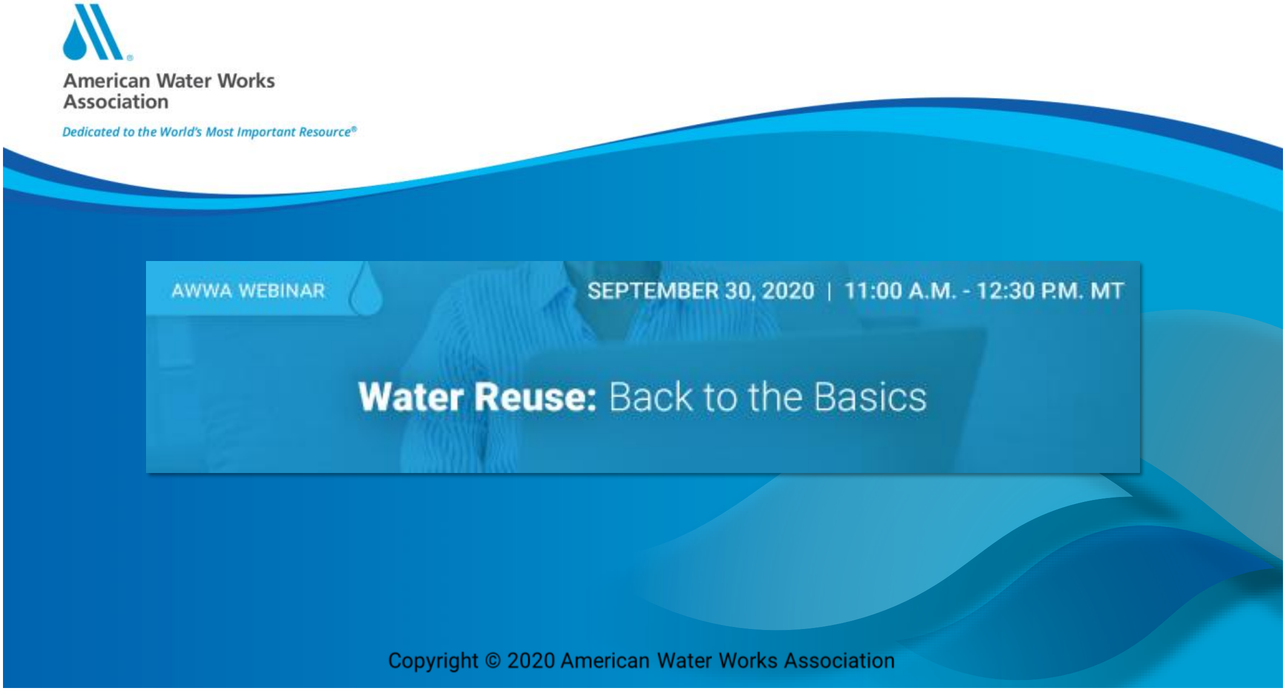
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WEBINAR MODERATOR

Corinne Bertoia

Engineer

American Water Works Association

Corinne Bertoia is an Engineer at the American Water Works Association. Her responsibilities include reviewing and developing technical programs and supporting the Divisions and Committees of the Technical and Education Council. Corinne received her MASc. in Civil Engineering from the University of Toronto in 2018, where her research focused on the removal of NDMA precursors from drinking water biofilters.

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PANEL OF EXPERTS

Alan Rimer
Vice President – Water Reuse
EnviroTechNovations LLC

Jason Curl
Regional Reuse Practice Lead
Hazen and Sawyer

Bruce Chalmers
Program Manager – Reuse
Metropolitan Water District

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AGENDA

I.	Planning for Water Reuse	Alan Rimer
II.	Treatment Technologies and Costs	Jason Curl
III.	Institutional Barriers and Permitting Challenges to Water Reuse	Bruce Chalmers

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ASK THE EXPERTS

Alan Rimer
EnviroTechNovations LLC

Jason Curl
Hazen and Sawyer

Bruce Chalmers
Metropolitan Water District

Enter your **question** into the **question pane** on the right-hand side of the screen.

