ORANGE COUNTY WATER DISTRICT

AMERICAN ACADEMY OF ENGINEERS AND SCIENTISTS (AAEES) CONFERENCE

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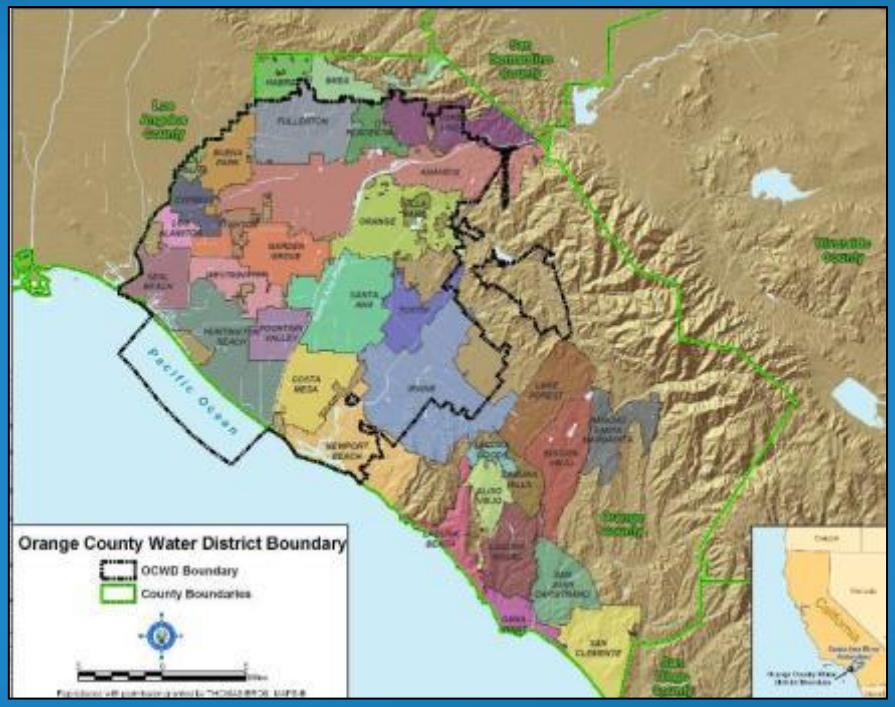
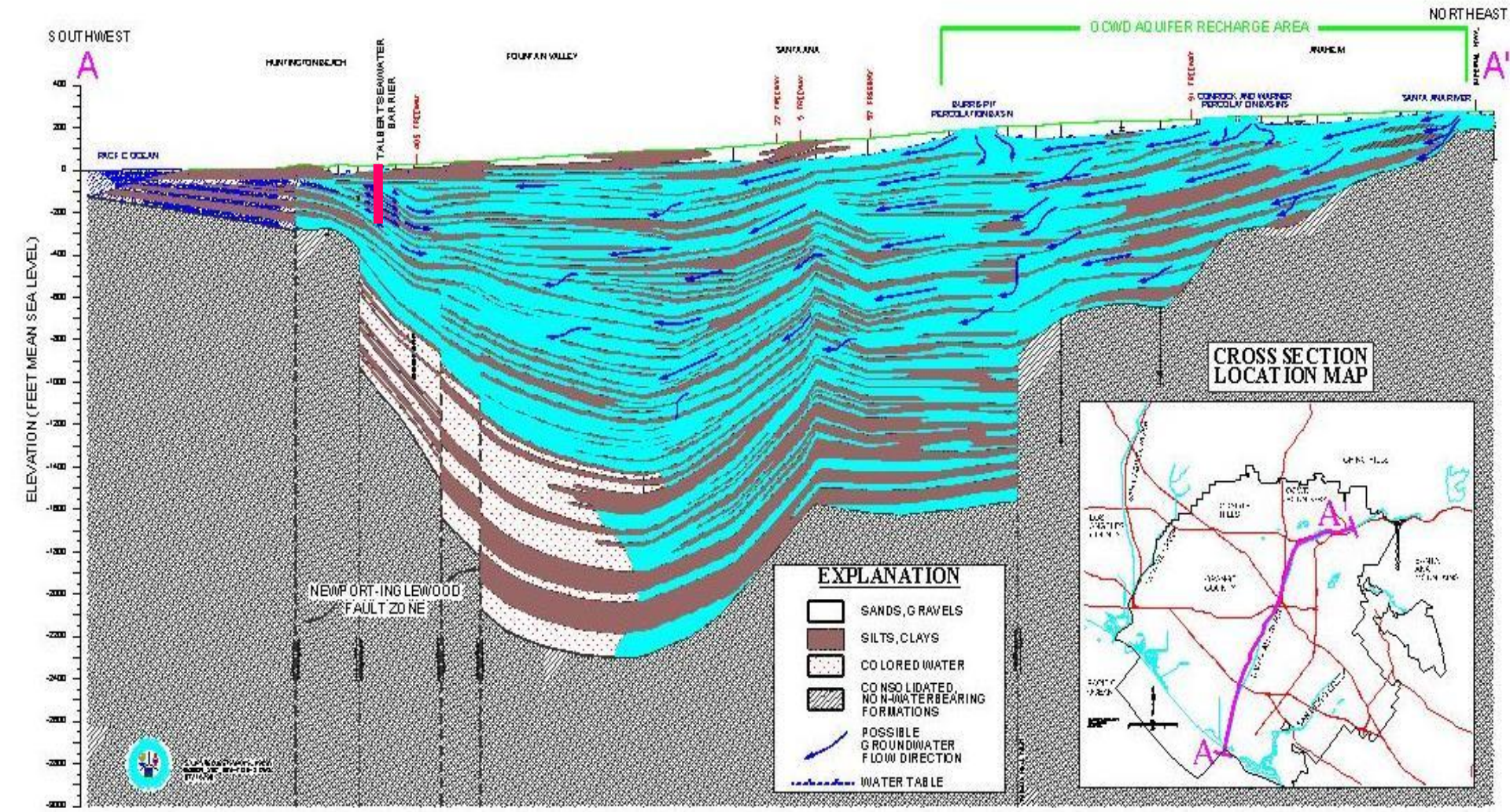
ORANGE COUNTY WATER DISTRICT (OCWD)

