



Indirect Potable Reuse in Orange County California

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Orange County Water District Background Information



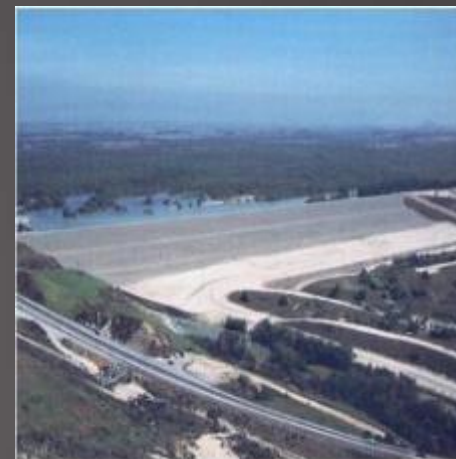
OCWD GENERAL INFORMATION

- **OCWD governed by a 10 person Board of Directors**
- **7 members directly elected by the public**
- **3 members appointed (Santa Ana, Anaheim & Fullerton)**
- **Non-adjudicated groundwater basin**
- **Each year the Board sets the percentage of groundwater that can be pumped (BPP)**
- **Each year the Board Replenishment Assessment (RA) and Basin Equity Assessment (BEA) for the cost of pumping groundwater**

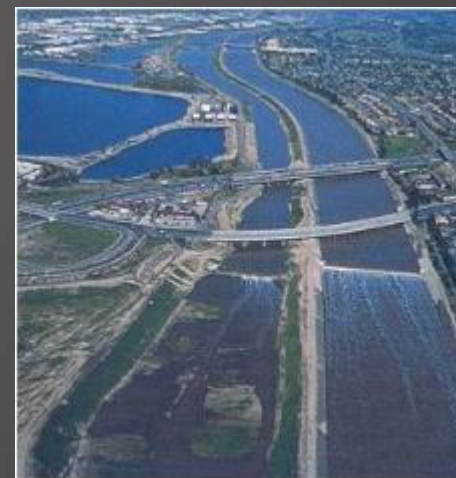


OCWD Facilities — Managing Water Reliability

- **Santa Ana River (SAR) facilities in Anaheim and Orange capture water for groundwater recharge. Area includes 24 recharge facilities on more than 1,500 acres. OCWD maintains water rights to the SAR downstream of Prado Dam.**



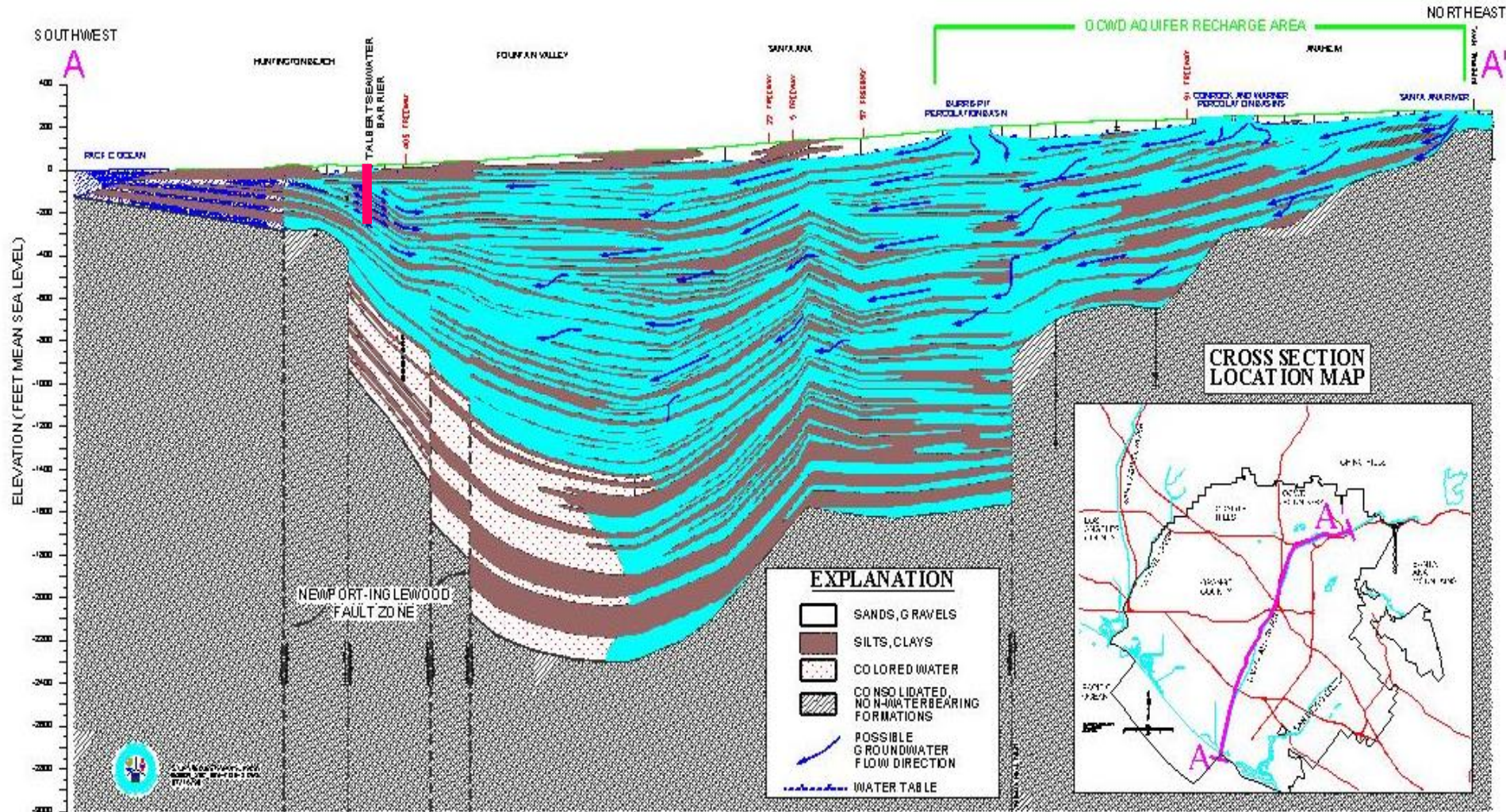
- **Prado Dam is a flood control structure. OCWD operates constructed wetlands to remove nitrogen from a portion of flows feeding Prado Dam. It also stores water behind the dam to increase water storage.**