Please specify to whom you are addressing the question.

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EnviroTechNovations LLC

PLANNING FOR WATER REUSE

Alan Rimer
Vice President – Water Reuse
EnviroTechNovations, LLC
alanrimer@outlook.com

Retired from Black & Veatch where I managed the water reuse practice

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AGENDA
WHAT MAJOR TOPICS ARE WE DISCUSSING

Water reuse planning has many facets:

- Why water reuse is important
- Planning challenges
- Creating the new water resource (reclaimed water)
- Applications for reclaimed water

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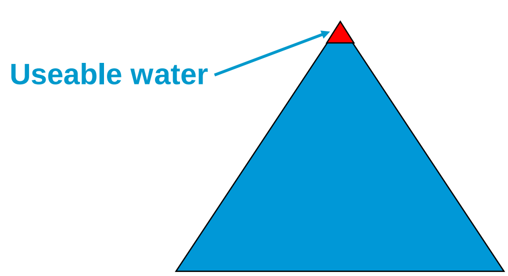
WATER – SCARCER THAN YOU THINK!

- Water is a scarce commodity. Of the world's available water (about 36,000,000,000,000,000,000 gallons) only 0.25 to 0.3% is useable for consumption, agricultural or industrial use (United Nations)



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WATER USE PATTERNS IN THE US

Water Use:

- Thermoelectric generation - 47%
- Irrigation – 34%
- Public water supplies – 11%
- Industrial – 6%
- Mining – 1%
- Livestock – 1%

Of these, irrigation is the most consumptive (81%) thus reducing water for reuse somewhere else

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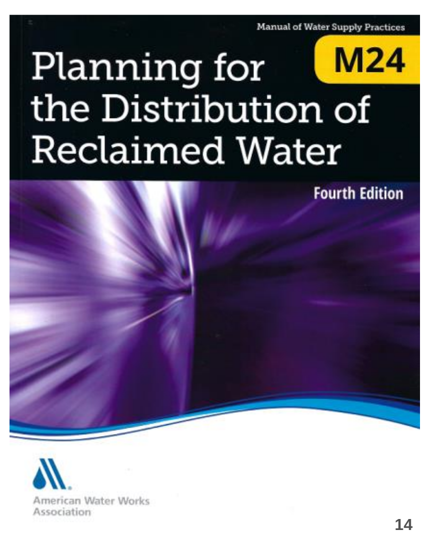
PLANNING – THE KEY TO SUCCESS

The new AWWA M24 manual has lots of information dedicated to understanding and planning for the use of reclaimed water – its not just about distribution!



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BACKGROUND

Throughout the world, many communities have adopted water conservation (a form of forced sustainability!)

Now, as communities reach the limits gained through water through conservation, reuse becomes a necessity

Reclaimed water now becomes a new "water resource" and fits nicely into a Total Water Management strategy

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BACKGROUND
(CONTINUED)

- Water conservation is increasing as water supplies become stressed. In my home state of North Carolina that is no exception
- Two major droughts were a reality check. One major city almost ran out of water
- In many states, like NC, FL, CA and others, consideration of the use of reclaimed water has been mandated for all water supply planning projects

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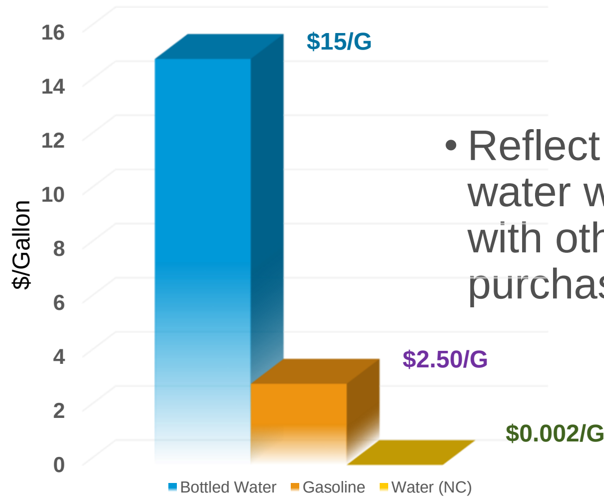
BUT WE DON'T VALUE WATER SO WHY REUSE IT?



