WateReuse – Orange County Chapter Meeting

Advancements in Potable Reuse

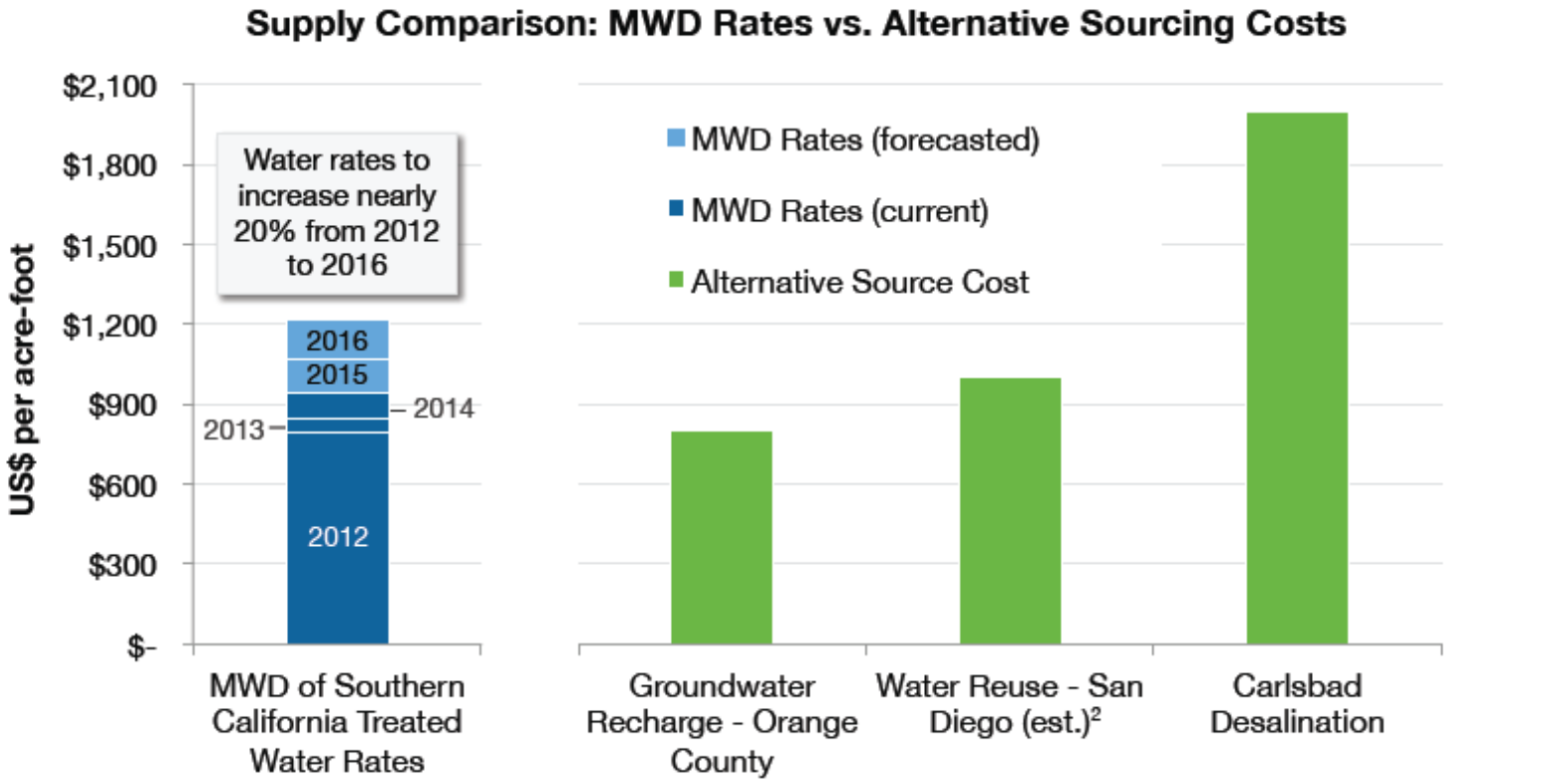
June 2017

PHOTOGRAPH BY GEORGE ROSE, GETTY

Sunny Wang

Andrew Lazenby

Alternative Water Supplies in the California Market



Source: Metropolitan Water District (MWD) of Southern California, Restore the Delta, City of San Diego, AWWA, Bluefield Research

[2] Estimated cost includes US$1000 per acre-foot offset for avoiding wastewater treatment capacity expansion.

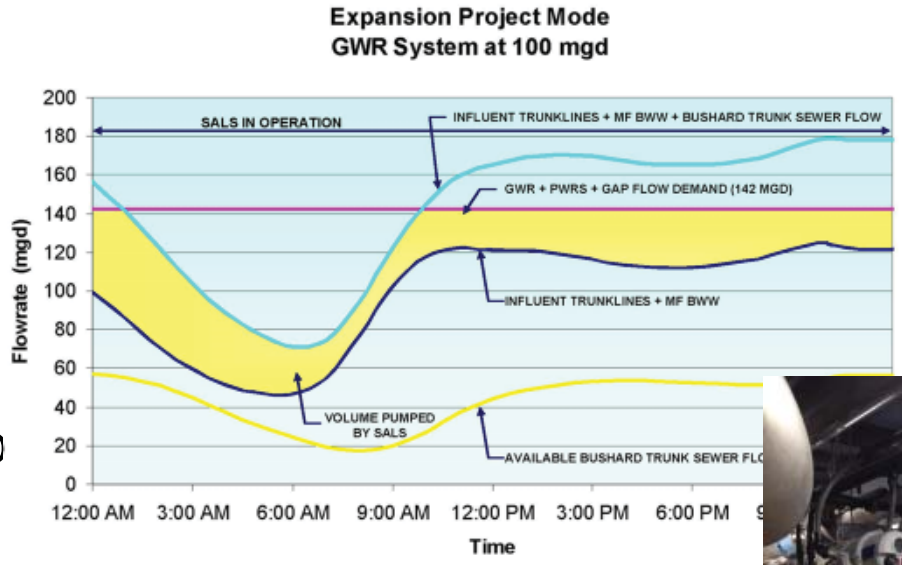
Potable reuse is cost competitive with imported water supplies and significantly less costly compared to seawater desalination. DPR could be even more cost effective.

