2200897.503 | 930-990 | 6/30/2021 | -71.45 | 6070727.949 | 2200897.503 |
| 19366 | IRWD-110 | 19367 | IRWD-110/1 | IRVINE RANCH WATER DISTRICT | Active Large-System Production Well | 6100371.561 | 2196315.961 | 555-1015 | <Null> | <Null> | 6100371.561 | 2196315.961 |
| 11474 | IRWD-3 | 11475 | IRWD-3/1 | IRVINE RANCH WATER DISTRICT | Active Large-System Production Well | 6072630.329 | 2206528.469 | 483.53-1249.9 | 6/23/2021 | -64.9 | 6072630.329 | 2206528.469 |
| 18510 | IRWD-C8 | 18511 | IRWD-C8/1 | IRVINE RANCH WATER DISTRICT | Active Large-System Production Well | 6062825.396 | 2204153.762 | 1080-1982 | <Null> | <Null> | 6062825.396 | 2204153.762 |
| 18512 | IRWD-C9 | 18513 | IRWD-C9/1 | IRVINE RANCH WATER DISTRICT | Active Large-System Production Well | 6062422.93 | 2205055.852 | 1055-1930 | <Null> | <Null> | 6062422.93 | 2205055.852 |
| 22065 | IRWD-52 | 22066 | IRWD-52/1 | IRVINE RANCH WATER DISTRICT | Inactive Production Well | 6073545.847 | 2203710.984 | 635-1290 | 6/29/2021 | -62.3 | 6073545.847 | 2203710.984 |
| 1941 | TIC-82 | 1942 | TIC-82/1 | IRVINE RANCH WATER DISTRICT | Monitoring Well | 6090541.059 | 2199639.983 | 410-1002 | 6/29/2021 | -8.83 | 6090541.059 | 2199639.983 |
| 1391 | ET-2 | 1392 | ET-2/1 | IRVINE RANCH WATER DISTRICT | Other Active Production Well | 6090684.562 | 2199800.983 | 280-1080 | <Null> | <Null> | 6090684.562 | 2199800.983 |
| 1389 | TIC-106 | 1390 | TIC-106/1 | IRVINE RANCH WATER DISTRICT | Other Active Production Well | 6084967 | 2197177.989 | 405-715 | <Null> | <Null> | 6084967 | 2197177.989 |
| 15780 | MCWD-11 | 15781 | MCWD-11/1 | MESA WATER DISTRICT | Active Large-System Production Well | 6055237.67 | 2197733.913 | 330-1000 | 7/7/2021 | -86.57 | 6055237.67 | 2197733.913 |
| 2135 | MCWD-6 | 2136 | MCWD-6/1 | MESA WATER DISTRICT | Active Large-System Production Well | 6055652.152 | 2197722.22 | 310-1025 | <Null> | <Null> | 6055652.152 | 2197722.22 |
| 1357 | MCAS-6 | 1358 | MCAS-6/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6094225.41 | 2191657.016 | 167-222 | 6/28/2021 | 76.17 | 6094225.41 | 2191657.016 |
| 2867 | OCWD-CTG1 | 2871 | OCWD-CTG1/4 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6061970.346 | 2206073.478 | 1060-1220 | 6/30/2021 | -81.88 | 6061970.346 | 2206073.478 |
| 2872 | OCWD-CTG5 | 2875 | OCWD-CTG5/3 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6062530.714 | 2206394.591 | 1040-1120 | 8/4/2021 | -87.56 | 6062530.714 | 2206394.591 |
| 2876 | OCWD-CTK1 | 2879 | OCWD-CTK1/3 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6062486.259 | 2205158.852 | 1260-1315 | 6/30/2021 | -83.03 | 6062486.259 | 2205158.852 |
| 22786 | OCWD-MRSH | 22854 | OCWD-MRSH/1 | ORANGE COUNTY WATER DISTRICT | Monitoring Well | 6074220 | 2188672.3 | 199-219 | 6/29/2021 | -28.15 | 6074220 | 2188672.3 |
| 547 | AMD-1 | 21142 | AMD-1/1/WB2/MP10 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6073916.932 | 2258572.091 | MP10 (1394) | 6/21/2021 | 139.96 | 6073916.932 | 2258572.091 |
| 565 | AMD-2 | 22211 | AMD-2/1/WB2/MP10 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6066705.21 | 2254540.618 | MP10 (1444) | 6/29/2021 | 104.23 | 6066705.21 | 2254540.618 |
| 7031 | AMD-4 | 7111 | AMD-4/1/WB1/MP11 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6050716.117 | 2255097.562 | MP11 (1409) | 6/28/2021 | 60.28 | 6050716.117 | 2255097.562 |
| 7295 | AMD-5 | 7324 | AMD-5/1/WB1/MP11 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6060070.244 | 2248962.576 | MP11 (1324) | 6/28/2021 | 82.65 | 6060070.244 | 2248962.576 |
| 8596 | AMD-7 | 8761 | AMD-7/1/WB1/MP14 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6049188.026 | 2247218.215 | MP14 (1424) | 6/28/2021 | 30.68 | 6049188.026 | 2247218.215 |
| 9682 | AMD-8 | 9916 | AMD-8/1/WB1/MP15 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6033488.697 | 2249624.328 | MP15 (2014) | 7/12/2021 | -13.155 | 6033488.697 | 2249624.328 |
| 9831 | BPM-1 | 9993 | BPM-1/1/WB1/MP14 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6022348.508 | 2259541.566 | MP14 (2109) | 7/12/2021 | -25.24 | 6022348.508 | 2259541.566 |
| 9832 | BPM-2 | 10188 | BPM-2/1/WB1/MP15 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6025195.413 | 2246739.597 | MP15 (2173) | 7/12/2021 | -23.16 | 6025195.413 | 2246739.597 |
| 685 | CB-1 | 8794 | CB-1/1/WB2/MP9 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6044695.232 | 2253837.186 | MP9 (1463) | 7/6/2021 | 29.14 | 6044695.232 | 2253837.186 |
| 5155 | COSM-1 | 7156 | COSM-1/1/WB1/MP14 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6055253.401 | 2197825.036 | MP14 (1599) | 6/30/2021 | -77.7 | 6055253.401 | 2197825.036 |
| 719 | FFS-1 | 14248 | FFS-1/1/WB2/MP8 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6061436.461 | 2262022.62 | MP8 (1420) | 7/6/2021 | 88.03 | 6061436.461 | 2262022.62 |
| 1291 | FVM-1 | 15700 | FVM-1/1/WB2/MP17 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6047178.815 | 2210990.613 | MP17 (1587) | 6/22/2021 | -29.3 | 6047178.815 | 2210990.613 |
| 7297 | GGM-1 | 10033 | GGM-1/1/WB1/MP13 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6045688.299 | 2230864.24 | MP13 (2011) | 7/8/2021 | -13.6 | 6045688.299 | 2230864.24 |
| 8923 | GGM-2 | 9057 | GGM-2/1/WB1/MP13 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6026525.607 | 2230233.156 | MP13 (1994) | 6/22/2021 | -15.01 | 6026525.607 | 2230233.156 |
| 7178 | HBM-1 | 8443 | HBM-1/1/WB1/MP11 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6031700.722 | 2216385.252 | MP11 (1464) | 7/2/2021 | -25.08 | 6031700.722 | 2216385.252 |
| 720 | IDM-1 | 18984 | IDM-1/1/WB2/MP9 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6099572.243 | 2207081.537 | MP9 (993) | 7/7/2021 | -10.34 | 6099572.243 | 2207081.537 |
| 9830 | IDM-2 | 10066 | IDM-2/1/WB1/MP8 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6080705.598 | 2209836.046 | MP8 (890) | 7/7/2021 | -53.81 | 6080705.598 | 2209836.046 |
| 11949 | LAM-1 | 12031 | LAM-1/1/WB1/MP12 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6009581.587 | 2238043.705 | MP12 (1613) | 6/15/2021 | -36.83 | 6009581.587 | 2238043.705 |
| 758 | MCAS-7 | 11831 | MCAS-7/1/WB3/MP6 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6093900.827 | 2194418.586 | MP6 (802) | 7/7/2021 | 21.5 | 6093900.827 | 2194418.586 |
| 756 | SAR-1 | 9269 | SAR-1/1/WB2/MP13 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6070684.206 | 2250425.314 | MP13 (1374) | 6/29/2021 | 85.58 | 6070684.206 | 2250425.314 |
| 761 | SAR-2 | 11995 | SAR-2/1/WB2/MP12 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6069096.008 | 2245410.807 | MP12 (1351) | 6/29/2021 | 74.07 | 6069096.008 | 2245410.807 |
| 762 | SAR-3 | 9471 | SAR-3/1/WB2/MP11 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6066892.02 | 2238409.284 | MP11 (1393) | 6/24/2021 | 58.87 | 6066892.02 | 2238409.284 |
| 763 | SAR-4 | 14637 | SAR-4/1/WB2/MP10 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6065370.966 | 2233375.154 | MP10 (1398) | 6/29/2021 | -9.56 | 6065370.966 | 2233375.154 |
| 1289 | SAR-5 | 21226 | SAR-5/1/WB3/MP11 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6062597.607 | 2227874.211 | MP11 (1735) | 6/30/2021 | -15.3 | 6062597.607 | 2227874.211 |
| 7181 | SAR-9 | 9807 | SAR-9/1/WB1/MP12 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6058380.802 | 2221450.982 | MP12 (1724) | 6/30/2021 | -28.443 | 6058380.802 | 2221450.982 |
| 9686 | SBM-1 | 9730 | SBM-1/1/WB1/MP8 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6016566.11 | 2224523.54 | MP8 (1256) | 6/15/2021 | -28.045 | 6016566.11 | 2224523.54 |
| 1001 | SC-2 | 6242 | SC-2/1/WB2/MP10 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6086489.295 | 2237887.557 | MP10 (664) | <Null> | <Null> | 6086489.295 | 2237887.557 |
| 1005 | SC-3 | 8841 | SC-3/1/WB2/MP5 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6081074.85 | 2229940.413 | MP5 (1022) | 7/1/2021 | 48.56 | 6081074.85 | 2229940.413 |
| 2888 | SC-4 | 6300 | SC-4/1/WB1/MP8 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6082605.785 | 2235080.546 | MP8 (830) | 7/1/2021 | 44.34 | 6082605.785 | 2235080.546 |
| 2854 | SC-5 | 6336 | SC-5/1/WB1/MP10 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6077454.866 | 2225543.458 | MP10 (1430) | 7/1/2021 | -27.75 | 6077454.866 | 2225543.458 |
| 9684 | SC-6 | 9763 | SC-6/1/WB1/MP11 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6066813.288 | 2216032.113 | MP11 (1684) | 7/7/2021 | -50.96 | 6066813.288 | 2216032.113 |
| 1293 | WMM-1 | 19892 | WMM-1/1/WB2/MP16 | ORANGE COUNTY WATER DISTRICT | Multiport Monitoring Well | 6038251.554 | 2221751.195 | MP16 (1745) | 7/8/2021 | -23.94 | 6038251.554 | 2221751.195 |
| 1883 | TIC-91 | 1884 | TIC-91/1 | PRIVATE | Destroyed and Sealed Well | 6075952.042 | 2204613.252 | 403-1208 | <Null> | <Null> | 6075952.042 | 2204613.252 |
| 22391 | RAY-MW25 | 22392 | RAY-MW25/1 | RAYTHEON TECHNOLOGIES CORPORATION | Monitoring Well | 6042037.4 | 2268206.9 | 449.4-479.8 | 6/30/2021 | 30.11 | 6042037.4 | 2268206.9 |
| 22408 | RAY-MW32 | 22411 | RAY-MW32/3 | RAYTHEON TECHNOLOGIES CORPORATION | Monitoring Well | 6039287.583 | 2267257.657 | 1070-1100 | 6/30/2021 | 26.62 | 6039287.583 | 2267257.657 |
| 8817 | SA-38 | 8818 | SA-38/1 | SANTA ANA | Standby Large-System Production Well | 6077082.488 | 2229427.758 | 400-1270 | 6/30/2021 | 27 | 6077082.488 | 2229427.758 |
| 1873 | TIC-93 | 1874 | TIC-93/1 | THE IRVINE COMPANY | Destroyed and Sealed Well | 6080030.447 | 2205228.503 | 400-1120 | <Null> | <Null> | 6080030.447 | 2205228.503 |
| 1927 | TIC-194 | 1931 | TIC-194/1 | THE IRVINE COMPANY | Monitoring Well | 6085062.044 | 2200644.721 | 562-726 | 6/29/2021 | -62.48 | 6085062.044 | 2200644.721 |
| 3524 | TIC-25 | 3525 | TIC-25/1 | THE IRVINE COMPANY | Monitoring Well | 6082128.447 | 2194002.252 | 666-760 | 6/29/2021 | -62.21 | 6082128.447 | 2194002.252 |
| 1829 | TIC-50 | 1830 | TIC-50/1 | THE IRVINE COMPANY | Monitoring Well | 6089719.969 | 2212322.221 | 475-1070 | 6/29/2021 | 19.34 | 6089719.969 | 2212322.221 |
| 958 | T-WALN | 959 | T-WALN/1 | TUSTIN | Active Large-System Production Well | 6084028.458 | 2212002.398 | 397-995 | 7/2/2021 | -40 | 6084028.458 | 2212002.398 |
| 21187 | WRD-SEALBEACH-1 | 21192 | WRD-SEALBEACH-1/5 | WATER REPLENISHMENT DISTRICT | Monitoring Well | 6002807.228 | 2229796.158 | 1020-1040 | 6/7/2021 | -39.7 | 6002807.228 | 2229796.158 |
| 3518 | WOOD-ISLK | 3519 | WOOD-ISLK/1 | WOODBRIDGE VILL HOMEOWNER ASSN | Inactive Production Well | 6089676.955 | 2191898.777 | 210-800 | 6/28/2021 | 26.83 | 6089676.955 | 2191898.777 |

APPENDIX F

# WATER SHORTAGE CONTINGENCY PLAN

# 2025 Water Shortage Contingency Plan

**FINAL DRAFT** / April 2026

carollo in collaboration with CDM Smith and Maddaus Water Management Inc.

City of Fullerton

# 2025 Water Shortage Contingency Plan

April 2026 / FINAL DRAFT

**Prepared By:**
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Phone: 213.489.1587
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**Prepared For:**
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**In collaboration with:**

CDM Smith
listen. think. deliver.

MADDAUS WATER MANAGEMENT
*Making a Difference in the World of Water ™*

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# Abbreviations

| | |
|---|---|
| % | Percent |
| AF | Acre-Feet |
| AWSDA | Annual Water Supply and Demand Assessment |
| BPP | Basin Production Percentage |
| CAMP4W | MET's Climate Adaptation Master Plan for Water |
| City | City of Fullerton |
| DDW | Division of Drinking Water |
| DVL | Diamond Valley Lake |
| DWR | California Department of Water Resources |
| EPA | Environmental Protection Agency |
| EOC | Emergency Operations Center |
| EOP | Emergency Operations Plan |
| FY | Fiscal Year |
| GRP | OCWD's Groundwater Resilience Plan |
| GSP | Groundwater Sustainability Plan |
| IAWP | Interim Agricultural Water Program |
| IRP | Integrated Water Resources Plan |
| LHMP | Local Hazard Mitigation Plan |
| M&I | Municipal and Industrial |
| MCL | Maximum Contaminant Level |
| MET | Metropolitan Water District of Southern California |
| MWDOC | Municipal Water District of Orange County |
| NIMS | National Incident Management System |
| OC Basin | Orange County Groundwater Basin |
| OCWD | Orange County Water District |
| PFAS | Per- and Polyfluoroalkyl Substances |
| PFOA | Perfluorooctanoic Acid |
| PFOS | Perfluorooctane Sulfonate |
| PPT | Parts Per Trillion |
| Producers | Groundwater Producers |
| RL | Response Level |
| SEMS | California Standardized Emergency Management System |
| Supplier | Urban Water Supplier |
| SWP | State Water Project |
| 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 |

# SECTION 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 Fullerton's (City) operating manual that is used to prevent catastrophic service disruptions through proactive, rather than reactive, management. A water shortage, when the 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, enabling 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 (AWSDA) 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 2025 WSCP is included as an appendix to its 2025 (UWMP) which will be submitted to DWR by July 1, 2026. However, while developed in conjunction with the UWMP, this WSCP is a standalone document 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. 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 AWSDA; monitoring and reporting requirements to determine customer compliance; reevaluation and improvement procedures for evaluating the WSCP.

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 Information** 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 2025 UWMP.

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

**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 percent 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** describes 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** provides a required definition for inclusion in a WSCP per the Water Code.

**Section 3.12 Plan Adoption, Submittal, and Availability** describes the process the City followed to adopt 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 Metropolitan Water District of Southern California (MET) (regional wholesaler for Southern California and the direct supplier of imported water to the City) and Orange County Water District (OCWD) (Orange County Groundwater Basin [OC Basin] manager and provider of recycled water in North Orange County).

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

- Municipal Water District of Orange County **(MWDOC's) 2025 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 2025 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.
- **MWDOC's 2023 Orange County Water Reliability Study** is a planning document to help guide planning for future water supply reliability for water providers in Orange County and provide input on regional water supply issues for MET.
- **2025 Orange County Water Demand Projection Model Technical Memorandum** is a collaborative effort amongst MWDOC, OCWD, and all retail water suppliers in Orange County that developed water demand projections to produce regionally consistent forecasts across all Orange County water agencies.
- **OCWD's 2025 Groundwater Resilience Plan (GRP)** is an adaptive strategies management plan outlining strategic projects to secure reliable future water supplies in the Orange County Basin.
- **MET's 2025 UWMP** uses assumptions that fall within the plausible futures contemplated in MET's Integrated Water Resources Plan to evaluate MET's future imported water supply reliability.
- **MET's 2025 WSCP** provides a water supply availability assessment and guide for MET's intended actions during water shortage conditions.
- **OCWD's 2023-24 Engineer's Report** provides information on the groundwater conditions, water supply, and basin utilization of the OC Basin.
- **OCWD's 2022 Basin 8-1 Alternative** is an alternative to the Groundwater Sustainability Plan (GSP) for the OC Basin, provides significant information related to sustainable management of the basin in the past and hydrogeology of the basin, including groundwater quality and basin characteristics, and addresses DWR's recommendations to ensure long-term basin sustainability.
- **City of Fullerton's 2025 Local Hazard Mitigation Plan (LHMP)** provides the basis for the seismic and other natural and natural disaster risk analysis of the water system facilities.
- **City of Fullerton's Public Works Department Water Division Emergency Response Plan** incorporates and coordinates all facilities and personnel of the City into an efficient organization that is capable of responding effectively to an emergency.
- **City of Fullerton's Risk and Resilience Assessment** assesses the risk and resilience of the City's water system to malevolent acts and natural hazards.

# SECTION 2 BACKGROUND INFORMATION

The City established its Water Utility in 1906, which functions to provide water to City residents. The City is a predominantly single and multi-family residential community, with a current population of 141,277, which is projected to increase by 12.5% over the next 25 years. This equates to an annual growth rate of 0.5%. The City is governed by a five-member council elected, each representing their own district, serving four-year staggered terms. As the City's legislative body, the Council is responsible for all municipal

programs and services, as well as local policy decisions. The City regards an adequate supply of water as an essential service to ensure public health and safety, economic growth, and community wellbeing.

## 2.1 City Service Area

The City's water service area covers 22.3 square miles, in north Orange County bounded to the north by the cities of La Habra and Brea, Placentia to the east, Buena Park to the west, and Anaheim to the south. The City's Water Utility operates 15 reservoirs with a capacity of 67.5 million gallons, 12 booster pumping stations, 7 active groundwater wells and manages about 424-mile water mains system with approximately 32,050 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 a predominantly single and multi-family residential community. Recent and ongoing developments in the City include various residential, commercial, industrial, and mixed-use projects. Moving forward, the City will continue planning for its Regional Housing Needs Allocation (RHNA) requirements and future planned developments may include accessory dwelling units (ADUs). A map of the City's water service area is shown in Figure 1.

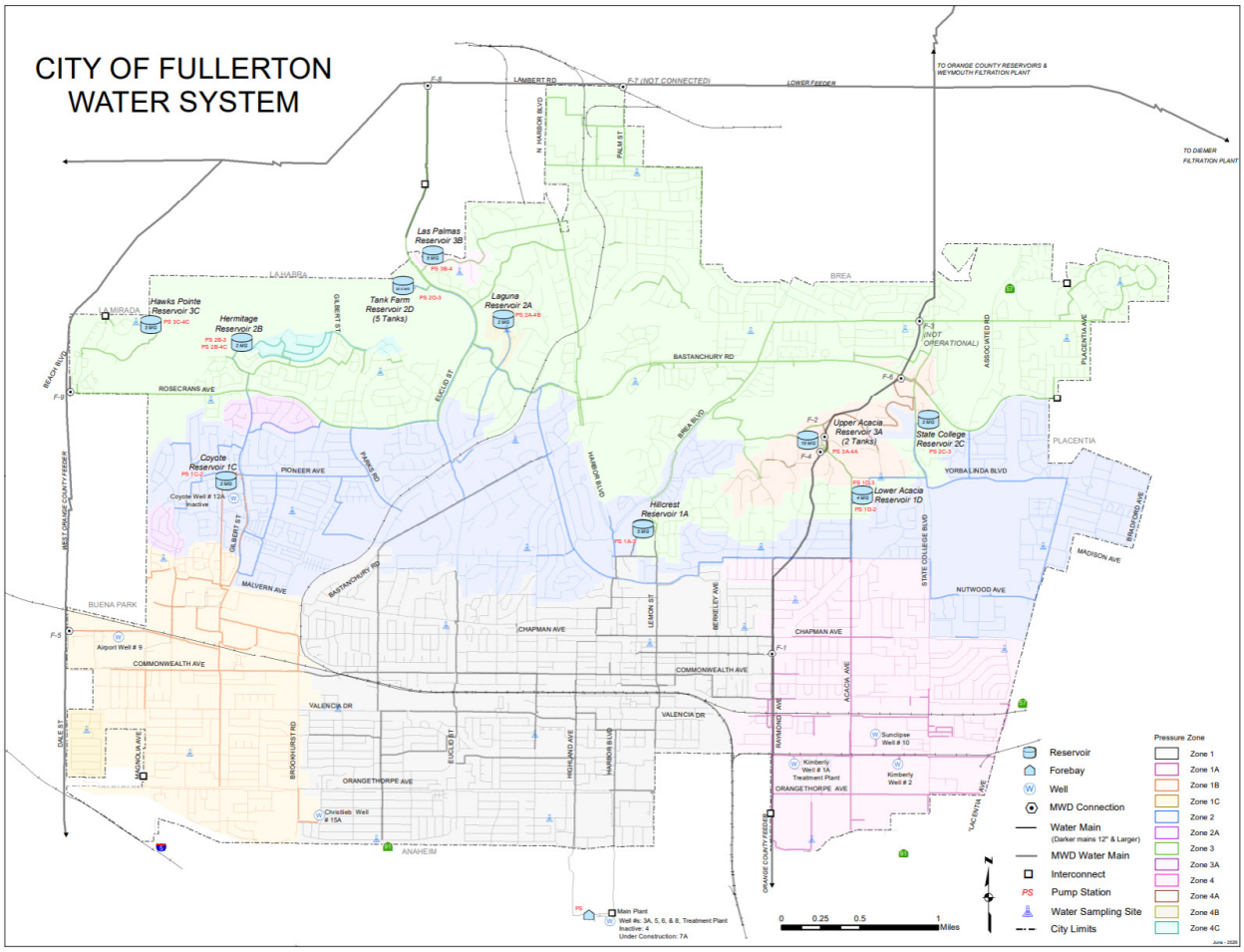



Figure 1 City of Fullerton Service Area

## 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. 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 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 City is one of MET's member agencies that purchases water directly from MET. The City's location within MET's service area and Orange County is shown in Figure 2.

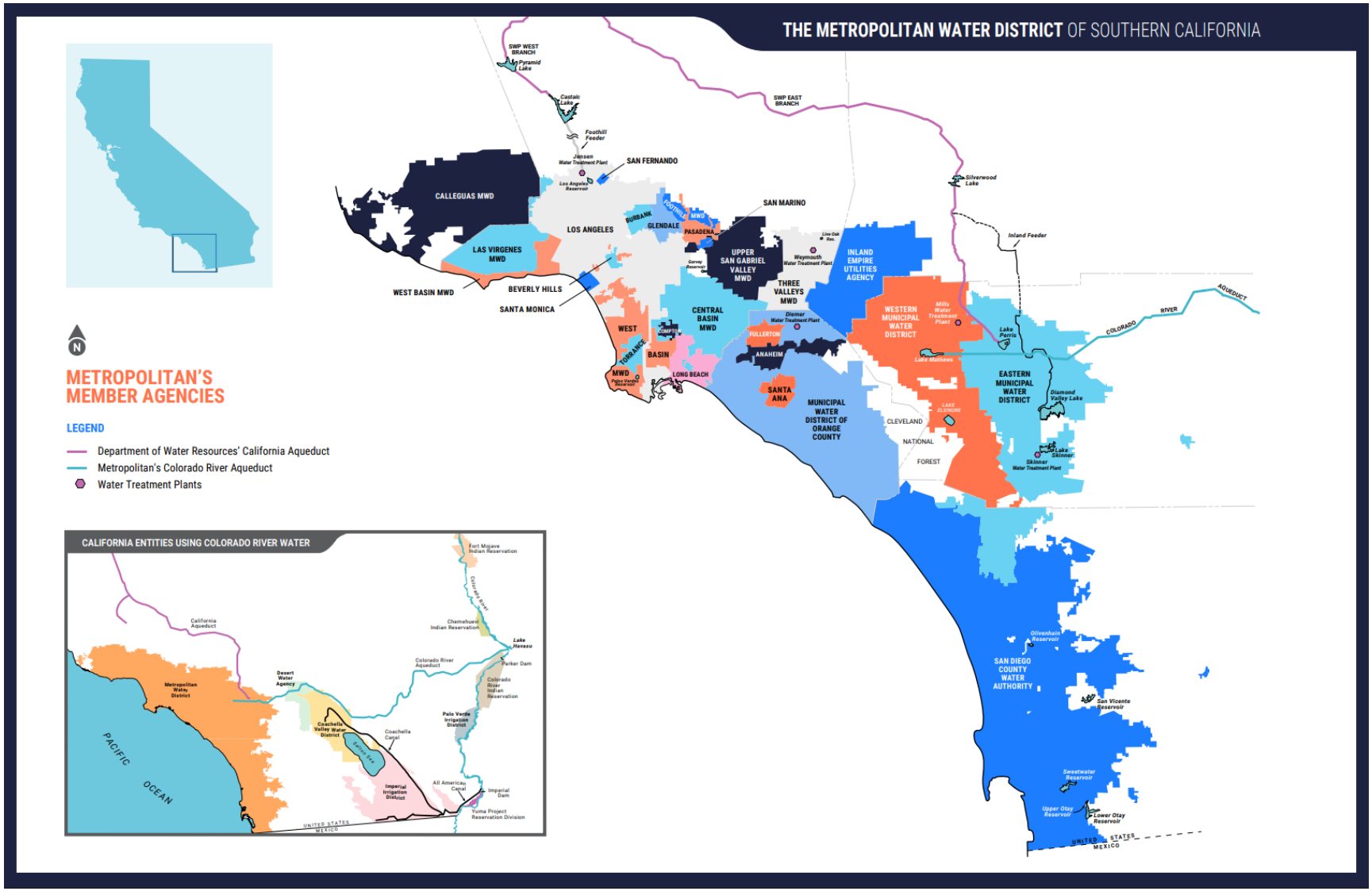



Figure 2 Regional Location of City of Fullerton and Other MET Member Agencies

## 2.3 Relationship with Wholesaler Water Shortage Planning

The WSCP is designed to be consistent with MET's Water Surplus and Drought Management (WSDM) Plan and Water Supply Allocation Plan (WSAP) and other emergency planning efforts as described below. MET's WSAP is integral to the WSCP's shortage response strategy in the event that MET determines that supply augmentation (including storage) and lesser demand reduction measures would not be sufficient to meet projected shortage levels needed to meet demands.

### 2.3.1 MET Water Surplus and Drought Management Plan

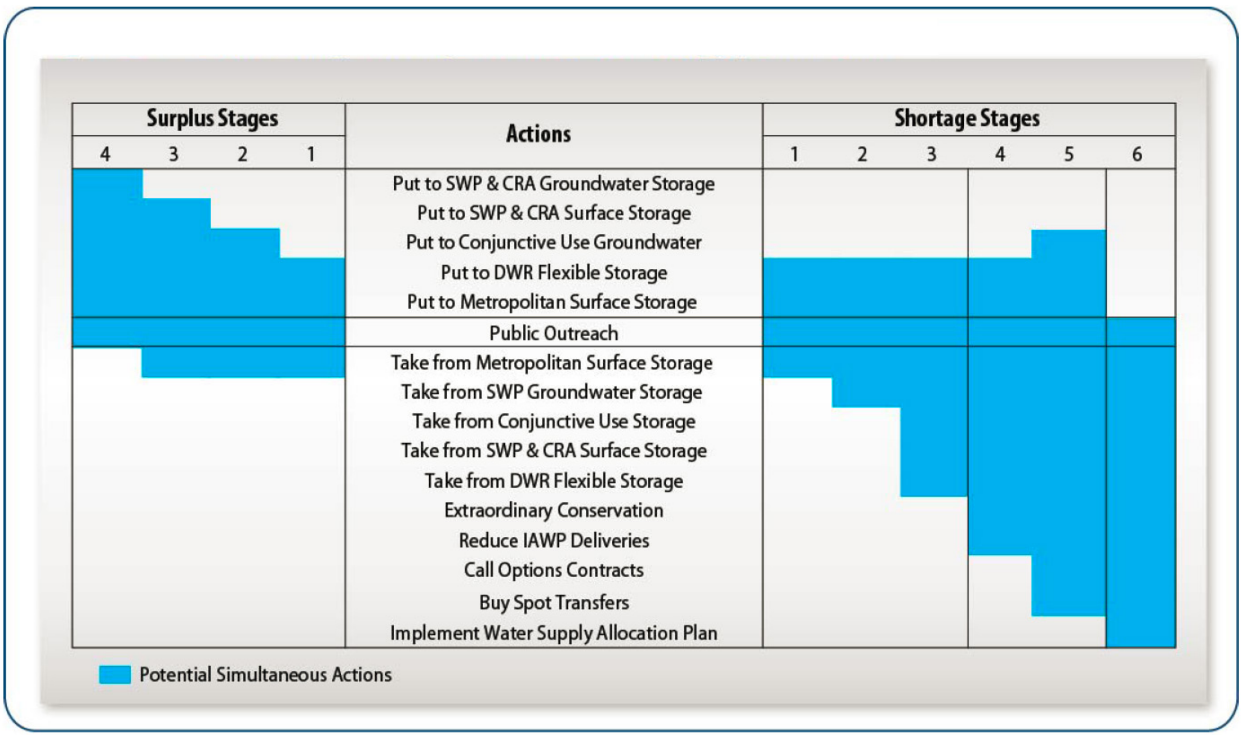
MET evaluates the level of supplies available and existing levels of water in storage to determine the appropriate management stage annually. Each stage is associated with specific resource management actions to avoid extreme shortages to the extent possible and minimize adverse impacts to retail customers 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 supply 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 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, 2026b).




*Source: MET's 2025 UWMP.*

Figure 3 Resource Stages, Anticipated Actions, and Supply Declarations

MET's Board of Directors adopted a Water Supply Condition Framework in June 2008 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, 2026a).

### 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, 2026a).

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 2025 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 up to greater than 50%. 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 base 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, 2026a).

As demonstrated by the findings in ET's 2025 UWMP both the Water Reliability Assessment and the Drought Risk Assessment (DRA) demonstrate that MET is projecting to be 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, 2025). Although MET's 2025 UWMP forecasts that MET will be able to meet projected imported demands throughout the projected period from 2026 to 2050, uncertainty in supply conditions can result in MET needing to implement its WSAP to preserve dry-year storage and curtail demands (MET, 2026a).

# SECTION 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 based on adequate details of demand reduction and supply augmentation measures that are structured to match varying degrees of shortage to 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. For the 2025 UWMP, the City worked collaboratively with MWDOC and OCWD to produce long-term projected water use over the next 25 years, in 5-year increments, for a normal water year, a single dry water year, and a drought lasting 5 consecutive water years (MWDOC, 2025).

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 (2026-2030). An analysis of both assessments determined that the City is capable of meeting all customers' demands from 2025 through 2050 for a normal year, a single dry year, and a drought lasting five consecutive years with significant imported water supplemental drought supplies from MET and ongoing conservation program efforts. As a result, there is no projected shortage condition due to drought that will trigger customer demand reduction actions until MET notifies the City of insufficient imported supplies. More information is available in the City's 2025 UWMP Sections 6 and 7 (Fullerton, 2026).

## 3.2 Annual Water Supply and Demand Assessment Procedures

Per Water Code Section 10632.1, the City will conduct an AWSDA pursuant to subdivision (a) of Section 10632 and by July 1st of each year, beginning in 2022, submit an annual water shortage 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 AWSDA. The AWSDA 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 AWSDA is due by July 1 of every year.

This section documents the decision-making process required for formal approval of the City's AWSDA 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 AWSDA determination of water supply reliability each year.

### 3.2.1.1 City Steps to Approve the AWSDA Determination

The AWSDA will be predicated primarily on the OCWD Basin Production Percentage (BPP) and secondarily on MET's AWSDA outcomes. Figure 4 shows the AWSDA reporting timeline for the City of Fullerton.

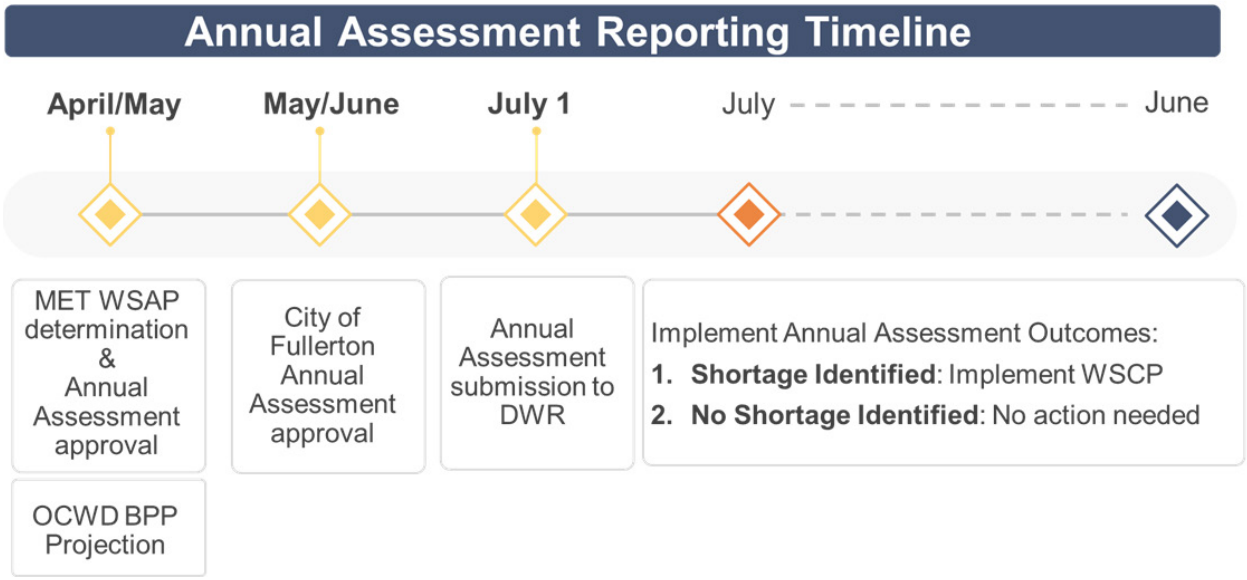



Figure 4 AWSDA Reporting Timeline

The City produces local groundwater from the OC Basin managed by 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 the OCWD on an annual basis. Based on the projected water demand and 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 AWSDA.

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 MET. As a direct MET member, the AWSDA will be predicated on MET's WSDM supply and demand tracking, which is reported monthly to their Board of Directors. MET WSDM planning involves the examination of developing demand and supply conditions

for the calendar year, as well as considerations of potential actions consistent with the WSDM Plan. Additionally, City staff simultaneously provide water supply and demand reports to MET to inform them of emerging demand and supply conditions. These monthly analyses provide key information for MET to manage resources to meet a range of estimated demands and adjust to changing conditions throughout the year. Based on the year's supply conditions and WSDM actions, MET will present a completed AWSDA 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 AWSDA will be approved by their Board at that time and the information will be incorporated into the City's AWSDA.

The AWSDA findings will determine the approval process. If a shortage is identified, the AWSDA will be taken to City Council for approval and formally submitted to DWR prior to the July 1 deadline. If no shortage is identified, the AWSDA will be approved by the Public Works Director and formally submitted to DWR prior to the July 1 deadline.

### 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 AWSDA. The AWSDA determination will be based on considerations of unconstrained water demand, local water supplies, MET imported water supplies, planned water use, and infrastructure considerations. The balance between projected in-service area supplies, coupled with MET imported supplies, and anticipated unconstrained demand will be used to determine what, if any, shortage level is expected under the WSCP framework as presented in Figure 5. The WSCP's standard shortage levels 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.