- Reflect on the cost of water when compared with other consumer purchases

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"WHAT – ME WORRY?" – A. E. NEWMAN, 1972

- Unlike Alfred E. Newman, we all really must be concerned about our water resources
- Business as usual will simply not cut it as investors and regulators push for changes and externalities such as climate change force that reality
- Moral: plan for water reuse

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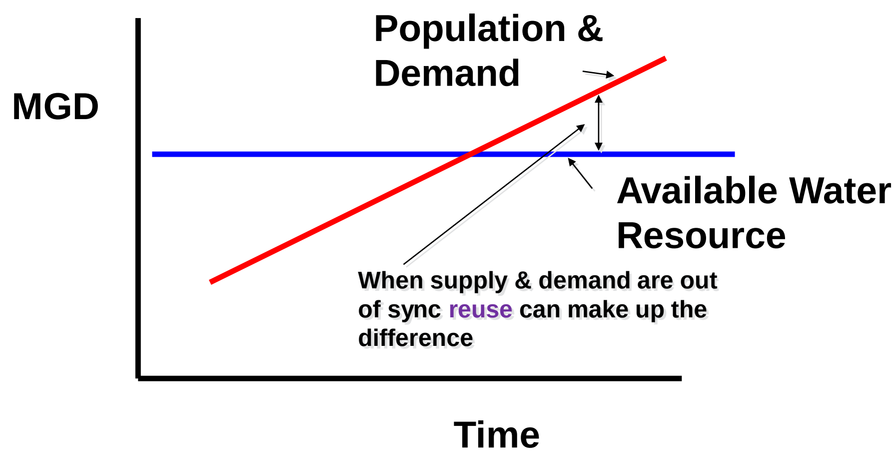
WHY IS WATER REUSE IMPORTANT?



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WHAT DRIVES REUSE:

- Demand exceeds sustainable supply
- Drought
- TMDLs/Nutrient load caps
- Climate change
- "Conventional" planning methods have not caught up with supply needs
- Little regulatory attention to an integrated water resource management approach

All Lead to "Water Scarcity"

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PLANNING CHALLENGES

- Population increase
- Public pressure
- Environmental Pressure
  - Potable Water Supplies
  - Water Quality
  - Stream Flow
  - Climate Change
- Sustainable Solutions Require:
  - Technical Capacity
  - Managerial and personnel capacity
  - Financial and managerial capacity
  - Regulatory initiatives
  - Public buy-in

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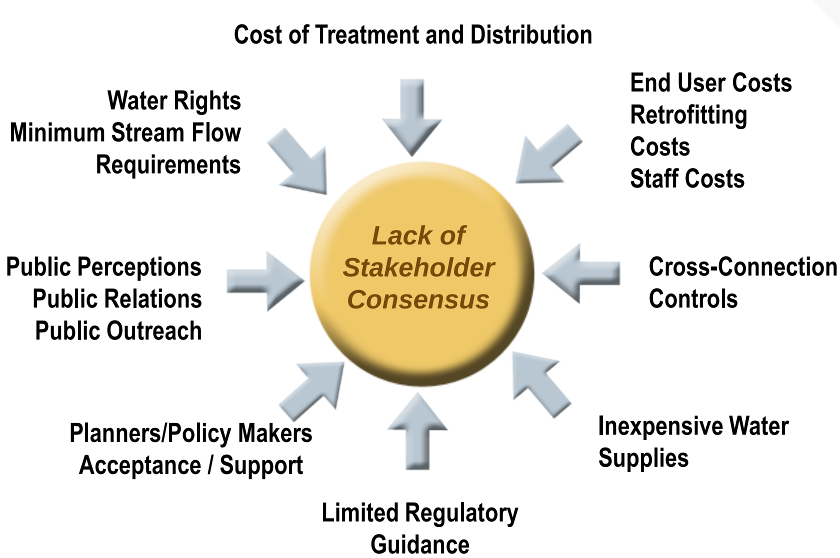
PLANNING CHALLENGES - CONTINUED



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WHY REUSE WATER?