Project Hurdles

Where Are We Headed in Potable Reuse

Initial Expansion of OCWD GWRS Provided Opportunities to Enhance Performance and Reliability

- Optimize Secondary Treatment
- Secondary flow equalization
- Incorporated energy recovery devices (ERD) to new RO units
- New lime system and post-treatment target
- Final Expansion of GWRS?



Post-Treatment Enhancements

- Post-treatment water quality target was adjusted during Initial Expansion to:
  - Better protect cement mortar lined pipes
  - Prevent scaling of the injection well screens

OCWD GWRS Purified Water Quality Targets

Parameter	Current Goal	Alternative Target
pH	8.5 to 8.8	7.6 to 7.9
Alkalinity, mg/L as $CaCO_3$	40	40 to 50
Calcium, mg/L	3 to 4	10 to 13
Hardness, mg/L as $CaCO_3$	7 to 10	25 to 33
Free Carbon Dioxide, mg/L	None	< 3
Buffer Intensity	None	0.100
CCPP, mg/L as $CaCO_3$	-4 to -2	-3

- Alternative target also mitigated against arsenic mobilization in the groundwater aquifer

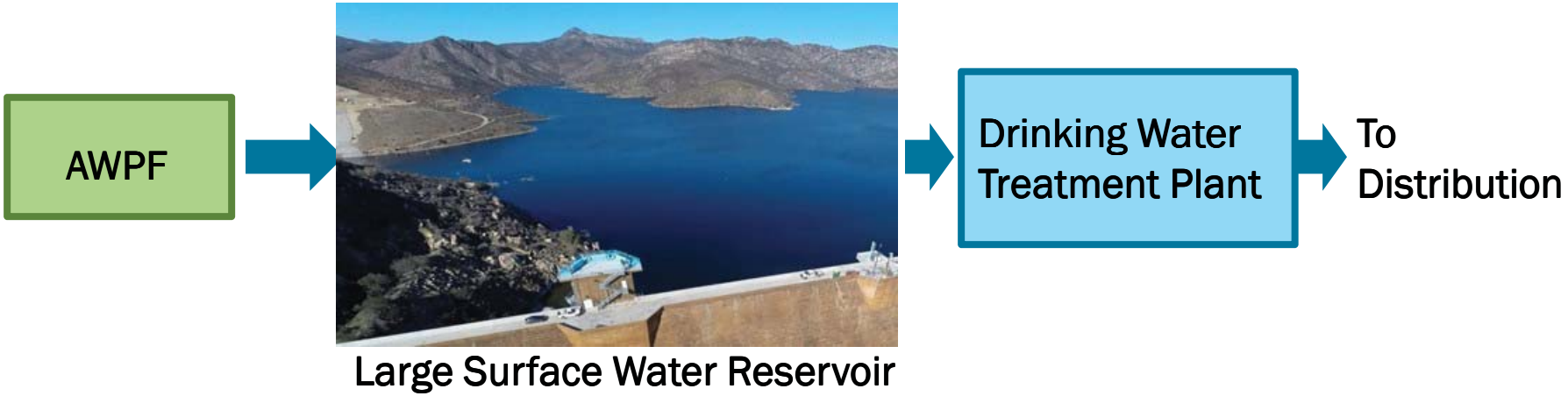
West Basin Municipal Water District

- Source Water Impacts
  - Climate Change
  - Conservation
- Performance Enhancements and Reliability
  - Pre-ozonation
  - Tertiary MBR
  - Universal module MF

Pure Water Runs a Successful Demonstration Plant

- Treatment: O_3+BAC +MF+RO+UV AOP
- 28,000 lab tests: **Met all standards**
- Water quality: **Exceptional**
- Energy use: **Comparable to imported water**
- Application: Surface Water Augmentation

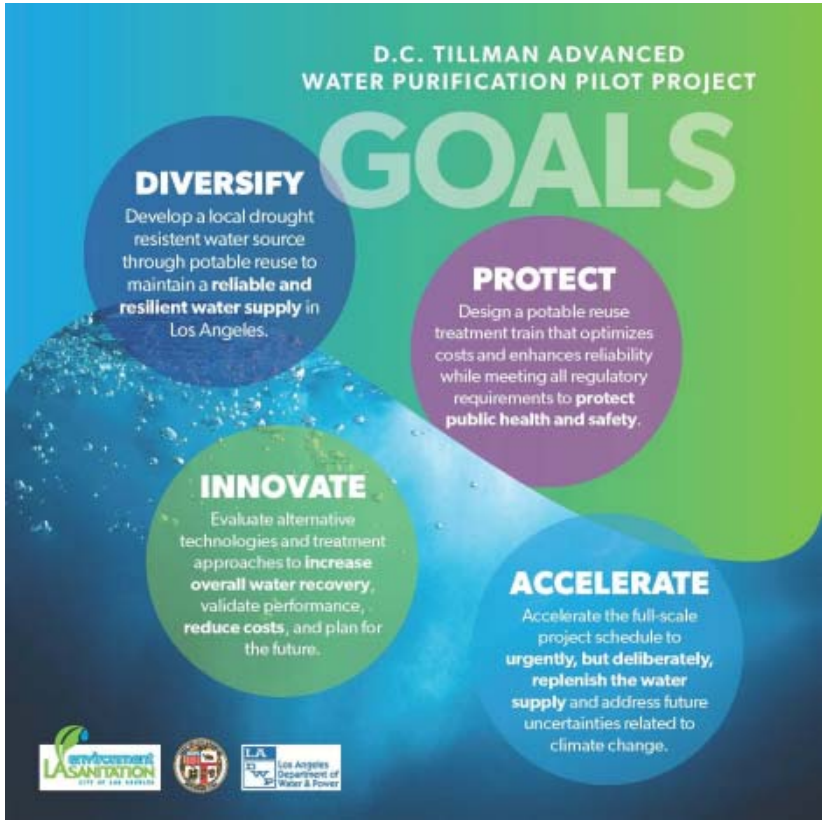
Surface Water Augmentation with Pure Water