- **OCWD's Advanced Water Quality Assurance Laboratory helps ensure high water quality. It performs more than 400,000 analysis on 20,000 samples annually.**



SECTION OF THE GROUNDWATER BASIN





SOUTHERN CALIFORNIA IS AN ARID DESERT

- Majority of population in Southern California, but majority of rainfall is in Northern California
- 330 mm average rainfall in Southern California
- Rainfall in Southern California in 2013 was 91 mm
- 2013 driest year on record
- Rainfall in Southern California in 2015-2016 rain season was only 245 mm in what was projected to be a wetter than normal year





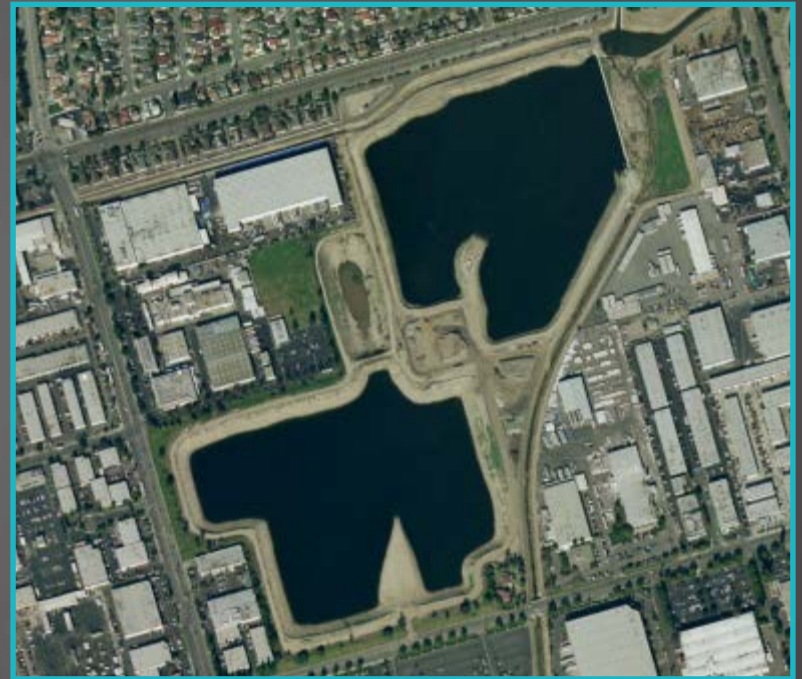
ORANGE COUNTY WATER PICTURE

Orange County Has Two Major Water Sources

(3.1 million people in Orange County of which 2.4 million in OCWD service area)



South Orange County: State Water Project & Colorado River Metropolitan Water District
\$0.81 (US Dollars)/m³
\$1000/AF



North & Central Orange County: Groundwater Orange County Water District
\$0.33 (US Dollars)/m³
\$402/AF