- Reduces potable water demand
- Conserves/protects groundwater resources
- Reduces nutrient loadings to rivers & estuaries
- Generally less expensive than other water supply alternatives
- Delays development of new water resources
- Delays implementation of expensive potable water plant construction (or upgrades)

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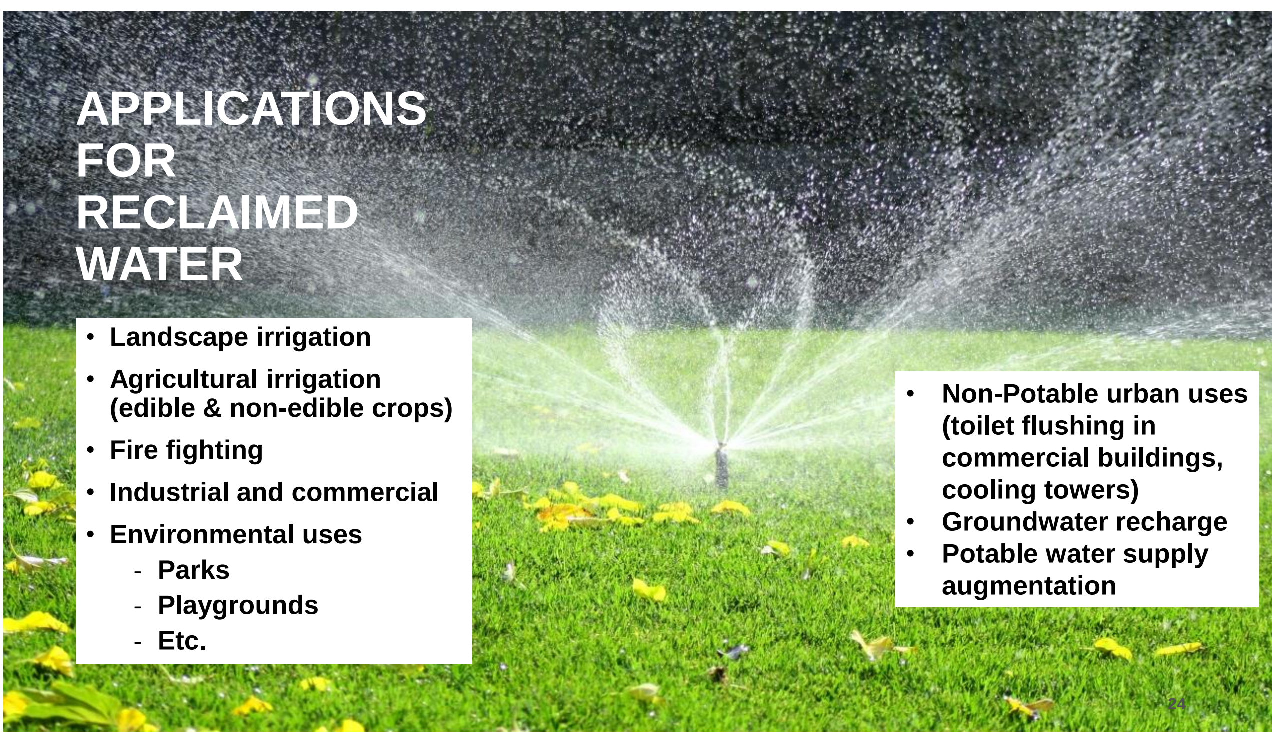

APPLICATIONS FOR RECLAIMED WATER

- Landscape irrigation
- Agricultural irrigation (edible & non-edible crops)
- Fire fighting
- Industrial and commercial
- Environmental uses
  - Parks
  - Playgrounds
  - Etc.