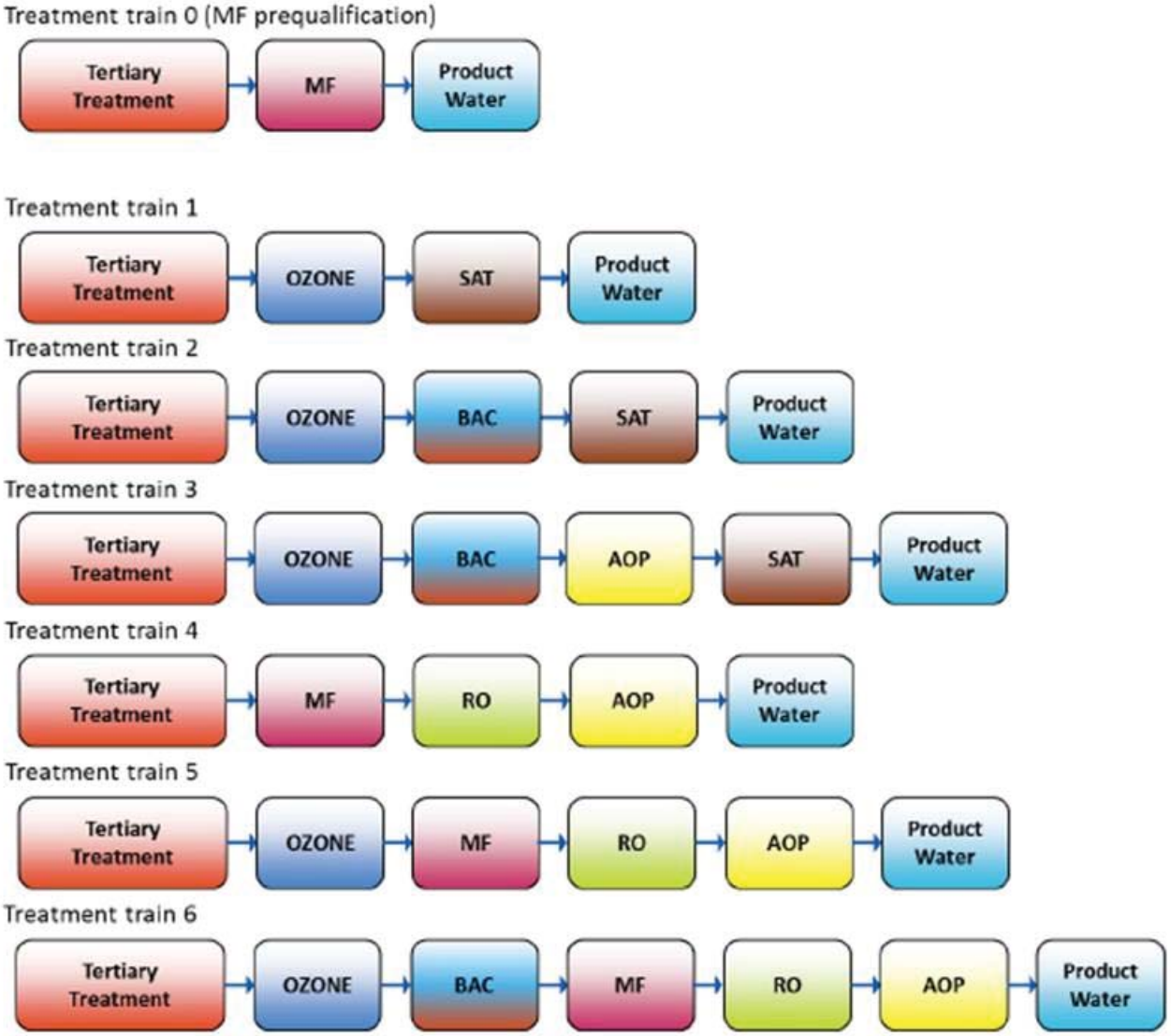
- Draft Criteria for Surface Water Augmentation (CA)
  - Retention time ≥ 6 months
  - Full advanced treatment
  - Dilution and mixing options = 99:1 dilution or 9:1 dilution with +1-log treatment

City of LA DC Tillman AWPF Pilot

1. Design a “Fit for Purpose” treatment train
2. Reverse osmosis brine minimization
3. Test new AOP technologies for DCTWRP water matrix
4. MF/UF Prequalification