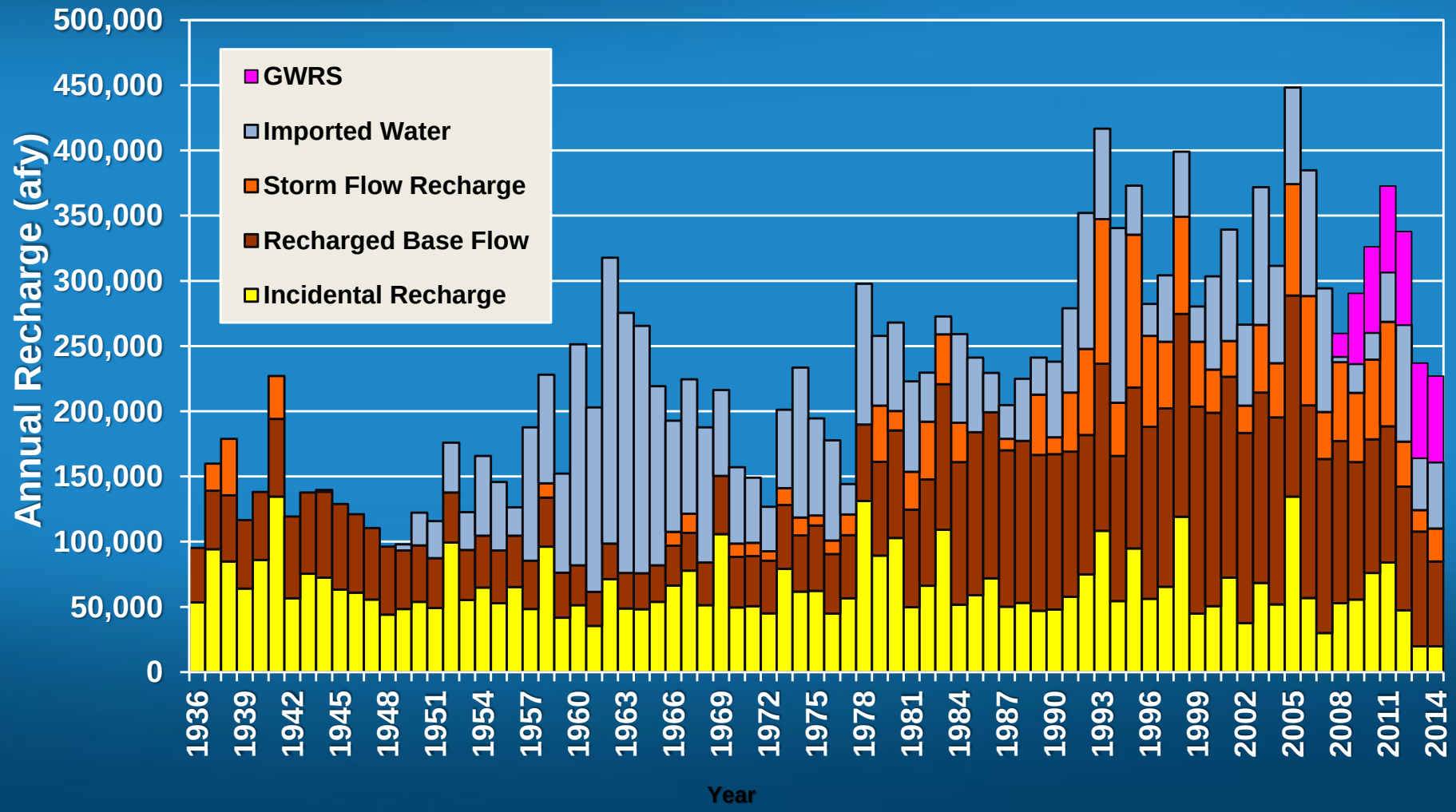
- Formed in 1933 by an act of the California legislature to manage the OC groundwater basin and protect OC's rights to the Santa Ana River water
- Basin provides groundwater to 19 municipal and special water districts that serve 2.4 million customers in north and central Orange County
- Basin currently supplies 75% of the water supply for north and central OC