- Non-Potable urban uses (toilet flushing in commercial buildings, cooling towers)
- Groundwater recharge
- Potable water supply augmentation

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CREATING THE WATER RESOURCE (RECLAIMED WATER)

- The steps to water resources sustainability
  - First understand the long-range water resource demands in the community
  - Develop thoughtful water conservation regulations to reduce demands
  - Educate consumers on water conservation
  - Estimate the part that reuse can play

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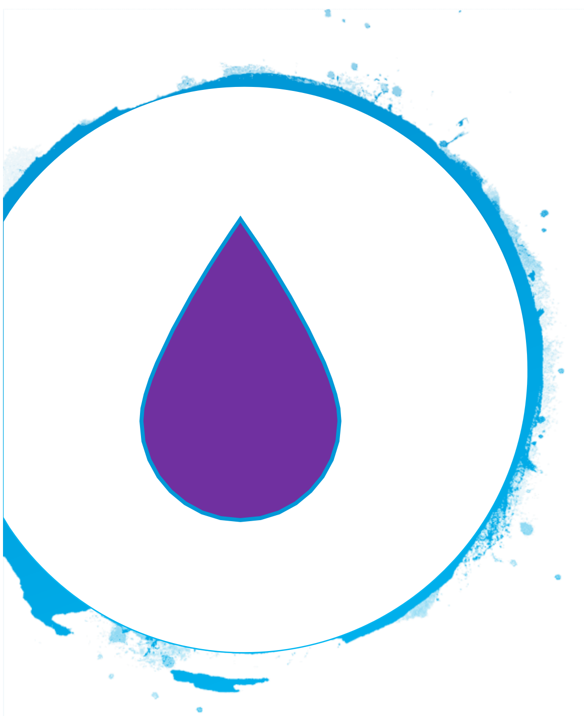

CREATING THE WATER RESOURCE (CONTINUED)

  - Develop reclaimed water resource using best practices
  - Evaluate reclaimed water resource and community's sustainability profile
- Two major types of reuse facilities
  - Add-on to an existing wastewater treatment facility
  - Construct a new satellite facility
    - Newest technology is the satellite facility
    - Small footprint using membrane technologies

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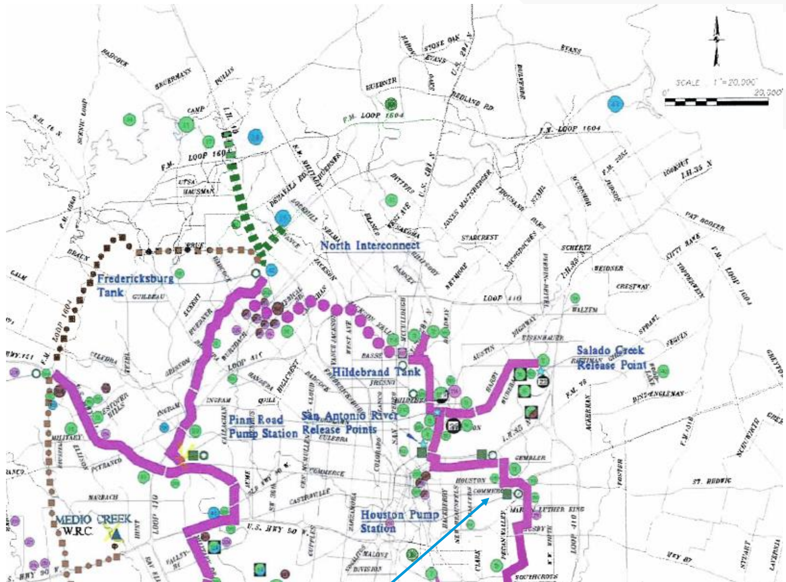
LOCATE EACH POTENTIAL CUSTOMER