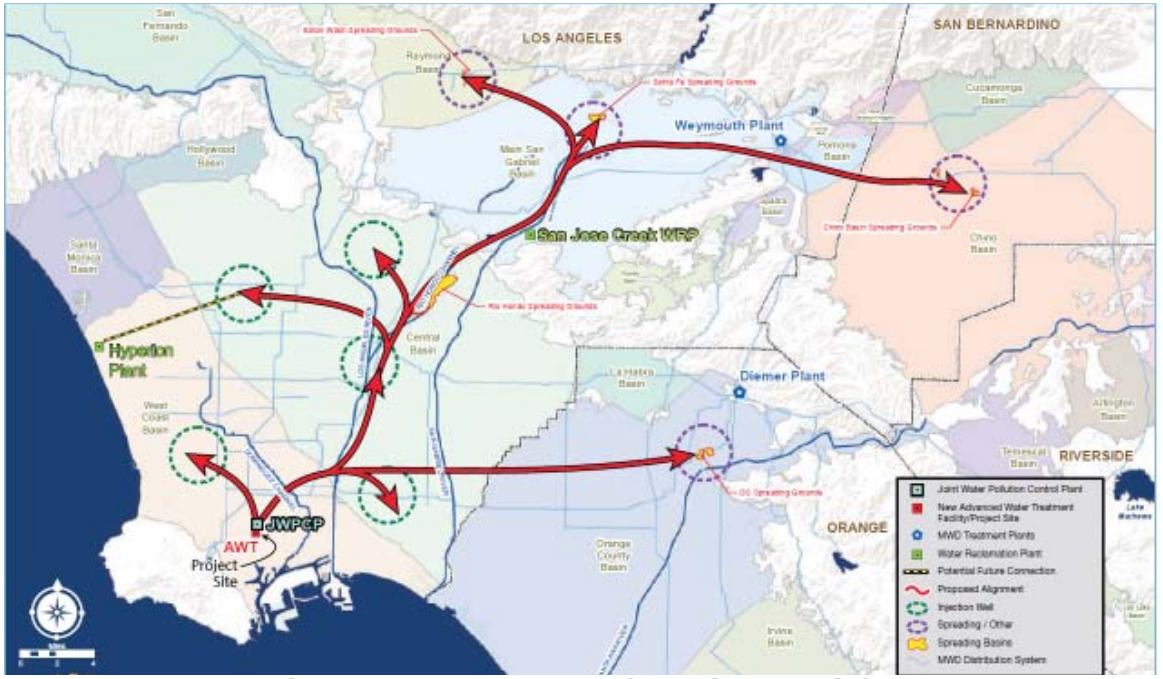


Treatment Trains for Pilot Evaluation



Metropolitan Water District of Southern California's Regional Recycled Water Supply Program

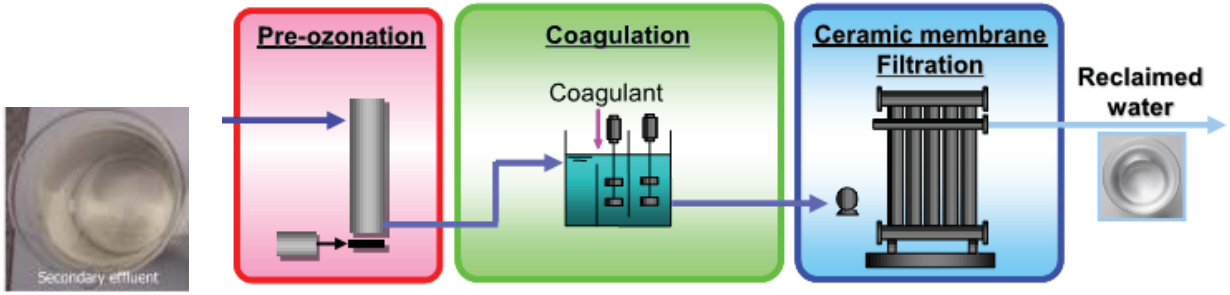
- Regional partnership between Metropolitan Water District of Southern California and Los Angeles County Sanitation District
- Diversify water supply portfolio beyond traditional supplies
- Demo project for proof of concept (tertiary MBR)
- Planned ultimate production capacity of 150 mgd



Source: Metropolitan Water District of Southern California

Treatment Technology Advancements

Technology Advancements – MF/UF



Preozonation

Microbial deactivation
Color removal
Odor removal

Coagulation

Fouling Reduction

Ceramic Membrane

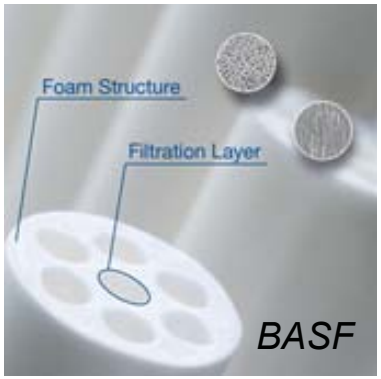
Particle removal
TOC & DOC removal
Ozone Resistance

O_3 +Ceramic MF Metawater, IOA 2015

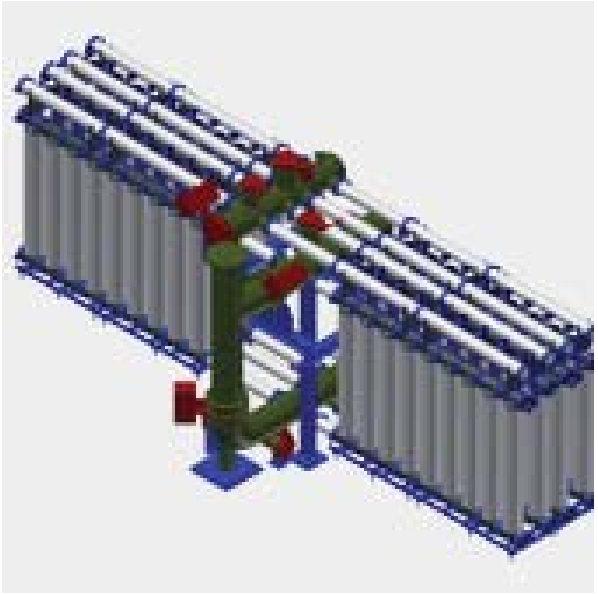
Alternative Non-RO Potable Reuse Train w/ O3 + Ceramic MF + GAC + UV AOP?