CROSS SECTION OF THE GROUNDWATER BASIN



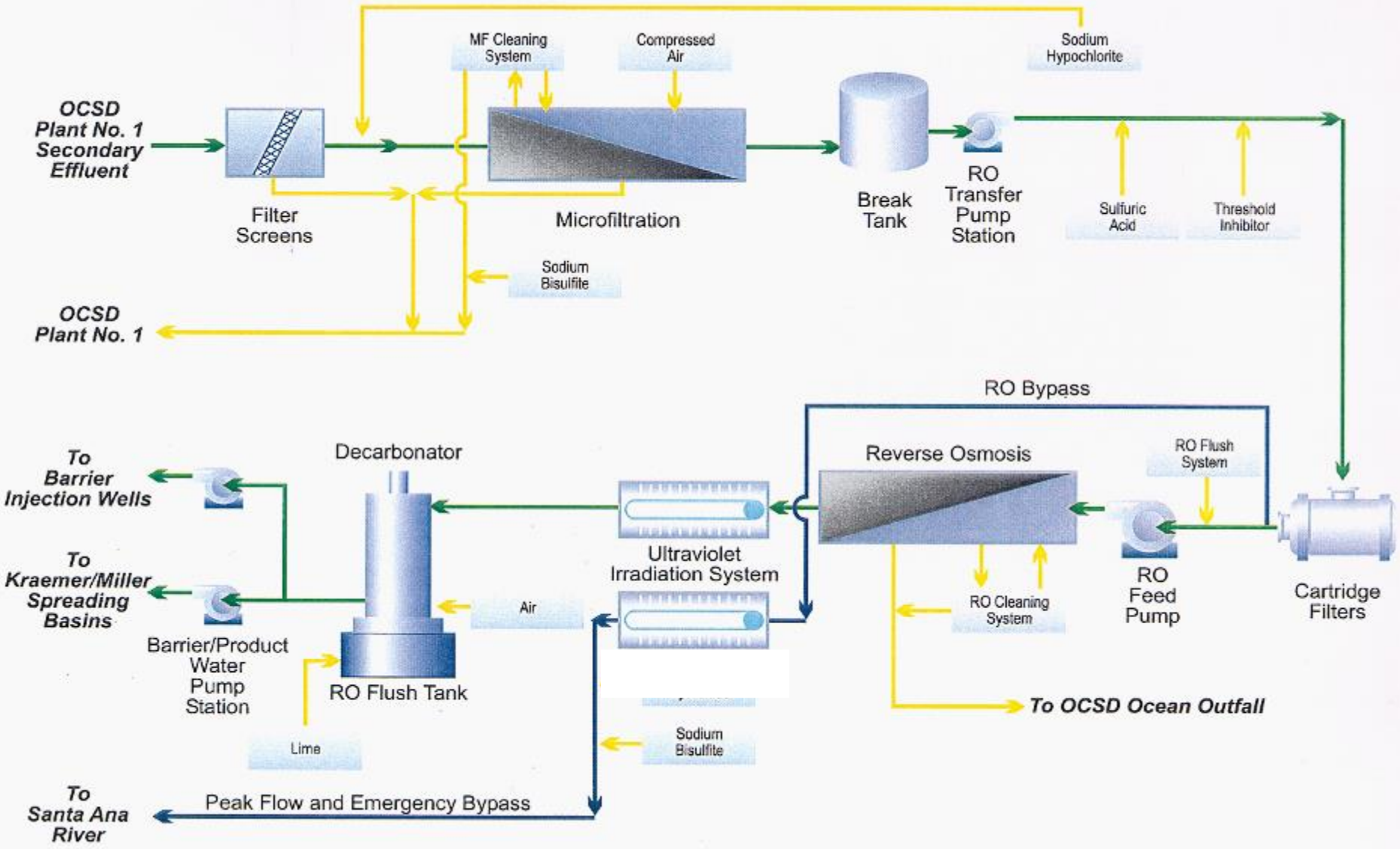
SOURCES OF WATER FOR GROUNDWATER BASIN



THE GROUNDWATER REPLENISHMENT SYSTEM (GWRS)

- New 100 million gallon per day (MGD) advanced water purification facility
- Takes sewer water 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 103,000 acre-feet per year (afy) source of water, which is enough water for nearly 850,000 people
- Operational since January 2008 (70 MGD) expanded May 2015 (30 MGD)
- Largest planned indirect potable reuse project in the world

GWRS ADVANCED PROCESS