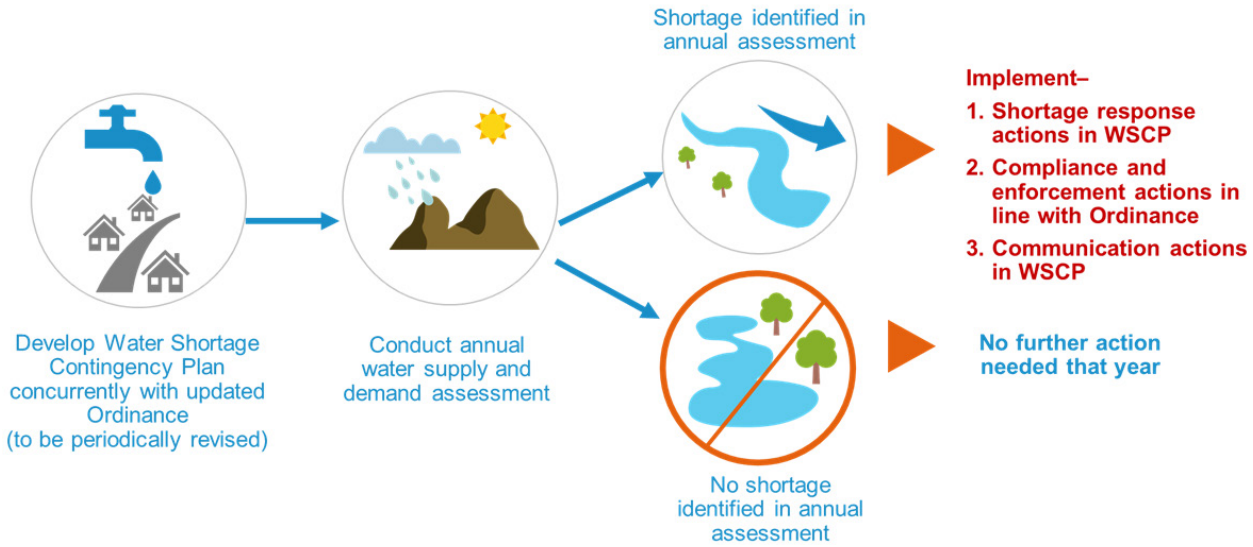



Figure 5 Water Shortage Contingency Plan AWSDA Framework

### 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 MET and take appropriate actions consistent with the flexibility and adaptiveness inherent to the WSCP. The City's AWSDA 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 MET's wholesale supply and demand, such as groundwater replenishment, surface water and local supply production, can differ significantly from earlier projections throughout the year.

However, 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 25-35% until the system is repaired. However, MET and MWDOC have taken proactive steps to handle such disruption, such as constructing DVL, and prepositioning necessary reconstruction resources to quickly recover from such a seismic event, which mitigates potential impacts. DVL, along with other local reservoirs, can store a six to twelve-month supply of emergency water (MET, 2026a).

#### 3.2.2.3 Water Supply

As detailed in the City's 2025 UWMP, the City meets all of its customers' demands with a combination of local groundwater and imported water from MET. The City's main source of water supply is groundwater from the OC Basin, and imported water from MET makes up the rest of the City's water supply portfolio. In Fiscal Year (FY) 2024-25, the City relied on 63 percent groundwater and 37 percent imported water. The volume of groundwater decreased in FY 2024-25 from historical averages while volume of imported water increased due to groundwater wells being temporarily taken offline while per- and polyfluoroalkyl substances (PFAS) treatment facilities are constructed to address PFAS contamination of groundwater. It is projected that by 2050, the water supply portfolio will change to approximately 85 percent groundwater and 15% imported water as PFAS treatment facilities are completed. (Fullerton, 2026).

#### 3.2.2.4 Unconstrained Customer Demand

The WSCP and AWSDA 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 2025-26 through FY 2029-30 (Fullerton, 2026). Water demands in a five-year consecutive drought are calculated as a 7% increase in water demand above a normal year for each year of the drought (MWDOC, 2025).

For the City, the five consecutive dry year demand scenario is based on the demand model's multiple dry year methodology. In accordance with the econometric demand model approach used to develop UWMP demand projections, a single hot/dry year was first identified based on weather conditions that produced the greatest demand response. Consecutive dry years were then represented by applying incremental scaling factors to this single hot/dry year demand to account for the compounding effects of persistent warm and dry conditions over time. These scaling factors show long-term relationships between regional water use and multi-year temperature and precipitation deficits and are applied sequentially to simulate second through fifth consecutive dry years. This approach is consistent with the demand modeling framework summarized in Chapter 7 of the City's UWMP.

#### 3.2.2.5 Planned Water Use for Current Year Considering Dry Subsequent Year

Water Code Section 10632(a)(2)(B)(ii) requires the AWSDA to determine "current year available supply, considering hydrological and regulatory conditions in the current year and one dry year."

The AWSDA 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 AWSDA'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 AWSDA 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 the City's sources of supply. Severe drought conditions in 2021-2022 affected must of the Western United States, including the Colorado River system, which caused its water supply decrease. As conditions worsened, Lake Mead and Lake Powell (the largest storage units in the system), had a combined total storage capacity of 25 percent in 2022, a significant decrease from 39% in 2021 (MWDOC, 2026).

The Orange County Water Demand Projection Model 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. For a single dry year condition (FY 2013-14), the model projects a 5% increase in demand for the OC Basin area where the City's service area is located (MWDOC, 2025). Detailed information of the model is included in the City's 2025 UWMP.

The City has documented that it is 100 percent reliable for single dry year demands from 2025 through 2050 with a demand increase of 7 percent from normal demand with significant reserves held by MET, local groundwater supplies, and conservation (Fullerton, 2026).

#### 3.2.2.6 Infrastructure Considerations

The AWSDA 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.

In partnership with OCWD, the City is in the process of constructing two PFAS Treatment Plants, each designed to treat at least two wells. The City also currently operates two PFAS Treatment Plants one of which is undergoing an expansion to accommodate well 7A, scheduled to come online May 2026.

The City is in the planning stages to drill a new well in the Fullerton service area. This well is expected to produce around 3,000 gallons per minute of flow and is estimated to be drilled by the end of 2028.

The City experiences, on average, approximately 100 water main breaks per year. These breaks often cause temporary water shutoffs to its customers. The City is planning to increase the rate of pipe replacement to a 60-year replacement cycle to reduce the rate of main breaks in the future.

#### 3.2.2.7 Other Factors

The Orange County North Basin Superfund Site is a six-and-a-half-square-mile portion of the groundwater aquifer located under the City, Anaheim, and Placentia. Manufacturing industries operating primarily in the 1950s, 1960s, and 1970s have left a legacy of industrial pollutants, mainly volatile organic compounds (VOCs), at their former factories. These VOCs have migrated through soils and have leached into the underlying groundwater.

Currently, OCWD is conducting a Remedial Investigation/Feasibility Study under the oversight of the US Environmental Protection Agency (EPA). The City continues to closely monitor VOC levels in all of its wells.

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.

MET has voluntarily monitored PFAS in its source and treated waters since 2017. Most samples have shown non detect (ND) for all tested PFAS, including PFOA and PFOS. A limited number of other PFAS—such as PFHxA, PFBA, PFPeA, PFDoA, PFTA, and PFBS, have been detected only at trace levels below their method detection limits. PFOA and PFOS have not been detected in MET's imported or treated water supplies. Some member agencies, however, have detected these compounds in local groundwater wells, which may require treatment or source management to comply with emerging DDW regulations. As DDW and EPA establish enforceable maximum contaminant levels (MCLs) for PFOA and PFOS, some agencies may supplement their local supplies with increased purchases of MET water (MET, 2026b).

EPA finalized the first national drinking water standards for six PFAS compounds in April 2024. These standards include enforceable MCLs for PFOA and PFOS set at 4 parts per trillion (ppt). In May 2025 the EPA announced that it would extend the compliance deadline for PFOA and PFOS from 2029 to 2031 to provide additional time for testing, planning, and installation of treatment technologies. While MET and its member agencies continue to monitor and test PFAS in imported and local sources, the delay in the federal compliance date allows additional time to evaluate treatment options, coordinate funding, and plan system upgrades necessary to meet forthcoming federal PFAS standards.

PFAS have been detected in the OC Basin in very small amounts (parts per trillion), entering primarily via the Santa Ana River whose flows infiltrate into the basin. Despite playing no role in releasing PFAS into the environment, OCWD is working with its cities and retail water districts to remove it from local water supplies in order to comply with new state and federal regulations. More than 100 wells have been impacted due to various state and federal regulations. Fifteen impacted agencies will have to temporarily purchase more costly imported water to replace PFAS contaminated supplies. As of 2025, 53 impacted wells are back online due to close to a billion dollars being spent on state-of-the-art testing, research and piloting of different treatment systems, and design and construction of treatment plants that are now operational.

## 3.3 Six Standard Water Shortage Levels

Per Water Code Section 10632 (a)(3)(A), Suppliers must include the six standard water shortage levels that represent shortages from the normal reliability as determined in the AWSDA or cross-reference their shortage levels to the standard levels. The shortage levels have been standardized to provide a consistent regional and statewide approach to conveying the relative severity of water supply shortage conditions. This is an outgrowth of the severe statewide drought of 2012-2016, and the widely recognized public communication and state policy uncertainty associated with the many different local definitions of water shortage levels.

The six standard water shortage levels correspond to progressively increasing estimated shortage conditions (up to 10%, 20%, 30%, 40%, 50%, and greater than 50% shortage compared to the normal reliability condition) and align with the response actions the Supplier would implement to meet the severity of the impending shortages (Table 1).

Table 1 Cross-Reference for Standard vs Supplier Shortage Levels

| Submittal Table 8-1: Cross-reference for Standard vs Supplier Shortage Levels<br>Water Code Section 10632(a)(3)(B) | | | |
|---|---|---|---|
| ☑ | Check the box if the Supplier uses the Standard six levels of water shortage.<br>Proceed to the next table. | | |
| **Standard Shortage Levels** | **Percent Shortage Range** | **Suppliers Shortage Levels** | **Percent Shortage Range** |
| 1 | Up to 10% | | |
| 2 | Up to 20% | | |
| 3 | Up to 30% | | |
| 4 | Up to 40% | | |
| 5 | Up to 50% | | |
| 6 | >50% | | |
| **NOTES:** | | | |

## 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 Supply Augmentation

The supply augmentation actions are described in DWR Table 8-2 (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 MET and OCWD. The City has the ability to pump additional groundwater from the OC Basin or purchase additional imported water from MET as a MET member agency. However, both additional pumped groundwater and purchased imported water are subject to rate penalties from OCWD and MET, respectively.

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.

### 3.4.2 Demand Reduction

The demand reduction measures that would be implemented to address shortage levels are described in DWR Table 8-3 (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.

### 3.4.3 Operational Changes

During shortage conditions, operations may be affected by supply augmentation or demand reduction responses. The City considered their operational procedures to identify changes that can be implemented to address water shortage on a short-term basis, such as temporarily altering maintenance cycles, deferring planned system outages, and adjusting the flow and routing of water through its system to more effectively distribute available supply across the service area.

### 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 Fullerton Municipal Code Chapter 12.06 Water Supply Shortage Conservation Plan (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 6 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 LHMP, and the Water Emergency Response Organization of Orange County (WEROC) Emergency Operations Plan (EOP).

#### 3.4.5.1 MET's WSDM and WSAP Plans

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.

The City is a participant of MET's Member Agency Response System (MARS). The City can communicate via two-way radio with the MET and its member agencies in extreme circumstances such as an earthquake, flood, fire, or a regional disaster to request or offer assistance, use certain facilities and equipment, and to request the service of certain personnel.

#### 3.4.5.2 Water Emergency Response 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, administered by MWDOC, was established through the creation of an indemnification agreement among 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 the 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 MWDOC 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 resulting from both natural and man-made causes, and can be activated through automatic, manual, or standby for activation.

WEROC recognizes 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 on 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.

The EOC Action Plans 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 that 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, 2021).

#### 3.4.5.3 City of Fullerton 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. (Fullerton, 2026).

### 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 is susceptible to damage from earthquakes and other disasters.

In lieu of conducting a seismic risk assessment specific to the City's 2025 UWMP, the City has included their LHMPas required under the federal Disaster Mitigation Act of 2000 (Public Law 106-390). The LHMP describes the City's approach to proactively decreasing threats before disaster occurs, including water supply specific mitigation actions such as supporting regional and subregional efforts to safeguard water infrastructure and supporting projects, programs, policies, and regulations to maintain adequate water supply as well as adequate water quality. (Fullerton, 2020).

### 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 Tables 8-2 and 8-3 (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. 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 AWSDA described pursuant to Section 10632.1; any shortage response actions triggered or anticipated to be triggered by the AWSDA described pursuant to Section 10632.1; and any other relevant communications. The City's Water Shortage Communication Plan is documented in Appendix C.

## 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. Communication procedures to ensure customer compliance are described in Section 3.5 and customer enforcement, appeal, and exemption procedures are defined in the Fullerton Municipal Code Chapter 12.06 Water Supply Shortage Conservation Plan (Appendix B). The City intends to update as needed existing enforcement procedures in a subsequently adopted ordinance which will supersede the existing ordinance.

## 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 Fullerton Municipal Code Chapter 12.06d Water Supply Shortage Conservation Plan (Appendix B).

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 2 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 2 Agency Contacts and Coordination Protocols

| Contact | Agency | Coordination Protocols |
|---|---|---|
| 714-433-6011 | Orange County Health Care Agency | Contact Agency Director to coordinate conservation efforts |
| 714-765-3300 | Anaheim | Contact City Manager to coordinate conservation efforts |
| 714-990-7687 or 714-990-7911 | Brea | Contact City Manager to coordinate conservation efforts |
| 714-528-1462 | Golden State Water Company | Contact General Manager to coordinate conservation efforts |
| 562-905-9750 or 562-905-9769 | La Habra | Contact City Manager to coordinate conservation efforts |
| 562-944-8219 | Suburban Water System | Contact General Manager to coordinate conservation efforts |

## 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. Table 3 shows the revenue impact analysis of the respective WSCP levels for the City of Fullerton.

Table 3 Revenue Impact Analysis

| Demand | Baseline (Normal Year) | Level 1 | Level 2 | Level 3 | Level 4 | Level 5 | Level 6 |
|---|---|---|---|---|---|---|---|
| | | 10% | 20% | 30% | 40% | 50% | >50% |
| Water Produced / Purchased (AF) | 23,799 | 21,419 | 19,039 | 16,659 | 14,279 | 11,900 | 11,900 max. |
| Water Losses (AF) | 1,293 | 1,164 | 1,034 | 905 | 776 | 647 | 647 max. |
| Water Sales (AF) | 22,506 | 20,255 | 18,005 | 15,754 | 13,504 | 11,253 | 11,253 max. |
| **Revenue** | | | | | | | |
| Commodity Rate ($/1000 Gal) | Tier 1: 2.60<br>Tier 2: 5.30<br>Tier 3: 5.73<br>Fixed: 3.30 | Tier 1: 2.60<br>Tier 2: 5.30<br>Tier 3: 5.73<br>Fixed: 3.30 | Tier 1: 2.60<br>Tier 2: 5.30<br>Tier 3: 5.73<br>Fixed: 3.30 | Tier 1: 2.60<br>Tier 2: 5.30<br>Tier 3: 5.73<br>Fixed: 3.30 | Tier 1: 2.60<br>Tier 2: 5.30<br>Tier 3: 5.73<br>Fixed: 3.30 | Tier 1: 2.60<br>Tier 2: 5.30<br>Tier 3: 5.73<br>Fixed: 3.30 | Tier 1: 2.60<br>Tier 2: 5.30<br>Tier 3: 5.73<br>Fixed: 3.30 |
| Commodity Revenue | 23,987,517 | 21,588,766 | 19,190,014 | 16,791,262 | 14,392,510 | 11,993,759 | 11,993,759 max. |
| Fixed Monthly Charge Revenue | 18,049,200 | 18,049,200 | 18,049,200 | 18,049,200 | 18,049,200 | 18,049,200 | 18,049,200 |
| Total Rate Revenue | 42,036,718 | 39,637,966 | 37,239,214 | 34,840,463 | 32,441,711 | 30,042,959 | 30,042,959 max. |
| **Revenue Lost** | | **$2,398,752** | **$4,797,503** | **$7,196,255** | **$9,595,007** | **$11,993,759** | **$11,993,759 min.** |
| **Variable Costs** | | | | | | | |
| Sources of Supply, Pumping, Treatment ($) | 17,019,303 | 15,317,372 | 13,615,442 | 11,913,512 | 10,211,582 | 8,509,651 | 8,509,651 max. |
| Unit Costs ($/AF) | 715 | 715 | 715 | 715 | 715 | 715 | 715 |
| **Avoided Costs** | | **$1,701,930** | **$3,403,861** | **$5,105,791** | **$6,807,721** | **$8,509,651** | **$8,509,651 min.** |
| **Net Revenue Change** | | **$696,821** | **$1,393,643** | **$2,090,464** | **$2,787,286** | **$3,484,107** | **$3,484,107 min.** |
| **Rate Revenue Increase Required(1)** | | **1.76%** | **3.74%** | **6.00%** | **8.59%** | **11.60%** | **11.60% min.** |

Notes:
(1) The City does not have water supply shortage rates.

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 12.06 Water Supply Shortage Conservation Plan (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 up to 50% and above of water sales may lead to a range of reductions 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 a plan to modify the water rate structure in a way that stabilizes revenue during times of drought by increasing the fixed revenue.

## 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. Monthly reports are prepared and monitored. This data 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,

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 the City and monitor the effectiveness of ongoing conservation programs.

The City will participate in regular meetings with local agencies 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 AWSDA 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 12.06 Water Supply Shortage Conservation Plan (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 Public Review Draft 2025 UWMP and 2025 WSCP and notice of the public hearing to consider adoption of the WSCP. The Public Review drafts of the 2025 UWMP and the 2025 WSCP were posted prominently on the City's website 14 days in advance of the public hearing on May 5, 2026. 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 D.

The City held the public hearing for the Draft 2025 UWMP and Draft WSCP on May 5, 2026 at the City Council meeting. The City Council reviewed and approved the 2025 UWMP and the WSCP at its May 5, 2026 meeting after the public hearing. See Appendix E for the resolution approving the WSCP.

By July 1, 2026, the City's adopted 2025 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 to its adopted WSCP, as required and directed by DWR.

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

# SECTION 4 REFERENCES

City of Fullerton. (2026). *2025 Urban Water Management Plan*.

City of Fullerton. (2020, May). *Local Hazard Mitigation Plan*.

Metropolitan Water District of Southern California (MET). (2026a). 2025 *Water Shortage Contingency Plan*.

Metropolitan Water District of Southern California (MET). (2026b, June). *2025 Urban Water Management Plan.*

Municipal Water District of Orange County (MWDOC). (2026). *2025 Urban Water Management Plan*.

Municipal Water District of Orange County (MWDOC). (2025, December 30). *Orange County Water Demand Projection Model Technical Memorandum.*

Municipal Water District of Orange County (MWDOC). (2023, July). *2023 Orange County Water Reliability Study*.

Water Emergency Response Organization of Orange County (WEROC). (2025). *WEROC 2025 Annual Report.*

APPENDIX A

# DWR SUBMITTAL TABLES

Submittal Table 8-1: Cross Reference for Standard vs Supplier Shortage Level

| **Submittal Table 8-1: Cross-reference for Standard vs Supplier Shortage Levels<br>Water Code Section 10632(a)(3)(B)** | | | |
|---|---|---|---|
| ☑ | Check the box if the Supplier uses the Standard six levels of water shortage.<br>Proceed to the next table. | | |
| **Standard Shortage Levels** | **Percent Shortage Range** | **Suppliers Shortage Levels** | **Percent Shortage Range** |
| 1 | Up to 10% | | |
| 2 | Up to 20% | | |
| 3 | Up to 30% | | |
| 4 | Up to 40% | | |
| 5 | Up to 50% | | |
| 6 | >50% | | |
| **NOTES:** | | | |

Submittal Table 8-2: Supply Augmentation and Other Actions

| **Submittal Table 8-2 Retail: Supply Augmentation and Other Actions<br>Water Code Section 10632(a)(4)(A),(C) and (E)** | | | | |
|---|---|---|---|---|
| Yes | Is the Supplier completing this table using the standard six levels? (yes/no) | | | |
| Shortage Level | Supply Augmentation Methods and Other Actions by Water Supplier<br>**Drop down list**<br>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? | | Additional Explanation or Reference (OPTIONAL) |
| | | Volume or Percentage Drop down | Shortage Gap Reduction Value (May be a range)<br>(AF) | |
| Add additional rows as needed | | | | |
| 0-6 | Other Actions (describe) | Percentage | 0-100% | Pump additional groundwater from OC Groundwater Basin (short-term shortage) with rate penalty |
| 0-6 | Other Actions (describe) | Percentage | 1-100% | Purchase additional imported water from MET with rate penalty |
| **DWR NOTES: Units of measure (AF, CCF, MG)** must remain consistent throughout the UWMP as reported in Submittal Table 2-3. | | | | |
| NOTES: Both additional pumped groundwater and purchased imported water are subject to rate penalties from OCWD and MET. | | | | |

Submittal Table 8-3: Demand Reduction Actions

| Submittal Table 8-3 Retail: Demand Reduction Actions<br>Water Code Section 10632(a)(4)(B) and (E) | | | | | |
|---|---|---|---|---|---|
| Yes | Is the Supplier completing this table using the standard six levels? (yes/no) | | | | |
| 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? | | Additional Explanation or Reference (OPTIONAL) | Penalty, Charge, or Other Enforcement? **For Retail Suppliers Only** Drop Down List |
| | | Volume or Percentage Drop down | Shortage Gap Reduction Value (May be a range) (AF) | | |
| Add additional rows as needed | | | | | |
| 0 | Landscape - Prohibit certain types of landscape irrigation | | Statewide Prohibition is Required | Watering or irrigation of nonfunctional turf (NFT) on State and local government properties, commercial, industrial, and institutional owned landscapes, homeowners' associations common area landscapes, and local government facilities in disadvantaged communities (DAC) is prohibited. See Note 1 below. | No |
| 0 | Other water feature or swimming pool restriction | Percentage | 0 | All decorative water features must re-circulate water or users mist secure a waiver from the City. | Yes |
| 0 | Other | Percentage | 0 | Washing or hosing down vehicles is prohibited except by use of a handheld container, hose with an automatic shut off device, or at a commercial car wash. | Yes |
| 0 | Other - Prohibit use of potable water for washing hard surfaces | Percentage | 0 | Washing hard or paved surfaces is prohibited except to alleviate safety or sanitary hazards using a handheld container, hose with an automatic shut off device, or a low-volume high pressure cleaning machine that recycles used water. | Yes |

| Submittal Table 8-3 Retail: Demand Reduction Actions<br>Water Code Section 10632(a)(4)(B) and (E) | | | | | |
|---|---|---|---|---|---|
| Yes | Is the Supplier completing this table using the standard six levels? (yes/no) | | | | |
| 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? | | Additional Explanation or Reference (OPTIONAL) | Penalty, Charge, or Other Enforcement? **For Retail Suppliers Only** Drop Down List |
| | | Volume or Percentage Drop down | Shortage Gap Reduction Value (May be a range) (AF) | | |
| 0 | Landscape - Restrict or prohibit runoff from landscape irrigation | Percentage | 0 | Watering vegetated areas in a manner that causes excessive water flow or runoff onto an adjoining sidewalk, driveway, street, alley, gutter, or ditch is prohibited. | Yes |
| 0 | Landscape - Other landscape restriction or prohibition | Percentage | 0 | Irrigating ornamental turf on public street medians is prohibited. No landscape watering shall occur within 48 hours after measurable precipitation. | Yes |
| 0 | Landscape - Limit landscape irrigation to specific times | Percentage | 0 | Watering or irrigation with a device that is not continuously attended to is limited to fifteen (15) minutes per day per valve. Low flow drip type systems, water efficient steam rotor systems. | Yes |
| 0 | Other - Customers must repair leaks, breaks, and malfunctions in a timely manner | Percentage | 0 | Fix leaks or faulty sprinkler promptly/within 3 day(s) | Yes |
| 0 | CII - Other CII restriction or prohibition | Percentage | 0 | No single pass cooling systems may be installed in new or remodeled buildings. | Yes |
| 0 | CII - Commercial kitchens required to use pre-rinse spray valves | Percentage | 0 | All new commercial car wash and laundry facilities must re-circulate the wash waster or obtain a waiver from the City. | Yes |
| 0 | Other - Require automatic shut of hoses | Percentage | 0 | Use a shutoff nozzle on hoses. | Yes |

| Submittal Table 8-3 Retail: Demand Reduction Actions<br>Water Code Section 10632(a)(4)(B) and (E) | | | | | |
|---|---|---|---|---|---|
| Yes | Is the Supplier completing this table using the standard six levels? (yes/no) | | | | |
| 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? | | Additional Explanation or Reference (OPTIONAL) | Penalty, Charge, or Other Enforcement? **For Retail Suppliers Only** Drop Down List |
| | | Volume or Percentage Drop down | Shortage Gap Reduction Value (May be a range) (AF) | | |
| 0 | Other - Prohibit vehicle washing except at facilities using recycled or recirculating water | Percentage | 0 | Food preparation establishments must use water efficient kitchen spray valves. | Yes |
| 0 | Other | Percentage | 0 | Unauthorized use of hydrants is prohibited. Authorization for use must be obtained from water supplier. | Yes |
| 1 | Expand Public Information Campaign | Percentage | 0-1% | Community outreach and messaging (Expand public information campaign), Encourage customers to wash only full loads when washing dishes or clothes. Encourage customers to use pool covers to minimize evaporation. | Yes |
| 1 | Landscape - Limit landscape irrigation to specific times | Percentage | 0-5% | watering or irrigation of vegetated areas is prohibited between 9 am and 6 pm except by use of a handheld device, hose equipped with an automatic shutoff device, or for adjusting. | Yes |
| 1 | CII - Restaurants may only serve water upon request | Percentage | 0-1% | CII- Restaurants may only serve water upon request. | Yes |

| Submittal Table 8-3 Retail: Demand Reduction Actions<br>Water Code Section 10632(a)(4)(B) and (E) | | | | | |
|---|---|---|---|---|---|
| Yes | Is the Supplier completing this table using the standard six levels? (yes/no) | | | | |
| 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? | | Additional Explanation or Reference (OPTIONAL) | Penalty, Charge, or Other Enforcement? **For Retail Suppliers Only** Drop Down List |
| | | Volume or Percentage Drop down | Shortage Gap Reduction Value (May be a range) (AF) | | |
| 1 | CII - Lodging establishment must offer opt out of linen service | Percentage | 0-1% | CII- Lodging establishment must offer opt out of linen service | Yes |
| 1 | CII - Other CII restriction or prohibition | Percentage | 0-1% | Commercial, industrial, institutional equipment must be properly maintained and in full working order. | Yes |
| 1 | Landscape - Prohibit certain types of landscape irrigation | Percentage | 0-1% | All non-essential water use for nurseries, public entities, and commercial and industrial use should cease. | Yes |
| 1 | Offer Water Use Surveys | Percentage | 0-1% | Offer water use surveys (offered through MET) | Yes |
| 1 | Provide Rebates on Plumbing Fixtures and Devices | Percentage | 0-1% | Provide Rebates on Plumbing Fixtures and Devices (offered through MET) | Yes |
| 1 | Provide Rebates for Landscape Irrigation Efficiency | Percentage | 0-1% | Provide Rebates for turf replacement (offered through MET) | Yes |
| 1 | Increase Water Waste Patrols | Percentage | 0-1% | Increase water waste patrols | Yes |
| 1 | Other | Percentage | 5-10% | Other prohibited uses: the city may implement other prohibited water uses as determined by the City, after notice to customers. | Yes |

| Submittal Table 8-3 Retail: Demand Reduction Actions<br>Water Code Section 10632(a)(4)(B) and (E) | | | | | |
|---|---|---|---|---|---|
| Yes | Is the Supplier completing this table using the standard six levels? (yes/no) | | | | |
| 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? | | Additional Explanation or Reference (OPTIONAL) | Penalty, Charge, or Other Enforcement? **For Retail Suppliers Only** Drop Down List |
| | | Volume or Percentage Drop down | Shortage Gap Reduction Value (May be a range) (AF) | | |
| 2 | Landscape - Limit landscape irrigation to specific days | Percentage | 5-10% | Irrigation shall be limited to 3 days per week turf watering when using potable water. Plant containers, trees, shrubs, and vegetable gardens may be watered additional days using only drip irrigation or hand watering. | Yes |
| 2 | Water Features - Restrict water use for decorative water features, such as fountains | Percentage | 0-1% | Filling or refilling ornamental lakes and ponds is prohibited. Ornamental lakes and ponds that sustain aquatic life of significant value and were actively managed prior to the storage declaration are exempt. | Yes |
| 2 | Decrease Line Flushing | Percentage | 0-1% | Decrease Line Flushing | Yes |
| 2 | Reduce System Water Loss | Percentage | 0-5% | Real loss reduction - Pressure management and more aggressive leak detection and repair | Yes |
| 2 | Pools and Spas - Require covers for pools and spas | Percentage | 0-1% | Pools and Spas - Require covers for pools and spas | Yes |
| 2 | Pools - Allow filling of swimming pools only when an appropriate cover is in place. | Percentage | 0-1% | Pools- allow filling of swimming pools only when appropriate cover is in place. | Yes |

| Submittal Table 8-3 Retail: Demand Reduction Actions<br>Water Code Section 10632(a)(4)(B) and (E) | | | | | |
|---|---|---|---|---|---|
| Yes | Is the Supplier completing this table using the standard six levels? (yes/no) | | | | |
| 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? | | Additional Explanation or Reference (OPTIONAL) | Penalty, Charge, or Other Enforcement? **For Retail Suppliers Only** Drop Down List |
| | | Volume or Percentage Drop down | Shortage Gap Reduction Value (May be a range) (AF) | | |
| 2 | Other | Percentage | 5-10% | Other prohibited uses: the city may implement other prohibited water uses as determined by the City, after notice to customers. | Yes |
| 3 | Other water feature or swimming pool restriction | Percentage | 0-1% | Decorative water features that use potable water must be drained and kept dry. | Yes |
| 3 | Other - Prohibit vehicle washing except at facilities using recycled or recirculating water | Percentage | 0-1% | Car washing is only permitted using a commercial carwash that recirculates water or by high pressure/low volume wash systems. | Yes |
| 3 | Other - Prohibit use of potable water for construction and dust control | Percentage | 0-1% | Require a construction water use plan be submitted to the water supplier that addresses how impacts to existing water users will be mitigated (such as a dust control) | Yes |
| 3 | Landscape - Other landscape restriction or prohibition | Percentage | 0-1% | With the exception of landscapes watered with non-potable water, limit the installation of new landscaping to drought tolerant trees, shrubs, and groundcover. Prohibit installation of new turf. | Yes |

| Submittal Table 8-3 Retail: Demand Reduction Actions<br>Water Code Section 10632(a)(4)(B) and (E) | | | | | |
|---|---|---|---|---|---|
| Yes | Is the Supplier completing this table using the standard six levels? (yes/no) | | | | |
| 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? | | Additional Explanation or Reference (OPTIONAL) | Penalty, Charge, or Other Enforcement? **For Retail Suppliers Only** Drop Down List |
| | | Volume or Percentage Drop down | Shortage Gap Reduction Value (May be a range) (AF) | | |
| 3 | Landscape - Limit landscape irrigation to specific days | Percentage | 10-25% | Irrigation shall be limited to 2 days per week turf watering when using potable water. Plant containers, trees, shrubs, and vegetable gardens may be watered additional days using only drip irrigation or hand watering. | Yes |
| 3 | Other | Percentage | 5-10% | Other prohibited uses: the city may implement other prohibited water uses as determined by the City, after notice to customers. | Yes |
| 4 | Other - Customers must repair leaks, breaks, and malfunctions in a timely manner | Percentage | 0-1% | Fix leaks or faulty sprinkler promptly/within 2 day(s) | Yes |
| 4 | Other water feature or swimming pool restriction | Percentage | 0-1% | No new permits for pools will be issued. | Yes |
| 4 | Landscape - Other landscape restriction or prohibition | Percentage | 0-1% | No new landscape installations or renovations will be permitted. | Yes |
| 4 | Landscape - Prohibit all landscape irrigation | Percentage | 0-1% | Previous waivers for watering during established period will be revoked. | Yes |

| Submittal Table 8-3 Retail: Demand Reduction Actions<br>Water Code Section 10632(a)(4)(B) and (E) | | | | | |
|---|---|---|---|---|---|
| Yes | Is the Supplier completing this table using the standard six levels? (yes/no) | | | | |
| 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? | | Additional Explanation or Reference (OPTIONAL) | Penalty, Charge, or Other Enforcement? **For Retail Suppliers Only** Drop Down List |
| | | Volume or Percentage Drop down | Shortage Gap Reduction Value (May be a range) (AF) | | |
| 4 | Landscape - Limit landscape irrigation to specific days | Percentage | 5-20% | Irrigation shall be limited to 1 days per week turf watering when using potable water. Plant containers, trees, shrubs, and vegetable gardens may be watered additional days using only. | Yes |
| 4 | Other | Percentage | 5-10% | Other prohibited uses: the city may implement other prohibited water uses as determined by the City, after notice to customers. | Yes |
| 5 | Other - Customers must repair leaks, breaks, and malfunctions in a timely manner | Percentage | 0-1% | Fix leaks or faulty sprinklers within 1 day(s) | Yes |
| 5 | Other | Percentage | 0-50% | Water for agricultural or commercial nursery purposes, except for livestock watering, is prohibited. Water use for public health safety purposes only. | Yes |
| 5 | Landscape - Prohibit all landscape irrigation | Percentage | 0-1% | All irrigation is prohibited. | Yes |
| 5 | Landscape - Prohibit certain types of landscape irrigation | Percentage | 0-1% | Watering of all golf course areas, parks, school grounds is prohibited, except for rare plant or animal species. | Yes |

| Submittal Table 8-3 Retail: Demand Reduction Actions<br>Water Code Section 10632(a)(4)(B) and (E) | | | | | |
|---|---|---|---|---|---|
| Yes | Is the Supplier completing this table using the standard six levels? (yes/no) | | | | |
| 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? | | Additional Explanation or Reference (OPTIONAL) | Penalty, Charge, or Other Enforcement? **For Retail Suppliers Only** Drop Down List |
| | | Volume or Percentage Drop down | Shortage Gap Reduction Value (May be a range) (AF) | | |
| 5 | Moratorium or Net Zero Demand Increase on New Connections | Percentage | 0-2% | Moratorium or Net Zero Demand Increase on new connections | Yes |
| 6 | Other | Percentage | 0-1% | The City may discontinue service to consumers who willfully violate any water conservation provisions. | Yes |
| 6 | Landscape - Prohibit all landscape irrigation | Percentage | 0-5% | The City may shut off all non-essential water services. All irrigation is prohibited. | Yes |
| 6 | CII - Other CII restriction or prohibition | Percentage | 0-15% | Water for commercial, manufacturing, or processing purposes shall be reduced in volume by up to 50% or exceeded if necessary for public health and safety purposes. | Yes |
| 6 | Other | Percentage | 0-70% | Water use for public health and safety purposes only. Customer rationing may be implemented. Other prohibited uses: The City may implement other prohibited water uses as determined by the City, after notice to customers. | Yes |
| **DWR NOTES: Units of measure (AF, CCF, MG)** must remain consistent throughout the UWMP as reported in Submittal Table 2-3. | | | | | |
| NOTES: Note 1: NFT irrigation requirements begin January 1, 2027 for State and local government properties, January 1, 2028 for commercial, industrial, and institutional owned landscapes, January 1, 2029 for homeowners' associations common area landscapes, and January 1, 2031 for local government properties in disadvantaged communities (DAC). | | | | | |

APPENDIX B

# FULLERTON MUNICIPAL CODE CHAPTER 12.06 WATER SUPPLY SHORTAGE CONSERVATION PLAN

**Below is the weblink to the current ordinance (last accessed on April 14, 2026)**
https://codelibrary.amlegal.com/codes/fullerton/latest/fullerton_ca/0-0-0-6837

APPENDIX C

# WATER SHORTAGE COMMUNICATION PLAN

APPENDIX D

# NOTICE OF PUBLIC HEARING (PENDING)

APPENDIX E

# ADOPTED WSCP RESOLUTION (PENDING)

APPENDIX G

# 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 | Program Start Date | Retrofits Installed in | Month Indicated | | Current Fiscal Year | | Overall Program | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Interventions | Water Savings | Interventions | Water Savings | Interventions | Annual Water Savings[4] | Cumulative Water Savings[4] |
| High Efficiency Clothes Washer Program | 2002 | October-25 | 82 | 0.22 | 350 | 2.28 | 131,459 | 4,312 | 64,060 |
| High Efficiency Toilet (HET) Program | 2005 | October-25 | 17 | 0.06 | 65 | 2.76 | 62,010 | 2,292 | 32,257 |
| Flow Monitoring Devices (FMD) Program | 2021 | October-25 | 10 | 0.04 | 39 | 0.37 | 1,045 | 52.25 | 158.24 |
| Commercial Plumbing Fixture Rebate Program | 2002 | October-25 | 3 | 0.05 | 164 | 1.07 | 119,829 | 5,295 | 89,451 |
| Water Savings Incentive Program (WSIP) | 2006 | October-25 | 0 | 0.00 | 1 | 16.47 | 51 | 1,286 | 11,460 |
| Turf Replacement Program[3] | 2010 | October-25 | 5,929 | 0.07 | 424,613 | 15.01 | 29,979,610 | 4,049 | 51,438 |
| Landscape Design Rebate Program (formerly LDAP) | 2019 | October-25 | 4 | - | 15 | - | 1,181 | - | - |
| Tree Rebate Program | 2024 | October-25 | 38 | - | 200 | - | 461 | - | - |
| Spray-to-Drip Program[3] | 2014 | October-25 | 9,687 | 0.11 | 410,712 | 11.50 | 5,740,148 | 779 | 2,295 |
| Smart Timer Program - Irrigation Timers | 2004 | October-25 | 63 | 0.88 | 426 | 16.60 | 36,100 | 9,152 | 96,656 |
| Rotating Nozzles Rebate Program | 2007 | October-25 | 103 | 0.41 | 297 | 1.12 | 586,364 | 2,891 | 28,030 |
| Rain Barrels Rebate Program | 2013 | October-25 | 2 | 0.00 | 8 | 0.00 | 9,077 | 17 | 162 |
| Recycled Water Retrofit (ORP) | 2015 | October-25 | 0 | 0.00 | 0 | 0.00 | 194 | 3,901 | 32,806 |
| 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** | | | | **2** | **836,890** | **67** | **38,012,352** | **60,029** | **665,276** |

(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 Replacement and Spray-to-Drip 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.