Technology Advancements – MF/UF

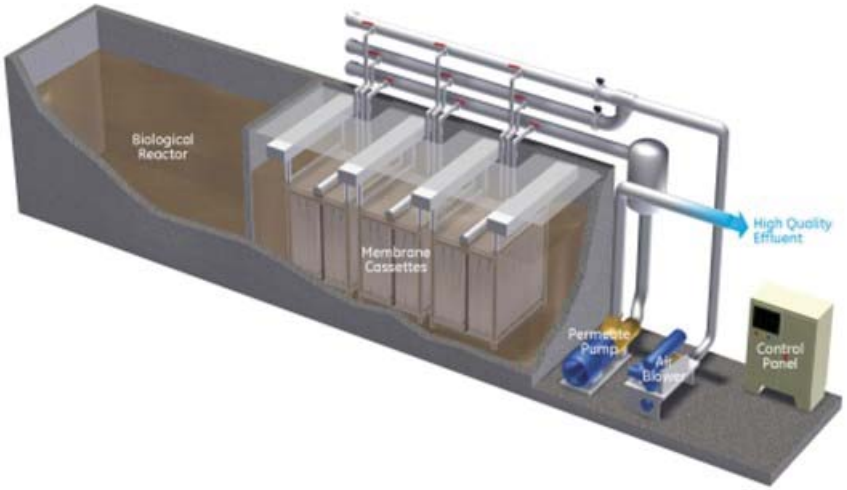
Universal Rack

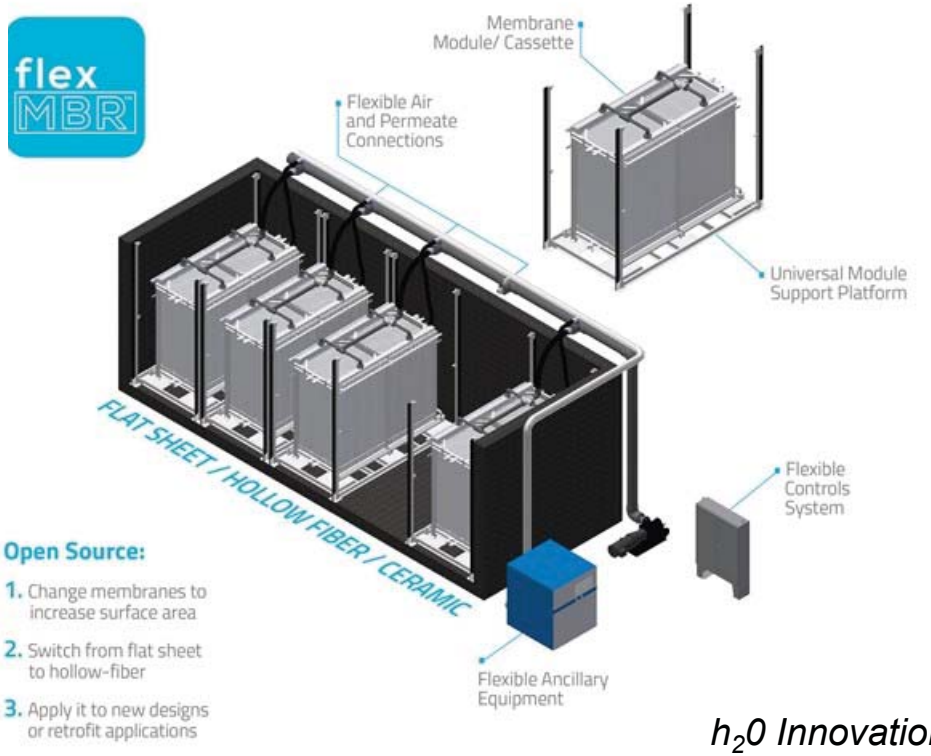


Multibore membranes (PES)