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DETERMINE DEMAND VARIATIONS

- Determine customer demands
- Consider yield to meet annual and monthly demand
- Irrigation peak > industrial peak
- Provide system storage or limit supply
- Consider requiring customers to provide storage
- Charge a rate based on time-of-day or peak rate

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BENEFITS OF RECLAIMED WATER

- Dependable source of supply
- Locally controlled
- Environmentally friendly
- Generally lower capital costs
- Augments existing supplies

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CONCLUSIONS

- Reclaimed water IS a water resource
- Reclaimed water can be used for many previously defined uses and is most often cheaper than developing traditional water supplies
- System design has its complications due to variable demand factors by time-of-day and customer type
- Public acceptance is critical to increased water reuse, as we heard earlier this afternoon
- Water reuse IS the **sustainable** future for water supplies

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How about some reused ice? It's all gone here!

Alan Rimer
alanrimer@outlook.com

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ASK THE EXPERTS

Alan Rimer
EnviroTechNovations LLC

Jason Curl
Hazen and Sawyer

Bruce Chalmers
Metropolitan Water District

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Hazen

TREATMENT TECHNOLOGIES AND COSTS

Jason Curl
Regional Reuse Practice Lead
Hazen and Sawyer

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AGENDA

- Types of Reuse Applications in Practice
  - Non-Potable
  - Small Scale
  - De-Facto
  - Potable
- Treatment Technologies
  - Reverse Osmosis-based
  - Carbon-based
- Cost Considerations
  - Capital
  - O&M
- Conclusions

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TYPES OF REUSE APPLICATIONS

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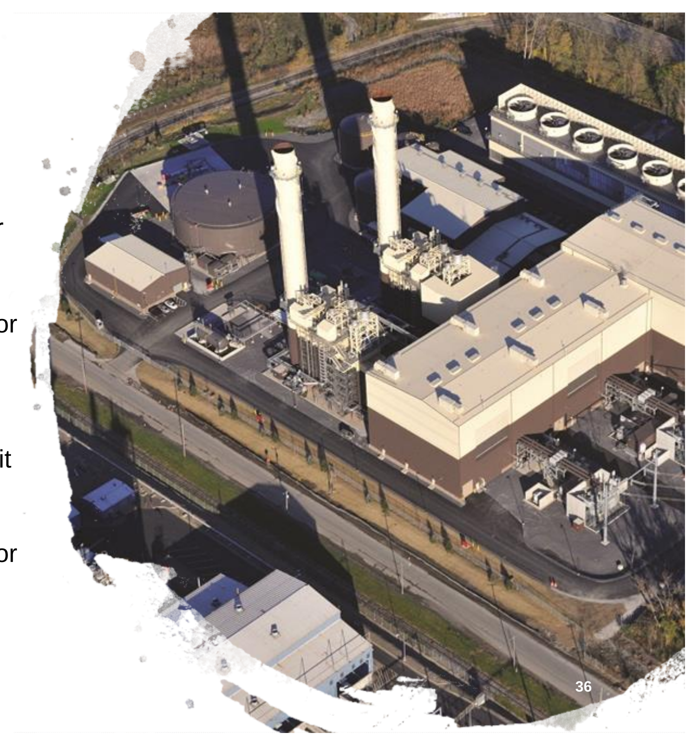
NON-POTABLE REUSE

- Non-potable reuse refers to recycled or reclaimed water that is not used for drinking but is safe to use for irrigation or industrial processes.
- Industrial
  - Use of treated municipal wastewater for industrial facilities (cooling towers)
  - Reuse of water within facilities (washdown, cycling cooling water, production processes)
  - Sometimes an industrial discharge limit encourages this practice
- Irrigation
  - Use of treated municipal wastewater for parks, golf courses, zoos
  - Decentralized reuse at buildings
- Regulations vary from state to state