SOURCES OF RECHARGE WATER

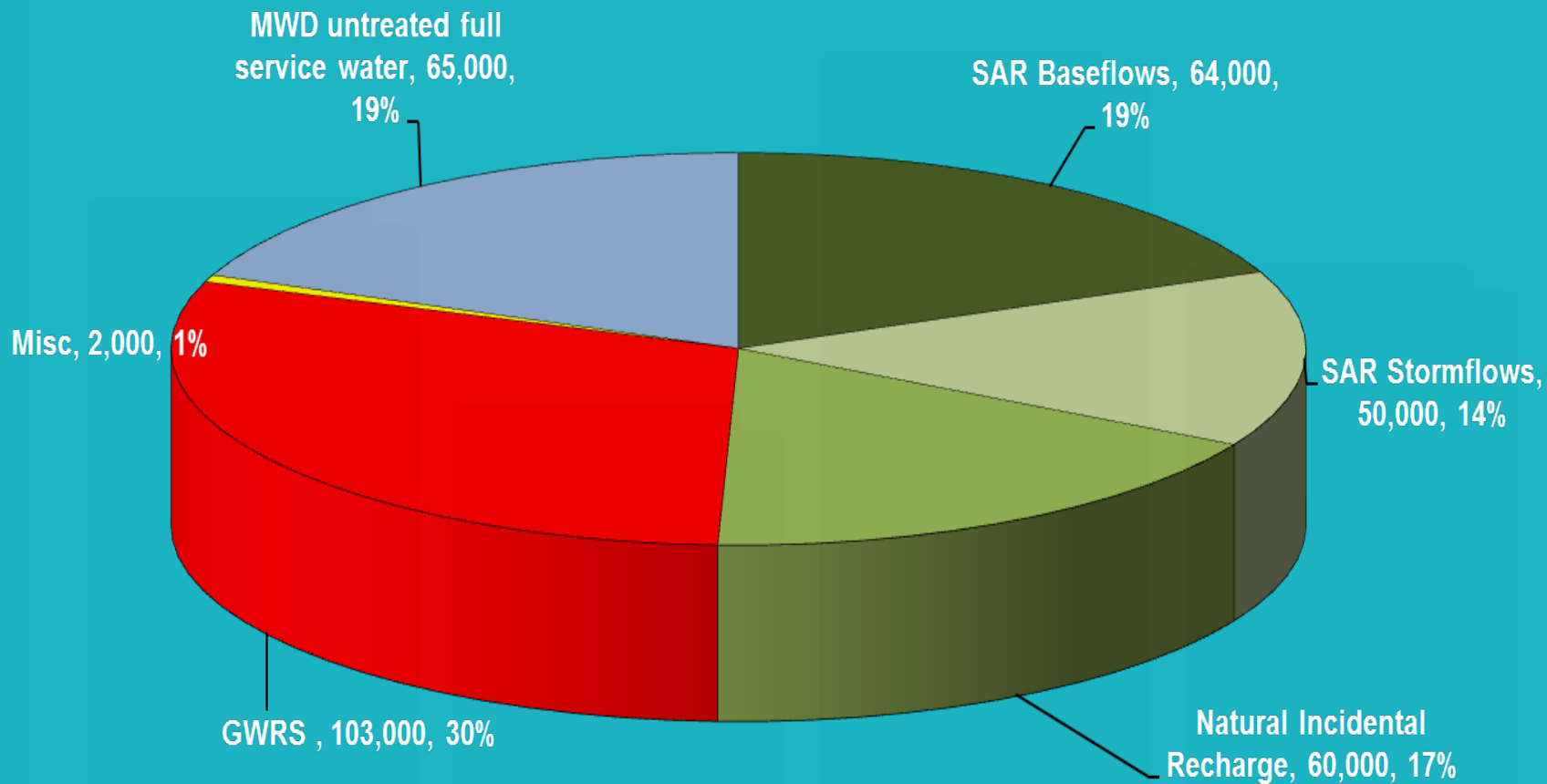
- Santa Ana River - primary recharge source, natural historical source for OC basin (river contains tertiary effluent treated wastewater)
- Colorado River and State Water Project (imported water)
- Local rainwater, urban runoff
- RO advanced treated recycled water





Typical Water Supplies Annually Recharged into the OCWD Groundwater Basin

Total of 344,000 acre feet/year (125 hm³/year)





HISTORY OF REUSE AT OCWD



- **Water Factory 21 - 1976 to 2003**
 - Lime, Recarbonation, Sand Filtration, GAC - 19,000 m³/d, RO - 19,000 m³/d, Deep wells - 19,000 m³/d
 - Research on RO and pretreatment options
 - First plant in the world to use RO to purify wastewater to drinking water standards
 - UV/H₂O₂ added in 2001 for NDMA, 1,4-dioxane

- **Green Acres - 1991 to present**
 - Tertiary treatment – 28,400 m³/d
- **Interim Water Factory - 2003 to 2006**
 - MF/RO/UV – 19,000 m³/d
- **GWRS – 2008 to present**
 - MF/RO/UV – 265,000 m³/d
(378,500 m³/d as of June 2015)