Tech Advancements - MBR



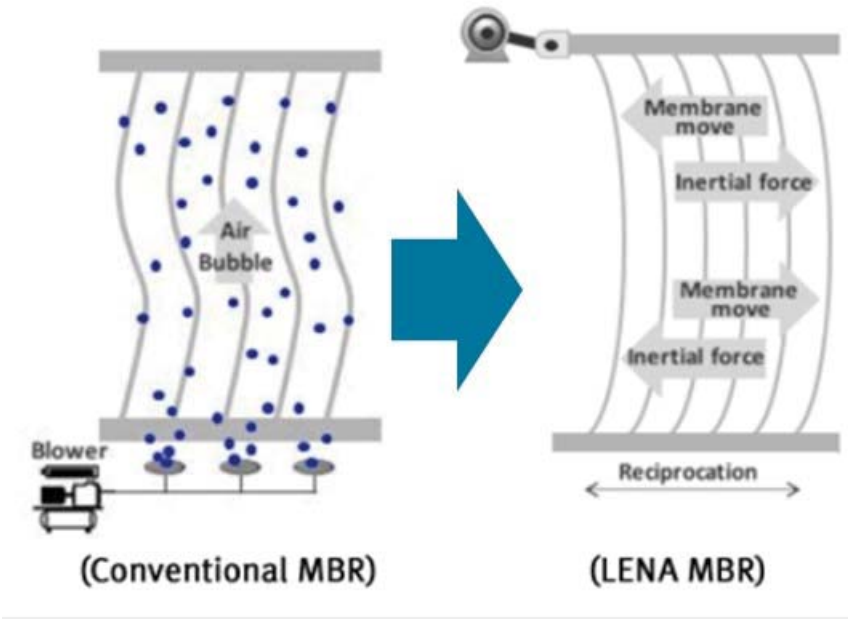


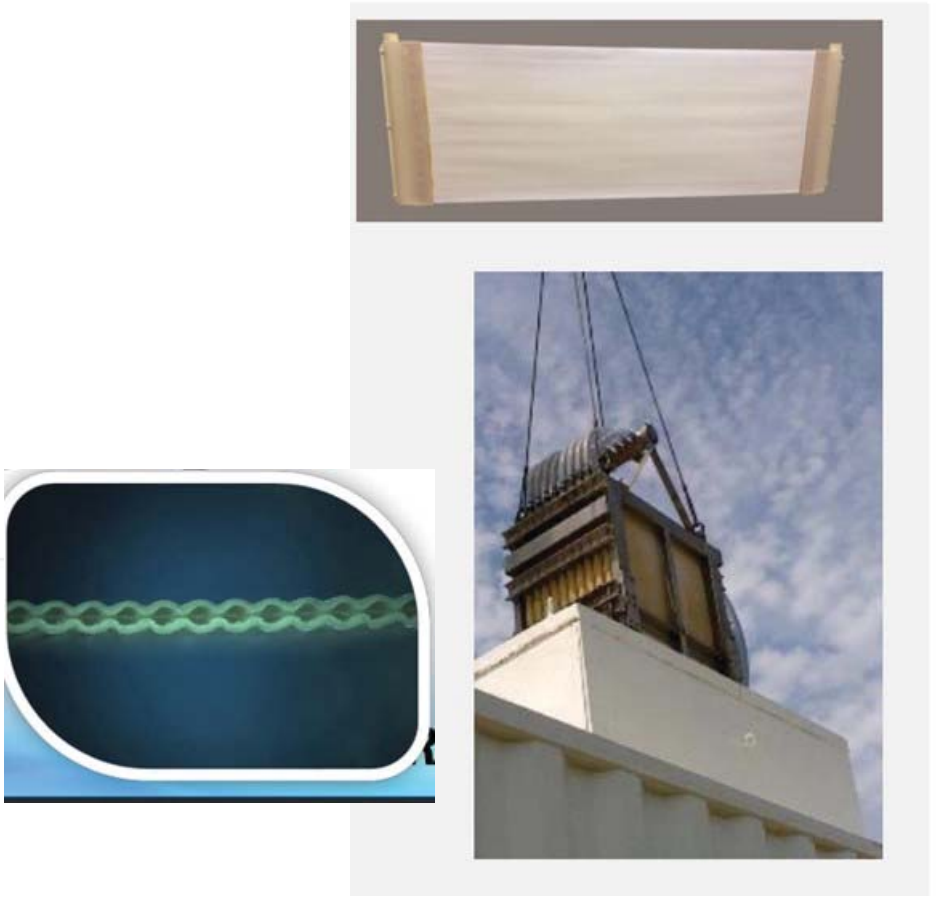
- Tertiary MBR
- MBR Log Removal Credits for Potable Reuse
- Open platform
- New configurations
- Alternative cleaning systems

h_20 Innovation

Tech Advancements - MBR

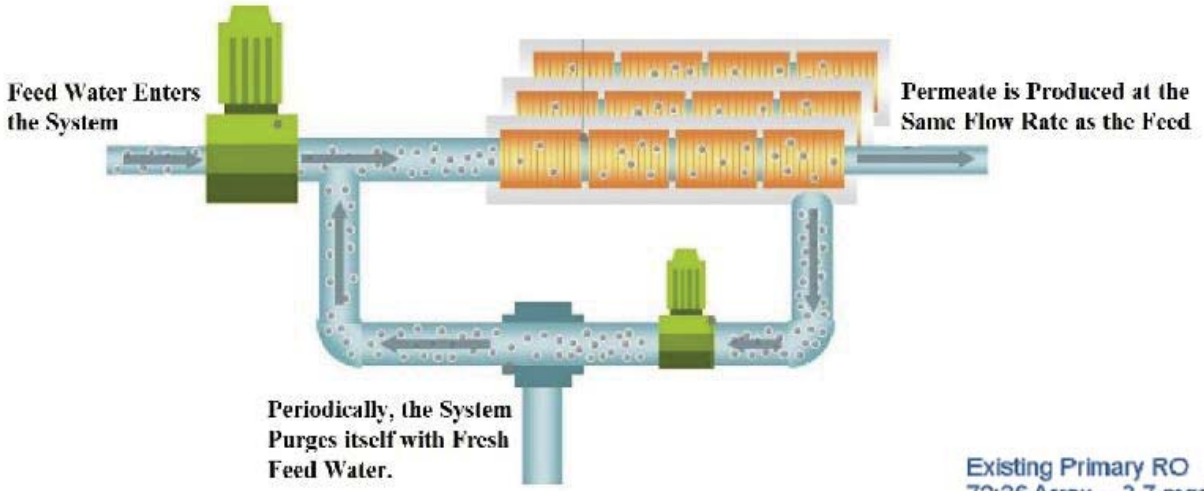
Doosan





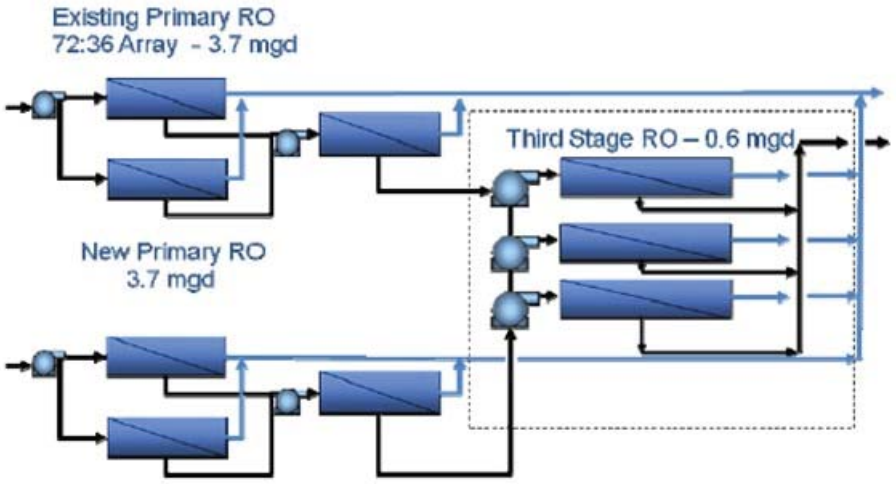
Anaergia FiberPlate

Technology Advancements - RO



Closed Circuit Desalination
Desalitech

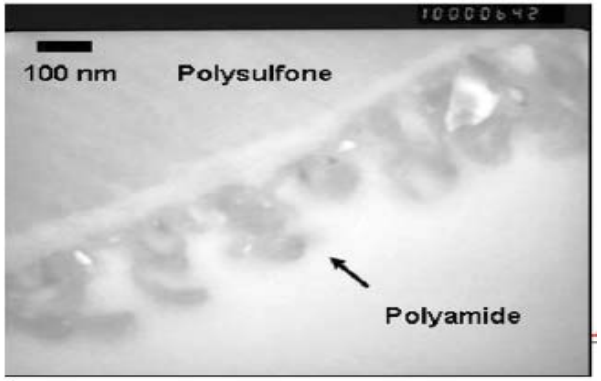
- Others:
  - HERO
  - VSEP
  - Forward Osmosis