MICROFILTRATION (MF) PROCESS

- 120 MGD Siemens CMF-S Microfiltration System
- In basin submersible system
- Tiny, straw like hollow fiber polypropylene membrane
- 0.2 micron pore size
- Recovery rate: 90%
- Removes bacteria, protozoa, and suspended solids

REVERSE OSMOSIS (RO) PROCESS

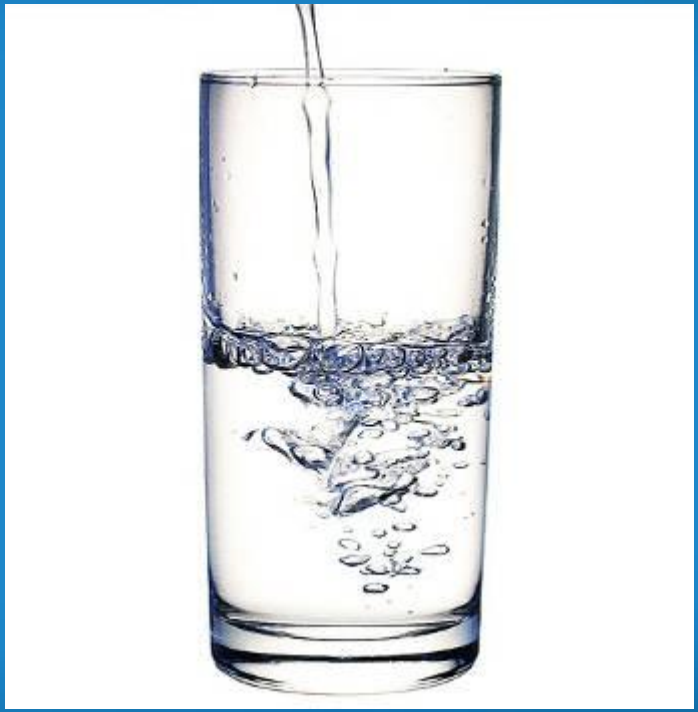
- 100 MGD Reverse Osmosis System
- 3 stage: 78-48-24 array
- Hydranautics ESPA-2, CSM RE8040-Fen and DOW XFRLE-400 Membranes
- Recovery rate: 85%
- Removes dissolved minerals, viruses, and organic compounds (incl. pharmaceuticals)
- Pressure range: 150 – 200 psi