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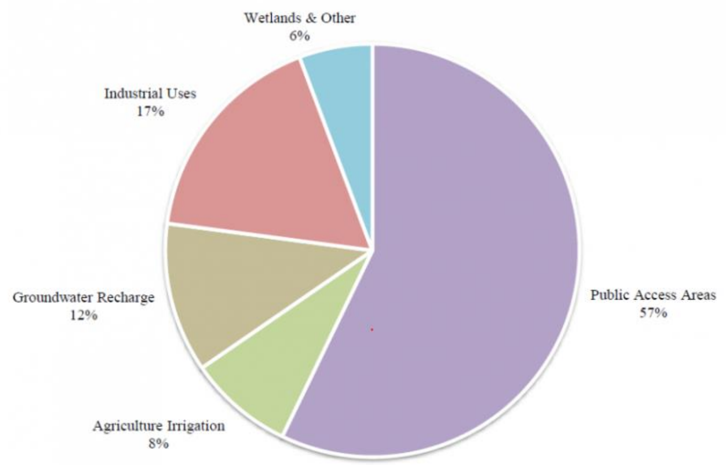
REUSE IS BEING PRACTICED WIDELY

Florida, for example…

- "Approximately 820 million gallons per day (mgd) of reclaimed water were used for beneficial purposes in 2019."
- "…average per capita reuse of 38.66 gallons per day per person."



Source: https://floridadep.gov/water/domestic-wastewater/content/floridas-reuse-activities

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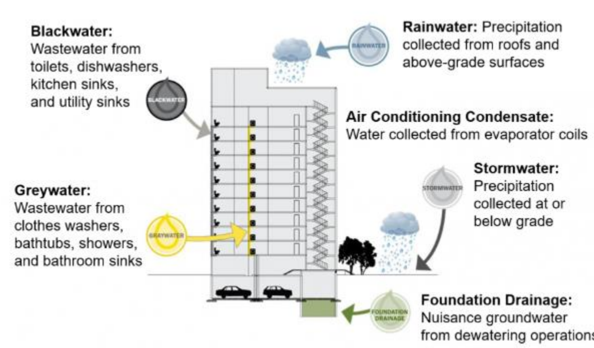
OTHER NON-POTABLE REUSE APPLICATIONS

- Reuse in buildings
  - Greywater
  - Blackwater
  - Rainwater/Green Roofs
- Small community systems
  - May be done effectively because of the small scale and the ability to "right-size"
  - Also see Scruggs et al. "Potable Water Reuse in Small Inland Communities: Oasis or Mirage?" Journal AWWA, Volume 112, Issue 4 (April 2020), Pages 10-17



Source: https://www.epa.gov/water-research/onsite-non-potable-water-reuse-research

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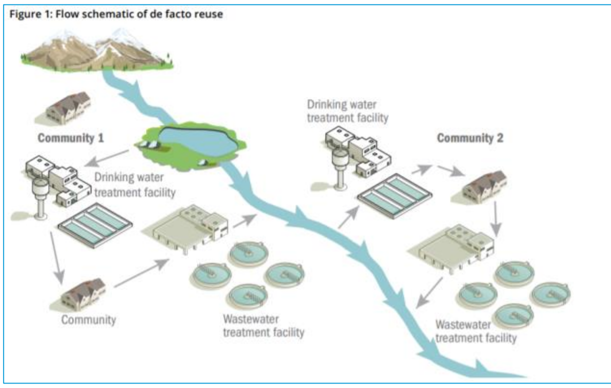
WHAT IS DE-FACTO REUSE?

- De-Facto Reuse occurs when downstream communities use surface water as a drinking water source that has been subjected to upstream wastewater discharges (Figure 1). Sometimes referred to as "unplanned reuse."
- Potable reuse refers to recycled or reclaimed water that is safe for drinking. Sometimes referred to as "planned reuse."