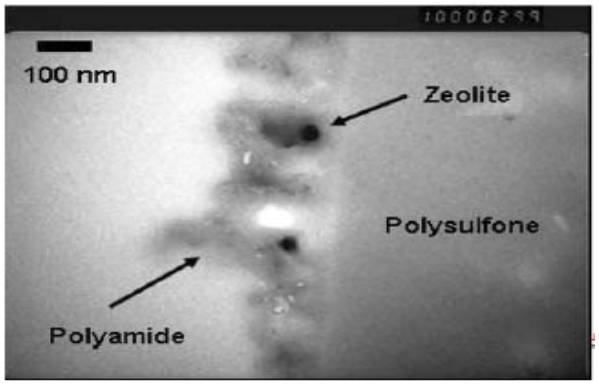


Three-Stage RO
Water Replenishment District of Southern California

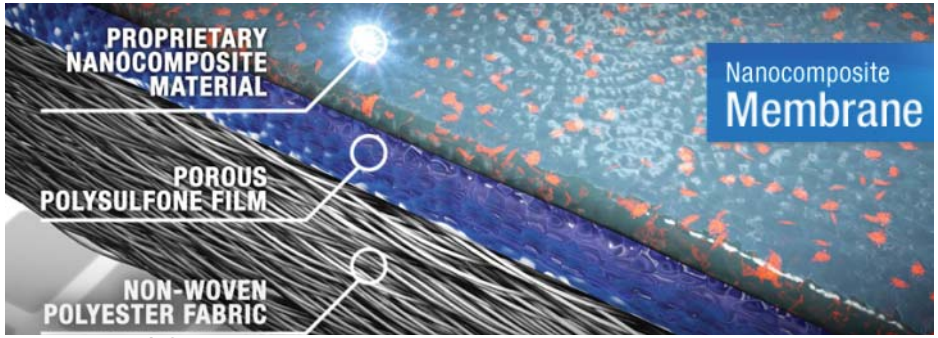
Technology Advancements – RO Membranes

- Thin Film Nanocomposite –
  Preferential transport of water molecules through super-hydrophilic nanoparticles.





Jeong et al., *J. Membr. Sci,*, 2007.



www.nanoh2o.com

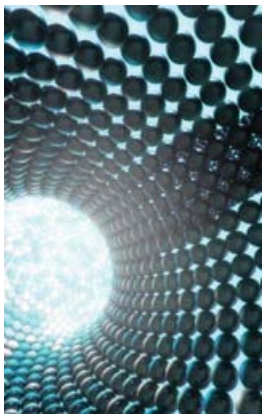
Up to 20% *Less* Energy

Up to 70% *More* Water

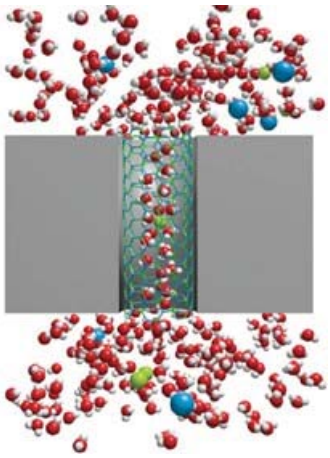
Up to 40% *Smaller* Plant

Technology Advancements – RO Membranes

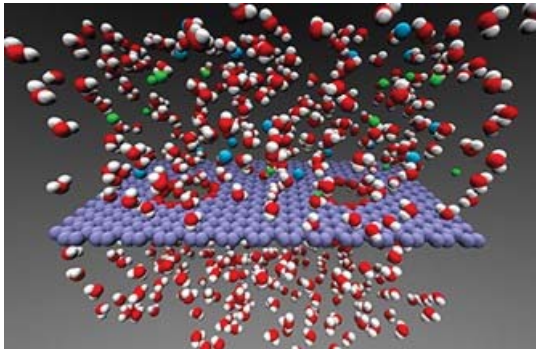
- Nanotube Membranes –
  Preferential transport of water molecules through super-hydrophilic carbon and boron nitride nanotubes.
- Graphene Oxide Membranes –
  Low-friction water molecules transport through two-dimensional nanocapillaries with sieving mechanism for salt rejection.
- Aquaporin Membranes –
  Transport of water molecules through protein channels. Selective rapid diffusion caused by osmotic gradients.



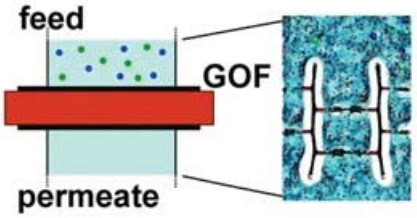
www.nanoasisinc.com



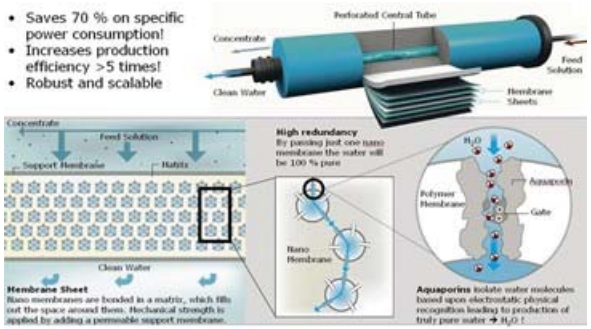
Hilder et al., Small, 2009.