The Partnership Created to Develop the Groundwater Replenishment System



THE GROUNDWATER REPLENISHMENT SYSTEM (GWRS)

- A 378,500 m³ per day advanced water purification facility
- Takes treated wastewater that otherwise would be discharged to the ocean, purifies it to near distilled quality and then recharges it into the groundwater basin
- Provides a new 130 hm³ per year source of water, which is enough water for nearly 850,000 people
- Operational since January 2008 (265,000 m³ per day), expanded May 2015 (378,500 m³ per day)
- Largest planned indirect potable reuse project in the world
- A final expansion to 492,000 m³ per day planned for completion by 2023





Two Public Agencies Partnered to Create the GWRS



- **Orange County Water District**
Provides local water retailers with a reliable, adequate, high-quality groundwater supply at the lowest reasonable cost in an environmentally responsible manner



- **Orange County Sanitation District**
Protects public health and the environment by providing effective wastewater collection, treatment, and recycling

Both agencies are special districts of the State of California and have the same service area.



Why did we partner? Planning in the 1990s



OCSD – Defer the need for a new ocean outfall

OCWD – Need more water

- Larger seawater intrusion barrier/Replace WF-21
- New sources of water to replenish groundwater
- 5 year drought 1987–92
- Steady population increases
- Imported water supply challenges
- Improve groundwater quality



LONG HISTORY OF PARTNERSHIP

- **Orange County Water District (OCWD) & Orange County Sanitation District (OCSD)**
- **Both serve the same 2.4 million residents plus businesses and industries in northern and central Orange County**
- **Came together on Water Factory 21 in 1975**
- **OCSD contributed half the capital cost to the Groundwater Replenishment System (GWRS) to avoid building an additional ocean outfall**
- **Finished as a dedicated team on the GWRS**



Why the Partnership Works

- OCSD needs disposal options beyond ocean disposal
- OCWD needs alternative sources for groundwater supply
- OCSD saves pumping costs by sending flows to GWRS
- OCSD and OCWD are both financially invested in the project, which insures ongoing cooperation
- OCSD enhanced source control effort provides additional protection to the GWRS
- The GWRS project ultimately benefits the same people in the same service area