Prepared by Municipal Water District of Orange County

# HIGH EFFICIENCY CLOTHES WASHERS INSTALLED BY AGENCY[1]

## through MWDOC and Local Agency Conservation Programs

| Agency | FY21/22 | FY22/23 | FY23/24 | FY24/25 | FY25/26 | Total | Current FY Water Savings Ac/Ft (Cumulative) | Cumulative Water Savings across all Fiscal Years | 15 yr. Lifecycle Savings Ac/Ft |
|---|---|---|---|---|---|---|---|---|---|
| Brea | 33 | 29 | 25 | 17 | 9 | 2,174 | 1.54 | 1,068.10 | 1,125 |
| Buena Park | 36 | 39 | 17 | 11 | 3 | 1,803 | 1.08 | 828.16 | 933 |
| East Orange | 4 | 3 | 4 | - | - | 214 | 0.22 | 111.44 | 111 |
| El Toro | 29 | 30 | 34 | 23 | 7 | 1,804 | 2.11 | 846.36 | 933 |
| Fountain Valley | 22 | 26 | 35 | 26 | 5 | 2,671 | 2.10 | 1,375.79 | 1,382 |
| Garden Grove | 69 | 56 | 43 | 33 | 8 | 4,092 | 2.67 | 1,989.00 | 2,117 |
| Golden State | 97 | 93 | 88 | 43 | 15 | 5,834 | 5.43 | 2,784.80 | 3,019 |
| Huntington Beach | 83 | 69 | 89 | 59 | 21 | 9,075 | 5.61 | 4,808.55 | 4,696 |
| Irvine Ranch | 473 | 373 | 308 | 265 | 75 | 29,229 | 18.97 | 13,273.38 | 15,124 |
| La Habra | 35 | 31 | 27 | 20 | 6 | 1,652 | 1.70 | 736.32 | 855 |
| La Palma | 10 | 3 | 11 | 6 | 2 | 530 | 0.66 | 241.21 | 274 |
| Laguna Beach | 17 | 9 | 11 | 13 | 4 | 1,065 | 0.72 | 557.57 | 551 |
| Mesa Water | 31 | 30 | 32 | 40 | 10 | 2,891 | 1.94 | 1,462.13 | 1,496 |
| Moulton Niguel | 255 | 205 | 191 | 177 | 59 | 12,404 | 12.01 | 5,662.74 | 6,418 |
| Newport Beach | 22 | 27 | 27 | 18 | 2 | 2,873 | 1.78 | 1,557.19 | 1,487 |
| Orange | 49 | 45 | 42 | 26 | 5 | 4,342 | 2.55 | 2,263.71 | 2,247 |
| San Clemente | 43 | 34 | 53 | 28 | 12 | 3,069 | 3.35 | 1,519.74 | 1,588 |
| Santa Margarita | 220 | 212 | 196 | 186 | 38 | 11,406 | 11.98 | 5,311.29 | 5,902 |
| Seal Beach | 7 | 10 | 9 | 3 | - | 691 | 0.61 | 345.43 | 358 |
| Serrano | 3 | 3 | 3 | 4 | - | 391 | 0.18 | 212.22 | 202 |
| South Coast | 24 | 24 | 22 | 11 | 7 | 1,795 | 1.31 | 922.50 | 929 |
| Trabuco Canyon | 15 | 19 | 10 | 18 | 2 | 922 | 0.66 | 456.76 | 477 |
| Tustin | 31 | 33 | 27 | 14 | 2 | 1,894 | 1.69 | 943.74 | 980 |
| Westminster | 40 | 34 | 27 | 30 | 7 | 2,948 | 1.67 | 1,476.05 | 1,525 |
| Yorba Linda | 52 | 52 | 42 | 26 | 8 | 4,176 | 2.62 | 2,175.21 | 2,161 |
| **MWDOC Totals** | 1,705 | 1,489 | 1,373 | 1,097 | 307 | 111,525 | 85.17 | 53,750.16 | 21,546 |
| Anaheim | 135 | 147 | 121 | 79 | 23 | 11,818 | 7.59 | 6,491.59 | 6,115 |
| Fullerton | 66 | 70 | 51 | 39 | 12 | 4,324 | 3.34 | 2,127.38 | 2,237 |
| Santa Ana | 167 | 104 | 40 | 47 | 8 | 3,792 | 2.59 | 1,690.71 | 1,962 |
| **Non-MWDOC Totals** | 368 | 321 | 212 | 165 | 43 | 19,934 | 13.51 | 10,309.68 | 3,851 |
| **Orange County Totals** | 2,073 | 1,810 | 1,585 | 1,262 | 350 | 131,459 | 98.68 | 64,059.84 | 25,397 |

[1]Totals include hidden rows for agencies that no longer exist

Prepared by the Municipal Water District of Orange County

# HIGH EFFICIENCY TOILETS (HETs) INSTALLED BY AGENCY[1]

## through MWDOC and Local Agency Conservation Programs

| Agency | FY 21-22 | FY 22-23 | FY 23-24 | FY 24-25 | FY 25-26 | Total | Cumulative Water Savings across all Fiscal Years |
|---|---|---|---|---|---|---|---|
| Brea | 0 | 2 | 6 | 2 | 0 | **470** | **214.63** |
| Buena Park | 5 | 0 | 114 | 3 | 0 | **813** | **367.71** |
| East Orange | 0 | 2 | 0 | 0 | 0 | **91** | **43.15** |
| El Toro | 2 | 1 | 0 | 0 | 0 | **2,063** | **1,050.49** |
| Fountain Valley | 1 | 3 | 6 | 1 | 0 | **848** | **457.34** |
| Garden Grove | 1 | 4 | 17 | 4 | 0 | **1,524** | **794.96** |
| Golden State | 3 | 18 | 27 | 12 | 0 | **2,882** | **1,480.89** |
| Huntington Beach | 3 | 0 | 3 | 0 | 0 | **2,928** | **1,443.94** |
| Irvine Ranch | 30 | 22 | 21 | 11 | 5 | **17,508** | **9,741.86** |
| Laguna Beach | 0 | 0 | 3 | 2 | 0 | **403** | **202.75** |
| La Habra | 0 | 6 | 1 | 0 | 1 | **602** | **342.64** |
| La Palma | 0 | 0 | 3 | 1 | 0 | **235** | **115.46** |
| Mesa Water | 0 | 0 | 0 | 2 | 0 | **1,645** | **999.67** |
| Moulton Niguel | 10 | 7 | 2 | 6 | 3 | **5,814** | **2,577.25** |
| Newport Beach | 3 | 0 | 1 | 0 | 1 | **739** | **364.73** |
| Orange | 2 | 1 | 24 | 3 | 0 | **2,234** | **1,079.13** |
| San Clemente | 4 | 6 | 2 | 1 | 0 | **907** | **447.42** |
| Santa Margarita | 18 | 9 | 10 | 4 | 0 | **3,437** | **1,519.23** |
| Seal Beach | 1 | 0 | 0 | 0 | 0 | **858** | **604.21** |
| Serrano | 0 | 0 | 0 | 0 | 0 | **124** | **55.20** |
| South Coast | 4 | 3 | 0 | 5 | 0 | **1,042** | **486.41** |
| Trabuco Canyon | 5 | 1 | 4 | 0 | 0 | **366** | **153.94** |
| Tustin | 0 | 2 | 0 | 3 | 0 | **1,530** | **914.42** |
| Westminster | 0 | 11 | 9 | 3 | 0 | **1,362** | **746.57** |
| Yorba Linda | 0 | 5 | 0 | 0 | 0 | **1,272** | **658.81** |
| **MWDOC Totals** | 95 | 103 | 253 | 63 | 10 | **52,235** | **27,117.06** |
| Anaheim | 3 | 33 | 331 | 74 | 52 | **6,404** | **3,465.63** |
| Fullerton | 5 | 11 | 35 | 5 | 3 | **1,142** | **547.48** |
| Santa Ana | 5 | 3 | 117 | 66 | 0 | **2,229** | **1,127.05** |
| **Non-MWDOC Totals** | 13 | 47 | 483 | 145 | 55 | **9,775** | **5,140.16** |
| **Orange County Totals** | **108** | **150** | **736** | **208** | **65** | **62,010** | **32,257.22** |

[1]Totals include hidden rows for agencies that no longer exist

Prepared by Municipal Water District of Orange County

# FLOW MONITORING DEVICES INSTALLED BY AGENCY

## through MWDOC and Local Agency Conservation Programs

| Agency | FY 21/22 | FY 22/23 | FY 23/24 | FY 24/25 | FY 25/26 | Total Program | Cumulative Water Savings across all Fiscal Years |
|---|---|---|---|---|---|---|---|
| Brea | 2 | 3 | 1 | 3 | **1** | **10** | **1.00** |
| Buena Park | 0 | 0 | 0 | 0 | **1** | **1** | **0.02** |
| East Orange | 0 | 0 | 0 | 0 | **0** | **0** | **-** |
| El Toro | 0 | 0 | 0 | 0 | **0** | **0** | **-** |
| Fountain Valley | 1 | 0 | 0 | 2 | **0** | **3** | **0.30** |
| Garden Grove | 0 | 0 | 0 | 0 | **0** | **0** | **-** |
| Golden State | 375 | 1 | 1 | 0 | **0** | **377** | **78.33** |
| Huntington Beach | 0 | 0 | 0 | 6 | **0** | **6** | **0.42** |
| Irvine Ranch | 4 | 3 | 3 | 23 | **5** | **38** | **2.83** |
| La Habra | 0 | 0 | 0 | 1 | **0** | **1** | **0.07** |
| La Palma | 0 | 0 | 0 | 0 | **0** | **0** | **-** |
| Laguna Beach | 0 | 0 | 0 | 4 | **0** | **4** | **0.32** |
| Mesa Water | 0 | 1 | 1 | 5 | **0** | **7** | **0.26** |
| Moulton Niguel | 0 | 0 | 0 | 0 | **0** | **0** | **-** |
| Newport Beach | 0 | 0 | 1 | 1 | **1** | **3** | **0.17** |
| Orange | 3 | 7 | 5 | 9 | **0** | **24** | **2.40** |
| San Clemente | 0 | 0 | 0 | 3 | **2** | **5** | **0.13** |
| Santa Margarita | 122 | 38 | 129 | 78 | **16** | **383** | **44.67** |
| Seal Beach | 0 | 3 | 1 | 1 | **0** | **5** | **0.46** |
| Serrano | 0 | 1 | 1 | 1 | **0** | **3** | **0.24** |
| South Coast | 103 | 2 | 0 | 0 | **3** | **108** | **21.75** |
| Trabuco Canyon | 0 | 0 | 0 | 0 | **0** | **0** | **-** |
| Tustin | 0 | 0 | 0 | 2 | **1** | **3** | **0.08** |
| Westminster | 0 | 0 | 0 | 0 | **0** | **0** | **-** |
| Yorba Linda | 0 | 0 | 1 | 4 | **0** | **5** | **0.22** |
| **MWDOC Totals** | **610** | **59** | **144** | **143** | **30** | **986** | **153.65** |
| Anaheim | 0 | 3 | 2 | 6 | **6** | **17** | **1.03** |
| Fullerton | 3 | 12 | 8 | 16 | **3** | **42** | **3.56** |
| Santa Ana | 0 | 0 | 0 | 0 | **0** | **0** | **-** |
| **Non-MWDOC Totals** | **3** | **15** | **10** | **22** | **9** | **59** | **4.58** |
| **Orange County Totals** | **613** | **74** | **154** | **165** | **39** | **1,045** | **158.24** |

# COMMERCIAL PLUMBING FIXTURES INSTALLED BY AGENCY[1][2]

## through MWDOC and Local Agency Conservation Programs

| Agency | FY 21/22 | FY 22/23 | FY 23/24 | FY 24/25 | FY 25/26 | Totals | Cumulative Water Savings across all Fiscal Years |
|---|---|---|---|---|---|---|---|
| Brea | 0 | 0 | 138 | 0 | 0 | **1,973** | **1,214** |
| Buena Park | 0 | 0 | 48 | 0 | 164 | **2,844** | **2,403** |
| East Orange CWD RZ | 0 | 0 | 0 | 0 | 0 | **0** | **0** |
| El Toro WD | 0 | 136 | 0 | 0 | 0 | **2,652** | **1,397** |
| Fountain Valley | 0 | 0 | 0 | 0 | 0 | **2,165** | **1,424** |
| Garden Grove | 574 | 0 | 209 | 0 | 0 | **3,976** | **3,214** |
| Golden State WC | 0 | 0 | 0 | 0 | 0 | **3,124** | **3,664** |
| Huntington Beach | 235 | 0 | 280 | 0 | 0 | **3,957** | **3,441** |
| Irvine Ranch WD | 2 | 644 | 0 | 0 | 0 | **31,128** | **18,724** |
| La Habra | 0 | 0 | 0 | 0 | 0 | **984** | **1,093** |
| La Palma | 0 | 0 | 0 | 113 | 0 | **788** | **361** |
| Laguna Beach CWD | 0 | 0 | 0 | 0 | 0 | **446** | **589** |
| Mesa Water | 0 | 251 | 18 | 161 | 0 | **4,815** | **4,307** |
| Moulton Niguel WD | 0 | 414 | 241 | 0 | 0 | **7,594** | **3,430** |
| Newport Beach | 0 | 0 | 0 | 3 | 0 | **3,449** | **2,974** |
| Orange | 0 | 359 | 151 | 0 | 0 | **6,915** | **4,174** |
| San Clemente | 0 | 0 | 0 | 0 | 0 | **753** | **747** |
| Santa Margarita WD | 0 | 212 | 0 | 112 | 0 | **2,571** | **949** |
| Seal Beach | 0 | 0 | 0 | 0 | 0 | **816** | **841** |
| Serrano WD | 0 | 0 | 0 | 0 | 0 | **0** | **0** |
| South Coast WD | 0 | 154 | 0 | 0 | 0 | **1,474** | **1,147** |
| Trabuco Canyon WD | 0 | 0 | 0 | 0 | 0 | **11** | **27** |
| Tustin | 0 | 41 | 88 | 0 | 0 | **2,195** | **1,846** |
| Westminster | 0 | 190 | 59 | 0 | 0 | **1,850** | **1,986** |
| Yorba Linda | 1 | 0 | 0 | 0 | 0 | **1,017** | **1,144** |
| **MWDOC Totals** | **812** | **2,401** | **1,232** | **389** | **164** | **87,757** | **61,763** |
| Anaheim | 0 | 648 | 175 | 1,194 | 0 | **19,067** | **14,636** |
| Fullerton | 0 | 331 | 839 | 3 | 0 | **4,965** | **3,707** |
| Santa Ana | 72 | 30 | 26 | 600 | 0 | **8,040** | **9,344** |
| **Non-MWDOC Totals** | **72** | **1,009** | **1,040** | **1,797** | **0** | **32,072** | **27,688** |
| **Orange County Totals** | **884** | **3,410** | **2,272** | **2,186** | **164** | **119,829** | **89,451** |

[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.

[2]Totals include hidden rows for agencies that no longer exist

# WATER SAVINGS INCENTIVE PROJECTS BY AGENCY

## through MWDOC and Local Agency Conservation Programs

| Agency | FY 21/22 | FY 22/23 | FY 23/24 | FY 24/25 | FY 25/26 | Totals | Cumulative Water Savings |
|---|---|---|---|---|---|---|---|
| Brea | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Buena Park | 0 | 0 | 0 | 0 | 0 | 2 | 911 |
| East Orange | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| El Toro | 0 | 0 | 0 | 0 | 0 | 1 | 62 |
| Fountain Valley | 0 | 0 | 0 | 0 | 0 | 1 | 197 |
| Garden Grove | 0 | 0 | 0 | 0 | 0 | 2 | 26 |
| Golden State | 0 | 0 | 0 | 0 | 0 | 2 | 379 |
| Huntington Beach | 0 | 0 | 0 | 0 | 0 | 6 | 1,893 |
| Irvine Ranch | 0 | 1 | 10 | 0 | 1 | 24 | 1,724 |
| La Habra | 0 | 0 | 0 | 0 | 0 | 1 | 3 |
| La Palma | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Laguna Beach | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Mesa Water | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Moulton Niguel | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Newport Beach | 0 | 0 | 0 | 1 | 0 | 2 | 229 |
| Orange | 0 | 0 | 0 | 0 | 0 | 5 | 1,223 |
| San Clemente | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Santa Margarita | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Seal Beach | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Serrano | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| South Coast | 0 | 0 | 0 | 0 | 0 | 2 | 1,148 |
| Trabuco Canyon | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tustin | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Westminster | 0 | 0 | 0 | 0 | 0 | 1 | 715 |
| Yorba Linda | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **MWDOC Totals** | **0** | **1** | **10** | **1** | **1** | **49** | **8,509** |
| Anaheim | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Fullerton | 0 | 0 | 0 | 0 | 0 | 1 | 1,587 |
| Santa Ana | 0 | 0 | 0 | 0 | 0 | 1 | 1,363 |
| **Non-MWDOC Totals** | **0** | **0** | **0** | **0** | **0** | **2** | **2,951** |
| **Orange County Totals** | **0** | **1** | **10** | **1** | **1** | **51** | **11,460** |

[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 REPLACEMENT BY AGENCY[1][2]

## through MWDOC and Local Agency Conservation Programs

| Agency | FY 21/22 | | FY 22/23 | | FY 23/24 | | FY 24/25 | | FY 25/26 | | Total Program | | Cumulative Water Savings across all Fiscal Years |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Res. | Comm. | Res. | Comm. | Res. | Comm. | Res. | Comm. | Res. | Comm. | Res | Comm. | |
| Brea | 6,066 | 0 | 13,979 | 6,598 | 8,997 | 40,459 | 930 | 32,570 | 1,230 | 0 | **267,328** | **601,425** | **1,704** |
| Buena Park | 3,094 | 0 | 14,435 | 0 | 9,798 | 54,144 | 2,085 | 71,385 | 1,112 | 0 | **138,788** | **143,645** | **285** |
| East Orange | 5,000 | 0 | 12,116 | 7,914 | 2,589 | 0 | 0 | 0 | 0 | 0 | **67,825** | **7,914** | **126** |
| El Toro | 3,153 | 2,379 | 18,364 | 7,739 | 8,780 | 31,396 | 1,270 | 43,948 | 435 | 0 | **180,991** | **667,721** | **1,572** |
| Fountain Valley | 14,031 | 0 | 11,871 | 3,260 | 11,427 | 1,394 | 7,329 | 7,739 | 1,343 | 0 | **185,953** | **74,817** | **399** |
| Garden Grove | 1,228 | 0 | 16,756 | 0 | 17,356 | 0 | 3,967 | 0 | 0 | 32,614 | **327,228** | **150,017** | **786** |
| Golden State | 0 | 0 | 2,614 | 0 | 3,716 | 603 | 9,977 | 1,044 | 3,027 | 0 | **601,236** | **396,514** | **2,092** |
| Huntington Beach | 32,411 | 19,914 | 44,842 | 89,264 | 29,038 | 64,199 | 20,037 | 72,389 | 4,407 | 0 | **723,943** | **721,928** | **2,373** |
| Irvine Ranch | 20,397 | 54,418 | 72,550 | 399,559 | 32,342 | 332,433 | 28,573 | 288,486 | 6,975 | 44,002 | **1,651,243** | **4,606,441** | **10,864** |
| La Habra | 4,183 | 3,263 | 15,254 | 6,654 | 13,062 | 65,496 | 5,980 | 0 | 0 | 0 | **119,162** | **165,432** | **298** |
| La Palma | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **15,141** | **59,760** | **207** |
| Laguna Beach | 2,905 | 0 | 5,702 | 0 | 1,161 | 0 | 723 | 0 | 0 | 0 | **87,378** | **48,788** | **307** |
| Mesa Water | 29,375 | 0 | 34,191 | 55,661 | 21,321 | 97,512 | 11,922 | 86,176 | 1,035 | 8,804 | **549,482** | **592,182** | **1,505** |
| Moulton Niguel | 37,648 | 115,313 | 59,372 | 394,839 | 29,606 | 311,146 | 23,335 | 128,512 | 11,919 | 118,880 | **1,928,474** | **4,125,941** | **10,503** |
| Newport Beach | 823 | 99,613 | 6,247 | 24,470 | 7,118 | 37,101 | 3,461 | 13,099 | 0 | 0 | **147,127** | **722,282** | **1,458** |
| Orange | 22,783 | 2,816 | 50,016 | 102,170 | 41,474 | 8,807 | 12,794 | 66,221 | 8,260 | 0 | **640,919** | **580,790** | **2,184** |
| San Clemente | 6,466 | 67,354 | 15,942 | 156,022 | 11,950 | 17,008 | 1,380 | 107,624 | 748 | 3,652 | **458,425** | **889,650** | **2,290** |
| Santa Margarita | 8,694 | 41,534 | 44,083 | 132,194 | 23,349 | 65,782 | 15,718 | 175,702 | 2,334 | 87,539 | **1,009,793** | **1,805,341** | **4,979** |
| Seal Beach | 4,226 | 0 | 2,901 | 0 | 627 | 13,614 | 0 | 4,427 | 0 | 0 | **47,654** | **38,418** | **123** |
| Serrano | 0 | 0 | 7,183 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **190,123** | **4,403** | **449** |
| South Coast | 1,409 | 76,798 | 7,575 | 85,956 | 3,937 | 67,910 | 3,325 | 69,866 | 0 | 55,315 | **352,560** | **949,239** | **2,201** |
| Trabuco Canyon | 6,817 | 50,000 | 5,379 | 106,068 | 3,459 | 50,000 | 2,244 | 0 | 1,864 | 0 | **100,720** | **366,313** | **547** |
| Tustin | 21,688 | 5,698 | 36,476 | 0 | 28,841 | 16,386 | 12,632 | 0 | 4,958 | 1,226 | **488,951** | **84,639** | **969** |
| Westminster | 4,614 | 0 | 8,042 | 0 | 10,392 | 4,932 | 9,036 | 14,932 | 0 | 0 | **148,122** | **78,397** | **374** |
| Yorba Linda | 6,529 | 10,068 | 25,784 | 50,488 | 15,576 | 36,482 | 4,691 | 57,084 | 1,646 | 21,288 | **581,139** | **320,813** | **1,566** |
| **MWDOC Totals** | **243,540** | **549,168** | **531,674** | **1,628,856** | **335,916** | **1,316,804** | **181,409** | **1,241,204** | **51,293** | **373,320** | **11,375,120** | **18,595,276** | **51,423** |
| Anaheim | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** | **0** | **-** |
| Fullerton | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** | **9,214** | **15** |
| Santa Ana | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** | **0** | **-** |
| **Non-MWDOC Totals** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **9,214** | **15** |
| **Orange County Totals** | **243,540** | **549,168** | **531,674** | **1,628,856** | **335,916** | **1,316,804** | **181,409** | **1,241,204** | **51,293** | **373,320** | **11,375,120** | **18,604,490** | **51,438** |

[1]Installed device numbers are listed as square feet

[2]Totals include hidden rows for agencies that no longer exist

# LANDSCAPE DESIGN REBATE PROGRAM BY AGENCY

## through MWDOC and Local Agency Conservation Programs

| Agency | FY21/22 | | FY22/23 | | FY23/24 | | FY24/25 | | FY25/26 | | Total Program | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | LDAP | LMAP | LDAP | LMAP | LDAP | LMAP | LDAP | LMAP | LDAP | LMAP | LDAP | LMAP |
| Brea | 3 | 2 | 10 | 2 | 1 | 1 | 0 | 0 | 0 | 0 | **20** | **8** |
| Buena Park | 5 | 1 | 5 | 2 | 1 | 1 | 1 | 0 | 0 | 0 | **17** | **6** |
| East Orange | 1 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **4** | **1** |
| El Toro | 11 | 0 | 6 | 6 | 4 | 1 | 0 | 0 | 1 | 0 | **35** | **9** |
| Fountain Valley | 8 | 4 | 13 | 3 | 5 | 4 | 0 | 0 | 0 | 0 | **43** | **12** |
| Garden Grove | 6 | 0 | 11 | 2 | 2 | 1 | 1 | 0 | 0 | 0 | **20** | **3** |
| Golden State | 0 | 0 | 2 | 1 | 3 | 1 | 1 | 0 | 0 | 0 | **6** | **2** |
| Huntington Beach | 38 | 18 | 34 | 19 | 9 | 5 | 3 | 0 | 0 | 0 | **130** | **59** |
| Irvine Ranch | 40 | 8 | 16 | 16 | 4 | 15 | 8 | 0 | 2 | 0 | **92** | **53** |
| La Habra | 7 | 0 | 8 | 3 | 0 | 0 | 1 | 0 | 0 | 0 | **27** | **4** |
| La Palma | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** | **0** |
| Laguna Beach | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **3** | **0** |
| Mesa Water | 14 | 6 | 18 | 11 | 4 | 6 | 0 | 0 | 0 | 0 | **63** | **32** |
| Moulton Niguel | 25 | 5 | 11 | 14 | 1 | 6 | 10 | 0 | 7 | 0 | **71** | **41** |
| Newport Beach | 3 | 0 | 6 | 2 | 0 | 2 | 1 | 0 | 0 | 0 | **13** | **5** |
| Orange | 22 | 3 | 22 | 6 | 10 | 6 | 0 | 0 | 2 | 0 | **76** | **20** |
| San Clemente | 4 | 1 | 4 | 1 | 0 | 4 | 0 | 0 | 0 | 0 | **13** | **11** |
| Santa Margarita | 11 | 4 | 19 | 12 | 4 | 6 | 5 | 0 | 1 | 0 | **71** | **33** |
| Seal Beach | 1 | 1 | 3 | 3 | 0 | 1 | 0 | 0 | 0 | 0 | **7** | **9** |
| Serrano | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** | **0** |
| South Coast | 4 | 0 | 2 | 1 | 1 | 2 | 1 | 0 | 0 | 0 | **13** | **5** |
| Trabuco Canyon | 4 | 0 | 4 | 3 | 0 | 0 | 1 | 0 | 0 | 0 | **13** | **7** |
| Tustin | 10 | 3 | 12 | 5 | 2 | 4 | 1 | 0 | 2 | 0 | **54** | **16** |
| Westminster | 6 | 1 | 4 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | **17** | **4** |
| Yorba Linda | 8 | 1 | 6 | 6 | 0 | 3 | 0 | 0 | 0 | 0 | **21** | **11** |
| **MWDOC Totals** | **232** | **59** | **220** | **120** | **52** | **69** | **34** | **0** | **15** | **0** | **830** | **351** |
| Anaheim | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** | **0** | **0** | **0** |
| Fullerton | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** | **0** | **0** | **0** |
| Santa Ana | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** | **0** | **0** | **0** |
| **Non-MWDOC Totals** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| **Orange County Totals** | **232** | **59** | **220** | **120** | **52** | **69** | **34** | **-** | **15** | **-** | **830** | **351** |

Prepared by the Municipal Water District of Orange County

# TREE REBATE PROGRAM BY MONTH

## through MWDOC and Local Agency Conservation Programs

| Month | FY23/24 | FY24/25 | FY25/26 | Total Program |
|---|---|---|---|---|
| | Trees | Trees | Trees | Trees |
| July | 0 | 9 | 36 | **45** |
| August | 0 | 15 | 60 | **75** |
| September | 0 | 18 | 44 | **62** |
| October | 0 | 9 | 22 | **31** |
| November | 0 | 17 | 38 | **55** |
| December | 0 | 28 | 0 | **28** |
| January | 0 | 23 | 0 | **23** |
| February | 0 | 24 | 0 | **24** |
| March | 0 | 18 | 0 | **18** |
| April | 0 | 24 | 0 | **24** |
| May | 0 | 33 | 0 | **33** |
| June | 3 | 40 | 0 | **43** |
| **Orange County Totals** | **3** | **258** | **200** | **461** |

Prepared by the Municipal Water District of Orange County

# SPRAY-TO-DRIP BY AGENCY[1][2]

## through MWDOC and Local Agency Conservation Programs

| Agency | FY 21/22 | | FY 22/23 | | FY 23/24 | | FY 24/25 | | FY 25/26 | | Total Program | | Cumulative Water Savings across all Fiscal Years |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Res. | Comm. | Res. | Comm. | Res. | Comm. | Res. | Comm. | Res. | Comm. | Res | Comm. | |
| Brea | 949 | 0 | 9,294 | 7,830 | 9,289 | 29,866 | 1,097 | 0 | 1,361 | 0 | 26,114 | 68,529 | **51.25** |
| Buena Park | 354 | 3,365 | 2,921 | 0 | 4,103 | 18,548 | 1,296 | 12,504 | 0 | 0 | 10,263 | 38,231 | **13.24** |
| East Orange | 5,000 | 0 | 6,314 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11,314 | 0 | **5.17** |
| El Toro | 1,175 | 0 | 11,911 | 7,939 | 4,185 | 1,761 | 0 | 8,735 | 3,499 | 13,831 | 25,354 | 101,149 | **78.93** |
| Fountain Valley | 10,271 | 0 | 2,275 | 0 | 7,357 | 2,506 | 4,472 | 6,093 | 492 | 0 | 30,066 | 29,455 | **31.20** |
| Garden Grove | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,125 | 0 | **3.08** |
| Golden State | 0 | 0 | 2,905 | 0 | 6,812 | 0 | 10,057 | 0 | 867 | 0 | 21,641 | 0 | **6.22** |
| Huntington Beach | 17,600 | 0 | 22,073 | 58,877 | 16,370 | 42,300 | 7,505 | 98,964 | 674 | 0 | 82,246 | 214,933 | **79.59** |
| Irvine Ranch | 14,046 | 30,118 | 50,139 | 208,019 | 25,863 | 432,567 | 41,127 | 365,869 | 16,987 | 92,888 | 197,601 | 1,384,354 | **492.74** |
| La Habra | 3,343 | 1,447 | 8,236 | 5,779 | 11,730 | 46,659 | 10,643 | 0 | 0 | 0 | 36,973 | 53,885 | **24.62** |
| La Palma | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0.00** |
| Laguna Beach | 2,426 | 0 | 4,065 | 0 | 1,204 | 0 | 0 | 0 | 0 | 0 | 12,494 | 0 | **8.97** |
| Mesa Water | 13,073 | 7,972 | 22,386 | 49,775 | 15,877 | 32,313 | 5,050 | 17,021 | 0 | 20,132 | 81,353 | 139,657 | **76.00** |
| Moulton Niguel | 0 | 66,612 | 0 | 144,223 | 0 | 258,353 | 0 | 103,990 | 0 | 74,445 | 15,125 | 973,871 | **478.88** |
| Newport Beach | 457 | 49,456 | 6,573 | 5,845 | 6,890 | 21,725 | 3,247 | 0 | 0 | 0 | 20,563 | 129,270 | **88.70** |
| Orange | 6,426 | 72,290 | 27,414 | 28,224 | 42,171 | 0 | 9,702 | 43,373 | 5,938 | 50,000 | 101,247 | 207,039 | **87.39** |
| San Clemente | 3,135 | 45,000 | 7,612 | 15,368 | 11,314 | 45,172 | 0 | 12,231 | 0 | 0 | 31,775 | 126,276 | **54.30** |
| Santa Margarita | 655 | 72,052 | 32,804 | 138,469 | 15,638 | 18,306 | 15,903 | 192,177 | 628 | 64,065 | 131,878 | 726,424 | **443.61** |
| Seal Beach | 0 | 0 | 3,509 | 0 | 0 | 3,623 | 0 | 16,280 | 0 | 0 | 3,509 | 19,903 | **4.06** |
| Serrano | 0 | 0 | 2,183 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5,487 | 0 | **4.88** |
| South Coast | 0 | 130,495 | 10,339 | 11,560 | 2,166 | 2,490 | 2,653 | 16,832 | 0 | 27,076 | 22,571 | 253,609 | **129.29** |
| Trabuco Canyon | 0 | 0 | 997 | 0 | 1,881 | 0 | 0 | 0 | 2,050 | 0 | 6,676 | 0 | **1.91** |
| Tustin | 19,787 | 5,305 | 24,575 | 0 | 15,977 | 0 | 15,884 | 1,397 | 1,786 | 1,977 | 97,646 | 14,140 | **50.60** |
| Westminster | 0 | 0 | 1,557 | 0 | 7,383 | 437 | 2,014 | 18,162 | 0 | 0 | 12,737 | 33,938 | **22.84** |
| Yorba Linda | 3,772 | 15,982 | 12,413 | 48,824 | 11,705 | 46,606 | 758 | 54,499 | 1,289 | 30,727 | 35,839 | 200,763 | **54.35** |
| **MWDOC Totals** | **102,469** | **500,094** | **272,495** | **730,732** | **217,915** | **1,003,232** | **131,408** | **968,127** | **35,571** | **375,141** | **1,024,722** | **4,715,426** | **2,294.69** |
| Anaheim | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| Fullerton | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| Santa Ana | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| **Non-MWDOC Totals** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| **Orange County Totals** | **102,469** | **500,094** | **272,495** | **730,732** | **217,915** | **1,003,232** | **131,408** | **968,127** | **35,571** | **375,141** | **1,024,722** | **4,715,426** | **2,294.69** |

[1]Installed device numbers are listed as square feet

[2]Totals include hidden rows for agencies that no longer exist

# ROTATING NOZZLES INSTALLED BY AGENCY[1]

## through MWDOC and Local Agency Conservation Programs

| Agency | FY 20/21 | FY 21/22 | | | FY 22/23 | | | FY 23/24 | | | FY 24/25 | | | FY 25/26 | | | Total Program | | | Cumulative Water Savings across all Fiscal Years |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Large | Small | | Large | Small | | Large | Small | | Large | Small | | Large | Small | | Large | Small | | Large | |
| | Comm. | Res | Comm. | Comm. | Res | Comm. | Comm. | Res | Comm. | Comm. | Res | Comm. | Comm. | Res | Comm. | Comm. | Res | Comm. | Comm. | |
| Brea | 0 | 0 | 0 | 0 | 47 | 0 | 0 | 15 | 0 | 0 | 0 | 1,130 | 0 | 0 | 0 | 0 | 634 | 3,879 | 0 | 109.84 |
| Buena Park | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 15 | 0 | 0 | 0 | 0 | 0 | 573 | 173 | 2,535 | 1,090.25 |
| East Orange | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 781 | 0 | 0 | 29.82 |
| El Toro | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,919 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,435 | 48,141 | 890 | 2,049.60 |
| Fountain Valley | 0 | 36 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 75 | 0 | 0 | 0 | 0 | 0 | 1,030 | 283 | 0 | 38.09 |
| Garden Grove | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 60 | 0 | 0 | 0 | 0 | 0 | 1,117 | 299 | 0 | 52.49 |
| Golden State | 0 | 0 | 0 | 0 | 15 | 0 | 0 | 0 | 0 | 0 | 109 | 0 | 0 | 15 | 0 | 0 | 3,896 | 11,080 | 0 | 476.69 |
| Huntington Beach | 0 | 0 | 0 | 0 | 79 | 0 | 0 | 72 | 0 | 0 | 98 | 0 | 0 | 0 | 0 | 0 | 4,154 | 12,526 | 2,681 | 1,843.84 |
| Irvine Ranch | 0 | 462 | 0 | 0 | 196 | 0 | 0 | 411 | 195 | 0 | 309 | 0 | 0 | 42 | 0 | 0 | 49,708 | 94,541 | 2,004 | 6,851.52 |
| La Habra | 0 | 0 | 0 | 0 | 15 | 0 | 0 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 542 | 1,236 | 900 | 485.01 |
| La Palma | 0 | 0 | 0 | 0 | 15 | 0 | 0 | 18 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 122 | 2,890 | 0 | 80.50 |
| Laguna Beach | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12,139 | 2,896 | 0 | 518.51 |
| Mesa Water | 0 | 0 | 0 | 0 | 21 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,137 | 385 | 343 | 265.61 |
| Moulton Niguel | 0 | 300 | 0 | 0 | 131 | 421 | 1,270 | 463 | 0 | 0 | 99 | 0 | 0 | 0 | 0 | 0 | 15,515 | 20,974 | 4,215 | 2,567.99 |
| Newport Beach | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 46,723 | 21,413 | 0 | 2,507.21 |
| Orange | 0 | 0 | 0 | 0 | 184 | 0 | 0 | 96 | 0 | 0 | 38 | 0 | 0 | 0 | 0 | 0 | 3,615 | 1,072 | 0 | 173.66 |
| San Clemente | 0 | 80 | 0 | 0 | 0 | 210 | 0 | 0 | 170 | 0 | 0 | 230 | 0 | 20 | 0 | 0 | 10,314 | 8,148 | 1,343 | 1,178.27 |
| Santa Margarita | 0 | 132 | 0 | 0 | 197 | 0 | 0 | 353 | 495 | 0 | 168 | 0 | 0 | 90 | 0 | 0 | 17,618 | 7,416 | 611 | 1,212.58 |
| Seal Beach | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 155 | 10,298 | 0 | 325.45 |
| Serrano | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,405 | 0 | 0 | 139.43 |
| South Coast | 0 | 0 | 0 | 0 | 69 | 510 | 0 | 0 | 480 | 0 | 0 | 440 | 0 | 0 | 0 | 0 | 8,199 | 20,300 | 0 | 899.76 |
| Trabuco Canyon | 0 | 50 | 0 | 0 | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 130 | 0 | 0 | 2,286 | 5,130 | 0 | 247.96 |
| Tustin | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 42 | 0 | 0 | 75 | 0 | 0 | 0 | 0 | 0 | 3,650 | 1,058 | 0 | 182.14 |
| Westminster | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 556 | 0 | 0 | 19.87 |
| Yorba Linda | 0 | 95 | 0 | 0 | 16 | 0 | 0 | 63 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6,289 | 4,359 | 500 | 656.84 |
| **MWDOC Totals** | 0 | 1,155 | 0 | 0 | 1,005 | 1,141 | 1,270 | 1,548 | 3,259 | 0 | 1,046 | 1,800 | 0 | 297 | 0 | 0 | 204,008 | 288,986 | 16,022 | 24,665.22 |
| Anaheim | 0 | 147 | 0 | 0 | 33 | 0 | 0 | 0 | 0 | 0 | 54 | 0 | 0 | 0 | 0 | 0 | 4,327 | 49,799 | 105 | 2,073.59 |
| Fullerton | 0 | 131 | 0 | 0 | 152 | 0 | 0 | 66 | 0 | 0 | 0 | 0 | 0 | 0 | 53 | 0 | 3,534 | 11,362 | 1,484 | 1,065.03 |
| Santa Ana | 0 | 50 | 0 | 0 | 42 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 985 | 5,752 | 0 | 225.86 |
| **Non-MWDOC Totals** | 0 | 328 | 0 | 0 | 227 | 0 | 0 | 66 | 0 | 0 | 54 | 0 | 0 | 0 | 53 | 0 | 8,846 | 66,913 | 1,589 | 3,364.47 |
| **Orange County Totals** | 0 | 1,483 | 0 | 0 | 1,232 | 1,141 | 1,270 | 1,614 | 3,259 | 0 | 1,100 | 1,800 | 0 | 297 | 53 | 0 | 212,854 | 355,899 | 17,611 | 28,029.69 |