Source: Lockheed Martin



Nicolia et al., *Phys.Chem.Chem. Phys.*, 2014.

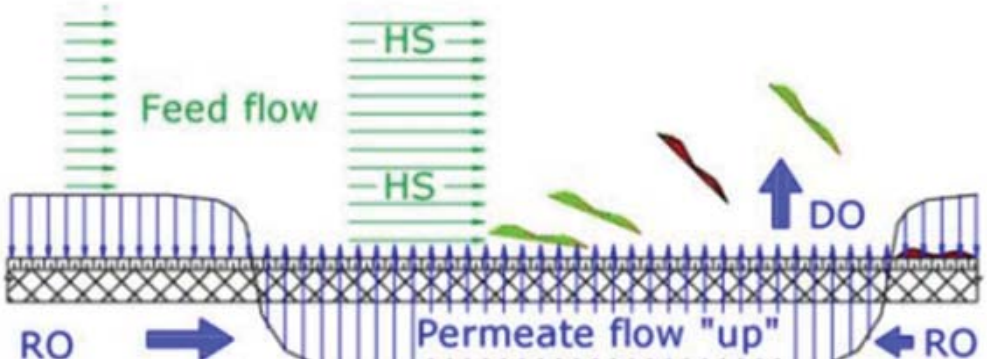


Technology Advancements – RO Membrane Cleaning

- IDE PROGREEN and Direct Osmosis Cleaning System

IDE Technologies

- Biofouling control via dehydration of bacteria with high salinity solution
- Increase in shear velocity from high salinity pulse
- Dissolution of proto-crystals from permeate backflow

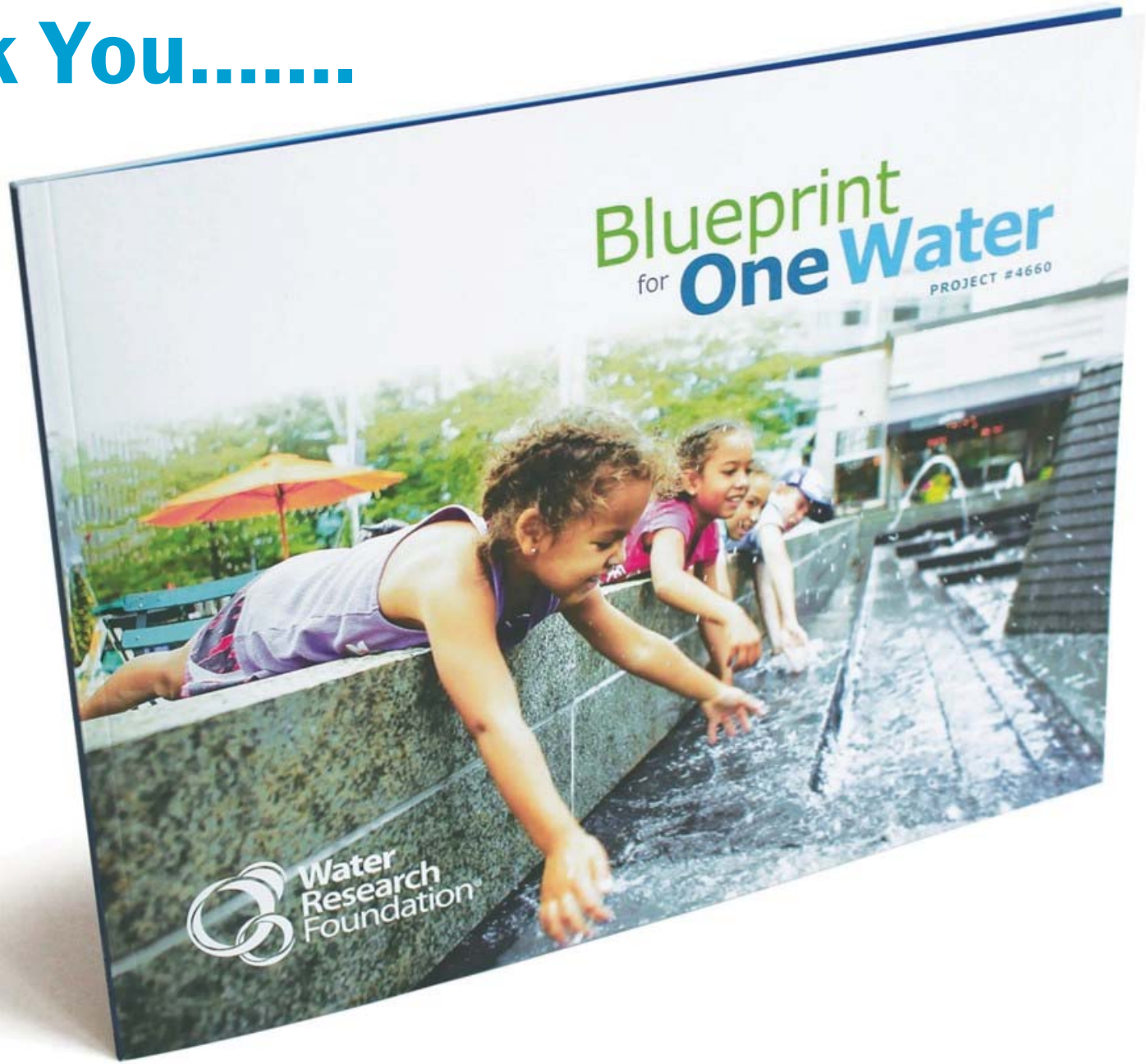


Qin et al., 2010

Alternative Treatment Solutions – Potable Reuse

- Aquifer Storage Recovery
- High Recovery RO systems
- Non RO based treatment trains = ozone, BAC, GAC, soil aquifer treatment
- Sensor Technology
- Critical Control Points
- Many more……..DIRECT POTABLE REUSE?

Thank You.....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