ADVANCED OXIDATION PROCESS (AOP)

- 100 MGD Trojan UVPhox System
- Low Pressure – High Output lamp system
- Destroys trace organics
- Uses 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

- Regional Water Quality Control Board issues permits for recycling
- Division of Drinking Water (DDW) regulates drinking water and establishes reclamation criteria
  - Treatment
  - TOC limit
  - Travel time
  - Blending
- No federal role regulating reuse
- DDW hearing findings and recommendations incorporated into permit by Regional Board



INDEPENDENT ADVISORY PANEL

- Appointed by National Water Research Institute
- Leading experts in hydrogeology, chemistry, toxicology, microbiology, engineering, public health, public communications and environmental protection
- Review operations, monitoring and water quality
- Panel makes recommendations to OCWD and regulatory agencies to assure quality and reliability

GWRS PROVEN RELIABILITY

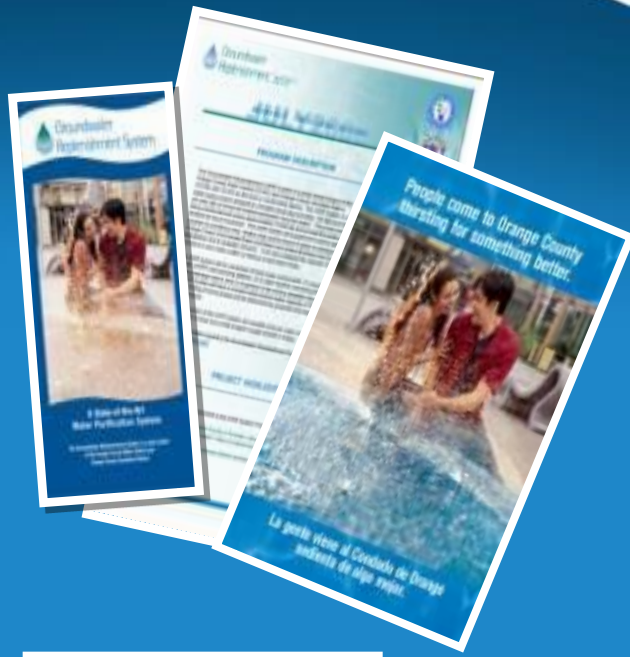
- California Department of Public Health (now Division of Drinking Water) developed permit requirements
- Test for over 400 compounds with all results well below permit levels or at non-detection (ND) levels
  - 28 Volatile Organic Compounds – All ND
  - 39 Non-Volatile Synthetic Organic Compounds – All ND
  - 8 Disinfection By-Products – All ND
  - 10 Unregulated Chemicals – All but one ND, all below permit levels
  - 51 Priority Pollutants – All ND
  - 16 Endocrine Disrupting Chemicals and Pharmaceuticals – All ND

PROJECT FUNDING

- Original Project Cost: $481 million
  - Split equally between OCWD and OCSD
- Expansion Project Cost: $142 million
- Costs comparable to imported water
  - Original Project received $92 million in state and federal grants, and $4 million per year (21 year) operation and maintenance subsidy from Metropolitan Water District
  - Expansion Project received $1 million in state grants
  - Both projects used State Revolving Fund (SRF) loans
  - Costs $480 per acre-ft ($850 per acre-ft without subsidies)