[1]Totals include hidden rows for agencies that no longer exist

# SMART TIMERS INSTALLED BY AGENCY[1]

## through MWDOC and Local Agency Conservation Programs

| Agency | FY21/22 | | FY22/23 | | FY23/24 | | FY24/25 | | FY25/26 | | Total Program | | Cumulative Water Savings across all Fiscal Years |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Res | Comm | Res | Comm | Res | Comm | Res | Comm | Res | Comm | Res | Comm. | |
| Brea | 25 | 4 | 18 | 0 | 18 | 8 | 16 | 0 | 4 | 0 | 357 | 92 | 1,003.86 |
| Buena Park | 10 | 2 | 13 | 0 | 39 | 1 | 16 | 0 | 4 | 0 | 195 | 56 | 454.27 |
| East Orange | 4 | 0 | 0 | 0 | 10 | 0 | 4 | 0 | 0 | 0 | 56 | 1 | 86.37 |
| El Toro | 23 | 1 | 21 | 77 | 18 | 175 | 10 | 178 | 6 | 0 | 305 | 794 | 4,218.01 |
| Fountain Valley | 24 | 6 | 28 | 0 | 13 | 0 | 24 | 0 | 1 | 0 | 324 | 60 | 554.60 |
| Garden Grove | 15 | 5 | 28 | 6 | 23 | 1 | 15 | 0 | 6 | 0 | 305 | 55 | 483.89 |
| Golden State | 65 | 16 | 63 | 0 | 68 | 2 | 35 | 0 | 10 | 0 | 807 | 231 | 2,084.63 |
| Huntington Beach | 52 | 18 | 78 | 2 | 72 | 20 | 47 | 8 | 22 | 5 | 864 | 439 | 3,182.51 |
| Irvine Ranch | 320 | 104 | 257 | 223 | 319 | 4 | 240 | 87 | 67 | 38 | 5,359 | 3,175 | 25,547.63 |
| La Habra | 11 | 1 | 13 | 0 | 7 | 5 | 14 | 1 | 4 | 0 | 153 | 52 | 460.42 |
| La Palma | 6 | 0 | 5 | 0 | 8 | 0 | 3 | 0 | 1 | 0 | 65 | 2 | 36.29 |
| Laguna Beach | 5 | 2 | 9 | 0 | 10 | 0 | 5 | 1 | 4 | 0 | 575 | 23 | 575.95 |
| Mesa Water | 18 | 4 | 25 | 14 | 28 | 8 | 11 | 0 | 4 | 0 | 548 | 240 | 1,945.71 |
| Moulton Niguel | 381 | 104 | 156 | 38 | 121 | 91 | 72 | 71 | 30 | 15 | 3,185 | 1,340 | 9,404.64 |
| Newport Beach | 16 | 21 | 9 | 15 | 14 | 16 | 13 | 0 | 1 | 0 | 1,163 | 505 | 5,146.92 |
| Orange | 39 | 12 | 47 | 0 | 53 | 16 | 28 | 0 | 16 | 1 | 816 | 250 | 2,240.71 |
| San Clemente | 14 | 41 | 29 | 1 | 28 | 19 | 14 | 16 | 8 | 3 | 1,289 | 541 | 5,310.62 |
| Santa Margarita | 184 | 75 | 177 | 12 | 283 | 35 | 244 | 5 | 73 | 29 | 3,059 | 1,992 | 15,163.25 |
| Seal Beach | 5 | 0 | 3 | 0 | 8 | 0 | 6 | 0 | 1 | 0 | 57 | 87 | 609.11 |
| Serrano | 7 | 1 | 10 | 0 | 3 | 0 | 6 | 0 | 3 | 0 | 107 | 3 | 61.87 |
| South Coast | 5 | 1 | 11 | 8 | 9 | 1 | 9 | 13 | 6 | 5 | 358 | 252 | 2,307.32 |
| Trabuco Canyon | 17 | 2 | 18 | 0 | 21 | 0 | 11 | 0 | 1 | 0 | 297 | 159 | 1,751.55 |
| Tustin | 29 | 5 | 41 | 0 | 27 | 0 | 25 | 2 | 6 | 0 | 427 | 88 | 860.58 |
| Westminster | 11 | 0 | 17 | 0 | 18 | 0 | 7 | 0 | 2 | 0 | 203 | 44 | 471.20 |
| Yorba Linda | 85 | 16 | 64 | 1 | 45 | 7 | 61 | 0 | 16 | 0 | 996 | 235 | 2,150.89 |
| **MWDOC Totals** | 1,380 | 446 | 1,140 | 397 | 1,263 | 409 | 936 | 382 | 296 | 96 | 22,185 | 10,861 | 87,530.56 |
| Anaheim | 74 | 19 | 83 | 1 | 82 | 0 | 69 | 2 | 18 | 0 | 1,066 | 581 | 5,461.90 |
| Fullerton | 50 | 17 | 42 | 0 | 59 | 0 | 24 | 13 | 10 | 0 | 660 | 239 | 2,111.68 |
| Santa Ana | 18 | 2 | 15 | 0 | 24 | 6 | 13 | 0 | 6 | 0 | 251 | 257 | 1,552.14 |
| **Non-MWDOC Totals** | 142 | 38 | 140 | 1 | 165 | 6 | 106 | 15 | 34 | 0 | 1977 | 1077 | 9,125.71 |
| **Orange County Totals** | 1,522 | 484 | 1,280 | 398 | 1,428 | 415 | 1,042 | 397 | 330 | 96 | 24,162 | 11,938 | 96,656 |

[1]Totals include hidden rows for agencies that no longer exist

Prepared by the Municipal Water District of Orange County

# RAIN BARRELS INSTALLED BY AGENCY[1]

## through MWDOC and Local Agency Conservation Programs

| Agency | FY 21/22 | FY 22/23 | FY 23/24 | FY 24/25 | FY 25/26 | Total Program | Cumulative Water Savings across all Fiscal Years |
|---|---|---|---|---|---|---|---|
| Brea | 0 | 2 | 0 | 4 | 0 | 95 | 1.66 |
| Buena Park | 1 | 0 | 2 | 0 | 0 | 201 | 3.61 |
| East Orange | 1 | 3 | 0 | 2 | 0 | 50 | 0.84 |
| El Toro | 3 | 0 | 2 | 1 | 0 | 125 | 2.13 |
| Fountain Valley | 2 | 10 | 5 | 1 | 0 | 421 | 7.37 |
| Garden Grove | 7 | 8 | 10 | 3 | 0 | 393 | 6.79 |
| Golden State | 2 | 19 | 9 | 2 | 0 | 573 | 9.91 |
| Huntington Beach | 6 | 14 | 9 | 5 | 1 | 1,261 | 23.92 |
| Irvine Ranch | 14 | 18 | 25 | 15 | 2 | 1,135 | 19.57 |
| La Habra | 1 | 10 | 1 | 1 | 0 | 86 | 1.47 |
| La Palma | 2 | 0 | 2 | 0 | 0 | 12 | 0.17 |
| Laguna Beach | 5 | 4 | 0 | 0 | 0 | 459 | 9.07 |
| Mesa Water | 4 | 6 | 3 | 3 | 0 | 384 | 6.87 |
| Moulton Niguel | 10 | 15 | 12 | 2 | 0 | 468 | 8.05 |
| Newport Beach | 0 | 2 | 1 | 0 | 0 | 78 | 1.35 |
| Orange | 6 | 5 | 11 | 3 | 1 | 421 | 7.36 |
| San Clemente | 5 | 6 | 4 | 0 | 0 | 189 | 3.37 |
| Santa Margarita | 4 | 9 | 4 | 7 | 0 | 389 | 6.85 |
| Santiago | 0 | 0 | 0 | 0 | 0 | 0 | - |
| Seal Beach | 0 | 2 | 0 | 0 | 0 | 73 | 1.39 |
| Serrano | 2 | 0 | 0 | 0 | 0 | 42 | 0.77 |
| South Coast | 2 | 0 | 0 | 2 | 0 | 188 | 3.61 |
| Trabuco Canyon | 1 | 3 | 0 | 1 | 0 | 64 | 1.13 |
| Tustin | 2 | 8 | 4 | 0 | 0 | 268 | 4.70 |
| Westminster | 0 | 7 | 17 | 1 | 0 | 298 | 4.61 |
| Yorba Linda | 0 | 8 | 6 | 0 | 3 | 250 | 4.40 |
| **MWDOC Totals** | 80 | 159 | 127 | 53 | 7 | 8,218 | 146.53 |
| Anaheim | 3 | 8 | 5 | 4 | 0 | 340 | 5.90 |
| Fullerton | 0 | 6 | 4 | 4 | 0 | 244 | 4.29 |
| Santa Ana | 0 | 9 | 5 | 5 | 1 | 274 | 4.79 |
| **Non-MWDOC Totals** | 3 | 23 | 14 | 13 | 1 | 858 | 14.98 |
| **Orange County Totals** | 83 | 182 | 141 | 66 | 8 | 9,076 | 161.51 |

[1]Totals include hidden rows for agencies that no longer exist

# RECYCLED WATER ON-SITE RETROFITS BY AGENCY

## through MWDOC and Local Agency Conservation Programs

| Agency | FY 21-22 | FY 22-23 | FY 23-24 | FY 24-25 | FY 25-26 | Total | Cumulative Water Savings across all Fiscal Years |
|---|---|---|---|---|---|---|---|
| Brea | 0 | 0 | 0 | 0 | 0 | **0** | **0** |
| Buena Park | 0 | 0 | 0 | 0 | 0 | **0** | **0** |
| East Orange CWD | 0 | 0 | 0 | 0 | 0 | **0** | **0** |
| El Toro WD | 4 | 0 | 0 | 0 | 0 | **47** | **10,651** |
| Fountain Valley | 0 | 0 | 0 | 0 | 0 | **0** | **0** |
| Garden Grove | 0 | 0 | 0 | 0 | 0 | **0** | **0** |
| Golden State WC | 0 | 0 | 0 | 0 | 0 | **0** | **0** |
| Huntington Beach | 0 | 0 | 0 | 0 | 0 | **0** | **0** |
| Irvine Ranch WD | 0 | 1 | 1 | 1 | 0 | **13** | **2,735** |
| La Habra | 0 | 0 | 0 | 0 | 0 | **0** | **0** |
| La Palma | 0 | 0 | 0 | 0 | 0 | **0** | **0** |
| Laguna Beach CWD | 0 | 0 | 0 | 0 | 0 | **0** | **0** |
| Mesa Water | 0 | 0 | 0 | 0 | 0 | **1** | **322** |
| Moulton Niguel WD | 0 | 0 | 0 | 2 | 0 | **44** | **1,131** |
| Newport Beach | 0 | 0 | 0 | 0 | 0 | **1** | **1,301** |
| Orange | 0 | 0 | 0 | 0 | 0 | **0** | **0** |
| San Clemente | 0 | 0 | 0 | 0 | 0 | **23** | **7,172** |
| Santa Margarita WD | 0 | 1 | 1 | 0 | 0 | **37** | **4,495** |
| Seal Beach | 0 | 0 | 0 | 0 | 0 | **0** | **0** |
| Serrano WD | 0 | 0 | 0 | 0 | 0 | **0** | **0** |
| South Coast WD | 0 | 1 | 3 | 1 | 0 | **19** | **1,909** |
| Trabuco Canyon WD | 0 | 0 | 0 | 0 | 0 | **1** | **2,297** |
| Tustin | 0 | 0 | 0 | 0 | 0 | **0** | **0** |
| Westminster | 0 | 0 | 0 | 0 | 0 | **0** | **0** |
| Yorba Linda WD | 0 | 0 | 0 | 0 | 0 | **0** | **0** |
| **MWDOC Totals** | 4 | 3 | 5 | 4 | 0 | **193** | **32,420** |
| Anaheim | 0 | 0 | 0 | 0 | 0 | **1** | **386** |
| Fullerton | 0 | 0 | 0 | 0 | 0 | **0** | **0** |
| Santa Ana | 0 | 0 | 0 | 0 | 0 | **0** | **0** |
| **Non-MWDOC Totals** | 0 | 0 | 0 | 0 | 0 | **1** | **386** |
| **Orange County Totals** | **4** | **3** | **5** | **4** | **0** | **194** | **32,806** |

APPENDIX H

# 2025 ORANGE COUNTY WATER DEMAND MODEL TECHNICAL MEMORANDUM

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# 2025 Orange County Water Demand Projection Model Technical Memorandum

December 30, 2025

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## List of Modeling Terms

| Term | Working Definition |
|---|---|
| Billing Class | Group of customers defined in rate schedule for revenue collection |
| Billing Accounts | Group of accounts defined in rate schedule for revenue collection |
| Sector | One or more billing classes combined for modeling |
| Driver Unit (Driver) | Indicator of scale or growth for a given sector (counts) |
| Rate of Use | Measure of water use per driver unit |
| Econometric Model | Multiple regression model specifying economic variables |
| Explanatory Variable (i.e. water price and maximum monthly temperature) | A variable specified in a regression model to explain variability in water use |
| Coefficient | Elasticity (multiplier) that measures the response of water use to changes in explanatory variables |
| Model Fitting | Process of estimating parameters that measure the response of water use to changes in explanatory variables |
| Model Prediction | Calculation of water use for assumed values of explanatory variables |
| Nominal Income | The amount of money a person or an entity earns, without accounting for inflation or changes in purchasing power |
| Nominal Price | The stated price of an item without any adjustments for inflation representing its value in currency at the time of a transaction |
| Relative Sectoral Employment | Employment in each Commercial, Industrial, or Institutional sector |

# List of Acronyms

| Term | Working Definition |
|---|---|
| CalAdapt | California Climate Adaptation Platform |
| CCF | Hundred Cubic Feet |
| CII | Commercial, Industrial & Institutional |
| CMIP6 | Coupled Model Intercomparison Project (Phase 6) |
| DOF | California Department of Finance |
| GDP | Gross Domestic Product |
| GIS | Geographic Information System |
| LEHD/LODES | Longitudinal Employer Household Dynamics / Origin Destination Employment Statistics |
| MF | Multifamily (Residential) |
| MGD / MG / AFY | Million Gallons per Day / Million Gallons / Acre Feet per Year |
| NRW | Non-Revenue Water |
| PPH | Persons per Household |
| SF | Single-family (Residential) |
| UWMP | Urban Water Management Plan |
| UWUO | Urban Water Use Objective |

# Executive Summary

The Municipal Water District of Orange County (MWDOC) supplies water to 26 retail agencies, and the Orange County Water District (OCWD). The Orange County demand forecasts include the MWDOC service area as well as 3 cities who are direct customers of the Metropolitan Water District of Southern California (MWD): Anaheim, Fullerton, and Santa Ana. Water demand forecasts are a foundational element of water supply and infrastructure planning, and MWDOC and OCWD selected Hazen and Sawyer (Hazen) to update the demand forecasts for Orange County's retail agencies for the 2025 Urban Water Management Plan. The update is necessary both because current demands are lower than previously projected, and new demographic and climate projections were made available in 2025.

Hazen created four demand models for each Orange County retail agency. The four models represent demand sectors in which agency billing sector uses are similar in magnitude, and in which changes in billing sector water use can be attributed to the same variables. The four sectors are:

1) Single-family Residential
2) Multifamily Residential
3) Commercial, Industrial, and Institutional (CII)
4) Dedicated Irrigation (potable, recycled & raw water)

The demand across all four models, plus other uses for each agency, is summed to a total forecast for each agency, the MWDOC service area, the OCWD service area, and total Orange County.

### Econometric Approach and Data Acquisition

A regression, or econometric, approach to demand forecasting statistically links retail level water use to weather, economic, and socioeconomic factors (explanatory variables). Orange County agencies provided comprehensive datasets of historical water use, and Hazen worked with MWDOC to obtain explanatory variables from reputable sources, including weather databases and Census-based reports. The explanatory variables used in the regression are based on Hazen's experience regarding what factors affect water use nationwide and in Southern California.

By statistically linking water use to explanatory variables, econometric models provide a robust foundation for understanding variability and projecting future consumption patterns. Modeled water use is the product of the driver count, and the rate of water use per driver (**Equation ES-1**).

$$Water\ use = Driver\ Count * Rate\ of\ Use\ per\ Driver$$ **Equation ES-1**

Driver units change into the future based on housing, employment, and population projections. The rate of water use per driver is based on the historical response of the use rate to explanatory variables (measured by coefficients) and the future values of those same explanatory variables. **Equation ES-2** shows an example use per account, where water price and temperature are examples of explanatory variables, and $C_{Intercept}$, $C_R$, and $C_T$ are example coefficients.

$$Historical\ Use\ per\ Account = C_{Intercept} + C_R \times Historical\ Water\ Price + C_T \times Historical\ Temperatures + \cdots$$

**Equation ES-2**

The coefficients explain how (both in terms of magnitude and sign) water use responds to changes to explanatory variables.

Hazen identified driver units based on data provided by agencies and the Center for Demographic Research at Cal State Fullerton (CDR) that can be easily projected into the future. The rate of water use per driver is based on agency provided billing sector uses from 2010 through 2024. **Table ES-1** shows the driver units and rate of use for each of the four models.

**Table ES-1: Summary of Demand Sectors**

| Sector | Driver Units | Rate of Use Definition |
|---|---|---|
| Single-family Residential | Accounts | Gallons / account / day |
| Multifamily Residential | | Gallons / account / day |
| Commercial, Institutional, Industrial (CII) | Jobs | Gallons / job / day |
| Dedicated Irrigation (potable, recycled & raw water) | Accounts | Gallons / account / day |

The rates of water use for each sector model are based on the historical responses to explanatory variables, and the future values of those explanatory variables. Addressing multiple influences on demand improves the accuracy and precision of all estimated parameters, and the Hazen team identified a large range of explanatory variables based on our experience with demand modeling and available data. **Table ES-2** displays the explanatory variables.

**Table ES-2: Summary of Historical Data Collected for Model Development**

| Dataset | Data Source(s) |
|---|---|
| Observed weather (monthly precipitation, monthly maximum temperature) | Parameter-elevation Regressions on Independent Slopes Model (PRISM) |
| Water Price | Retail agency provided (2010 – 2024) |
| Drought Restrictions | State Water Resources Control Board |
| Gross Domestic Product (GDP) | Federal Reserve Bank of St. Louis Real Gross Domestic Product: All Industries in Orange County, CA |
| Median income | US Census American Community Survey (ACS) |
| Housing density | US Census American Community Survey (ACS), California State University Fullerton Center for Demographics Research (CDR), Southern California Association of Governments (SCAG) land use data |
| Persons Per Household | |
| Relative sectoral economic activity | US Census LODES, CDR |
| Passive Efficiency Estimates | Analysis of trend indicators and MWDOC/FLUME insight |
| COVID Binary Indicator | Assumed active from March 2020 – May 2023 |

The MWDOC Water Use Efficiency Group provided annual savings achieved by various active conservation measures. To avoid additional calculations and potential errors in the classification of historical conservation data, total historical conservation was captured in each sectoral model using a linear trend term. While historical conservation is captured in a linear trend, projected passive conservation is based on the 2021 Orange County Residential Water Efficiency Potential and Opportunities Study (2021 Study) and assumes a 1.9% decrease in annual residential demand from 2025 to 2030, at which point passive conservation will remain constant going forward. Active conservation is not accounted for in the models.

The process of identifying the explanatory variables to include in the regression equation and developing coefficients that accurately measure the response of water use to changes in these variables is the most time-intensive part of the demand forecasting process.

### Econometric Model Development

Orange County water use varies by time with changes to the price of water, drought restrictions, and weather, as well as by geography. For example, different agency income levels and household densities result in different water use rates. Hazen fit the four sectoral econometric models using a panel regression approach to account for explanatory variables that vary primarily over geography as well as those that

vary over time. The panel approach fits consumption data from all retail agencies simultaneously, improving model accuracy with a larger sample size.

Hazen evaluated model fits using $R^2$ values as well as visual confirmation that the modeled historical water use captured long-term trends, drought restrictions, and COVID pandemic work from home orders. The models demonstrated strong performance in replicating historical consumption patterns over the past decade. Most regressions achieved $R^2$ values of 0.80 or higher, indicating a high degree of explanatory power. Model results show:

- Single-family consumption is highly seasonal, and the econometric model correlates well to seasonality and temperature.
- Multifamily use is generally less responsive to weather than single-family demands as some outdoor use has been shifted into the irrigation sector. Seasonal price elasticity varies the least between months for the multifamily sector.
- CII use per job is positively correlated to each job proportion as well as gross domestic product throughout Orange County.
- Irrigation is much more responsive to temperature and precipitation than the other sectors. Seasonal price elasticity varies the most between months for the irrigation sector.

The Hazen team worked with each retail agency to calibrate sectoral model equations and quantify other uses (those not included in the single-family, multifamily, irrigation, or CII demand sectors).

### Baseline Forecast

Forecasted demand is a function of both the change in driver units into the future as well as the change in explanatory variables. **Table ES-3** summarizes the future drivers and variables.

**Table ES-3: Future Model Parameters**

| Data Category | Variable | Source | Assumptions |
|---|---|---|---|
| Driver Units | Single-family and multifamily accounts | CDR | Historical households per account; averages are multiplied by households projected by CDR |
| | Irrigation accounts | Agency Billing Data | Accounts are assumed to be constant into the future |
| | Sectoral employment | CDR | Proportion of jobs within CII sectors projected by CDR |
| Explanatory Variables | Monthly Maximum Temperature and Total Precipitation | PRISM | 30-year historical normal weather |
| | Water Price | Retail Agencies | Prices increase by 3% per year above inflation for 2025-2030 and keeps pace with inflation thereafter (zero difference from inflation trend) |

| Data Category | Variable | Source | Assumptions |
|---|---|---|---|
| | Water Use Restrictions | State & Local Restrictions | None |
| | Seasonality | | Sine/cosine functions to capture monthly pattern |
| | Median income | US Census | Constant income at 2022 value (real dollars) |
| | Housing density | CDR | Derived from CDR housing unit projections, assuming residential area remains at 2024 levels |
| | Persons Per Household | CDR | CDR projected demographics |
| | Gross Domestic Product | Federal Reserve | Long-term GDP trend |
| | Relative Sectoral Employment | CDR | Calculated based on CDR projections |
| | Passive Efficiency Estimates | Flume Insight | Assumes a 2% decrease in residential demand due to conservation by 2030 (linearly extrapolated), then no change |
| | COVID Binary Indicator | | None (occurred between March 2020 and May 2023) |

The baseline scenario assumes no active conservation measures.

Residential use (single-family and multifamily) accounts for approximately 60% of total Orange County demand and is expected to drive changes to the total demand forecast, despite CII use increasing as jobs increase. **Figure ES-1** indicates that multifamily growth is expected to outpace single-family growth out to 2050.

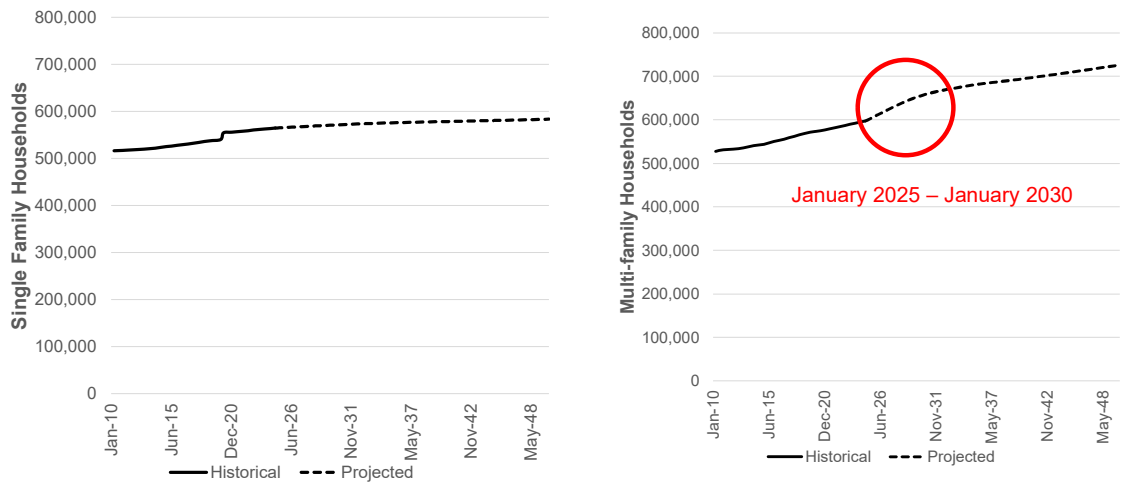


**Figure ES-1: Single-family and Multifamily Growth**

Additionally, **Figure ES-2** shows that average persons per household is expected to decrease for both residential sectors while household density increases.

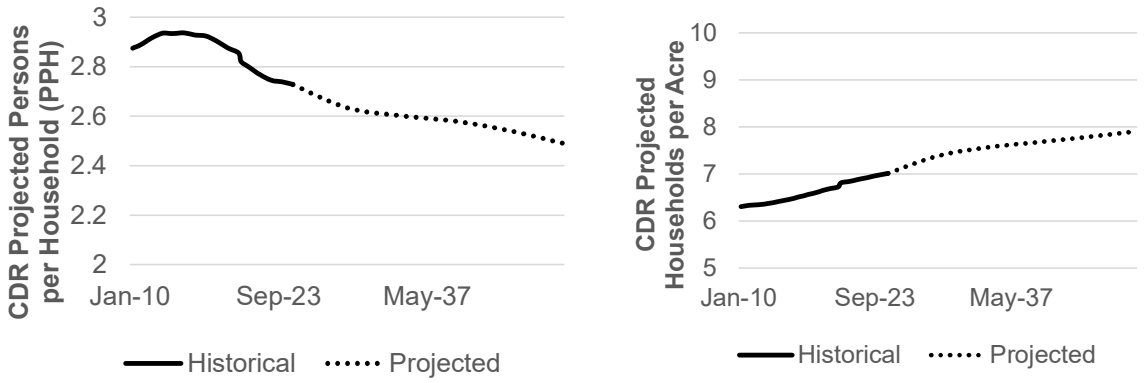


**Figure ES-2: Demographic Parameters**

While increasing density, decreasing persons per household, and increasing prices are expected to moderate demand, they do not fully offset growth in multifamily driver units. **Table ES-4** shows the slow growth trend out to 2050 for all of Orange County.

**Table ES-4: Orange County Forecast**

| Forecast Year | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 |
|---|---|---|---|---|---|---|
| Single-family Demand (AFY) | 196,682 | 189,600 | 189,594 | 190,010 | 189,146 | 188,368 |
| Multifamily Demand (AFY) | 91,462 | 93,631 | 95,823 | 97,339 | 97,976 | 98,583 |
| Irrigation Demand (AFY) | 88,837 | 86,849 | 86,849 | 86,966 | 86,849 | 86,849 |
| CII Demand (AFY) | 82,873 | 87,224 | 89,565 | 91,928 | 93,866 | 95,492 |
| Other Demands (AFY) | 28,194 | 28,007 | 28,314 | 28,613 | 28,735 | 28,831 |
| Total Demand (AFY) | 488,049 | 485,312 | 490,145 | 494,856 | 496,572 | 498,124 |

Single-family demand remains relatively flat due to limited growth in single-family housing units, and multifamily demands are forecasted to increase steadily, driven by rising multifamily housing development. Irrigation demand is expected to remain flat, and other uses (e.g., fire flows, construction) are projected as a fixed percentage of total use. Under expected future conditions, total Orange County demand is projected to remain relatively stable through 2050.

### Alternative Forecasts and UWMP Scenarios

As part of this model, alternative demand forecasts were developed to evaluate the impacts of climate change and long-term water rate increases on future water use in Orange County. Using CMIP6 climate models and downscaled LOCA2 data from CalAdapt, the model applied temperature and precipitation deltas to historical weather patterns across four Flume-defined microclimate quadrants. These projections

were used to simulate two climate scenarios, dry/warm and wet/cool. The dry/warm scenario showed increased water demand due to higher temperatures, while the wet/cool scenario, when paired with a 3% annual price increase above inflation, demonstrated demand suppression.

The 2025 Urban Water Management Plan (UWMP) requires agencies to project long-term water demand under three hydrologic conditions, normal year, single dry year, and five consecutive dry years, over a 20-year horizon in 5-year increments. In this model, the single dry year scenario used a hot-dry index (HDI) to identify the year with the most weather-sensitive demand, with 2014 selected for most agencies. The multiple dry year was developed to describe the potential impact of consecutive dry years. **Figure ES-3** summarizes all forecasts.

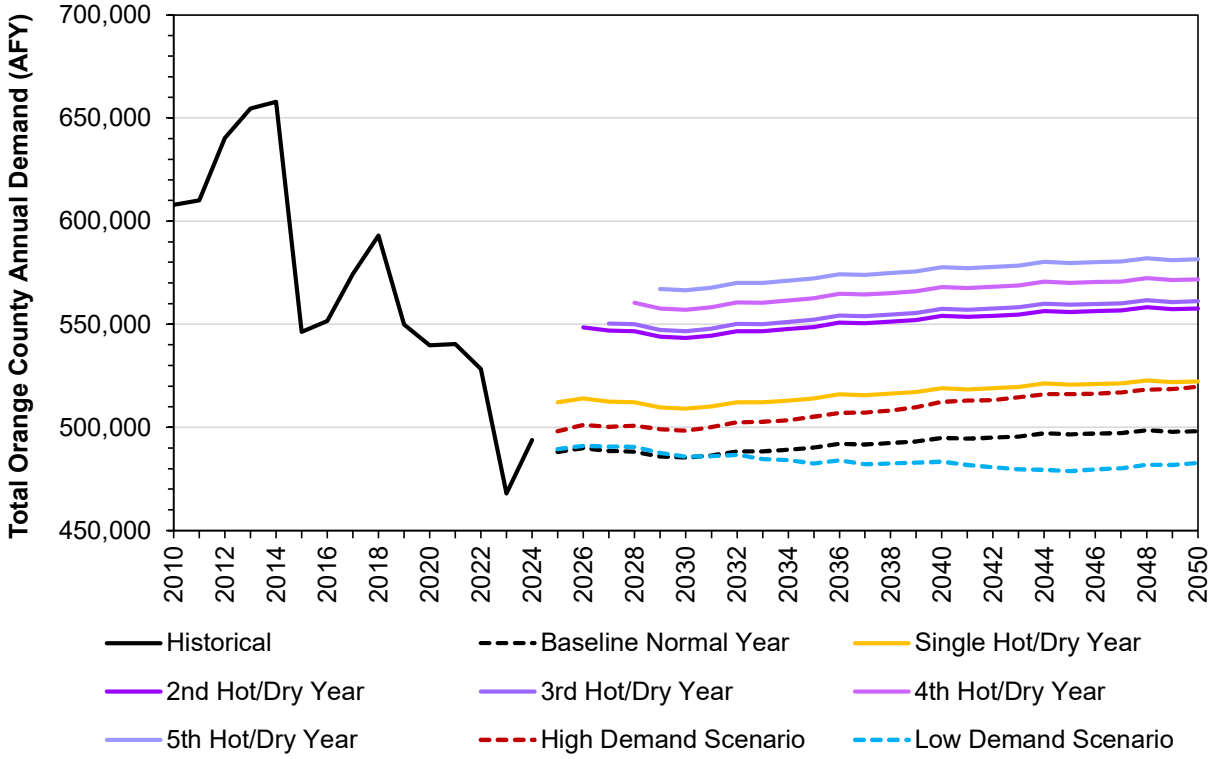


**Figure ES-3: Baseline, Alternative, and UWMP Forecasts**

Although Orange County demands are forecast to be relatively flat into the future, Figure ES-3 shows that annual variations in weather could cause high fluctuations.

# 1. Introduction

The Municipal Water District of Orange County (MWDOC) supplies water to 26 retail agencies and the Orange County Water District (OCWD). The 3 cities: Anaheim, Fullerton, and Santa Ana, who are direct customers of the Metropolitan Water District of Southern California (MWD) are also analyzed to provide a complete picture of the county. Water demand forecasts are a foundational element of water supply and infrastructure planning. MWDOC, OCWD, and representatives of the retail agencies selected an econometric model approach for the update. Hazen and Sawyer (Hazen) developed the demand model was developed by regressing historical water consumption against several explanatory variables known to influence water demand (including weather, water price, regional economic conditions, and housing density).

This technical memorandum (TM) describes the econometric demand model developed to produce regionally consistent forecasts across all Orange County agencies. Model development was funded by both MWDOC as the imported water wholesale provider and OCWD the OC Groundwater Basin manager.

**Table 1-1** highlights a range of available approaches to long-term demand forecasting. Among these, an econometric approach incorporates high-resolution data at the agency scale and integrates many explanatory variables to properly identify the individual influence of each variable on historical and future demand.

**Table 1-1: Pros and Cons of Several Demand Models**

| Model | Pro's | Con's |
|---|---|---|
| Time Series | • Simple and easily estimated in a Spreadsheet | • Trends are simply extended into the future<br>• Model provides no indication of what causes trends in water use |
| Gross per Capita | • Ability to decouple the rate of water use from growth | • GPCD is often held constant at the historical rate<br>• No indication of what causes trends in GPCD |
| End Use Accounting | • Estimates the amount of use associated with individual purposes<br>• Addresses technological change and water use efficiency | • Consists of many assumptions for each time period<br>• Difficult to explain observed variability in water use due to weather, price, or demographic influences |
| Regression (Econometric) | • Links water use statistically to explanatory variables<br>• Provides estimates of how variability in explanatory factors affect water use<br>• Allows for scenario design around inputs | • Difficult to address the historical impacts of technology<br>• Statistical parameters contain a degree of potential error<br>• Uncertainty in future values of inputs |

MWDOC, OCWD, and Hazen chose the econometric approach as it provides estimates of how variability in explanatory variables affect water use. An econometric model also facilitates future scenario planning because the future values of explanatory variables are easy to change to present different scenarios.

The model relies on a comprehensive dataset of historical water-use data collected from Orange County retail agencies. Water use is provided from 2010 to 2025 (where available) for almost 40 different billing sectors; the 15-year history enables Hazen to fit the models to a range of historical droughts, price variations, and socioeconomic patterns. Hazen fit the approximately 40 different billing sectors into 4 demand sectors to limit the total project effort while providing a reliable forecast.

Prior to developing the forecasts, model calibration and fine tuning for each of the four demand sectors occurred at the individual retail agency level. The forecasts for individual agencies were then summed to the regional level.

This TM first discusses data collection and the model fitting process and ends with the demand forecasts as presented in **Figure 1-1**.

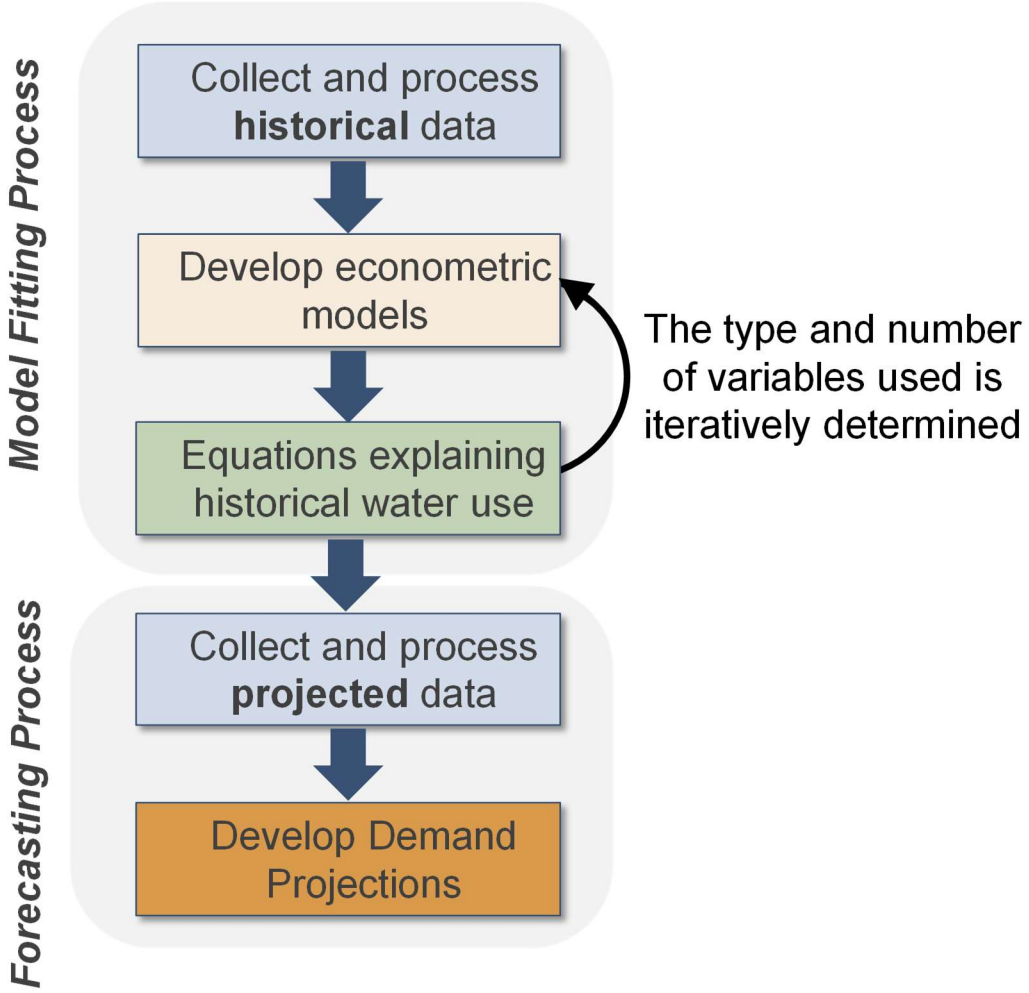


**Figure 1-1: Econometric Demand Forecast Development Process**

The process of identifying the explanatory variables to include in the regression equation and developing coefficients that accurately measure the response of water use to changes in these variables is called model fitting. Fitting the model is the most time-intensive part of the demand forecasting process, because a model must be fitted for each demand sector, and the type and number of variables used are iteratively determined. Once the model is fitted, the coefficients derived for historical water use are applied to the assumed future values of the associated explanatory variables to generate a forecast.