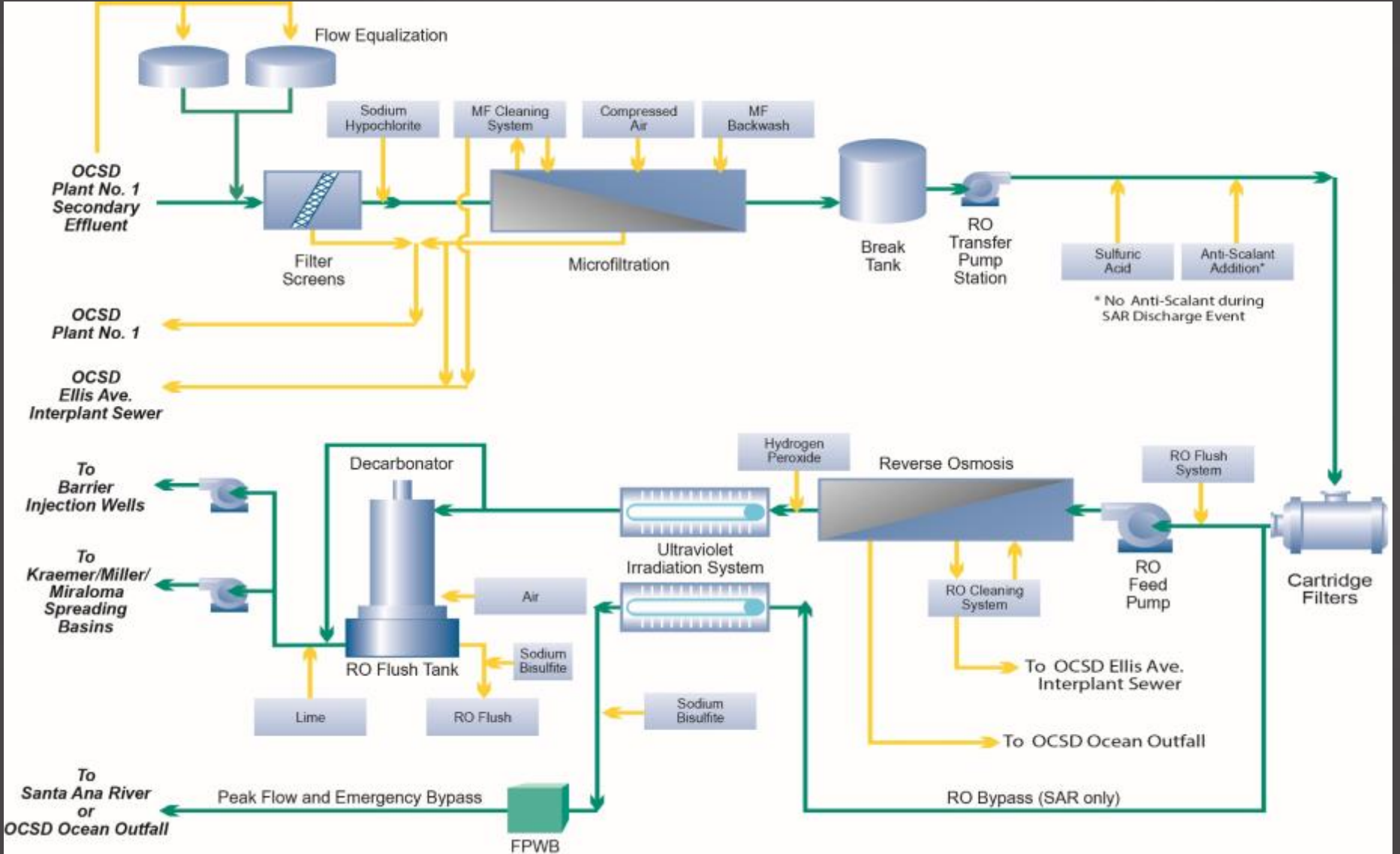


The Groundwater Replenishment System Treatment Process and Project Costs





GWRS ADVANCED PROCESS





MICROFILTRATION (MF) PROCESS



- 545,100 m³/d Evoqua CS Microfiltration System
- In basin submersible system
- Hollow fiber polypropylene membrane
- 0.2 micron pore size
- Recovery rate: 90%
- Removes bacteria, protozoa, and suspended solids



REVERSE OSMOSIS (RO) PROCESS



- 378,500 m³/d Reverse Osmosis System
- 3 stage: 78-48-24 array per unit
- Twenty one, 19,000 m³/d units
- Hydranautics ESPA-2 & ESPA2LD, Dow XFRLE, CSM FLR Membranes
- Recovery rate: 85%
- Used to met TOC limit of 0.5 mg/L and Total N of 5 mg/L
- Pressure range: 10 – 14 bar



ADVANCED OXIDATION PROCESS (AOP)



- 378,500 m³/d Trojan UVPhox System
- Low Pressure – High Output lamp system
- Destroys trace organics
- System designed around NDMA and 1,4 dioxane removal
- Uses 3 mg/L Hydrogen Peroxide to create an Advanced Oxidation Process
- After treatment, water is so pure (and aggressive) that minerals (lime) are added back into the water



Regulatory Oversight

- OCWD worked closely with regulators over several years prior to finalization of groundwater recharge regulations
- OCWD collaborative relationship with regulatory agencies key to successful permitting of original GWRS project
- Regional Water Quality Control Board issues permits for recycling
- State Division of Drinking Water (DDW) regulates drinking water and establishes recycling criteria
- DDW regulations manage microbial and chemical risk, acute & chronic via:
 - Treatment requirements
 - TOC limits
 - Retention time
 - Blending requirements
 - Monitoring requirements
- DDW findings & recommendations incorporated into Regional Board permit
- No direct federal EPA role regulating reuse