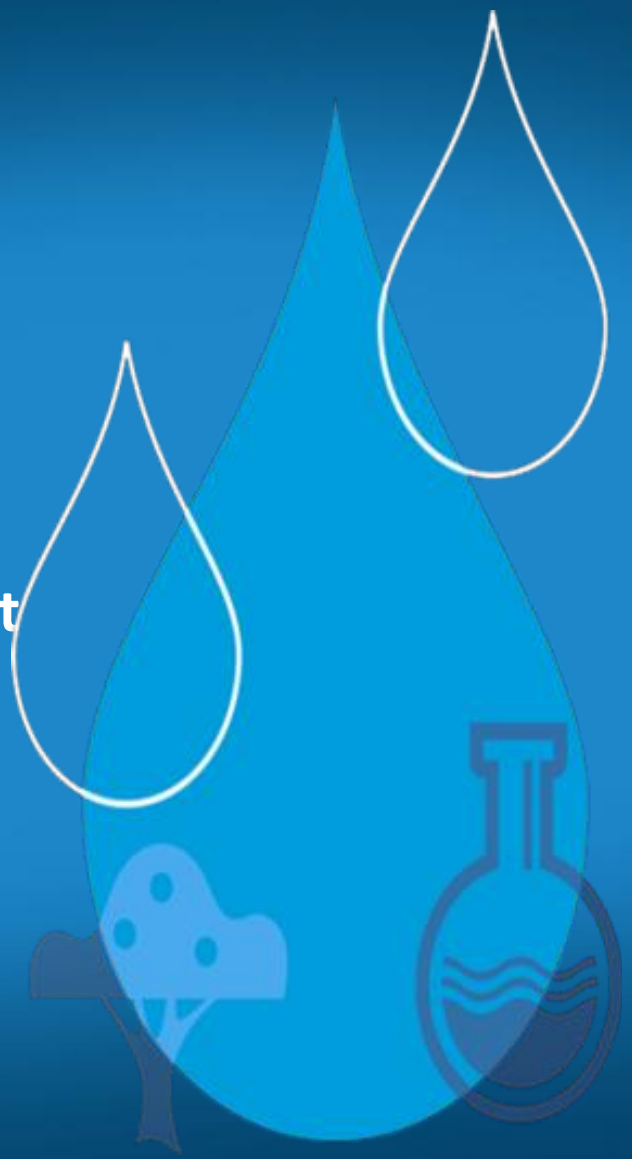
PUBLIC OUTREACH

- 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



BENEFITS OF GWRS

- Creates a new local water supply
- Reuses a wasted resource
- Increases water supply reliability
- Costs less than water from the Colorado River and the State Water Project
- Uses one-half the energy it takes to import water and one-third the energy to desalinate seawater
- Improves quality of water in the basin



KEYS TO SUCCESS

- Project meets Orange County's water needs
- Board of Directors insistence on highest quality water
- History of successful water reuse in Orange County with Water Factory 21 recycling facility
- Groundwater basin provides environmental buffer and psychological barrier
- Successful outreach from conception of facility, to construction and finally commissioning

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

GWRS SUCCESS

USA TODAY

From toilets to tap: How we get tap water from sewage

By Kathy Chu, USA TODAY

Making wastewater pure enough to drink

Wastewater is increasingly being purified for drinking, industrial and agricultural purposes. A look at the latest wastewater purification technology:

SINGAPORE — This island nation is aggressively promoting a solution to the water scarcity that vexes countries worldwide: recycling toilet water to drink.

It's an idea that many people find revolting. But, in Singapore at least, the nearly 5 million residents largely seem to have accepted it as necessary.

"In the past, we had to get water from another country, but what happens if the ties between the two countries are jeopardized?" asks Khating Tan, 20, a student at Nanyang Technological University in Singapore. "It's better to be self-reliant."

DRINKING URINE: Astronauts do it aboard the Space Station

Once heavily dependent on neighboring Malaysia for its water supply, Singapore is unapologetically recycling sewage and other wastewater in a way that the city-state believes will help make it self-sufficient. The

THE WALL STREET JOURNAL.

U.S. EDITION ▾ Thursday, May 15, 2008

Sewer to Spigot: Recycled Water

Article | Comments

By ANJALI ATHAVALEY

A growing number of cities and counties grappling with water shortages are turning to a solution that may be tough for some homeowners to stomach: purifying wastewater so that residents can drink it.

In an effort to replenish its groundwater supply, Los Angeles is slated to announce Thursday a plan that will recycle 4.9 billion gallons of treated wastewater to drinking standards by 2019. In San Diego, the city council voted in favor of a pilot project that would pump recycled sewage water into a drinking-water reservoir, despite a veto from the mayor over the system's cost. Miami-Dade County, Fla., is planning a system that would pump 23 million gallons a day of purified wastewater into the ground, the water will eventually travel to a supply well and be reclaimed for drinking use.

Water recycling is just one of a number of tactics parched cities -- many of which have faced water shortages for years -- are using. "Demand is growing, and supply is pretty much staying static," says Wade Miller, executive director of the WateReuse Association, a nonprofit in Alexandria, Va., that

GWRS AERIAL VIEW