# 2. Historical Data Collection and Review

Demand model development requires a robust historical data set comprised of water consumption, driver units (billing accounts), and explanatory variables to explain historical changes in water use. The explanatory variables used in the models reflect both data availability and Hazen's nationwide demand modeling experience, which has focused heavily on variables that affect long term demand in California. **Table 2-1** provides a summary of the data used to develop the econometric models.

**Table 2-1: Summary of Historical Data Collected for Model Development**

| Data Category | Dataset | Data Source(s) |
|---|---|---|
| Water Use | Historical billed consumption and accounts | Retailer billing records (2010 – 2024) |
| Driver Units | For SF, MF, and Irr uses: Single-family, and multifamily, commercial, and irrigation accounts, Dedicated Irrigation (potable, recycled & raw water) | Retailer billing records (2010 – 2024) |
| | For CII uses: CII Sectoral employment | US Census |
| Explanatory Variables | Observed weather (monthly precipitation, monthly maximum temperature) | Parameter-elevation Regressions on Independent Slopes Model (PRISM) |
| | Water Price | Retail agency provided (2010 – 2024) |
| | Drought Restrictions | State Water Resources Control Board |
| | Gross Domestic Product (GDP) | Federal Reserve Bank of St. Louis Real Gross Domestic Product: All Industries in Orange County, CA |
| | Median income | US Census American Community Survey (ACS) |
| | Housing density | US Census American Community Survey (ACS), California State University Fullerton Center for Demographics Research (CDR), Southern California Association of Governments (SCAG) land use data |
| | Persons Per Household | |
| | Relative sectoral economic activity | US Census LODES, Center for Demographics Research (CDR) |
| | Passive Efficiency Estimates | Analysis of trend indicators and MWDOC/FLUME insight |
| | COVID Binary Indicator | Assumed active from March 2020 – May 2023 |

The following sections provide a detailed description of each dataset summarized in Table 2-1. Data sources documented in this section are limited to historical datasets; a review of datasets describing projected future conditions and assumptions are documented in **Section 4**.

## 2.1 Data Collected from Retail Agencies

Orange County retail agencies responded to a questionnaire spreadsheet that asked for their historical billed water consumption volumes and account data by customer class for the 2010 to 2024 period, as well as water rate schedules covering the same period, and, where possible, a summary of water shortage management activities implemented over the last decade. **Figure 2-1** summarizes the historical duration of data provided by each agency as well as an identification of the billing cycle (monthly or bimonthly) that defines the general frequency of water bills.

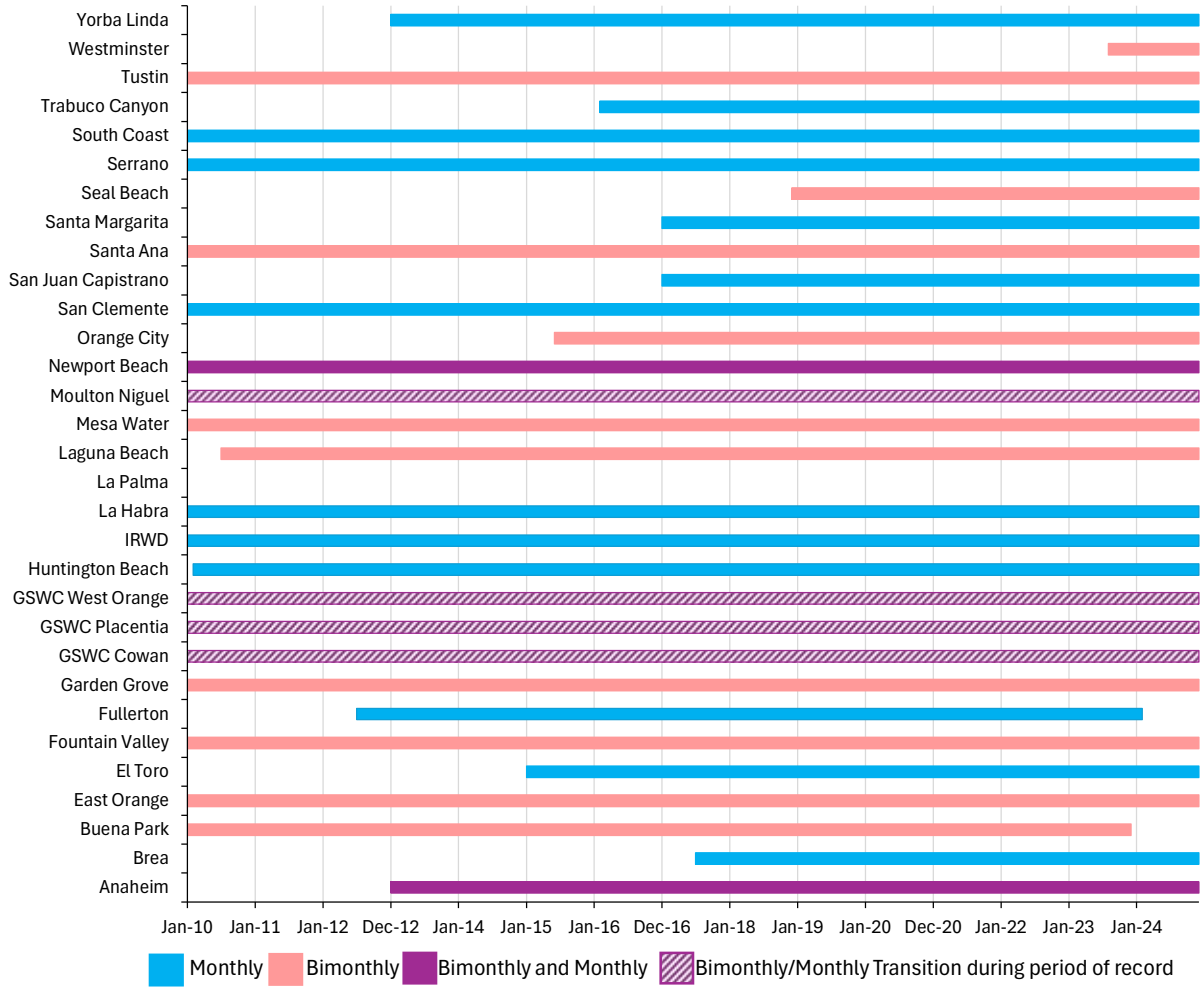


**Figure 2-1: Summary of Time Range of Available Billing Data Provided by Retail Agencies**

The water use and account data provided by the agencies varied. Billing sectors and their definitions can be agency-specific (almost 40 billing classifications were collected from 29 retail agencies), and water use data was not always consistently available back to 2010 for all retailers. Billing cycles differ between agencies: monthly, bimonthly, or a combination of the two.

After the water use and account data were obtained, the data needed to be standardized into consistently defined demand sectors and to a monthly basis. The following sections discuss how billing-sector data

were standardized into four demand sectors, and how water use per account was standardized to yield monthly use per account accounting for differences in billing cycles.

### 2.1.1 Standardized Agency Billing Sectors

Retail agencies provided billing and account data organized by each agency's own internal billing classifications. Billing classifications were relatively consistent across retail agencies for defining residential water use, as most retail agencies characterized separate classifications for single-family and multifamily sectors. Water use of mobile home and other housing customer classes not associated with single-family detached structures was generally found to be similar to water use rates within the multifamily sector.

Billing classifications were less consistent in describing non-residential uses. Most agencies defined a commercial billing classification; however, the distinction and definition of industrial, institutional, and irrigation classes were inconsistent across retail agencies. For example, certain retail agencies include industrial or institutional uses within their commercial billing classification. Similarly, landscape use is not necessarily limited to a single end use, and not all retailers reported irrigation use as a class. Water billed within a landscape or irrigation category could represent use at commercial, industrial, institutional, and residential properties. Uncertainty and inconsistency in retail agency definitions of commercial, industrial, and institutional water use can affect the accuracy and performance of statistical demand models. To address this, the commercial, industrial, and institutional sectors were combined into an aggregate Commercial, Industrial, Institutional (CII) sector for modeling.

**Table 2-2** provides the general breakdown of sector classifications across MWDOC agencies.

**Table 2-2: Summary of Standardized Water Use Sectors**

| Standardized Water Use Sector (Modeled Sector) | Description |
|---|---|
| Single-family | Water use associated with single-family residential homes. |
| Multifamily | Water use associated with multifamily residential properties. Multifamily use shows less seasonal variation than single-family use due to shared irrigable area per dwelling unit and some multifamily irrigation is likely to be attributed to the irrigation class. Multifamily use generally includes all residential accounts not defined as single-family |
| CII (Commercial, Industrial, Institutional) | Water use associated with commercial developments, industrial applications, and institutional activity. CII use includes non-irrigation recycled uses. |
| Irrigation | Water use associated with outdoor (typically non-residential) and agricultural irrigation. This irrigation use includes recycled water for irrigation. |
| Other | Other water use includes classifications not well represented by the water use sectors above (including fire flows, temporary meters, construction, power uses, water loss, and other small miscellaneous uses). |

Agency staff provided additional information (via email and phone conversations) to support parsing landscape and recycled water use into modeled sectors. **Figure 2-2** shows the agency billing classes separated into the four modeled sectors and the Other category.

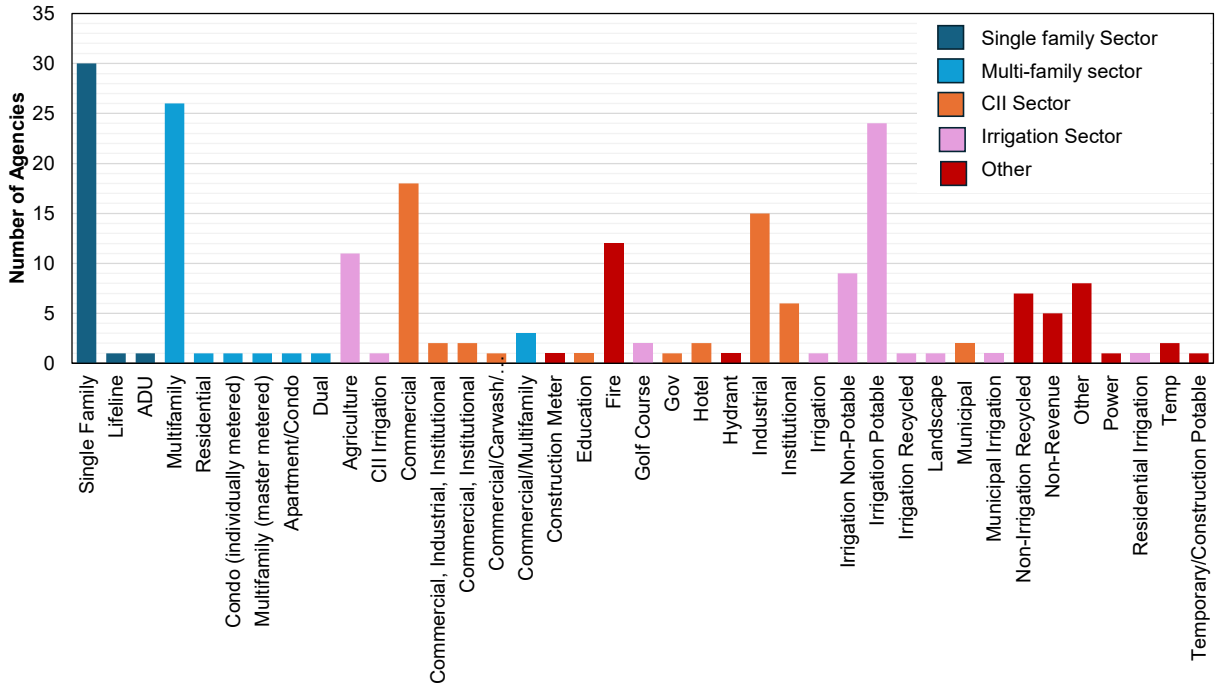


**Figure 2-2: Billing Sectors by standardized demand sector**

Figure 2-2 indicates that across all agencies, single-family and multifamily use were the most consistently classified.

### 2.1.2 Standardized Agency Rate of Use

Retail agencies have different billing and meter reading frequencies. Additionally, within each agency, meter reading cycles can vary by customer. Many agencies universally adopt either monthly or bimonthly billing; however, some utilize a combination of the two billing cycles depending on customer class and date. Water use rates for the different agency billing cycles were standardized to a calendar-month to better reflect the actual seasonal timing of water use for each of the four modeled sectors (other uses are applied as a percentage of total use across the single-family, multifamily, CII, and irrigation sectors).

Water use billed at monthly intervals can generally overlap with two consecutive calendar months. A smoothing equation extracts a single calendar-month use from the two monthly billing periods. For example, April water use is equal to the fraction of the April consumption billed in April plus the fraction of the April consumption billed in May (**Equation 2-1**).

$$April\ Use = \left(Billed\ April\ Consumption \times \frac{April\ Accounts}{April\ Accounts + May\ Accounts}\right) + \left(Billed\ May\ Consumption \times \frac{May\ Accounts}{April\ Accounts + \quad Accounts}\right)$$

**Equation 2-1**

Customers billed at bimonthly intervals are divided into two groups, and each group is billed every second month. Bimonthly meter readings contain water use that occurs over a span of three calendar months. For example, April use equals the fraction of April consumption billed in April and June (billing group 1) plus the fraction of April consumption billed in May (billing group 2), per **Equation 2-2**.

$$April\ Use = \left(\left(\frac{1}{4} Billed\ April\ Consumption + \frac{1}{4}\ Billed\ June\ Consumption\right) \times \frac{\frac{1}{2}April\ Accounts + \frac{1}{2}June\ Accounts}{\frac{1}{2}April\ Accounts + May\ Accounts\ \ \frac{1}{2}June\ Accounts}\right) + \left(\frac{1}{2} Billed\ May\ Consumption \times \frac{May\ Accounts}{\frac{1}{2}April\ Accounts + May\ Accounts + \frac{1}{2}June\ Accounts}\right)$$

**Equation 2-2**

**Figure 2-3** depicts smoothed water use for an agency whose billing structure changes from bimonthly to monthly in late 2022.

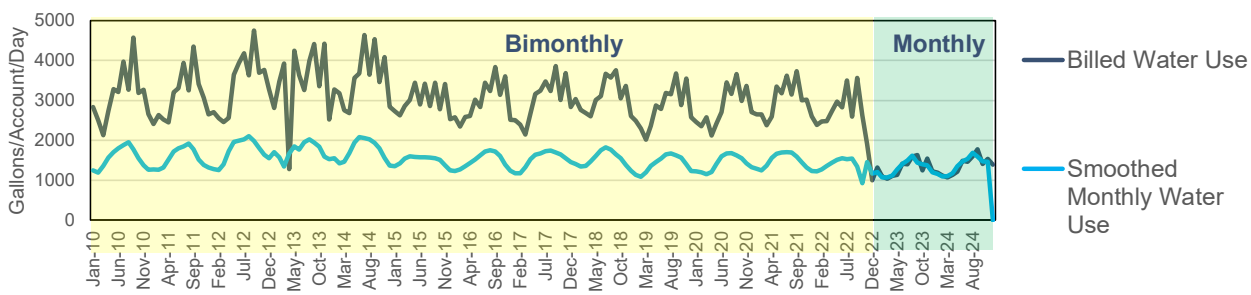


**Figure 2-3: Example smoothing of consumption for an Agency with a Billing Structure that Changes Over Time**

If an agency employs both monthly and bimonthly billing cycles for billing sectors that fall into a single model demand sector, a weighting of smoothed monthly (m) and bimonthly (b) water use (q) is employed to average use ($q_{M,avg}$) over the two cycles (**Equation 2-3**).

$$q_{M,avg} = w_m \times q_m + w_b \times q_b$$

**Equation 2-3**

The weighting factors are defined in **Equations 2-4** and **2-5**.

$$w_m = \frac{A_{M,m} + A_{M+1,m}}{(A_M + 2A_{M+1,b} + A_{M+2,b}) + (A_{M,m} + A_{M+1,m})}$$

**Equation 2-4**

$$w_b = \frac{A_{M,b} + 2A_{M+1,b} + A_{M+2,b}}{(A_M + 2A_{M+1,b} + A_{M+2,b}) + (A_{M,m} + A_{M+1,m})}$$

**Equation 2-5**

### 2.1.3 Development of Retail Agency Driver Units

Driver units reflect the scale of a water use sector indicative of the number of water users. Total water consumption (Q) is derived by multiplying the number of driver units (N) by the rate of water use per driver unit (q), as shown in **Equation 2-6**.

$$Q = N \cdot q \rightarrow q = \frac{Q}{N}$$ **Equation 2-6**

To be useful for model development and forecasting, driver units must have a consistent historical record coincident with consumption and have a corresponding future dataset representing projected driver unit counts. Driver units were selected for each model sector, as shown in **Table 2-3**. The following sections detail the data sources and data processing used to develop estimates of drivers for each retail agency and model sector.

**Table 2-3: Driver Units and Rates of Use for each Demand Sector**

| Sector | Driver Units | Rate of Use Definition |
|---|---|---|
| Single-family Residential | Accounts | Gallons / account / day |
| Multifamily Residential | | Gallons / account / day |
| Commercial, Institutional, Industrial (CII) | Jobs | Gallons / job / day |
| Dedicated Irrigation (potable, recycled & raw water) | Accounts | Gallons / account / day |

Other water uses that are small and do not neatly fit above classifications are projected using a long-term average of historical consumption.

### 2.1.4 Residential Housing Units

Driver units for both single-family and multifamily residential water use were set to the number of accounts provided by retail agencies. Distinct housing unit data was available through the Center for Demographic Research at California State University, Fullerton (CDR) by retailer service area boundaries.

The number of single-family accounts recorded by retail agencies may be slightly greater than the number of single-family housing units reported by CDR due to auxiliary dwelling units (ADUs), other property-specific meter additions, and subtle differences in how the single-family class is defined (e.g., some agencies may include individually metered townhomes). Multifamily dwellings are generally billed collectively on a single meter, and the number of units per account is higher than for single-family accounts.

The total number of accounts are used as a driver for the residential sectors, and units per account is used as an explanatory variable providing a means of using CDR projections of residential households as a driver for residential sector forecasts. Both values are reported in **Table 2-4**.

**Table 2-4: 2024 Estimated Residential Driver Units by Retailer**

| | Total SF Units | Total SF Accounts | SF Units/Account | Total MF | Total MF Accounts | MF Units/Account |
|---|---|---|---|---|---|---|
| Anaheim | 46,323 | 52,743 | 0.88 | 69,041 | 4,311 | 16.02 |
| Brea | 9,979 | 11,091 | 0.90 | 8,855 | 210 | 42.18 |
| Buena Park | 14,885 | 16,865 | 0.88 | 11,142 | 696 | 16.01 |
| East Orange CWD | 1,141 | 1,174 | 0.97 | 96 | 26 | 3.69 |
| El Toro WD | 6,725 | 5,670 | 1.19 | 18,193 | 2,619 | 6.95 |
| Fountain Valley | 13,266 | 16,090 | 0.82 | 7,061 | 190 | 37.20 |
| Fullerton | 25,248 | 26,687 | 0.95 | 25,334 | 1,933 | 13.11 |
| Garden Grove | 28,148 | 30,114 | 0.93 | 22,611 | 1,795 | 12.60 |
| GSWC Cowan | 2,376 | 2,443 | 0.97 | 85 | 48 | 1.77 |
| GSWC Placentia | 9,497 | 11,886 | 0.80 | 7,023 | 1,222 | 5.75 |
| GSWC West Orange | 19,397 | 24,710 | 0.79 | 18,209 | 3,511 | 5.19 |
| Huntington Beach | 39,828 | 44,950 | 0.89 | 43,299 | 4,329 | 10.00 |
| Irvine Ranch WD | 72,377 | 71,228 | 1.02 | 105,949 | 40,636 | 2.61 |
| La Habra | 10,728 | 11,094 | 0.97 | 9,920 | 877 | 11.31 |
| La Palma | Not Provided | | | | | |
| Laguna Beach CWD | 7,076 | 7,093 | 1.00 | 3,583 | 1,125 | 3.19 |
| Mesa WD | 15,943 | 14,350 | 1.11 | 26,671 | 6,302 | 4.23 |
| Moulton Niguel | 33,583 | 47,418 | 0.71 | 35,269 | 2,017 | 17.48 |
| Newport Beach | 14,994 | 19,706 | 0.76 | 20,291 | 4,077 | 4.98 |
| Orange City | 26,112 | 23,452 | 1.11 | 22,480 | 6,091 | 3.69 |
| San Clemente | 12,664 | 12,478 | 1.01 | 9,419 | 3,706 | 2.54 |
| San Juan Capistrano | 6,684 | 6,802 | 0.98 | 6,079 | 3,148 | 1.93 |
| Santa Ana | 35,197 | 35,334 | 1.00 | 47,658 | 3,732 | 12.77 |
| Santa Margarita WD | 38,217 | 38,260 | 1.00 | 22,574 | 15,137 | 1.49 |
| Seal Beach | 4,666 | 4,438 | 1.05 | 10,011 | 569 | 17.58 |
| Serrano WD | 2,214 | 2,229 | 0.99 | 24 | Not Provided | |
| South Coast WD | 9,997 | 10,994 | 0.91 | 8,483 | 1,591 | 5.33 |
| Trabuco Canyon WD | 3,620 | 3,907 | 0.93 | 497 | 31 | 16.03 |
| Tustin | 10,252 | 12,035 | 0.85 | 12,329 | 849 | 14.52 |
| Westminster | 16,273 | 19,724 | 0.83 | 13,139 | 1,103 | 11.92 |
| Yorba Linda WD | 20,674 | 23,510 | 0.88 | 5,919 | 264 | 22.43 |

### 2.1.5 CII Jobs

Total employees, or jobs, within the CII sector are estimated from the U.S. Census Bureau Longitudinal Employer Household Dynamics (LEHD) Origin-Destination Employment Statistics (LODES) dataset (U.S. Census Bureau, 2020). The most recent LODES data set provides total employment data from 2002 to 2022 at a census tract level based on job location. LODES also categorizes jobs by North American Industry Classification System (NAICS) sector, which is the standard used by federal statistical agencies.

Jobs were appropriately calculated for each agency's service area in two steps:

1) Geoprocessing jobs to water service area boundaries: Census tract-level jobs by industry are geo-processed to align with Orange County retail agency service area boundaries. During

geoprocessing, a scaling ratio is developed for each agency, for each census tract. The number of jobs within a census tract multiplied by an agency-specific scaling ratio equals the number of jobs for a given retail agency in that tract.

2) Verifying job numbers with CDR data: CDR provided employment data for city boundaries in Orange County from 2019 to 2025. The CDR jurisdictional forecasts are spatially aligned with Orange County water agency boundaries using the same technique applied to the LODES data, and the 2019 job numbers were compared with the LODES 2019 job numbers.

Comparison of the LODES data to the CDR data helped with the assignment of appropriate GIS census tracts and agency boundaries. The differences are shown in **Table 2-5**.

**Table 2-5: 2019 LODES and CDR Jobs Comparison**

| Agency | Total 2019 Jobs (LODES) | Total 2019 Jobs (CDR) | CDR Projection Difference from LODES (CDR-LODES)/LODES |
|---|---|---|---|
| Anaheim | 196,461 | 209,100 | 6.43% |
| Brea | 43,818 | 45,716 | 4.33% |
| Buena Park | 36,214 | 37,474 | 3.48% |
| East Orange CWD | 493 | 354 | -28.19% |
| El Toro WD | 21,280 | 18,290 | -14.05% |
| Fountain Valley | 32,804 | 31,917 | -2.70% |
| Fullerton | 66,899 | 66,622 | -0.41% |
| Garden Grove | 53,476 | 60,948 | 13.97% |
| GSWC Cowan (assumes City of Orange service) | 986 | 1,383 | 40.21% |
| GSWC Placentia | 15,885 | 18,238 | 14.81% |
| GSWC West Orange | 53,365 | 51,862 | -2.82% |
| Huntington Beach | 71,084 | 84,726 | 19.19% |
| Irvine Ranch WD | 364,318 | 422,026 | 15.84% |
| La Habra | 17,795 | 18,643 | 4.77% |
| La Palma | 5,230 | 5,589 | 6.86% |
| Laguna Beach (includes Emerald Bay) | 7,317 | 10,343 | 41.36% |
| Mesa Water | 107,313 | 98,526 | -8.19% |
| Moulton Niguel WD | 60,584 | 70,203 | 15.87% |
| Newport Beach | 51,627 | 48,769 | -5.54% |
| Orange City | 112,543 | 109,218 | -2.95% |
| San Clemente | 17,994 | 20,669 | 14.87% |
| San Juan Capistrano | 15,058 | 16,990 | 12.83% |
| Santa Ana | 161,955 | 164,884 | 1.81% |
| Santa Margarita WD | 39,661 | 43,717 | 10.22% |
| Seal Beach | 10,484 | 13,059 | 24.56% |

| Agency | Total 2019 Jobs (LODES) | Total 2019 Jobs (CDR) | CDR Projection Difference from LODES (CDR-LODES)/LODES |
|---|---|---|---|
| Serrano WD | 1,521 | 2,288 | 50.43% |
| South Coast WD | 13,305 | 14,936 | 12.26% |
| Trabuco Canyon WD | 1,312 | 2,605 | 98.52% |
| Tustin | 37,530 | 22,765 | -39.34% |
| Westminster | 30,892 | 28,153 | -8.87% |
| Yorba Linda WD | 24,139 | 25,866 | 7.15% |

The differences in actual job numbers across the two data sources vary by agency. The actual jobs implemented in the forecast were based on conversations with each agency. For most retail agencies, the job growth rate predicted by CDR, rather than actual job numbers, is used. However, in cases where agencies indicated that CII demands differed from observed Fiscal Year 2024-2025 values, Hazen substituted the job source (CDR or LODES) that provided a forecast closer to observations.

## 2.2 Collection and Processing of Explanatory Variables

Explanatory variables are variables specified in a regression model to explain variability in water use, such as water rates, maximum monthly temperature, housing density, and other socioeconomic parameters. Explanatory variables used in the econometric demand model are identified based on adherence to three key characteristics:

1) Logical or understood connection to explaining changes in water consumption;
2) Historical records available for the historical modeling period; and
3) Availability of future projections consistent with the desired forecast horizon (2025-2050) or a reasonable means for assuming or deriving projected values.

**Table 2-6** provides an overview of the collected explanatory variables for Orange County water agencies' demand models and their relevance to explaining changes in water consumption.

**Table 2-6: Summary of Explanatory Variables**

| Explanatory Variable | Relevance to Water Consumption |
|---|---|
| Temperature | Higher than normal temperatures are associated with higher demands. |
| Precipitation | Higher than normal rainfall is associated with lower demands. |
| Price | Economic theory suggests a negative correlation with demand. |
| Economic Index | Water demand is positively correlated with real GDP, which is modeled as departure from the long-term trend. |
| Median Income | Economic theory suggests a positive correlation between income and demand; generally, areas with higher median incomes tend to use more water. |

| Explanatory Variable | Relevance to Water Consumption |
|---|---|
| Mix of industries | The representation of industries within a geographical area is related to the amount of water used within the CII sector. |
| Housing density | Housing density is negatively correlated with demand; on average, residences with more units per acre (or smaller parcel sizes relative to dwellings) tend to use less water for outdoor uses. |
| Persons per Household | Positively correlated with demand; generally, residences with more people tend to use larger amounts of water on average. |
| Households per account | Higher units per account are associated with higher average demands per account. |
| Conservation | Decreases the amount of water customers consume. |
| Drought Restrictions | The presence of drought restrictions on water use tends to decrease the amount of water consumed by customers. |
| COVID Pandemic | The presence of COVID restrictions tends to increase the amount of water consumed by residential customers and decrease the amount used in the CII sector. |

The following sections document the raw data sources and the processing involved to derive each explanatory variable.

### 2.1.6 Historical Weather Data

Based on Hazen's modeling experience, total monthly precipitation and maximum monthly temperature will have the greatest impact on demand. These weather characteristics best define demand when calculated for each retail service area boundary, which accounts for microclimates driven by elevation gradients and proximity to large water bodies. The Northwest Alliance for Computational Science and Engineering at Oregon State University produces the PRISM (PRISM Climate Group 2004) weather dataset from a wide monitoring network, including the California Data Exchange Center (CDEC) and the California Irrigation Management Information System (CIMIS) gages. PRISM provides gridded weather data at a 4-kilometer resolution, and Python scripts were then used to process the total monthly precipitation (inches per month) and monthly average maximum daily temperature (degrees Fahrenheit) for each member agency's service area based on the coordinates of agency centroids.

Weather data are normalized to average conditions to disconnect weather variations from systematic seasonal cycles. Historical normal weather values were calculated for each member agency as the average monthly values over the period 1991 to 2024. Departures from the historical normal were then calculated as the actual monthly value minus the monthly historical norm in the natural log-scale, as shown in **Equation 2-6**.

$$Departure = \ln X_{i,m,t} - \overline{\ln X_{i,m}}$$ **Equation 2-6**

Where $X_{i,m,t}$ is an observed weather value for agency i in month m for year t and $X_{i,m}$ is the historical normal value for agency i in month m. A positive departure indicates above-normal conditions, and a negative value indicates below-normal conditions.

### 2.1.7 Water Price

Agencies provided historical water prices (in dollars per volumetric unit), which Hazen used to measure the effects of pricing on water usage. Three types of price structures were present across the agencies:

- Uniform volumetric prices which are constant across demand sectors or equivalent for all demand sectors, which do not vary by amount of water purchased;
- Volumetric tier prices, which vary by amount of water purchased by demand sector or are equivalent for all demand sectors; or
- Water-balance based (also called budget-based) prices in which prices for single and multifamily demand sectors are based on specific indoor use thresholds and outdoor irrigation characteristics.

Several agencies changed price structures over time; however, volumetric prices used in modeling reflect the marginal (or incremental) portion of the water rate that can be avoided by reducing consumption, consistent with economic theory. Any changes to price structure are incorporated in the marginal rate. The marginal price of water used in the demand model is defined as the cost of the 10th hundred cubic foot (CCF) for the single-family residential sector, and the cost of the 20th CCF for the multifamily residential, irrigation, and CII sectors.

Prior to modeling, all marginal prices were converted into real, inflation-adjusted, 2022 dollars using the Bureau of Labor Statistics, Consumer Price Index – All Urban Consumers for the Urban West (Series ID: CUUR0400SA0, CUUS0400SA0).-

### 2.1.8 Economic Indices

Water demand is positively correlated with economic fluctuations of the business cycle. Periods of economic growth generally see increased water use. Annual Real Gross Domestic Product (GDP) is used to reflect general economic trends. GDP for all industries in Orange County, CA, was downloaded from the Federal Reserve Bank of St. Louis Economic Research Division (FRED Economic Data). The trend in the time series of the GDP index was removed during model development to better identify short-term fluctuations in economic activity. Departure from the trend **(Figure 2-4**) was calculated by running a regression on the natural log of GDP on a linear time counter (each subsequent year means the time counter is increased by 1) and the residual is used as the explanatory variable. This is standard econometric practice for addressing common statistical problems with trending variables and allows for a more flexible interpretation of forecast scenarios.

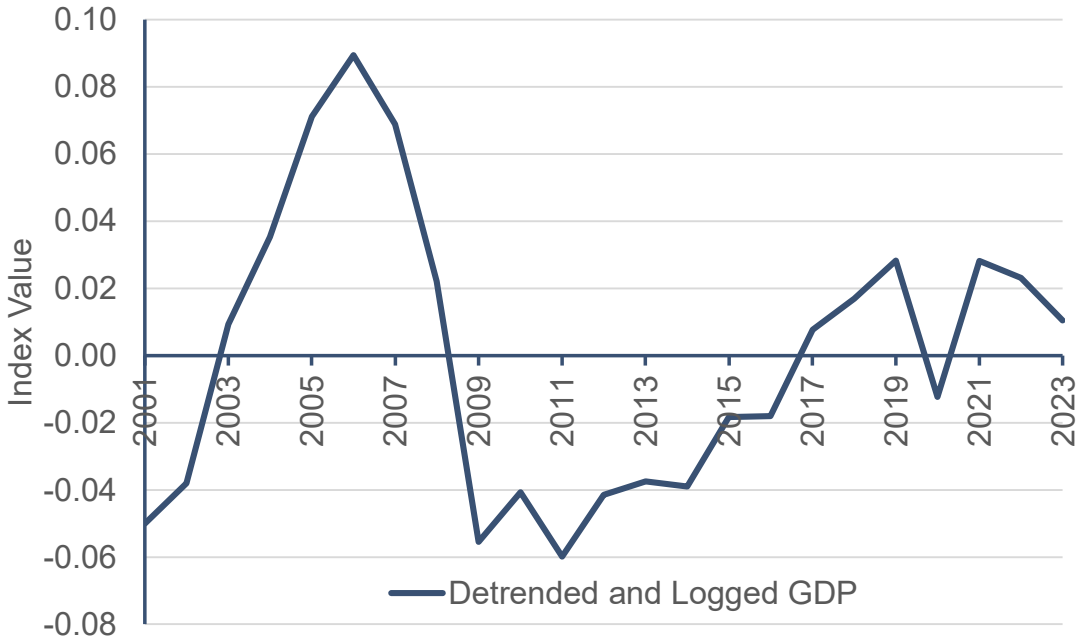


**Figure 2-4: GDP Departure from Trend**

The detrended GDP series shows the timing and magnitude of economic expansion prior to the effects of the Great Recession (after 2008) and COVID (in 2020) on macroeconomic output, while highlighting periods of positive and negative economic growth relative to the long-term trend.

### 2.1.9 Median Household Income

Median household income was identified as a potential explanatory variable for the residential sectors. Economic theory suggests a positive correlation between income and demand; generally, areas with higher median incomes tend to use more water. Median income was estimated from the US Census American Community Survey (ACS) data as the median value of all census tracts within each retailer's service area boundary. Median income was adjusted for inflation by normalizing to 2022-dollar values and held constant over time for each retailer (**Table 2-7**) because future changes in income are unknown and will likely change slowly.

**Table 2-7: 2024 Median Income by Retailer (2022 $)**

| Agency | Income |
|---|---|
| Anaheim | $102,629 |
| Brea | $119,135 |
| Buena Park | $106,284 |
| East Orange CWD | $192,611 |
| El Toro WD | $118,718 |
| Fountain Valley | $113,579 |
| Fullerton | $104,061 |
| Garden Grove | $91,554 |
| GSWC Cowan | $191,042 |
| GSWC Placentia | $191,042 |
| GSWC West Orange | $191,042 |
| Huntington Beach | $124,294 |
| Irvine Ranch WD | $142,613 |
| La Habra | $105,816 |
| La Palma | $116,923 |
| Laguna Beach CWD | $145,655 |
| Mesa WD | $120,134 |
| Moulton Niguel | $137,457 |
| Newport Beach | $169,322 |
| Orange City | $130,669 |
| San Clemente | $131,079 |
| San Juan Capistrano | $144,210 |
| Santa Ana | $92,739 |
| Santa Margarita WD | $153,652 |
| Seal Beach | $127,699 |
| Serrano WD | $164,156 |
| South Coast WD | $134,980 |
| Trabuco Canyon WD | $175,218 |
| Tustin | $122,041 |
| Westminster | $92,741 |
| Yorba Linda WD | $144,687 |

### 2.1.10 Mix of Industries

Additional explanatory variables were developed to reflect the mix of CII activity within each member agency's service area. The presentation of the model drivers covers the LODES employment data and the geoprocessing used to generate the number and category of jobs for each retail agency. Historical employment data supplied by LODES was categorized by the North American Industry Classification System (NAICS) of the US Census Bureau. The LODES NAICS sectors were aggregated into four employment categories previously defined by CDR in other employment-related datasets: Retail, Public School K-12, Service, and Other **(Table 2-8**).

**Table 2-8: NAICS Sector Jobs by Model Sector**

| CDR Sector | LODES NAICS sector |
|---|---|
| Retail | - Retail Trade |
| K-12 Public School | - No exact LODES NAICS match for this CDR sector. The NAICS sector *Educational Services* was incorporated both into services and included as a separate explanatory variable to determine its relative importance to CII demand. |
| Service | - Information<br>- Real Estate and Rental and Leasing<br>- Professional, Scientific and Technical Services<br>- Management of Companies and Enterprises<br>- Administrative and Support and Waste Management and Remediation Services<br>- Health Care and Social Assistance<br>- Arts, Entertainment, and Recreation<br>- Accommodation and Food Services<br>- Educational Services |
| Other | - Agriculture, Forestry, Fishing and Hunting<br>- Mining<br>- Utilities<br>- Construction<br>- Manufacturing<br>- Wholesale Trade<br>- Transportation and Warehousing<br>- Public Administration |

The log of the percentage of each of these four sectors relative to total jobs was used as an explanatory variable to linearize the data and improve its suitability for modeling. For example, for the Retail sector in **Equation 2-7**.

$$Retail = log\left(1 + \left(100 \times \frac{Jobs\ in\ the\ CDR\ Service\ Classification}{Total\ Jobs}\right)\right) \qquad \textbf{Equation 2-7}$$

The CDR grouping Other was not included as an explanatory variable representing a reference point captured within the CII model intercept terms.

### 2.1.11 Housing Density

Housing density is negatively correlated with demand; on average, residences with more units per acre (or smaller parcel sizes) tend to use less water for outdoor uses. Housing density is calculated as the CDR provided housing units for each retail agency divided by the total single-family and multifamily parcel area, respectively. The total parcel area for each agency was determined based on processed GIS records from the Southern California Association of Governments (SCAG) and verified with ESRI's Regrid Nationwide Parcel Boundaries for the United States. **Table 2-9** shows the total parcel area for each agency.