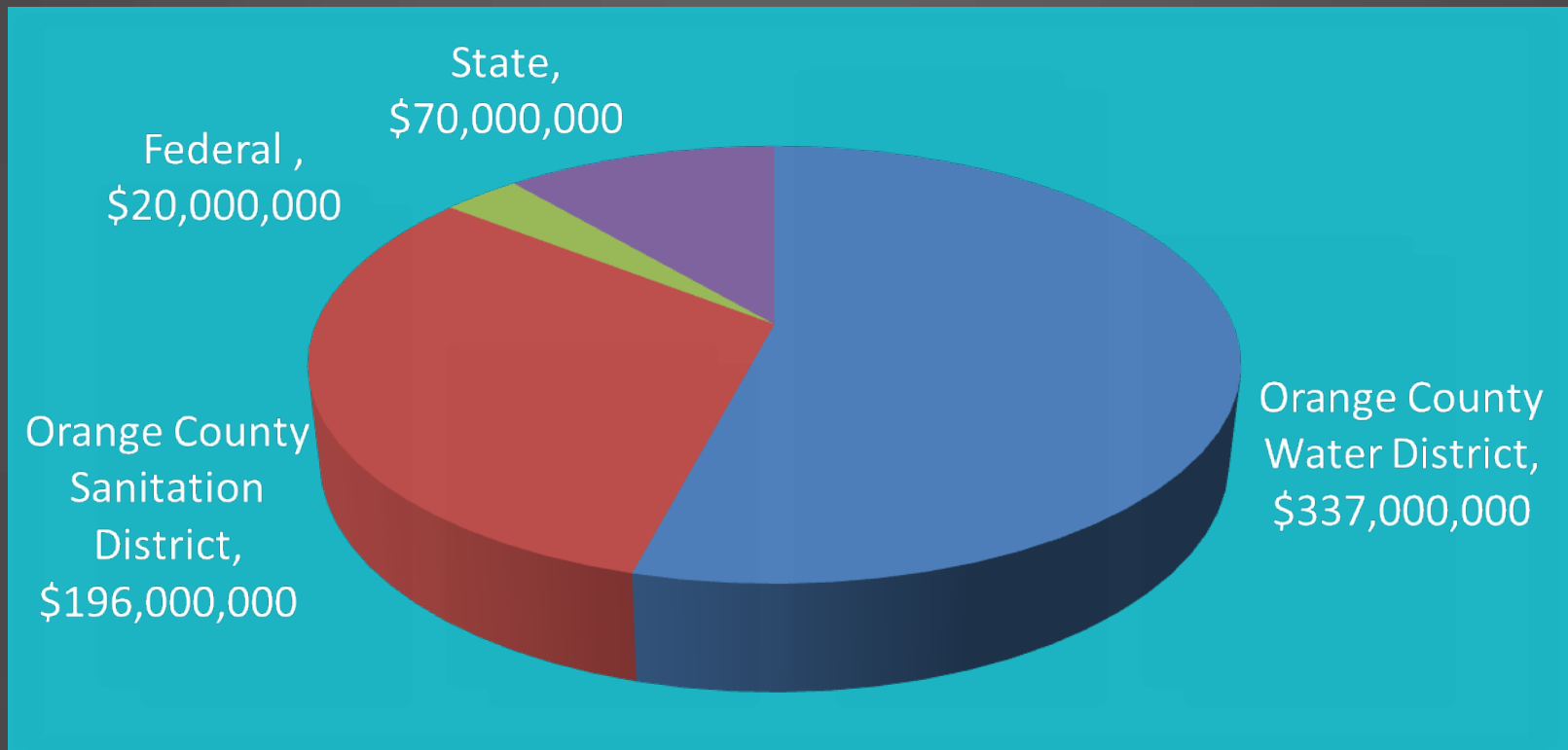


GWRS Monitoring & Water Quality

- **DDW helped develop Regional Board permit requirements**
- **Test Final Product Water (FPW) quarterly for 400+ targets**
 - **Volatile Organic Compounds (e.g., industrial solvents)**
 - **Non-Volatile Synthetic Organic Compounds (e.g., pesticides)**
 - **Inorganics and metals (e.g., arsenic, lead, copper, nitrate)**
 - **Disinfection By-Products (e.g, TTHMs, HAAs, NDMA)**
 - **EPA Priority Pollutants**
 - **Pharmaceuticals and personal care products (PPCPs)**
 - **Endocrine Disrupting Compounds (EDCs)**
- **All results below permit limits or non-detect (ND)**



GWRS Project Construction Funding Sources (including recent expansion)



GWRS Total Capital Cost at current 378,500 m³/d capacity is \$623 million



FY 2015-16 Operating Cost (July 2015 to June 2016)

Item	Annual Cost	Cost/AF
Electricity <small>Power used is 1,385 kWh/acre foot or 1.12 kWh/m³</small>	\$12,494,5299	\$122
Chemicals	\$5,559,252	\$54
Labor	\$9,678,633	\$95
R&R Fund Contribution	\$6,882,996	\$67
Plant Maintenance	\$3,586,290	\$35
Debt Service	<u>\$20,700,000</u>	<u>\$203</u>
Sub Total	\$58,901,700	\$577
Operating Subsidies <small>(Includes Demand Response and MWD LRP)</small>	<u>(\$9,469,996)</u>	<u>(\$93)</u>
Total Net Cost*	\$49,431,704	\$484/af (\$0.39/m³)

* Based on a production of 102,138 acre feet or 125,985,180 m³



The Final Expansion of the Groundwater Replenishment System Driven by Ongoing Drought Conditions



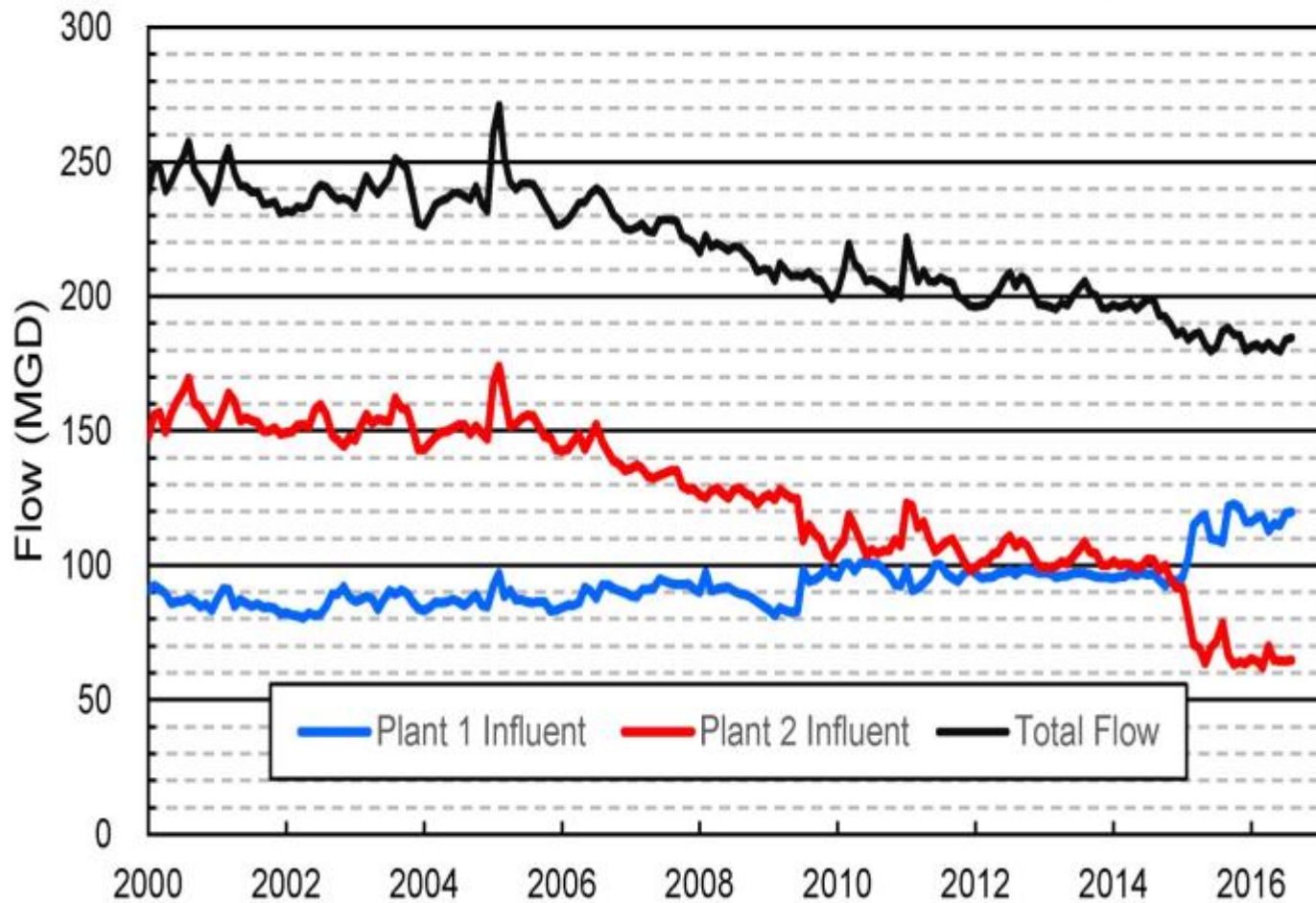
GWRS Planned Expansion Projects

- GWRS Project (Completed 2008)
 - Construction of 70 MGD (265,000 m³/d) treatment facility **with future expansion capacities (up to 130 MGD)**, injection wells, and pipeline
- GWRS Initial Expansion (Completed 2015)
 - Expansion of 70 MGD treatment facility to 100 MGD (378,500 m³/d) including SEFE pump station & storage tanks
- GWRS Final Expansion (Est completion 2022)
 - Expansion of 100 MGD treatment facility to 130 MGD (492,000 m³/d) including pump station, water supply pipeline & treatment process reconfiguration at OCSD