**Table 2-9: 2024 Total Residential Acreage**

| Agency | Single-family Residential Acreage | Multifamily Residential Acreage |
|---|---|---|
| Anaheim | 9,977.09 | 4,912.70 |
| Brea | 1,811.03 | 482.29 |
| Buena Park | 2,466.53 | 476.03 |
| East Orange | 473.04 | 17.42 |
| El Toro | 1,088.96 | 1,753.94 |
| Fountain Valley | 2,337.74 | 205.75 |
| Fullerton | 6,162.68 | 1,148.85 |
| Garden Grove | 5,099.65 | 965.29 |
| Gold Cowan | 1,528.76 | 7.22 |
| Gold Placentia | 1,843.66 | 346.31 |
| Gold West Orange | 3,148.31 | 826.74 |
| Huntington Beach | 6,451.57 | 1,823.83 |
| IRWD | 19,932.92 | 6,120.52 |
| La Habra | 2,053.92 | 526.46 |
| La Palma | 454.42 | 42.67 |
| Laguna Beach | 1,448.16 | 384.09 |
| Mesa Water | 2,436.95 | 1,338.02 |
| Moulton Niguel | 9,375.38 | 2,232.31 |
| Newport Beach | 2,962.92 | 814.65 |
| Orange City | 5,841.42 | 1,165.48 |
| San Clemente | 4,091.96 | 722.78 |
| San Juan Capistrano | 4,087.79 | 545.10 |
| Santa Ana | 5,336.01 | 2,189.99 |
| Santa Margarita | 14,333.86 | 1,608.48 |
| Seal Beach | 542.81 | 513.34 |
| Serrano | 1,050.94 | 0.46 |
| South Coast | 2,088.12 | 584.61 |
| Trabuco Canyon | 1,754.56 | 30.76 |
| Tustin | 2,547.23 | 690.39 |
| Westminster | 2,541.25 | 680.32 |
| Yorba Linda | 6,556.85 | 508.99 |

**Figure 2-5** shows the household density (households per acre) for each agency. (Serrano WD has no multifamily housing and the households per acre is abnormally high and is not shown.)

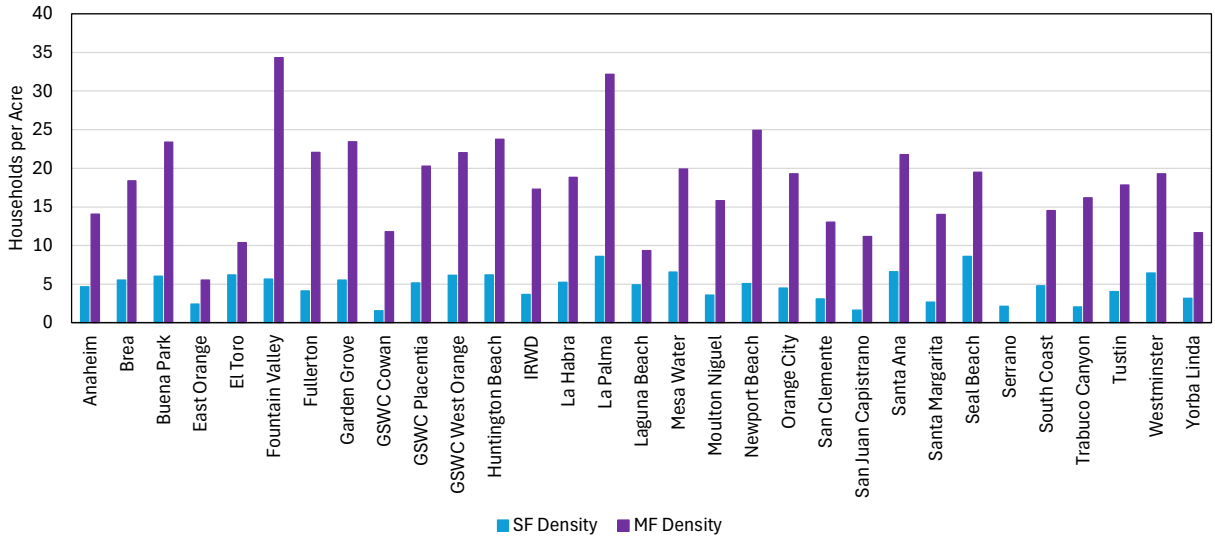


**Figure 2-5: 2024 Household Density (average households per acre)**

Multifamily density can be as much as an order of magnitude (i.e., ten times) higher than single-family density.

### 2.1.12 Persons per Household

Generally, households with more people tend to use larger amounts of water i.e. "persons per household" is an explanatory variable that is positively correlated with demand. The American Community Survey (ACS) is census-based data that provides information on housing units, total household population, and a breakdown of single-family and multifamily populations. ACS datasets are available at the census tract level. To derive ACS data specific to Orange County water agency boundaries, a geoprocessing approach was implemented to match census tract boundaries with MWDOC's service area boundaries, as was done for employment data. Using the single-family and multifamily population split, an estimate of persons per household (PPH) for both single-family and multifamily housing was developed based on water agency boundaries

Hazen used ACS data because it calculates population in each single-family and multifamily household categories. CDR provides total population. To ensure consistency with the CDR provided housing unit and population data, the ACS-derived single-family and multifamily PPH estimates were calibrated to align with the CDR's single-family and multifamily housing unit data.

The persons per household ratio was calculated separately for single-family and multifamily residences as shown in **Figure 2-6**.

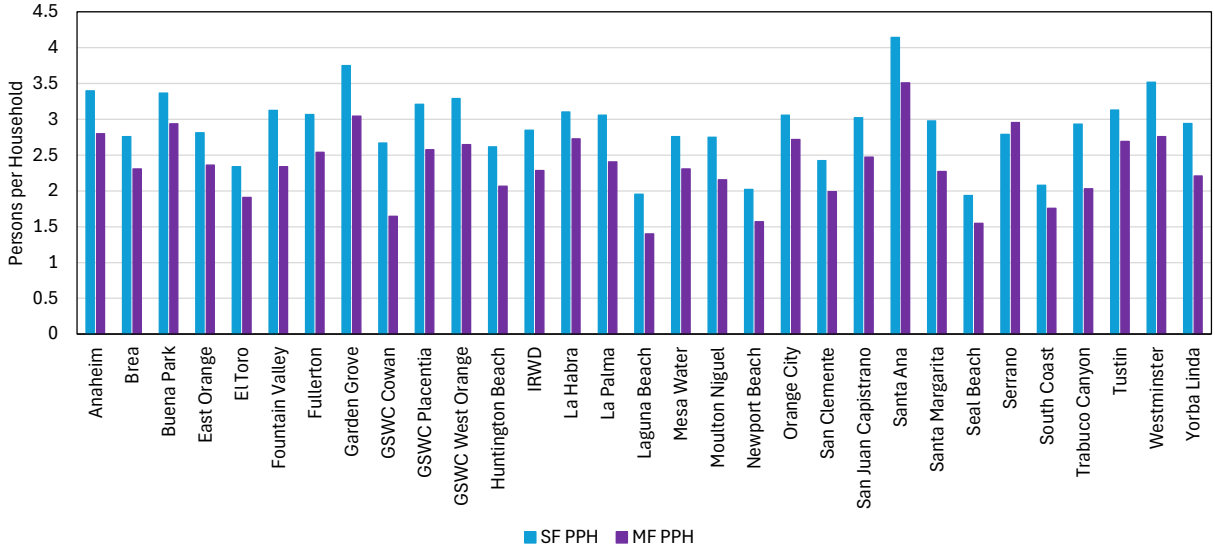


**Figure 2-6: 2024 Estimated Persons per Household**

In general, single-family homes have more residents per household.

### 2.1.13 Households Per Account

The number of households is not always equal to the number of accounts. Higher units per account is associated with higher demands. Average annual units per account for each residential class was used to (a) account for differences in the number of units per account in the historical modeling and (b) to permit the translation of CDR projections of households to be translated into accounts for forecasting purposes.

### 2.1.14 Conservation

The MWDOC Water Use Efficiency Group (WUE) provided annual savings achieved by various active conservation measures (represented by rebate program participation from the start of that specific program to present) for each MWDOC member agency and the adjacent cities of Anaheim, Fullerton, and Santa Ana. The sum of residential and commercial programs yields the total active annual conservation for each retail agency. Many of these programs were not specified as residential versus CII and were difficult to label as either passive conservation (water savings that occur without incentives) or active conservation practices.

To avoid additional calculations and potential errors in the classification of historical conservation data, total historical conservation was depicted in each sectoral model as a linear increasing trend. The coefficient derived for this trend in the regression explains whether agency water use that could not be explained by the other explanatory variables tended to increase or decrease with time; decreases over time were attributed to conservation, independent of the effects of price.

### 2.1.15 Drought Restrictions

The presence of drought restrictions tends to decrease the amount of water consumed by customers. Water use restrictions were represented by the presence of Statewide drought declarations or mandatory restrictions (both assigned a binary value of 0 or 1, meaning either the restriction is in place or it is not), and the state-required cutback (as a decimal from 0 to 1 corresponding to the restriction percentage) if a restriction was in place. The time series of historical water restrictions is shown in **Figure 2-7**.

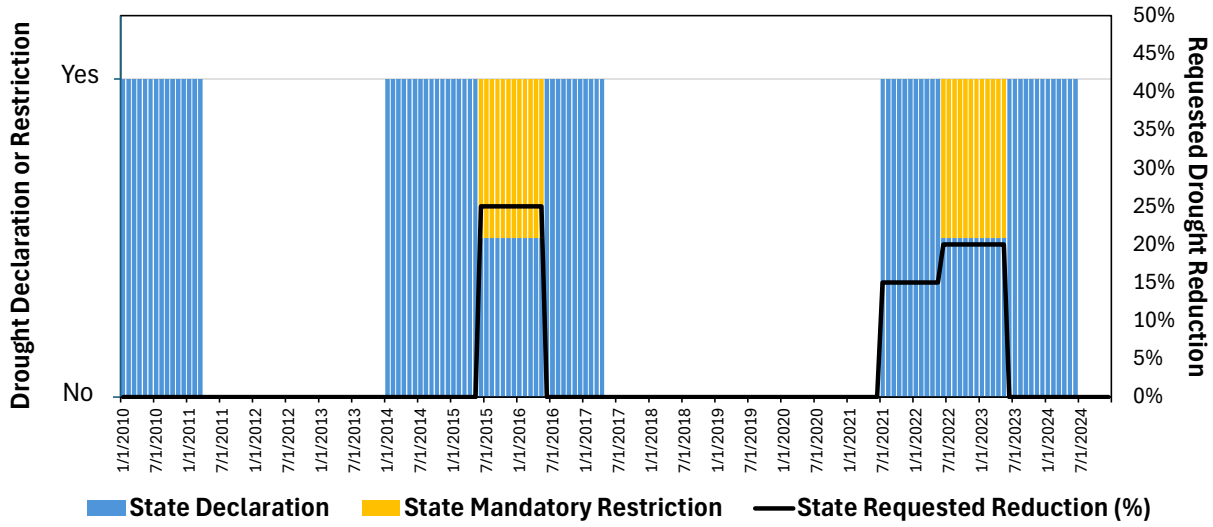


**Figure 2-7: Time Series of Historical Water Restrictions Imposed by the State**

Retail agencies also provided their agency-specific drought stages, which were categorized as level 1, level 2, or level 3 and greater. During the model fitting process, Hazen determined that while the State Declarations resolved water use for the single-family, multifamily, and CII sectors, the agency-specific drought stages (which did not always coincide with the State binary or percentage requests) yielded a better fit across the irrigation sector models.

### 2.1.16 COVID

COVID is introduced as a binary variable for March 2020 through May 2023, the period in which the World Health Organization designated COVID-19 a pandemic. The presence of COVID restrictions tended to increase the amount of water consumed by residential customers and decreased the amount used in the CII sector.

# 3. Model Approach and Development

The development of historical econometric models provides a significant analytical benefit for forecasting demand, as Historical models enable the capture of cause-and-effect relationships among weather, prices, socioeconomic factors, and other factors that drive water demand variability. Quantifying these causal relationships enables forensically sound analysis of "what-if" scenarios that are uncertain but important for planning considerations (for example, climate change, development patterns, and drought recovery).

## 3.1 Modeling Approach

The econometric demand model relies on the comprehensive set of historical water use data discussed in **Section 2** to develop a set of equations that equates total water use to the rate of water use per driver multiplied by the specific sectoral driver (**Equation 3-1**). Each of the four demand sectors modeled (single-family, multifamily, CII, and irrigation) has a separate equation.

$$\underset{Q}{Water\ use} = \underset{N}{Driver\ Count} \times \underset{q}{Rate\ of\ Use\ per\ Driver}$$ **Equation 3-1**

Driver units for a particular demand sector (e.g., household water accounts or employment) will change in the future. The rate of water use per driver (e.g. gallon/account/day) is based on the historical response of the water use rate to the explanatory variables (independent variables in the econometric equations) and on the future values of those explanatory variables.

Linear regression produces the coefficients for each explanatory variable to closely reproduce the historical rate of use per driver unit. **Equation 3-2** shows an example linear regression for single-family water use, where water rates and temperatures are examples, and represent only a subset of possible explanatory variables. $C_R$ and $C_T$ represent the water rate coefficient and temperature coefficient, respectively.

$$Rate\ of\ Use\ per\ Driver = \frac{Historical\ Single\ Family\ Use}{Single\ Family\ Account} = C_{Intercept} + C_R \times Historical\ Water\ Rates + C_T \times Historical\ Temperatures + \ldots$$ **Equation 3-2**

Panel fixed effects ordinary least squares (OLS) regression is used to estimate the coefficients that relate multiple independent explanatory variables (such as weather and water price) to the dependent variable (water user per account) by minimizing the sum of the squares in the difference between observed and predicted values of the water use rate. OLS regression can be coded to incorporate:

- A systematic and predictable relationship between the explanatory variable and use per account;
- Agency-specific coefficients (the effect of seasonal trends might differ between agencies); and
- Potential interdependence, or interactions, between fixed effects (for example, the dependence of water use on price may differ depending on the season).

The derivation of appropriate coefficient values (both sign and magnitude) through regression requires sound judgment of demand behavior and the inclusion of numerous explanatory variables to address multiple influences on demand. **Figure 3-1** illustrates that excluding key explanatory variables from the regression, which account for reasons not associated with responses to price (such as mandatory state restrictions or local conservation), could incorrectly attribute changes in demand to the volumetric price of water (i.e., incorrectly magnifying the effect price has on demand).

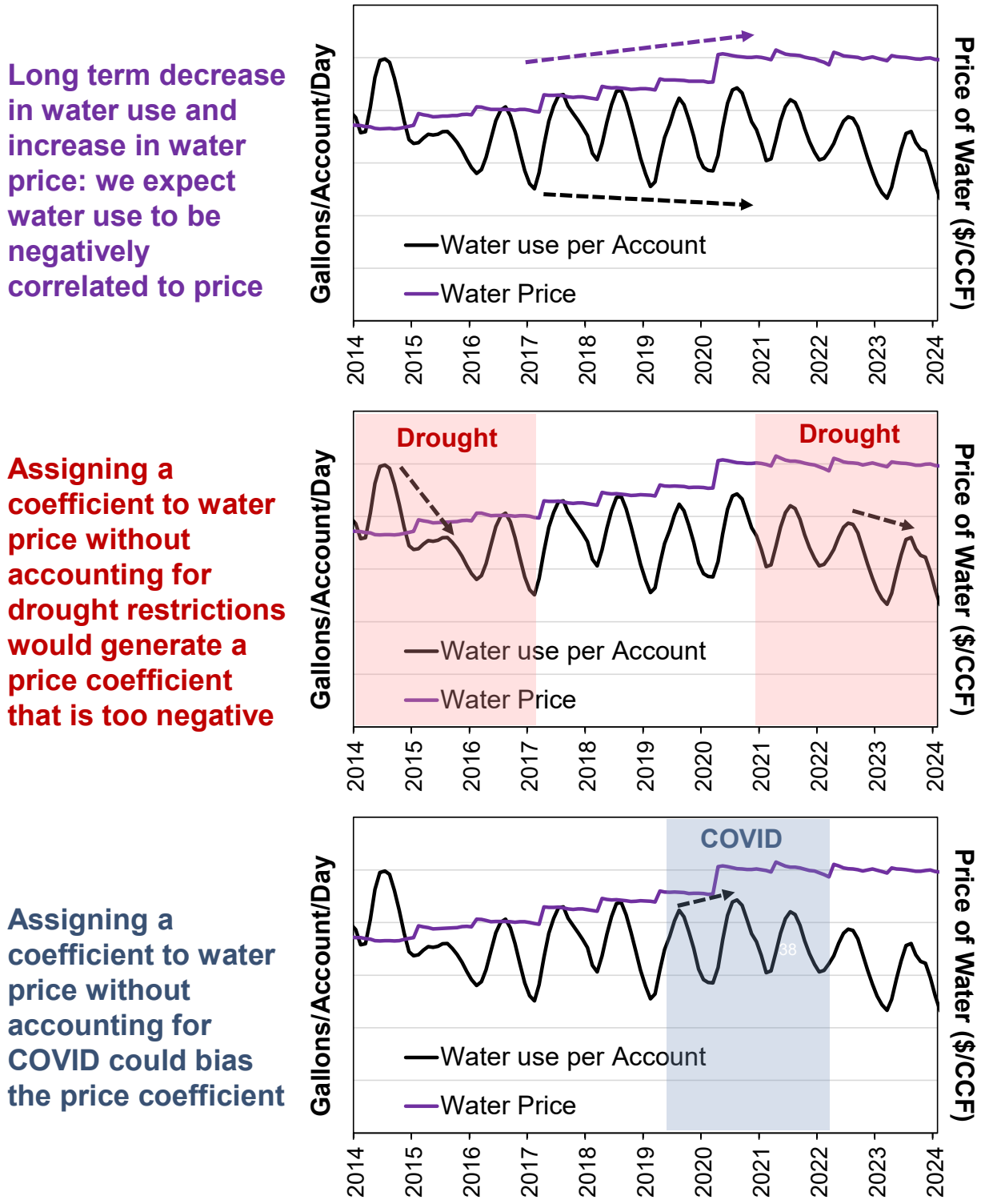


**Figure 3-1: Improving Coefficient Accuracy by Addressing Multiple Demand Factors**

There are additional expectations for model coefficients affiliated with the explanatory variables that helped in model development. Estimated coefficients needed to be rational (both in signs and magnitudes), aligning with Hazen's experience and yielding as high of an explanatory power as practically possible. Orange County water use varies widely by geography (agency) and time. A panel regression modeling approach is best suited to explicitly account for variables that have historically varied highly across geography but not time (for example, median income, persons per household, and housing density). The panel approach enhances forecast accuracy for each agency by simultaneously fitting consumption data from all member agencies. The larger sample size enables more robust fits for agencies with data gaps. All agencies still receive their own unique statistical equations and outputs, although some coefficients may apply to all (or be the same across) agencies. Because consumption data was not consistently available back to 2010 for all member agencies, the dataset represents what is called an "unbalanced panel" (not all retail agencies have the same number of observations for the same time periods), requiring these special techniques to account for missing information and potential cross-sectional biases.

## 3.2 Model Development

The development of econometric models is an iterative process as outlined in **Section 3.2.1.** Model fitting results in a set of explanatory variables used to forecast water use. In **Section 3.3**, model fits and performance are organized by water-use sector.

### 3.2.1 Model Fitting

**Table 3-1** outlines the model fitting process.

**Table 3-1: Iterative Process for Developing Econometric Models**

| Model Fitting Procedure | Description |
|---|---|
| Pre-process model input data | Conduct necessary pre-processing calculations prior to model fitting:<br>• Geographical processing of driver units.<br>• Calculate per-unit use.<br>• Calculate natural logarithms of per-unit use and appropriate explanatory variables.<br>• Calculate departures from normal conditions for appropriate explanatory variables (i.e., economic trend and weather).<br>• Calculate any index, "dummy", or interacted parameters (e.g., seasonal cycle, geography, drought severity).<br>• Smooth monthly and bimonthly data to adjust for irregular billing cycles. |
| Fit regression models for each sector | Use statistical estimation software (e.g., R, SAS, EViews) to fit linear regression equations to per unit use with the initially selected explanatory variables. |
| Examine coefficient estimates and measure of fit | Check measures of fit (such as $R^2$) and coefficient values for reasonable magnitude, direction/sign, and significance. |

| Model Fitting Procedure | Description |
|---|---|
| Refine the model to improve measures of fit and coefficient estimates | If the model fit is poor or if coefficient estimates are illogical or insignificant, several actions can be taken, including but not limited to:<br>• Identifying and removing outlier data points that have significant leverage on coefficient estimates.<br>• Remove explanatory variables with insignificant or illogical coefficient estimates from the regression equation.<br>• Testing alternate specifications of explanatory variables. |
| Check models for cross-sector consistency | Model fits and explanatory variables are compared across sectors to judge estimates relative to prior expectations, for example, testing if the relative effects of price and socioeconomic variables vary by sector in a logical way based on past experience. |

The models are fit to historical data using a combination of data management and statistical analysis software (R, SAS, or EViews). The model estimation results were checked to ensure strong measures of fit (e.g., $R^2$) and that coefficients were significant and reasonable. Goodness of fit is a holistic exercise requiring judgement based on two classifications of indicators:

1) Overall summary statistics used to evaluate relative model performance: these may include $R^2$, Measures of average error (mean absolute error, standardized error metrics such as SAME and RMSE), and measures of bias; and

2) Visual inspection applied to plots of historical data provides an indication of the model's ability to represent long-term trends, perform as expected during periods of interest (for example, COVID and State water use restrictions), allows the modeler to evaluate the presence of systematic biases and assess the variance in the underlying data.

**Section 3.3** summarizes the statistical model fits and their performance in comparison to historical observations of water consumption.

### 3.2.2 Summary of Explanatory Variables

The initial selection of explanatory variables is discussed in detail in Section 2. However, during the model fitting process, derivatives of initially selected variables were also developed and included in model equations. For example, an agency's monthly water use may also be influenced by the precipitation, or temperature, in the prior month. In some cases, time lags of 1 to 3 months in weather variables improved the estimation of weather impacts on demand.

**Table 3-2** details the explanatory variables used to develop the demand models and identifies the expected sign and magnitude of the coefficient estimates resulting from the linear regression. The coefficient sign represents whether an explanatory variable will have a negative or positive impact on demand, for example, water use will decrease as price increases and the price coefficient should be negative. The coefficient magnitude illustrates the importance of the explanatory variable relative to all others. For example, a persons per household coefficient of 0.3 indicates that persons per household has a lesser influence on demand than a coefficient of -0.5 assigned to density.

**Table 3-2: Description of Demand Model Explanatory Variables**

| Explanatory Variable | Log Transformed? | Expectations about Coefficient Estimates | Description |
|---|---|---|---|
| Departure from normal monthly maximum temperature (lagged values of temperature were also evaluated and included as explanatory variables as the influence of weather on water demand can persist for several months.) | Yes | Positive Sign | Represents the difference from long-term temperature. Higher than normal temperatures are associated with increased demands. |
| Departure from normal monthly precipitation (lagged values precipitation were also evaluated and included as explanatory variables as the influence of weather on water demand can persist for several months.) | Yes | Negative sign | Represents the difference from long-term precipitation. Higher than normal rainfall is associated with lower demands. |
| Seasonal index | No | Larger magnitudes for agencies with greater seasonal peaking | Reflects the cyclical pattern in water use, where demands are generally higher in the summer and lower in the winter. Represented in the model as a sine / cosine pair of variables. (Most sectors have a single sine/cosine pair representing the seasonal cycle). |
| Price | Yes | Negative sign with absolute value between 0 and 1 | Economic theory suggests negative correlation with demand. |
| GDP | Yes | Positive Sign | Water demand is positively correlated with economic fluctuations of the business cycle. The index is modeled as departures from long-term trends. |
| Mix of jobs across industries | Yes | N/A | The representation of jobs in many industries within a geographical area is related to the amount of water used within the CII sector. There is generally no expectations on the range of coefficient estimates. |
| Housing density | Yes | Negative sign (commonly between 0 and -1) | Housing density is negatively correlated with demand; on average, residences with more units per acre (or smaller parcel sizes) tend to use less water on outdoor uses. |

| Explanatory Variable | Log Transformed? | Expectations about Coefficient Estimates | Description |
|---|---|---|---|
| Median income | Yes | Positive sign (commonly between 0 and 1) | Economic theory suggests positive correlation of income with demand; generally geographical areas with higher median incomes tend to use more water. |
| Persons per household | Yes | Positive sign (commonly between 0 and 1) | Positively correlated with demand; generally, residences with more people tend to use larger amounts of water |
| Water Use Restrictions | No | Negative sign | Reflects the effect of drought restrictions |

Most explanatory variables are log-transformed because some variables are orders of magnitude larger than others (for example, income is in the tens of thousands of dollars while monthly precipitation may be smaller than 1 inch). Log transformation compresses the large values and spreads out smaller ones, balancing the data and facilitating the regression's ability to interpret how each variable affects demand.

## 3.3 Single-family Regression Development

This section reviews the development of the statistical regression for the single-family residential sector.

### 3.3.1 Explanatory Variables and Fitted Coefficients

The fit for the final single-family regression is presented in **Table 3-3**. While all coefficients are generated with the panel regression approach, Hazen relied on experience and the model fitting process to allows some coefficients to vary by agency (shown as a range of values) and restricted some to be constant across all agencies (and a single value is shown in Table 3-3). Coefficient estimates are within the expected range for all explanatory variables).

**Table 3-3: Single-family Regression Variables and Coefficients**

| Explanatory Variable | General Directional Influence | Model Coefficient Range |
|---|---|---|
| Persons per Household | + | 0.32 |
| Single-family Units per Account | + | 0.52 |
| Housing Density | - | -0.52 |
| Average Agency Income | + | 0.09 |
| Marginal Price (per 10 CCF) | - | -0.12 |
| Departure from normal monthly maximum temperature | + | 0 to 0.93 |
| Departure from normal monthly maximum temperature (lagged 1 month) | + | 0 to 0.95 |
| Departure from normal monthly precipitation | - | 0 to -0.031 |
| Departure from normal monthly precipitation (lagged 1 month) | - | 0 to -0.05 |
| Departure from normal monthly precipitation (lagged 2 months) | - | 0 to -0.023 |
| Departure from normal monthly precipitation (lagged 3 months) | - | 0 to -0.0139 |
| Residual Trend | - | -0.0027 to 0.0003 |
| COVID Indicator | + | 0.02 to 0.15 |
| State Requested Percent Restriction | - | 0 to -0.81 |
| State Drought Declaration | - | -0.08 to 0.01 |

Variables with an increasing effect on water demands included temperature, economic index, median income, and persons per household. Variables with a negative effect on water demands included precipitation, price, housing density, and water-use restrictions. Consumption is highly seasonal in the Orange County region, and the econometric model correlates well to seasonality and temperature. The single-family sector model produced the best fit among the four demand sectors.

### 3.3.2 Historical Model Performance

Visual inspection of the time series plots and review of the model fit parameters showed good performance across all agencies. **Figure 3-2** shows an example model fit for a single retail agency in the single-family sector in gallons per account per day. The model accounts for all dips in demand.

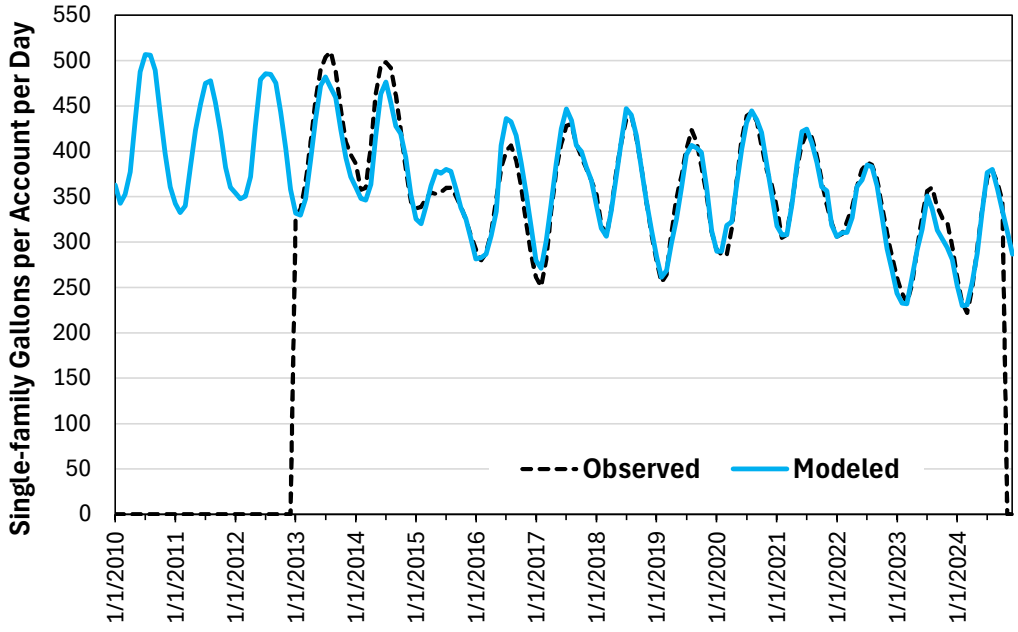


**Figure 3-2: Modeled vs Historical Water Use per Account for Single-Family for One Agency**

The $R^2$ values for all retail agencies are all above 80%, which indicates that the explanatory variables used in the model as well as their multipliers (model coefficients) explain 80% or more of the historical variability in the single-family use per account measurements.

## 3.4 Multifamily Regression Development

This section reviews the development of the statistical regression model for the multifamily residential sector.

### 3.4.1 Explanatory Variables and Fitted Coefficients

Most explanatory variables for the multifamily sector are the same as for the single-family sector. Median income and a 2-month lagged departure from precipitation were dropped. These modifications to the model design resulted in stronger measures of fit and more reasonable coefficient estimates. Final coefficient estimates presented in **Table 3-4** are within the expected range for all explanatory variables

**Table 3-4: Multifamily Regression Variables and Coefficients**

| Explanatory Variable | General Directional Influence | Model Coefficient Range |
|---|---|---|
| PPH | + | 0.5 (restricted)* |
| Housing Density | - | -0.33 |
| MF Units per Account | + | 0.79 |
| Marginal Price (per 20 CCF) | - | -0.035 |
| Departure from normal monthly maximum temperature | + | 0 to 1.07 |
| Departure from normal monthly maximum temperature (lagged 1 month) | + | 0 to 1.46 |
| Departure from normal monthly precipitation | - | 0 to -0.04 |
| Departure from normal monthly precipitation (lagged 1 month) | - | 0 to -0.06 |
| Residual Trend | - | -0.007 to 0.0017 |
| COVID Indicator | + | -0.05 to 0.14 |
| State Requested Percent Restriction | - | -0.8 to 0.32 |
| State Drought Declaration | - | -0.16 to -0.04 |
| *The persons per household coefficient was set to 0.5, which was lower than the initial econometric estimate (which was >1). This change avoided instabilities, with little effect on the other coefficient estimates. | | |

The multifamily use per account is less influenced by water price than single-family (lower coefficient).

### 3.4.2 Historical Model Performance

Visual inspection of the time series plots and review of the model fit parameters showed good model performance, with most fits exceeding an $R^2$ of 80%. **Figure 3-3 s**hows the performance of the multifamily regression for an example agency.

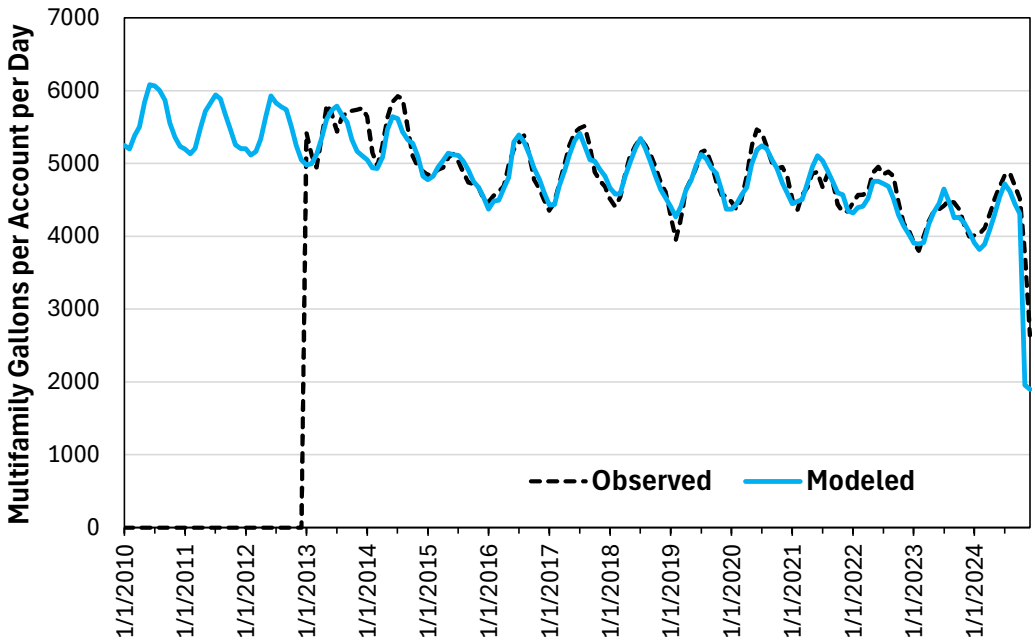


**Figure 3-3: Modeled vs Historical Water Use per Account for Multifamily for an Agency**

Multifamily use is generally less responsive to weather than the single-family demands; some of the outdoor use has been shifted over into the irrigation sector, and the reported multifamily use is primarily indoor.

## 3.5 CII Regression Development

Different billing classification schemes among retail agencies introduced definitional uncertainty in sectoral water use and driver units. For example, certain agencies lacked a distinct industrial billing classification while others combined commercial and institutional categories. Additional verification of water use at the account level was not possible, given the data constraints for this project. In response to these constraints and uncertainties, total use within the commercial, industrial, and institutional sectors was consolidated into a single composite CII regression. The benefit of combining these classifications is a more "parsimonious representation" (i.e., a simpler, clearer approach) with one sector, while providing a means to use the mix of industries to explain CII water-use variability across retail agencies.

### 3.5.1 Explanatory Variables and Fitted Coefficients

Explanatory variables for the final CII regression equation, along with their coefficients, are reported in **Table 3-5**.

**Table 3-5: CII Regression Variables and Coefficients**

| Explanatory Variable | General Directional Influence | Model Coefficient Range |
|---|---|---|
| Proportion of Total Jobs in Retail | + | 0.42 |
| Proportion of Total Jobs in Education | + | 0.287 |
| Proportion of Total Jobs in Services | + | 0.294 |
| GDP | + | 0.81 |
| Marginal price (per 20 CCF) | - | -0.114 |
| Departure from normal monthly maximum temperature | + | 0 to 1.63 |
| Departure from normal monthly maximum temperature (lagged 1 month) | + | 0 to 0.7 |
| Departure from normal monthly precipitation | - | 0 to -0.50 |
| Departure from normal monthly precipitation (lagged 1 month) | - | 0 to -0.06 |
| Departure from normal monthly precipitation (lagged 2 month) | - | 0 to -0.034 |
| Residual Trend | - | -0.01 to 0.01 |
| State Requested Percent Restriction | - | -0.24 to 0.17 |

The coefficients for CII indicate the job proportion used: total services portion, total education portion, and total retail portion. CII use per job is positively correlated with each job proportion as well as gross domestic product throughout Orange County.

### 3.5.2 Historical Model Performance

Visual inspection and performance metrics showed good model performance, including the same seasonal cycle and quantities. Like other classes, most fits exceed an $R^2$ of 80%. **Figure 3-4** shows the model performance for an example agency.

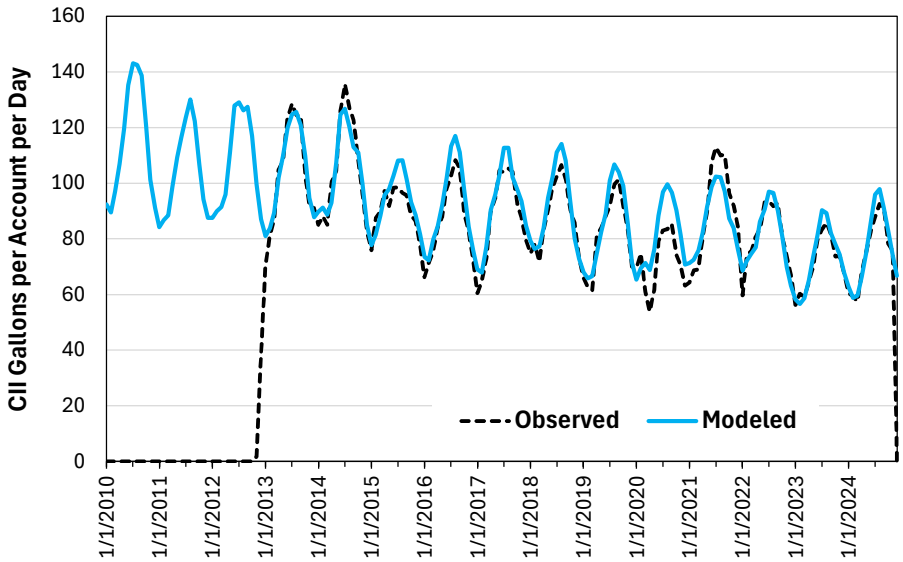


**Figure 3-4: Modeled vs Historical Water Use per Account for CII Use for an Agency**

## 3.6 Irrigation Regression Development

This section reviews the development of the statistical regression model for the irrigation sector. Both potable and recycled irrigation water demands were included in the analysis.

### 3.6.1 Explanatory Variables and Fitted Coefficients

Explanatory variables for the final Irrigation regression equation, along with their coefficients, are reported in **Table 3-6**.

**Table 3-6: Irrigation Regression Variables and Coefficients**

| Explanatory Variable | General Directional Influence | Model Coefficient Range |
|---|---|---|
| Marginal Price (per 20 CCF) | - | -0.14 |
| Normal monthly maximum temperature | + | 0 to 2.58 |
| Normal monthly maximum temperature (lagged 1 month) | + | 0 to 2.34 |
| Normal monthly precipitation | - | 0 to -0.13 |
| Normal monthly precipitation (lagged 1 month) | - | 0 to -0.11 |
| Normal monthly precipitation (lagged 2 month) | - | 0 to -0.068 |
| Agency Stage 1 | - | -0.46 |
| Agency Stage 2 | - | -0.13 |
| Agency Stage 3 | - | -0.37 |
| COVID | | -0.18 to 0.26 |

During the model fitting process, historical precipitation values were found to generate a better fit than departures from normal weather precipitation. Additionally, irrigation use is better defined by agency-declared stages than by State declarations. Irrigation is much more responsive to temperature and precipitation than the other sectors, as expected.

### 3.6.2 Historical Model Performance

Visual inspection and performance metrics showed good model performance, matching the seasonal cycles and quantities with high overall accuracy. **Figure 3-5** shows the model performance for an example agency.

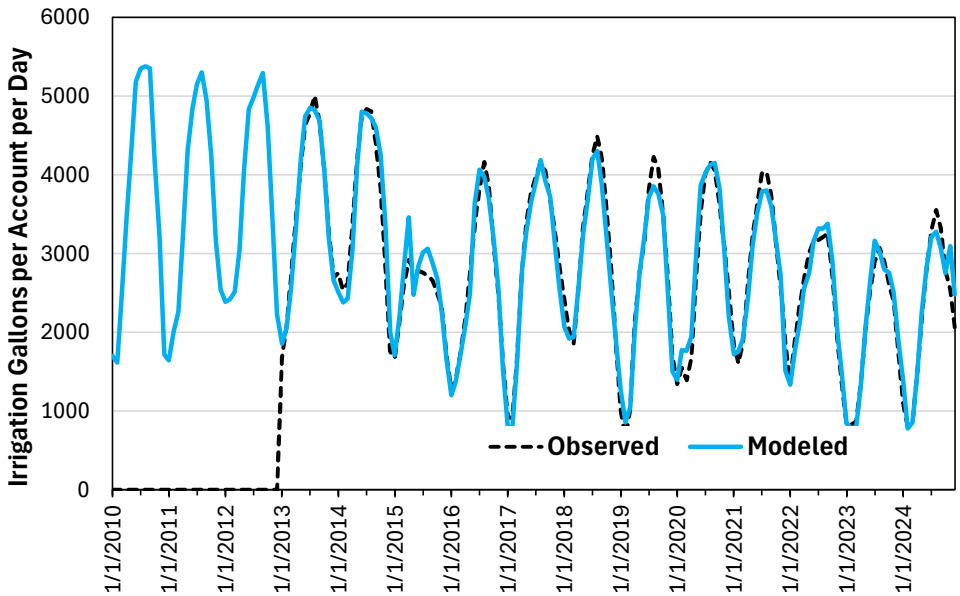


**Figure 3-5: Modeled vs Historical Water Use per Account for Irrigation for an Agency**

## 3.7 Price Elasticity

The sensitivity of the quantity of water demand to a change in its price is known as the price elasticity. The sector-specific results showed average price elasticities across the year, but the demand models allow the elasticity to vary by time of year. As water use becomes more discretionary in the summer, the estimated price elasticity (the response to price changes) tends to increase. Comparison of the four elasticity values in **Figure 3-6** reveals that multifamily demand is the least price-responsive (i.e., the least elastic of the demand sectors). The other sectors show a blend in terms of when the price signal starts mattering more. For single-family use, price changes have a large impact in late spring and early summer. Prices for CII and irrigation have the biggest impact in the summer (irrigation price elasticity approaches a coefficient of -0.25, which means that a 1% increase in the volumetric price of water leads to a 0.25% decrease in water use per account). The average regional response to price varies for a given sector over the calendar year.

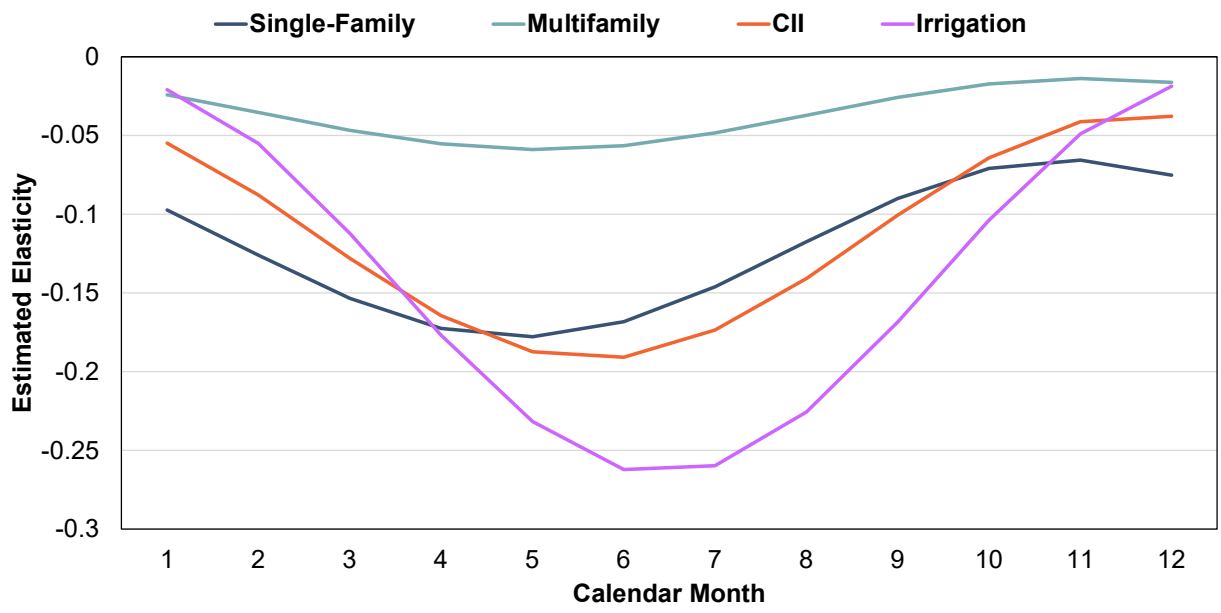


**Figure 3-6: Estimated Seasonal Price Elasticities by Demand Sector for Orange County Water Agencies**

Even though the model coefficient for price is equal for each agency across all four sectors, the actual water rate data each agency provided is in the panel dataset, so the data by which this price coefficient is multiplied differs. Additionally, agencies adopt different block structures (different prices for the 10th or the 20th CCF) over time. Both the spatial and temporal variability in water rates allows us to estimate these elasticities, even though the coefficients are applied at the regional level.

## 3.8 Model Development Summary

The econometric regressions show strong performance in explaining historical patterns of consumption over the 15 years from 2010 to 2024, including two major droughts and the COVID pandemic. Most of the regressions had R-squared values of 0.80 or greater. None of the regressions demonstrated a large, consistent bias. Based on this analysis, the estimated regression equations reflect a suitable basis for forecasting.

The overall model approach allows for demand forecast scenario analysis based on varying assumptions of future conditions. Several forecast scenarios may be explored, including climate change-adjusted weather, alternate assumptions around the timing and magnitude of drought recovery, alternate assumptions around urban development, and/or different assumptions around future economic conditions. For any of these future scenarios, the model coefficients presented in this section should be maintained as they reflect the best-fitted estimates of the causal relationships between external socioeconomic conditions and historical water demand, given the available modeling data.

Model scenarios can also be developed to address uncertainties in future explanatory variables, such as housing/job growth and density. Future inputs in these scenarios could be conducted as a sensitivity analysis or be driven by alternate growth projections. On a regular basis, overall model performance

should be evaluated. Annually, forecasted consumption and input assumptions (driver unit counts, economic conditions, water rates, etc.) can be compared with observed conditions as data becomes available to monitor predictive performance. Less frequent (approximately every 5 years), model explanatory variables should be re-evaluated. Major events, such as another drought or a severe economic recession, may necessitate reexamination and/or refitting model coefficients and may cause changes in longer-term expectations over the forecast period.

# 4. Future Demand Analysis

The four sector-specific econometric models are used to establish baseline demand projections from 2025 to 2050 at a monthly timestep for each retail agency[1]. Prior to forecasting, the models are calibrated to a specific observation year, and other uses are quantified (other uses are miscellaneous uses not included in the original four demand sectors).

Hazen worked with each agency separately to change the calibration factors or household and job variables to yield a forecast start year value (Fiscal Year 2024-2025) that was reasonably close to agency observations. Calibration refers to adjustments for residual biases in the output of fitted econometric models to establish a historical point in time to anchor projections of the future to a recent, representative historical period for each agency and sector. The calibration approach implemented a simple scalar calibration at the per-account (rate-of-use) level for each agency and sector. The use of simple scalar (i.e., a constant multiplicative factor) preserves the econometric relationships (e.g., weather and price elasticities) while removing differences/errors in the statistical model predictions for the selected calibration period.

For each member agency and model sector a calibration factor was calculated as the ratio needed to make the model's average predicted per-unit use equal the observed per-unit use over the selected calibration period. Calculated factors were then applied multiplicatively to all forward-looking monthly rate-of-use predictions. Model output for each sector (water use per unit) was multiplied by calibration factors to account for biases in the historical model fits. Calibration factors were derived from the ratio of predicted to observed water demand for historical normal weather years for each retail agency, or historical water demand based on agency-requested time periods (**Equation 4-1**).

$$Calibration\ Factor = \frac{Historical\ (observed)\ water\ use}{Modeled\ (predicted)\ water\ use}$$ **Equation 4-1**

Calibration factors were unique to each retail agency and sector and are summarized in **Table 4-1**.

**Table 4-1: Calibration Factors**

| Agency | SF Calibration Factor | MF Calibration Factor | CII Calibration Factor | Irr Calibration Factor |
|---|---|---|---|---|
| Anaheim | 0.99 | 0.99* | 1.09* | 0.78 |
| Brea | 1.00 | 1.00 | 0.98 | 1.08 |
| Buena Park | 0.99 | 0.99 | 1.04 | 0.97 |
| East Orange CWD | 1.06 | 0.99 | 0.99 | 0.99 |
| El Toro WD | 1.00 | 1.00 | 1.02 | 0.69 |
| Fountain Valley | 1.03 | 1.01 | 1.04 | 0.33 |
| Fullerton | 1.01 | 1.00 | 0.98 | 0.99 |
| Garden Grove | 1.02 | 1.01 | 1.32 | 0.99 |

[1] Due to the timing of the project, water use data were collected up to December 2024. The model projections begin in January 2025.

| Agency | SF Calibration Factor | MF Calibration Factor | CII Calibration Factor | Irr Calibration Factor |
|---|---|---|---|---|
| GSWC Cowan | 0.97 | 1.00* | 0.00 | 0.91 |
| GSWC Placentia | 1.00 | 1.43* | 0.00 | 0.93 |
| GSWC Orange | 0.98 | 1.33* | 0.55 | 0.97 |
| Huntington Beach | 1.00 | 0.93 | 0.98 | 0.80 |
| Irvine Ranch WD | 1.01 | 0.99* | 0.85* | 0.66 |
| La Habra | 1.01 | 0.99 | 1.02 | 1.01 |
| La Palma | 1.00 | 1.00 | 1.00 | 1.00 |
| Laguna Beach CWD | 0.97 | 1.00 | 1.10 | 0.84 |
| Mesa WD | 1.00 | 1.00 | 1.01 | 1.00 |
| Moulton Niguel | 1.02 | 1.01 | 0.26 | 1.08 |
| Newport Beach | 1.03 | 1.01 | 1.08 | 0.77 |
| Orange City | 1.00 | 1.00* | 0.94* | 1.11 |
| San Clemente | 1.01 | 1.00 | 0.99 | 0.64 |
| San Juan Capistrano | 1.00 | 0.93 | 1.00 | 0.96 |
| Santa Ana | 1.03 | 1.01 | 1.00 | 1.39 |
| Santa Margarita WD | 1.00 | 0.99 | 0.61 | 0.83 |
| Seal Beach | 0.95 | 0.97 | 1.01* | 1.01 |
| Serrano WD | 1.07* | 0.00 | 0.00 | 1.05 |
| South Coast | 1.03 | 0.99 | 1.14 | 0.66 |
| Trabuco Canyon WD | 0.96 | 0.93 | 1.00 | 0.68 |
| Tustin | 1.02 | 1.00 | 1.04 | 0.99 |
| Westminster | 1.00 | 1.17 | 0.99 | 1.05 |
| Yorba Linda WD | 1.07 | 1.08 | 1.03 | 1.02 |
| *Agencies have several billing sectors within this demand sector and have several different calibration factors in their specific spreadsheet model | | | | |

Total water use was summed for each sector to derive annual total use for each agency (**Equation 4-2**).

$$Forecast\ Water\ Use = \sum_{Four\ Demand\ Sectors} Driver\ Count \times Use\ per\ Driver \times Calibration$$ **Equation 4-2**

Other uses are predominantly low flows and include fire flows, temporary meters, construction and power uses, and losses. **Equation 4-3** shows these computed as a fraction of the annual total use after calibration.

$$Other\ Use\ \% = \frac{(Delivered - Bill\ \ )}{Billed}$$ **Equation 4-3**

**Table 4-2** quantifies the other uses for each agency.

**Table 4-2: Other Uses by Agency**

| Agency | Other Use (Percent of Volume Billed) |
|---|---|
| Anaheim | 3% |
| Brea | 7% |

| Agency | Other Use (Percent of Volume Billed) |
|---|---|
| Buena Park | 8% |
| East Orange CWD | 12% |
| El Toro WD | 3% |
| Fountain Valley | 6% |
| Fullerton | 4% |
| Garden Grove | 8% |
| GSWC Cowan | 6% |
| GSWC Placentia | 6% |
| GSWC Orange | 6% |
| Huntington Beach | 11% |
| Irvina Ranch WD | 5% |
| La Habra | 4% |
| La Palma | 4% |
| Laguna Beach | 8% |
| Mesa Water | 13% |
| Moulton Niguel | 5% |
| Newport Beach | 8% |
| Orange City | 6% |
| San Clemente | 4% |
| San Juan Capistrano | 6% |
| Santa Ana | 6% |
| Santa Margarita WD | 4% |
| Seal Beach | 4% |
| Serrano WD | 5% |
| South Coast WD | 2% |
| Trabuco Canyon WD | 16% |
| Tustin | 12% |
| Westminster | 8% |
| Yorba Linda WD | 10% |

Calibrated models with other uses are used to forecast future total water use[2].

## 4.1 Baseline Scenario Assumptions

Future growth in driver units (housing and jobs) was tied to CDR projections through 2050. Future conditions for all other explanatory variables were selected to represent expected changes or to remain constant. **Table 4-3** summarizes the baseline demand scenario assumptions for driver units and explanatory variables.

[2] Values of calibration factors (Table 4-1) and other uses % (Table 4-2) may change from these initial values as agencies refine their individual model.

**Table 4-3: Future Model Parameters and Assumptions for Baseline Demand Forecast**

| Data Category | Variable | Source | Assumptions |
|---|---|---|---|
| Driver Units | Single-family and multifamily accounts | CDR | Historical households per account; averages are multiplied by households projected by CDR |
| | Irrigation accounts | Agency Billing Data | Accounts are assumed to be constant into the future |
| | Sectoral employment | CDR | Proportion of jobs within CII sectors projected by CDR |
| Explanatory Variables | Monthly Maximum Temperature and Total Precipitation | PRISM | 30-year historical normal weather |
| | Water Price | Retail Agencies | Prices increase by 3% per year above inflation for 2025-2030 and keeps pace with inflation thereafter (zero difference from inflation trend) |
| | Water Use Restrictions | State & Local Restrictions | None |
| | Seasonality | | Sine/cosine functions to capture monthly pattern |
| | Median income | US Census | Constant income at 2022 value (real dollars) |
| | Housing density | CDR | Derived from CDR housing unit projections, assuming residential area remains at 2024 levels |
| | Persons Per Household | CDR | CDR projected demographics |
| | Gross Domestic Product | Federal Reserve | Long-term GDP trend |
| | Relative Sectoral Employment | CDR | Calculated based on CDR projections |
| | Passive Efficiency Estimates | Flume Insight | Assumes a 2% decrease in residential demand due to conservation by 2030 (linearly extrapolated), then no change |
| | COVID Binary Indicator | | None (occurred between March 2020 and May 2023) |

Future assumptions were defined for every element of the water demand models, including sectoral driver units and explanatory variables.

## 4.2 Development of Forecast Inputs

Data sources documented in this section are limited to projected future datasets.

### 4.2.1 Retailer Driver Units

Driver units reflect the size or scale of a water use sector and allow for differentiation of the rate of use from total consumption. CDR provided the Orange County Projections 2022 (OCP-2022) as an update of the 2018 Orange County Projections. OCP-2022 estimates single-family residential housing units,

multifamily residential housing units, jobs by sector, and total population at five-year intervals from 2025 through 2050.

CDR job projections were available at census tract level geographies, which required geoprocessing to retail service area boundaries. Geoprocessing was performed using GIS overlays of census tract boundaries and retail agency service area boundaries to aggregate CDR projections by retail agency as described in Section 2. CDR projections at the retailer level did not always align in magnitude with the historical driver units. To ensure consistency between historical and future datasets, the future time series for driver units were developed by calculating the rate of change in the CDR projections and applying the corresponding CDR rate of change to the last historical value of the driver units.

The econometric forecast models were developed using individual retail agencies' socioeconomic data. The averaged Orange County trends were examined for their potential impacts on future demands. **Figure 4-1** shows that average persons per household decreases and average household density increases. These trends are expected to provide decreased residential demand. Residential coefficients are positive for PPH, indicating demand will decrease as PPH decreases. Residential coefficients are negative for household density, indicating demand will decrease as housing density increases.

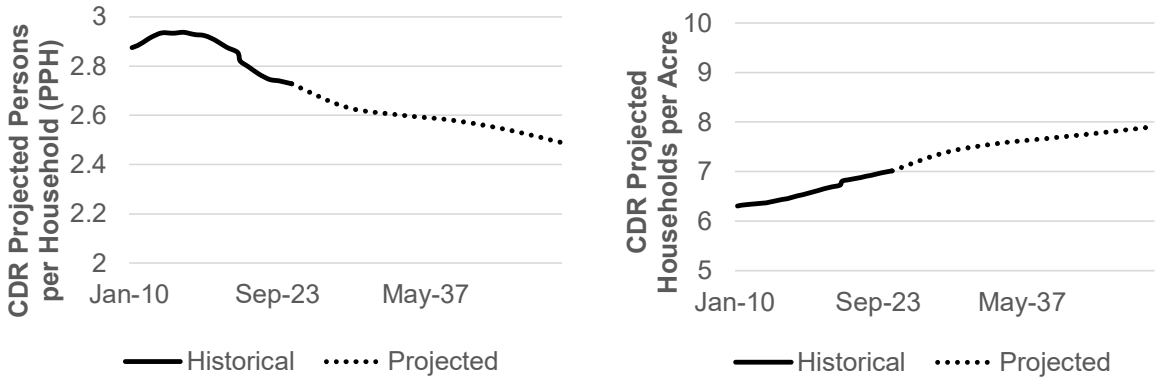


**Figure 4-1: Historical and Projected Demographic Values for Orange County (2010 – 2050)**

The decrease in demand inferred from the future explanatory variable values may be counteracted by the forecasted increase in driver units. Within the residential sector, average multifamily household growth exceeds average single-family household growth. **Figure 4-2** demonstrates that between 2025 and 2030, projected multifamily households increase substantially while single-family households show very little growth.

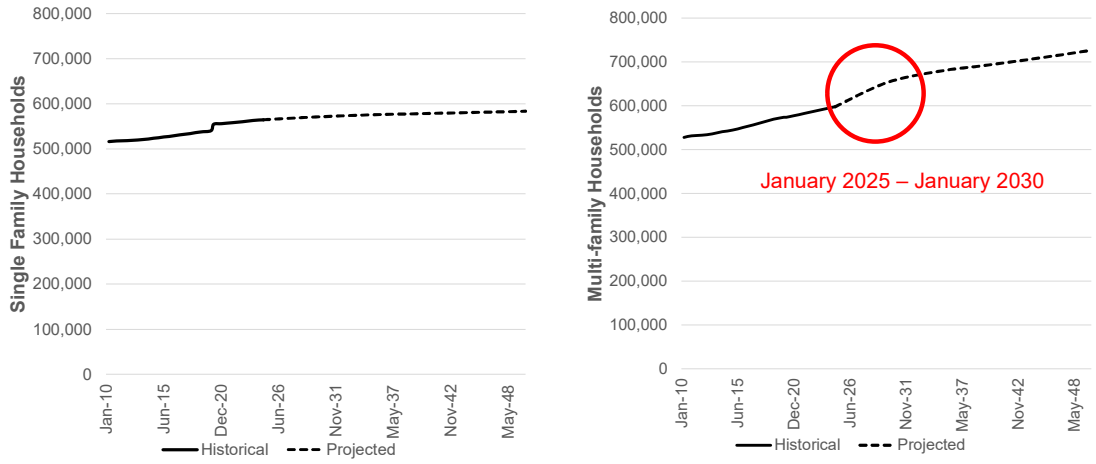


**Figure 4-2: Historical and Projected Household Growth for Orange County (2010 – 2050)**

CII demand is expected to increase corresponding to a projected average increase in jobs throughout Orange County (**Figure 4-3**).

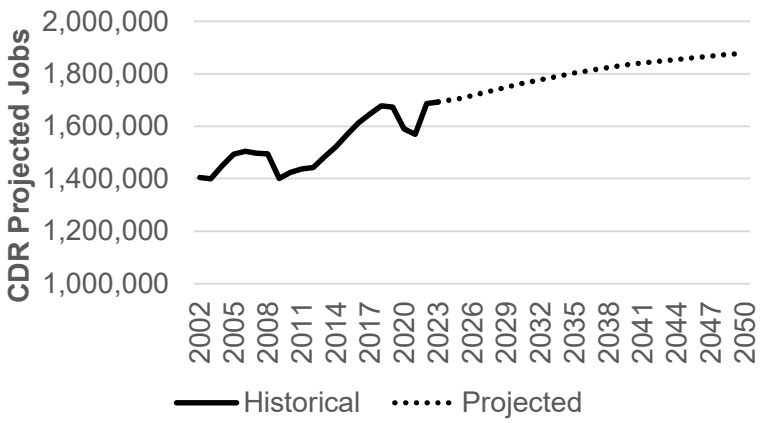


**Figure 4-3: Historical and Projected Job Numbers for Orange County (2002 – 2050)**

Although the counteracting explanatory variable values and driver units indicate that demands may remain flat into the future, variations in demand by sector exist at the retail agency level and underscore the importance of the econometric models for each agency.

### 4.2.2 Weather and Climate

**For the model baseline scenario**, future precipitation and temperature values were assumed to be equal to historical normal values. Historical normal values were calculated as the average monthly values based on all values from 1991 to 2024. The demand model uses departures from historical normal precipitation and temperature for the residential and CII forecasts and unadjusted historical normal precipitation and temperature for the irrigation forecasts. Given this, future weather inputs in the residential and CII

forecasts are reflected by projected departure values of 0 for the precipitation and temperature variables. Future weather inputs for the irrigation sector consist of monthly normal precipitation values.

Alternative demand scenarios (**Section 5**) consider the potential effects of climate change on precipitation and temperature using CMIP6 data from CalAdapt. CMIP6 represents the sixth phase of the World Climate Research Program (WCRP) Coupled Model Intercomparison Project (CMIP) and includes 134 models from 53 modelling centers. CMIP6 relies on Shared Socio-economic Pathways (SSPs) that describe plausible futures of societal development and impacts on greenhouse gas emissions. A 2021 report explains why the CalAdapt models best represent the California climate.[3]

#### 4.2.3 Water Price

Projections of future water rates were included as an explanatory variable in the water demand model. The future values for water prices assumes 5 years of a 3% (above inflation) increase in price per year, after which prices are held at nominal prices adjusted for inflation. Additional water pricing scenarios can be generated as agencies formulate and become more certain about future price paths.

#### 4.2.4 Detrended Economic Factor

The future economy was assumed to run at its long-run trend rate of growth; thus real GDP is assumed to increase at the long-term rate. The detrended GDP value used to project future demands is 0, indicating no difference from the long-term GDP growth.

#### 4.2.5 Median Income

Median income was included as an explanatory variable in the water demand model. Median income by retailer was held constant at the historical 2024 level, denominated in inflation-adjusted 2022-dollar values.

#### 4.2.6 Housing Density

Housing density was included as an explanatory variable in the single-family and multifamily residential model sectors. Separate variables were created for single-family housing density and multifamily housing density. The baseline density projection assumed a “build up” scenario where housing units could vary within a constant land area, thereby affecting average density. Future values for the density variables are derived from the projected number of single-family or multifamily housing units (**Section 2**) divided by the land area classified as residential land use within the retail service area boundary (which is assumed to stay constant throughout the forecast).

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[3] Interim Deliverable for EPC-20-006, Prepared by: Will Krantz, David Pierce, Naomi Goldenson, Danile Cayaan; November 29, 2021

### 4.2.7 Persons Per Household

The ACS-derived single-family and multifamily PPH estimates were calibrated to align with the CDR's single-family and multifamily projected housing unit data.

### 4.2.8 Relative Sectoral Employment

Ratios of sectoral employment were included as explanatory variables in the CII model sector. These sectoral employment ratios represent the estimated mix of CII activity within each retail service area. The projected number of jobs by sector was obtained from the 2025 CDR projections of four aggregated NAICS sectors.

### 4.2.9 Seasonality

Seasonal indices were included as explanatory variables in the water demand model. These seasonal indices are represented in the model as a sine/cosine pair of variables to capture the cyclical monthly pattern in water use, where demands are generally higher in the summer and lower in the winter. Most sectors had a single sine/cosine pair representing the seasonal cycle; some have two sine/cosine pairs to more effectively capture seasonal effects associated with the academic calendar. These factors are maintained for the forecast horizon.

### 4.2.10 Conservation

The 2021 Orange County Residential Water Efficiency Potential and Opportunities Study (2021 Study) assumes that total County-wide passive conservation in the residential sectors will increase by 695 acre-feet per year through 2030, after which it will remain constant. The conservation increase to 2030 represents a 1.9% decrease in annual demand, as shown in **Table 4-4**.

**Table 4-4: Projected County-wide Passive Conservation[4]**

| Year | Residential Demand (AFY) | Passive Conservation Volume (AFY) | Percent Demand Reduction |
|---|---|---|---|
| 2025 | 222,572 | 695 | 0.31% |
| 2026 | 222,572 | 1390 | 0.62% |
| 2027 | 222,572 | 2085 | 0.94% |
| 2028 | 222,572 | 2780 | 1.25% |
| 2029 | 222,572 | 3475 | 1.56% |
| 2030 | 222,572 | 4170 | 1.87% |
| 2035 | 2021 Study does not report post-2030 demand and conservation; percent demand reduction is assumed to stay constant | | 1.87% |
| 2040-2050 | | | 1.87% |

[4] Data shown on Table 4-4 were obtained from the 2021 Orange County Residential Water Efficiency Potential and Opportunities Study.

The model output does not include projected active water conservation.

## 4.3 Baseline Sectoral Forecasts

This section provides a summary of the baseline demand forecasts by each model sector. The model output does not include projected active water conservation. This section provides a summary of the baseline demand forecasts by each model sector. The baseline scenario results represent a projection of future water demand for Orange County, assuming **no additional active conservation**.

### 4.3.1 Forecast Expectations

**Figure 4-4** summarizes the Orange County averaged annual demand projections as well as the historical values.

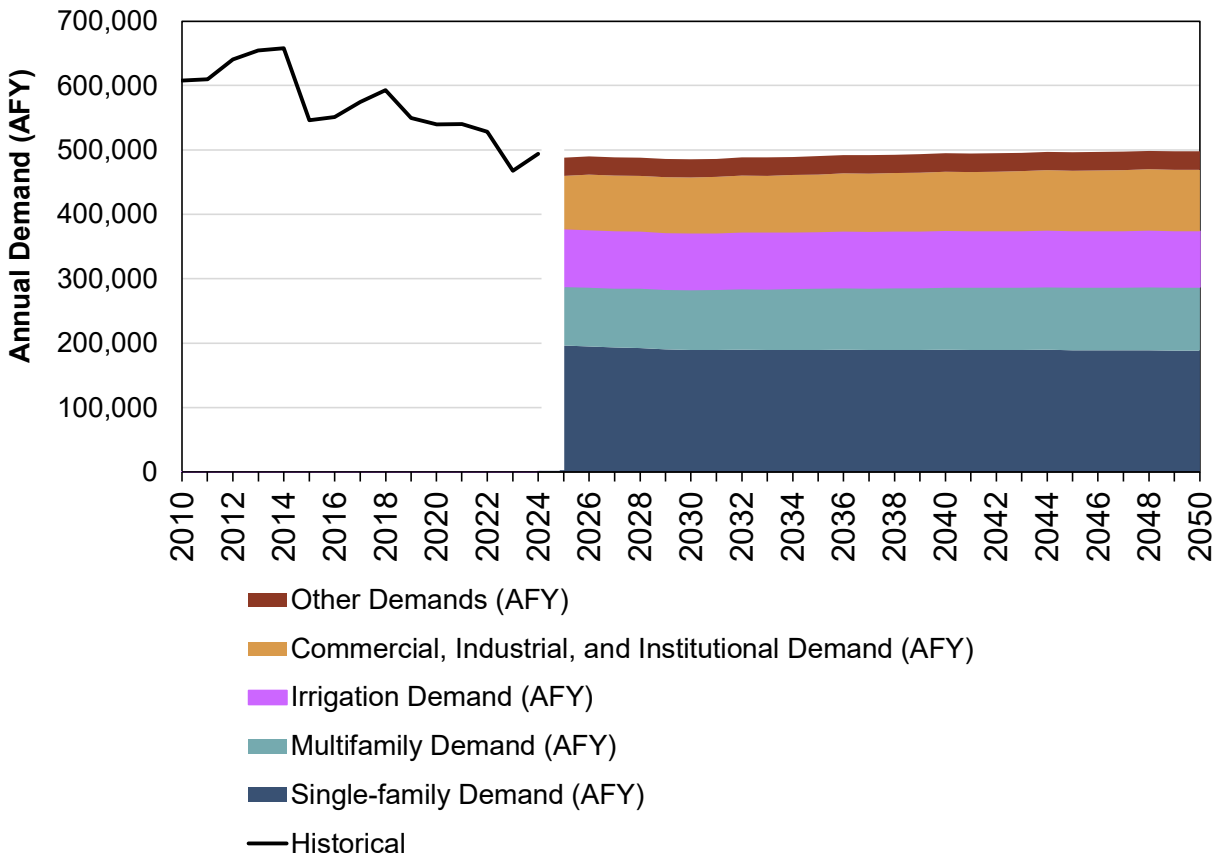


**Figure 4-4: Total Orange County Demands**

Annual county-wide single-family residential projected water demand values are projected to decrease from 2025 to 2030, then remain relatively constant through 2050. Multifamily residential projected water demand values are projected to steadily increase from 2025 through 2050. This increase is largely driven by rising multifamily housing units over time. CII demands are projected to steadily increase from 2025

through 2050. This increase is largely driven by an increase in the driver units of total non-agricultural jobs. Irrigation demand decreases due to higher water prices from 2025 to 2030, then remains constant thereafter.

### 4.3.2 Forecast Summary

The baseline scenario results represent a projection of future water demand for Orange County, assuming **no additional active conservation**. The scenario assumptions outlined in Section 4 reflect a reasonable estimate of the future conditions of parameters known to influence water demand derived from multiple available sources. The forecast uses ACS and CDR data to depict local and regional trends in demographics and development in the demand model. Consistent with regional trends, demands in the single-family sector are forecasted to remain relatively flat over the next 25 years as there is not expected to be substantial growth in single-family housing units.

Growth in residential demand is largely forecast to occur in the multifamily sector, consistent with anticipated increases in multifamily housing. Demands in the CII sector are also expected to increase, which is consistent with CDR forecasts of total jobs in the county. Increasing water rates and housing density are expected to have some modulating effect on demand (as housing density and water rates increase, water demand decreases); however, under the baseline scenario, projected changes in the values of these variables do not completely counteract the effects of growth in overall driver units.

# 5. Alternative Forecasts

Alternative forecasts were established using new climate data and possible additional water rate increases. Alternative demand scenarios consider the potential effects of climate change on precipitation and temperature using CMIP6 data from CalAdapt. A 2021 report explains why the CalAdapt models best represent the California climate.[5]

### 5.1.1 Future Climate Change

CMIP6 is the sixth phase of the World Climate Research Program (WCRP) Coupled Model Intercomparison Project (CMIP) and includes 134 models from 53 modelling centers. CMIP6 relies on Shared Socio-economic Pathways (SSPs) that describe plausible futures of societal development and impacts on greenhouse gas emissions. Downscaling originally included only dynamic downscaling, in which high-resolution physics-based simulations are used to help models reproduce the location and frequency of events that drive regional weather and climate. The State has introduced statistical downscaling, in which dynamically downscaled simulations train a new version of Localized Construction Analogs (LOCA) to downscale a broader set of GCMs than would be computationally feasible with dynamical downscaling.

Alternative forecasts were established using new climate data with the same quadrants Flume developed (**Figure 5-1**) to evaluate varying microclimates and the age of housing stock across Orange County (North and South Coastal, and North and South Inland).

[5] Interim Deliverable for EPC-20-006, Prepared by: Will Krantz, David Pierce, Naomi Goldenson, Danile Cayaan; November 29, 2021

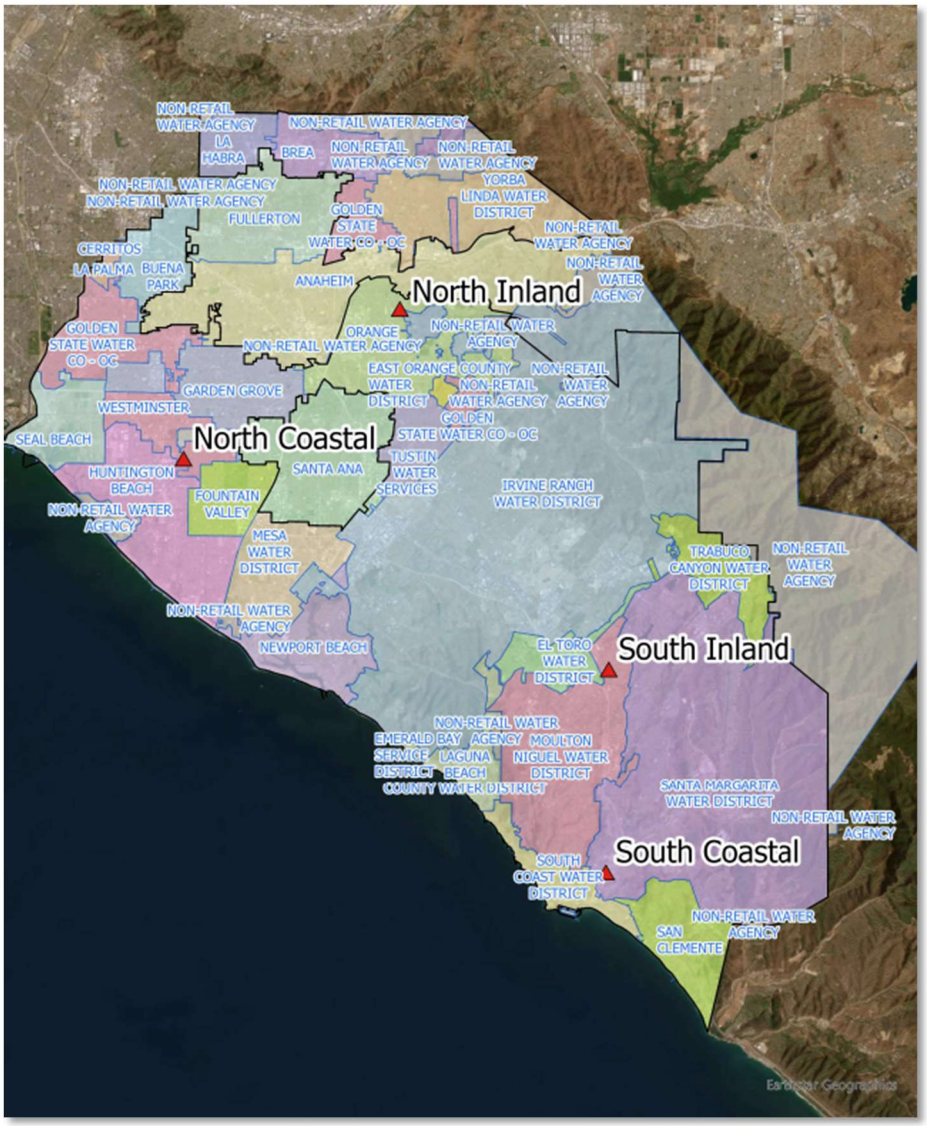


**Figure 5-1: Flume Quadrants**

Each retail agency was matched to the Flume-specific quadrant. **Figure 5-22** plots the CMIP6 model runs for the South Coastal Flume quadrant and plots the model results on a temperature-precipitation climate graph with quadrants of dry/warm, wet/warm, dry/cool, and wet/cool.

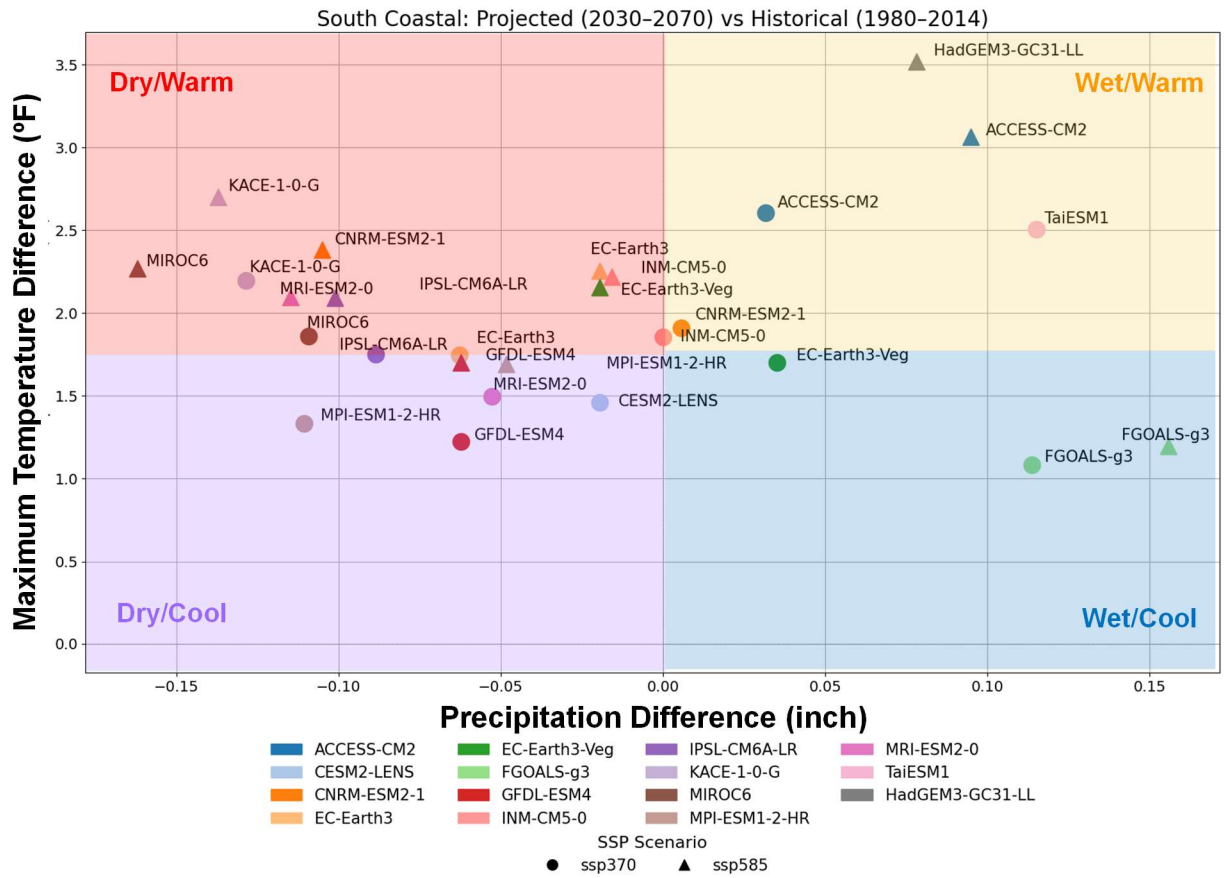


**Figure 5-2: Climate Forecasts**

Climate data is applied to the baseline weather patterns in a two-step process:

1) Download the CMIP6 datasets for each of the four Flume quadrants using Python scripts, then calculate the difference in the modeled future and modeled historical (delta, Δ) for temperature and precipitation (**Equations 5-1** and **5-2**):

$$\Delta Temp = Modeled\ Future\ Temp - Modeled\ Historical\ Temp \qquad \textbf{Equation 5-1}$$

$$\Delta Precip = \frac{Modeled\ Future\ Precip}{Modeled\ Historical\ Precip} \qquad \textbf{Equation 5-2}$$

The historical records produced for each model span 1950 to 2014, and the modeled historical data in the equations consist of the average weather parameter for each month over that period. Modeled futures extend from 2015 to 2100.