Wastewater Flows Declining with Drought and Economic Downturn

Orange County Sanitation District Influent Flows Report



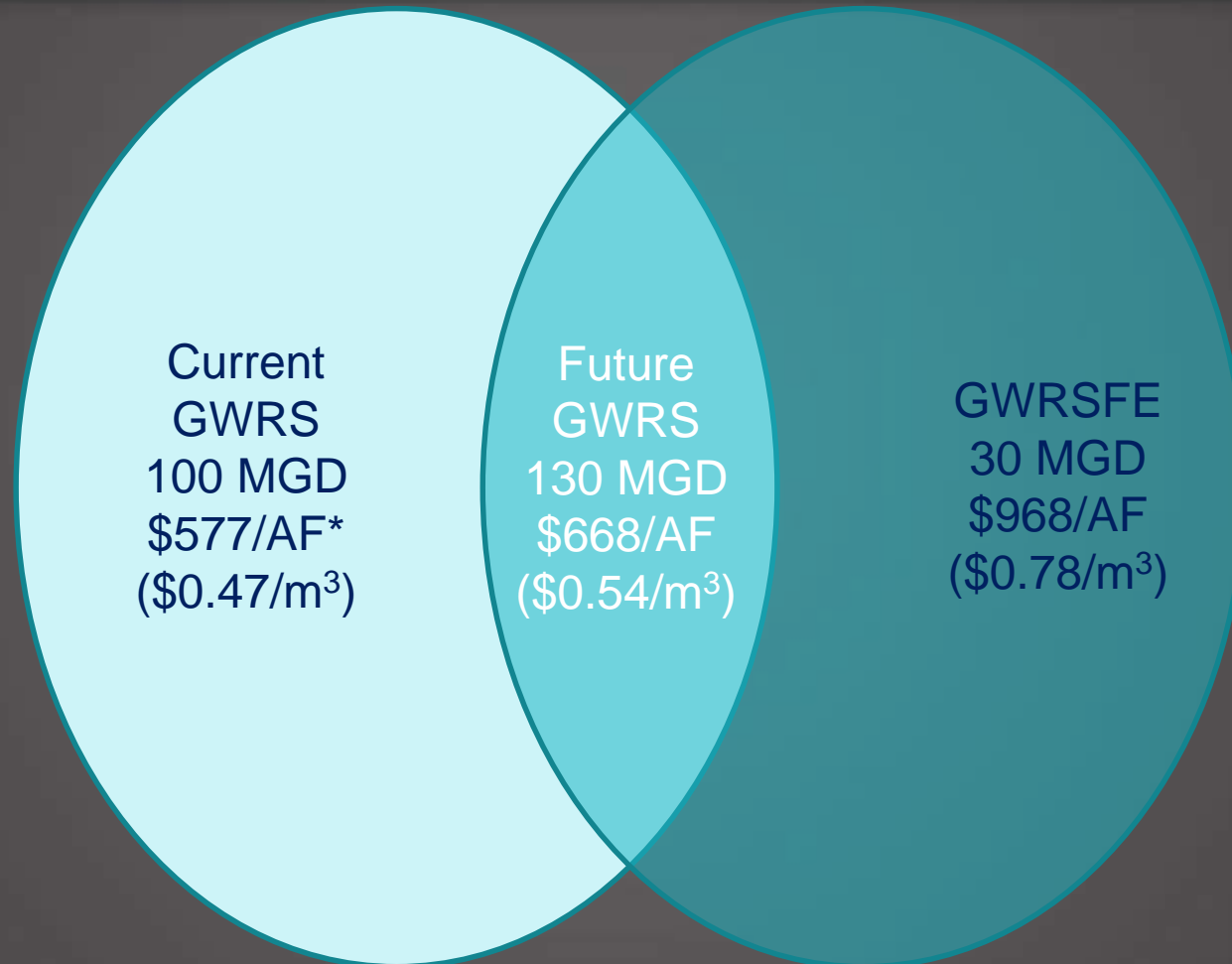


GWRS Final Expansion Projected Costs

Project Description	Cost (Millions)
OCWD AWTF Expansion to 130 mgd (492,000 m ³ /day)	\$130
OCSD Plant No. 2 Pump Station	\$18
OCSD Pipeline Rehabilitation	\$37
OCSD Plant No. 2 Headworks Modification	\$44
<i>Flow EQ Tanks</i>	<u>\$23</u>
TOTAL	\$252



Melded Unit Cost for GWRS



*This unit cost does not include the MWD LRP subsidy for GWRS – which expires in 2010



Public Outreach, Lessons Learned, and Keys to Success



PUBLIC OUTREACH

- Many projects stopped by public and political opposition
- Outreach began early, more than 10 years prior to start-up
- Researched public concerns
- Face-to-face presentations
- Community leaders
- Measured effects of outreach
- Community support
- Outreach continues today, assisted by media interest
- No active opposition





WHAT HAVE WE LEARNED FROM GWRS?

- **Public can accept indirect potable reuse projects if:**
 - Need is clear
 - Outreach is effective and ongoing
 - Elected officials and community leaders make commitment
 - Quality is higher than alternatives
 - Regulators have ongoing oversight
- **The more people know about GWRS, the more they accept it**





Keys to Success

- **Project meets Orange County's water needs**
- **Board of Director's insistence on highest quality water**
- **Effective medical and minority outreach programs**
- **History of successful water reuse in Orange County from the Water Factory 21 recycling facility**
- **Groundwater basin as final destination (not tap)**
- **Excellent outreach speakers bureau program obtained written support of project**
- **Successful outreach from conception of facility, to construction and finally commissioning**



Thank You! Contact: mpatel@ocwd.com