**2)** Apply the changes, or deltas, to the historical normal weather values. The historical normal has the same value each month, but applying a different delta value each month allows the climate change impacts to differ in the future. Each agency was matched to the Flume-specific quadrant and the appropriate regional delta values.

Future climate projections based on many CMIP6 models indicate a general increase in water demands over the forecast period (**Figure 5-3**). Note that the models shown are applied to a total baseline demand scenario prior to member agency review and final numbers were published.

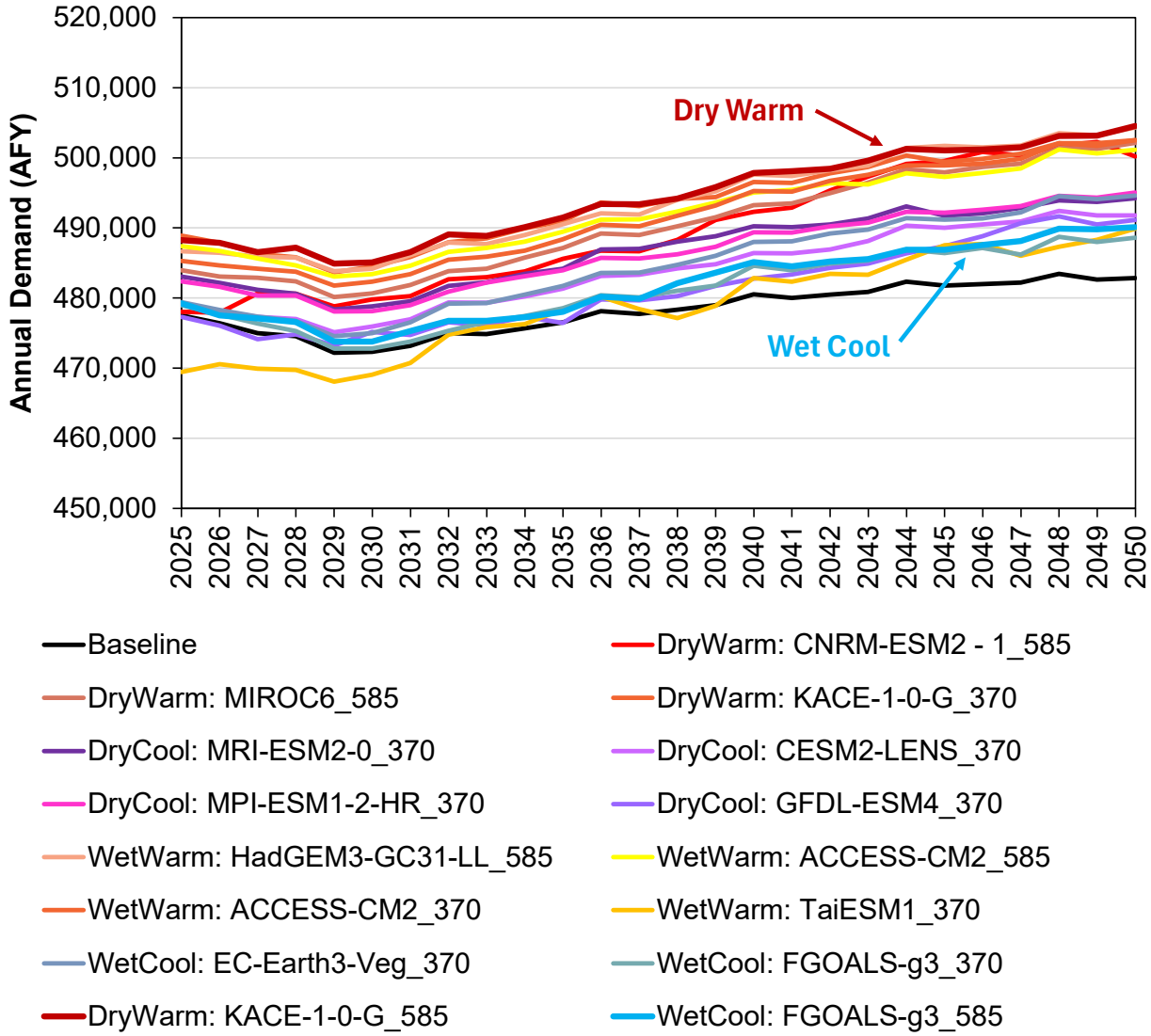


**Figure 5-3: CMIP6 Climate Change Futures**

CMIP6 data from the 15 model runs that were determined to be a good fit for California were substituted for baseline weather conditions in the demand model, and the resulting total Orange County demand was used to define a dry warm (high demand) scenario and a wet cool (lower demand) scenario to provide a range of possible climate impacted outcomes. Both scenarios predict increasing temperatures, and as a result, water demands that are higher than baseline demands.

### 5.1.2 Alternative Forecasts

The dry warm, and wet cool CMIP6 scenarios are depicted relative to historical Orange County demands in **Figure 5-4**.

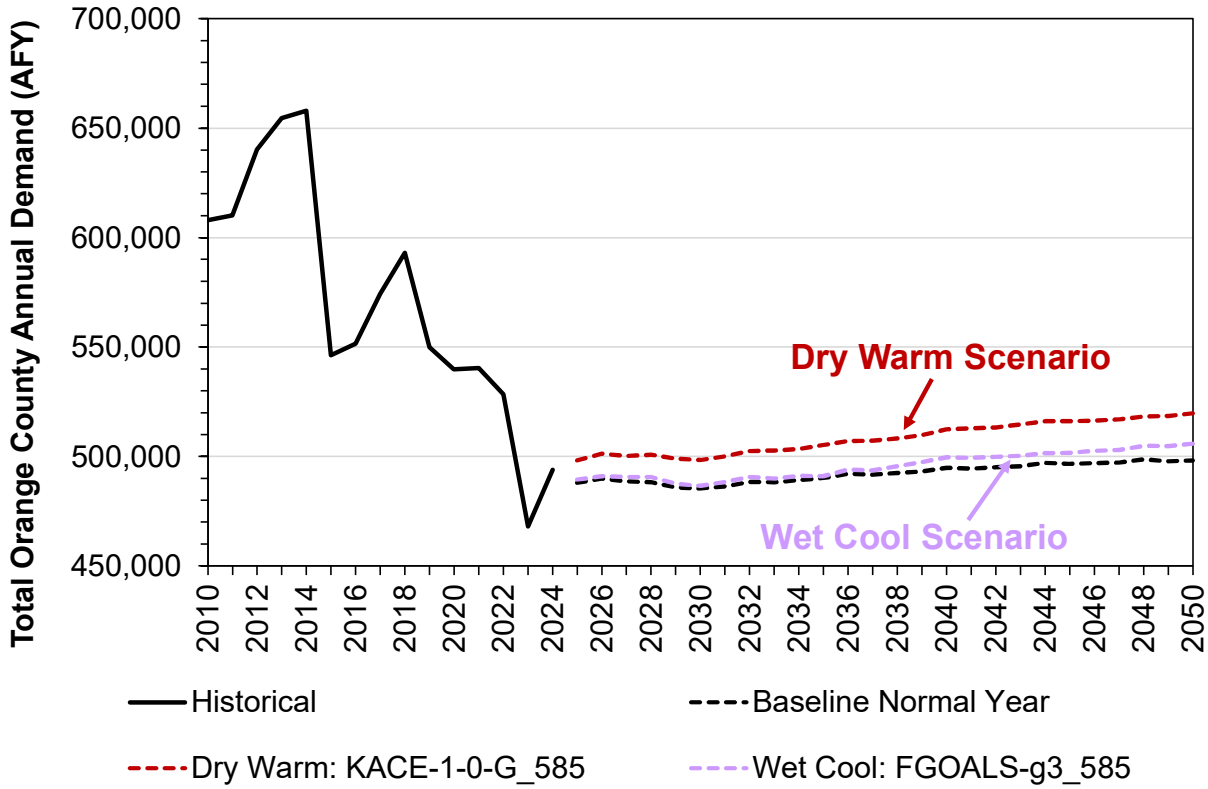


**Figure 5-4: Future CMIP6 Scenarios**

To create a possible envelope of demands with only two additional (non-baseline) forecasts, a long-term price increase (in addition to inflation) was imposed on the wet-cool simulation to illustrate additional price pressure (i.e., further decrease in demands). The price increase was assumed to be 3% per year for the entire forecast period. **Figure 5-5** shows that the general increases in demand are suppressed when price increases are included in the forecast.

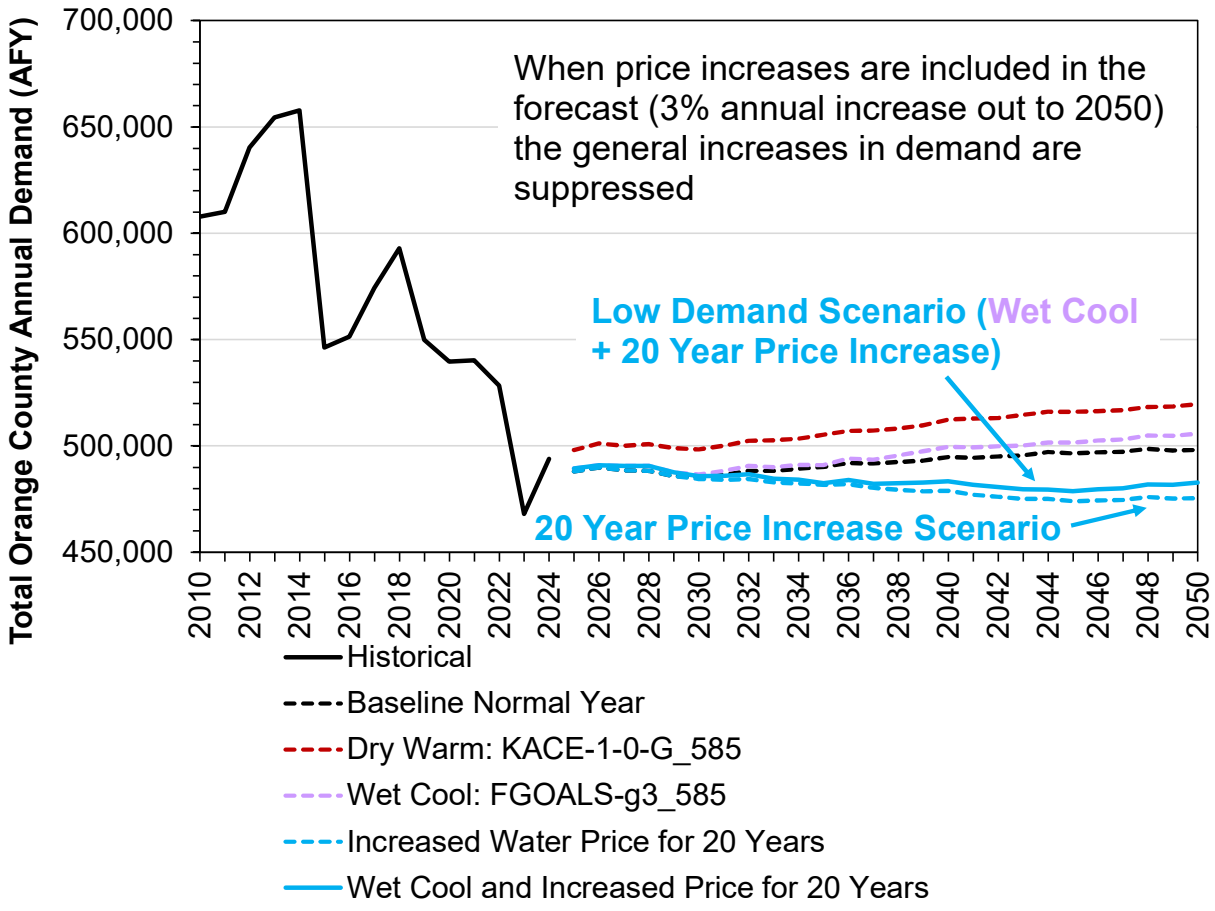


**Figure 5-5: Alternative Demand Scenarios**

The dry warm scenario with baseline water prices and the wet cool scenario with additional price increases constitute the two alternative forecasts.

# 6. UWMP Scenarios

The 2025 Urban Water Management Plan requires tabulation of the long-term projected water use over the next 20 years, in 5-year increments, for three types of hydrology:

- Normal Year: The demand a Supplier believes will occur during normal conditions. It could be a single year or an average range of years that most closely represent the average water demand. This is provided by the Baseline Forecast in Section 5.
- Single Dry Year: A year that represents higher water demand on the Supplier. Provided by finding the historical year most sensitive to all weather parameters (2010 – present)
- Five Consecutive Year Drought: The demand during the driest five-year historical sequence for the Supplier. Provided through a separate regression on total Orange County demand and historical weather (2004 – present)

### 6.1.1 Single Dry Year Scenario

The single dry year is the historical year in which weather factors have the largest combined impact as measured by a hot-dry index (HDI). The HDI was developed in four steps:

1) Calculate the HDI for each month in the historical weather series. This monthly hot-dry index (MHDI) is calculated for each member agency (a) and monthly observation (m) as the sum of the estimated weather effects for each sector model (j). The weather effects for each sectoral model are derived from the historical weather values (W) and weather model parameters (β) assigned to the weather variables in each model (i), which vary by member agency (**Equation 6-1**).

$$MHDI_{a,m,j} = exp\left(\sum_i \beta_{a,i,j} W_{a,i,m,j}\right)$$ **Equation 6-1**

2) Calculate the HDI for each calendar year in the historical weather series. The monthly index values are summed across the month of any given annual period to derive a set of annual index values (AHDI) for each member agency and sector (**Equation 6-2**).

$$AHDI_{a,j} = \sum_{m=1}^{12} MHDI_{a,m,j}$$ **Equation 6-2**

3) Weight the annual sector indices by the proportion of total annual water sales attributed to each sector (w) to define the final hot-dry index (HDI) values used to evaluate and select the hot-dry periods for scenario development (**Equation 6-3**). The weights are based on the estimated proportion of sales by sector for as many full annual records were available for each agency from 2010 to 2024.

$$HDI_a = \sum_{j=1}^{4} w_j \times AHDI_{a,j}$$ **Equation 6-3**

4) Determine the maximum value of HDI for each member agency across all years in the historical weather series. Retain weather data for the selected calendar year for each member agency.

**Table 6-1** lists the calendar years containing the maximum of HDI by member agency. As shown, calendar year 2014 was selected more often than any other year in the historical weather series as the hot-dry year, and the weather data for 2014 were selected for all agencies to represent the hot-dry scenario.

**Table 6-1: Selected Calendar Years for Hot/Dry Weather Scenario**

| Agency | Single Year Hot/Dry Periods | |
|---|---|---|
| | Calendar Year | HDI Value |
| Anaheim | 2014 | 12.40 |
| Brea | 2018 | 12.26 |
| Buena Park | 2014 | 12.16 |
| East Orange CWD | 2014 | 13.14 |
| El Toro WD | 2014 | 12.72 |
| Fountain Valley | 2014 | 12.26 |
| Fullerton | 2014 | 12.65 |
| Garden Grove | 2014 | 12.28 |
| GSWC Cowan | 2014 | 13.27 |
| GSWC Placentia | 2014 | 12.61 |
| GSWC West Orange | 2014 | 12.42 |
| Huntington Beach | 2014 | 12.62 |
| Irvine Ranch WD | 2014 | 12.46 |
| La Habra | 2014 | 12.84 |
| La Palma | No data available | |
| Laguna Beach WD | 2014 | 12.62 |
| Mesa WD | 2014 | 12.61 |
| Moulton Niguel | 2014 | 13.35 |
| Newport Beach | 2014 | 12.52 |
| Orange City | 2014 | 12.70 |
| San Clemente | 2014 | 12.54 |
| San Juan Capistrano | 2014 | 12.38 |
| Santa Ana | 2014 | 12.32 |
| Santa Margarita WD | 2014 | 12.76 |
| Seal Beach | 2022 | 12.08 |
| Serrano WD | 2014 | 13.85 |
| South Coast WD | 2014 | 12.56 |
| Trabuco Canyon WD | 2017 | 11.82 |
| Tustin | 2014 | 12.53 |
| Westminster | 2014 | 12.43 |
| Yorba Linda WD | 2014 | 12.89 |

### 6.1.2 Multiple Dry Year Scenario

Trends in historical regional water use (supplied from all sources) were correlated with trends in observed weather conditions to develop a set of factors to describe the potential impact of consecutive dry years. The weather coefficients of the sectoral water demand equations can be used to generate weather scenarios for any given set of monthly weather data, for example, for a given hot/dry year. However, conceptually, the persistence of drier-than-normal weather could intensify water use rates in the absence of interventions, such as water-use restrictions. Because the sectoral forecasting equations, by construction, treat time periods independently, other statistical methods were derived to evaluate potential or "latent", or unconstrained, demands that could develop with the persistence of dry weather conditions.

Trends in historical total regional water use (supplied from all sources) were correlated with trends in observed Orange County weather conditions to develop a set of factors to describe the potential impact of consecutive dry years. Specifically, the running 12-month average of regional water use (USE12) was modeled as a function of the following variables:

- 12-month running average of the ratio of observed to normal average maximum daily temperature (MAXT12)
- 24-month running average of the ratio of observed to normal precipitation (PRCP24)
- 36-month running average of the ratio of observed to normal precipitation (PCRP36)
- 48-month running average of the ratio of observed to normal precipitation (PCRP48)
- 60-month running average of the ratio of observed to normal precipitation (PCRP60)
- Departure from long-term GDP trend
- Linear time trend counter (TREND)

Except for the linear time counter, all variables were transformed into natural log form prior to estimating the model using ordinary least squares regression. A binary water restriction variable was added to the regression to eliminate supply constraints (allow the regression to assume no curtailments instated during the hot dry spell). The estimated weather parameters (**Table 6-2**) are used to estimate the potential change in water use that would occur during the driest 24-month, 36-month, 48-month, and 60-month period over the historical record, assuming the warmest 12-month period estimated over the historical record.

**Table 6-2: Regression Coefficients and Variable Values**

| | Coefficient | Historical Value |
|---|---|---|
| MAXT12 | 0.6279 | 1.0522 |
| PRCP24 | -0.0832 | 0.3783 |
| PRCP36 | -0.0076 | 0.4408 |
| PRCP48 | -0.0269 | 0.4977 |
| PRCP60 | -0.0296 | 0.5656 |

Consecutive dry-year scaling factors are derived using the historical minimums of the precipitation and historical maximum of the temperature variable from the historical weather data set.

**Equation 6-4** shows the 2nd consecutive dry year scaling factor.

$$Factor = MAXT12^{0.6279} \times PRCP24^{-0.0832} = 1.1195$$ **Equation 6-4**

**Equation 6-5** shows the 3rd consecutive dry year scaling factor.

$$Factor = MAXT12^{0.6279} \times PRCP24^{-0.0832} \times PRCP36^{-0.0076} = 1.1265$$ **Equation 6-5**

**Equation 6-6** shows the 4th consecutive dry year scaling factor.

$$Factor = MAXT12^{0.6279} \times PRCP24^{-0.0832} \times PRCP36^{-0.0076} \times PRCP48^{-0.0269} = 1.1478$$ **Equation 6-6**

**Equation 6-7** shows the 5th consecutive dry year scaling factor.

$$Factor = MAXT12^{0.6279} \times PRCP24^{-0.0832} \times PRCP36^{-0.0076} \times PRCP48^{-0.0269} \times PRCP60^{-0.0296} = 1.1673$$ **Equation 6-7**

These scaling factors are used to supplement the results of the single hot/dry year scenario. There is a 5-year sequence for any year in the forecast: single hot/dry year, followed by the second dry year, followed by the third consecutive dry year, and so on. Under these assumptions, the second consecutive dry year would result in water use that is about 12 percent higher than under normal precipitation conditions. The estimate of water use for the third consecutive dry year would be incrementally higher, or about 13 percent greater than normal. By the end of the fifth consecutive dry year, the estimated potential would grow to about 17 percent higher than the normal year baseline. The consecutive dry year scenarios are calculated based on the total baseline forecast and thus implicitly account for differences in growth occurring among Orange County's water use sectors and agencies. As indicated by the magnitudes of the scaling factors described above, this implies increasingly higher demands as conditions become drier. It is possible that demands would be restricted through demand management actions prior to reaching these levels if such conditions were to occur.

### 6.1.3 All UWMP Scenarios

All UWMP scenarios are shown in **Figure 6-1**, along with the baseline, high demand, and low demand scenarios discussed in the previous sections.

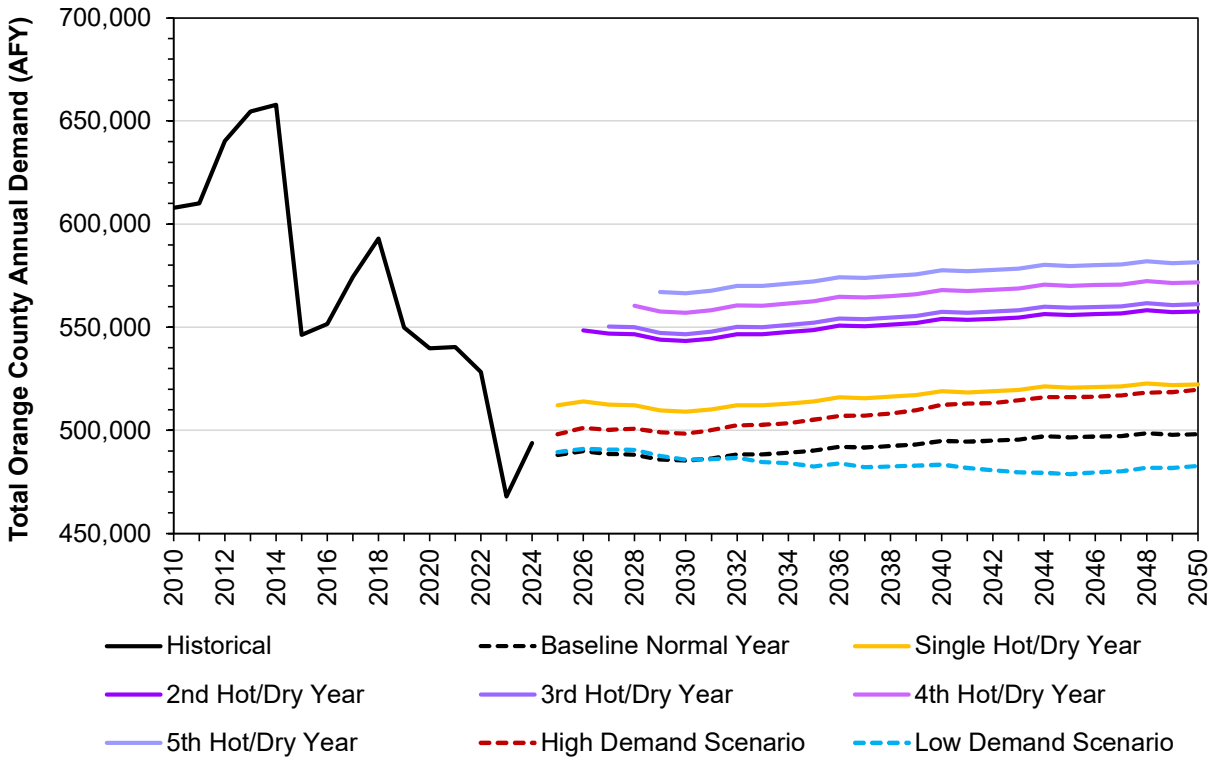


**Figure 6-1: Total Orange County Historical Water Use vs Projected Water Demands for All UWMP Scenarios**

The UWMP scenarios are tabulated for each agency in the Spreadsheet model.

Although Orange County demands are forecast to be relatively flat into the future, annual variations in weather could cause high fluctuations.

# 7. Urban Water Use Objectives (UWUO) Metrics

The Urban Water Use Objective (UWUO) requires residential indoor consumption to decrease from 47 GPCD in 2025 to 42 GPCD in 2030 and remain at 42 GPCD through 2050. Although **future active conservation is not included in the baseline forecast,** the UWUO target residential demand is calculated for each agency in this section, and active conservation may be assumed from these target values and subtracted from the baseline forecast.

While the indoor conservation target specified by the UWUO is fixed, the outdoor target depends on precipitation, evapotranspiration, landscape area, and a landscape efficiency factor (**Equation 7-1**).

$$Outdoor\ Budget\ \left(\frac{gal}{year}\right) = (ETo - Peff) \times Landcape\ Area\ \times LEF\ \times 0.62 \qquad \textbf{Equation 7-1}$$

ETo is local reference evapotranspiration, Peff is effective rainfall, and 0.62 represents a conversion factor from inches to square feet. The landscape efficiency factor (LEF) provides a way to reduce irrigation targets; water use increases as the LEF increases. The California State Water Board requires a LEF of 80% through September 2030, at which point the required LEF decreases to 63%. In October 2035, the LEF decreases to 55% for residential irrigation and 45% for CII irrigation. **When/If an agency can comply with the State UWUO outdoor conservation targets is a retail agency determination based on each agency's unique circumstances.**

Although the forecasts provided by Hazen do not include active conservation, each retail agency may compare the forecasted gallons per capita per day (GPCD) with their UWUO target to build or forecast an active conservation program.

# 8. Summary and Conclusions

The water demand forecasts presented in this technical memorandum provide a foundation for long-term planning across Orange County retail water agencies and aligns with needs for the 2025 Urban Water Management Plan. The model approach, which combined rigorous data collection and assessment and econometric model development, ensures that projections are grounded in historical trends and agency-approved demographic inputs.

Work with individual agencies to calibrate the forecasts revealed that the demand forecasts are highly sensitive to demographic projections. Future water use is driven primarily by changes in population, housing units, and jobs, all of which are subject to uncertainty and local planning decisions. The baseline scenario reflects CDR-OCP2022 growth rates and member agency feedback, and alternative demographic trajectories may be considered by individual agencies. Agencies may also use their calculated UWUO targets to incorporate active conservation plans, which are not included in the forecasts.

APPENDIX I

# NOTIFICATION OF PUBLIC AND SERVICE AREA PROVIDERS

**CITY OF FULLERTON**
**Public Works Department** – *Water Operations Division*

02/09/2026

Rudy Emami
City of Anaheim
200 S Anaheim Boulevard, Suite 276
Anaheim CA, 92805

**Subject: City Of Fullerton 2025 Urban Water Management Plan Update**

Dear Rudy Emami:

The City of Fullerton (City) is in the process of preparing and updating its 2025 Urban Water Management Plan (UWMP) in compliance with the Urban Water Management Planning Act. An update of the City's UWMP is required every five 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 notification the City is preparing and updating its 2025 UWMP, to be adopted and submitted to the California Department of Water Resources (DWR) before the July 1, 2026 deadline. The City will be re-adopting its 2025 Water Shortage Contingency Plan (WSCP), as required by DWR, as part of the 2025 UWMP.

A copy of the City's draft 2025 UWMP will be available for review on the City's website https://www.cityoffullerton.com/government/departments/public-works/water-system in Spring of 2026, and the City will subsequently hold noticed public hearings on the 2025 UWMP and 2025 WSCP.

The City invites you to submit comments regarding its 2025 UWMP and 2025 WSCP. The City anticipates holding a public comment period in late Spring 2026, with a public hearing planned during that time.

If you have any questions, please contact me at 714.738.6895 or by email at, gar.huang@cityoffullerton.com.

Sincerely,
Gar Huang
Associate Engineer

**CITY OF FULLERTON**
**Public Works Department** – *Water Operations Division*

02/09/2026

Chris Tanio
City of Placentia
401 E Chapman Avenue
Placentia, CA 92870

**Subject: City Of Fullerton 2025 Urban Water Management Plan Update**

Dear Chris Tanio:

The City of Fullerton (City) is in the process of preparing and updating its 2025 Urban Water Management Plan (UWMP) in compliance with the Urban Water Management Planning Act. An update of the City's UWMP is required every five 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 notification the City is preparing and updating its 2025 UWMP, to be adopted and submitted to the California Department of Water Resources (DWR) before the July 1, 2026 deadline. The City will be re-adopting its 2025 Water Shortage Contingency Plan (WSCP), as required by DWR, as part of the 2025 UWMP.

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Sincerely,
Gar Huang
Associate Engineer

**CITY OF FULLERTON**
**Public Works Department** – *Water Operations Division*

02/09/2026

Mr. Craig Gott, President
Suburban Water Systems
15088 Rosecrans Avenue
La Mirada, CA 90638

**Subject: City Of Fullerton 2025 Urban Water Management Plan Update**

Dear Mr. Gott:

The City of Fullerton (City) is in the process of preparing and updating its 2025 Urban Water Management Plan (UWMP) in compliance with the Urban Water Management Planning Act. An update of the City's UWMP is required every five 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 notification the City is preparing and updating its 2025 UWMP, to be adopted and submitted to the California Department of Water Resources (DWR) before the July 1, 2026 deadline. The City will be re-adopting its 2025 Water Shortage Contingency Plan (WSCP), as required by DWR, as part of the 2025 UWMP.

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Sincerely,
Gar Huang
Associate Engineer

**CITY OF FULLERTON**
**Public Works Department** – *Water Operations Division*

02/09/2026

John Kennedy
Orange County Water District
18700 Ward Street
Fountain Valley, CA 92708

**Subject: City Of Fullerton 2025 Urban Water Management Plan Update**

Dear John Kennedy:

The City of Fullerton (City) is in the process of preparing and updating its 2025 Urban Water Management Plan (UWMP) in compliance with the Urban Water Management Planning Act. An update of the City's UWMP is required every five 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 notification the City is preparing and updating its 2025 UWMP, to be adopted and submitted to the California Department of Water Resources (DWR) before the July 1, 2026 deadline. The City will be re-adopting its 2025 Water Shortage Contingency Plan (WSCP), as required by DWR, as part of the 2025 UWMP.

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Sincerely,
Gar Huang
Associate Engineer

**CITY OF FULLERTON**
**Public Works Department** – *Water Operations Division*

02/09/2026

Harvey De La Torre
Municipal Water District of Orange County
18700 Ward Street, Unit B
Fountain Valley, CA 92708

**Subject: City Of Fullerton 2025 Urban Water Management Plan Update**

Dear Harvey De La Torre:

The City of Fullerton (City) is in the process of preparing and updating its 2025 Urban Water Management Plan (UWMP) in compliance with the Urban Water Management Planning Act. An update of the City's UWMP is required every five 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 notification the City is preparing and updating its 2025 UWMP, to be adopted and submitted to the California Department of Water Resources (DWR) before the July 1, 2026 deadline. The City will be re-adopting its 2025 Water Shortage Contingency Plan (WSCP), as required by DWR, as part of the 2025 UWMP.

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If you have any questions, please contact me at 714.738.6895 or by email at, gar.huang@cityoffullerton.com.

Sincerely,
Gar Huang
Associate Engineer

**CITY OF FULLERTON**
**Public Works Department** – *Water Operations Division*

02/09/2026

Brad Coffey; Manager, Water Resources Management Group
Metropolitan Water District
PO Box 54153
Los Angeles, CA 90054-0153

**Subject: City Of Fullerton 2025 Urban Water Management Plan Update**

Dear Mr. Coffey:

The City of Fullerton (City) is in the process of preparing and updating its 2025 Urban Water Management Plan (UWMP) in compliance with the Urban Water Management Planning Act. An update of the City's UWMP is required every five 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 notification the City is preparing and updating its 2025 UWMP, to be adopted and submitted to the California Department of Water Resources (DWR) before the July 1, 2026 deadline. The City will be re-adopting its 2025 Water Shortage Contingency Plan (WSCP), as required by DWR, as part of the 2025 UWMP.

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Sincerely,
Gar Huang
Associate Engineer

**CITY OF FULLERTON**
**Public Works Department** – *Water Operations Division*

02/09/2026

Mr. Jeff Boynton, City Manager
City of La Mirada
13700 La Mirada Boulevard
La Mirada, CA 90638

**Subject: City Of Fullerton 2025 Urban Water Management Plan Update**

Dear MR. Boynton:

The City of Fullerton (City) is in the process of preparing and updating its 2025 Urban Water Management Plan (UWMP) in compliance with the Urban Water Management Planning Act. An update of the City's UWMP is required every five 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 notification the City is preparing and updating its 2025 UWMP, to be adopted and submitted to the California Department of Water Resources (DWR) before the July 1, 2026 deadline. The City will be re-adopting its 2025 Water Shortage Contingency Plan (WSCP), as required by DWR, as part of the 2025 UWMP.

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Sincerely,
Gar Huang
Associate Engineer

**CITY OF FULLERTON**
**Public Works Department** – *Water Operations Division*

02/09/2026

Elias Saykali
City of La Habra
621 West Lambert Road
La Habra, CA 90631

**Subject: City Of Fullerton 2025 Urban Water Management Plan Update**

Dear Elias Saykali:

The City of Fullerton (City) is in the process of preparing and updating its 2025 Urban Water Management Plan (UWMP) in compliance with the Urban Water Management Planning Act. An update of the City's UWMP is required every five 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 notification the City is preparing and updating its 2025 UWMP, to be adopted and submitted to the California Department of Water Resources (DWR) before the July 1, 2026 deadline. The City will be re-adopting its 2025 Water Shortage Contingency Plan (WSCP), as required by DWR, as part of the 2025 UWMP.

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If you have any questions, please contact me at 714.738.6895 or by email at, gar.huang@cityoffullerton.com.

Sincerely,
Gar Huang
Associate Engineer

**CITY OF FULLERTON**
**Public Works Department** – *Water Operations Division*

02/09/2026

Mr. Ken Vecchiarelli, General Manager
Golden State Water Company
2281 E Via Burton St.
Anaheim, CA 92806

**Subject: City Of Fullerton 2025 Urban Water Management Plan Update**

Dear Mr. Vecchiarelli:

The City of Fullerton (City) is in the process of preparing and updating its 2025 Urban Water Management Plan (UWMP) in compliance with the Urban Water Management Planning Act. An update of the City's UWMP is required every five 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 notification the City is preparing and updating its 2025 UWMP, to be adopted and submitted to the California Department of Water Resources (DWR) before the July 1, 2026 deadline. The City will be re-adopting its 2025 Water Shortage Contingency Plan (WSCP), as required by DWR, as part of the 2025 UWMP.

A copy of the City's draft 2025 UWMP will be available for review on the City's website https://www.cityoffullerton.com/government/departments/public-works/water-system in Spring of 2026, and the City will subsequently hold noticed public hearings on the 2025 UWMP and 2025 WSCP.

The City invites you to submit comments regarding its 2025 UWMP and 2025 WSCP. The City anticipates holding a public comment period in late Spring 2026, with a public hearing planned during that time.

If you have any questions, please contact me at 714.738.6895 or by email at, gar.huang@cityoffullerton.com.

Sincerely,
Gar Huang
Associate Engineer

**CITY OF FULLERTON**
**Public Works Department** – *Water Operations Division*

02/26/2026

Mr. Hugh Nguyen, Clerk Recorder
County of Orange
12 Civic Center Plaza, Room 101
Santa Ana, CA 92701

**Subject: City Of Fullerton 2025 Urban Water Management Plan Update**

Dear Mr. Nguyen:

The City of Fullerton (City) is in the process of preparing and updating its 2025 Urban Water Management Plan (UWMP) in compliance with the Urban Water Management Planning Act. An update of the City's UWMP is required every five years.

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Sincerely,
Gar Huang
Associate Engineer

**CITY OF FULLERTON**
**Public Works Department** – *Water Operations Division*

02/09/2026

Mina Mikhael
City of Buena Park
6650 Beach Blvd, P.O. Box 5009
Buena Park CA, 90622-5009

**Subject: City Of Fullerton 2025 Urban Water Management Plan Update**

Dear Mina Mikheal:

The City of Fullerton (City) is in the process of preparing and updating its 2025 Urban Water Management Plan (UWMP) in compliance with the Urban Water Management Planning Act. An update of the City's UWMP is required every five years.

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If you have any questions, please contact me at 714.738.6895 or by email at, gar.huang@cityoffullerton.com.

Sincerely,
Gar Huang
Associate Engineer

**CITY OF FULLERTON**
**Public Works Department** – *Water Operations Division*

02/09/2026

Michael Ho
City of Brea
545 Berry St.
Brea CA, 92821

**Subject: City Of Fullerton 2025 Urban Water Management Plan Update**

Dear Michael Ho:

The City of Fullerton (City) is in the process of preparing and updating its 2025 Urban Water Management Plan (UWMP) in compliance with the Urban Water Management Planning Act. An update of the City's UWMP is required every five years.

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Sincerely,
Gar Huang
Associate Engineer

APPENDIX J

# ADOPTED UWMP RESOLUTIONS