Figure 1: Flow schematic of de facto reuse



Source: https://www.awwa.org/Portals/0/AWWA/ETS/Resources/PotableReuse101.pdf?ver=2018-12-12-182505-710

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POTABLE REUSE

- Indirect Potable Reuse (IPR) introduces purified water into an environmental buffer (e.g., a groundwater aquifer or a surface water reservoir, lake, or river) before the blended water is introduced into a water supply system (Figure 2).
- Direct Potable Reuse (DPR) introduces purified water directly into an existing water supply system (Figure 3).

Figure 2: Flow schematic of indirect potable reuse

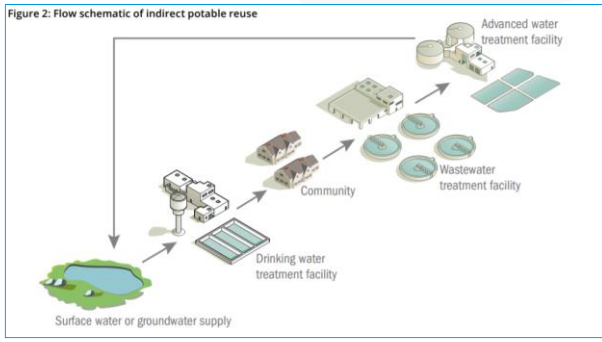
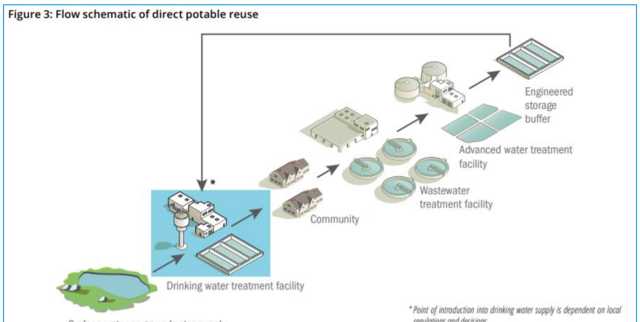


Figure 3: Flow schematic of direct potable reuse



Source: https://www.awwa.org/Portals/0/AWWA/ETS/Resources/PotableReuse101.pdf?ver=2018-12-12-182505-710

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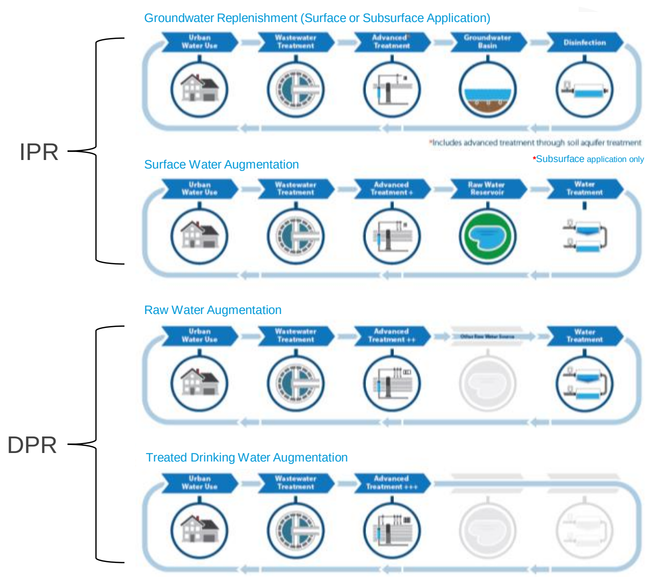
TREATMENT TECHNOLOGIES

TREATMENT TECHNOLOGY CONSIDERATIONS

Considerations

- "Source" of water
  - Secondary treated municipal effluent
  - Tertiary treated municipal effluent (often includes filtration and extra disinfection)
- Regulatory landscape
- Water quality goals
  - Multiple barrier approach
- Monitoring performance
  - Log removal of key microorganisms
  - Total Organic Carbon (TOC) removal
  - Compounds of Emerging Concern (CEC) removal



California WaterReuse Action Plan, July 2019

TREATMENT TECHNOLOGIES

- So, what are the treatment technologies used for potable reuse?

RO Based Systems

Carbon Based Systems

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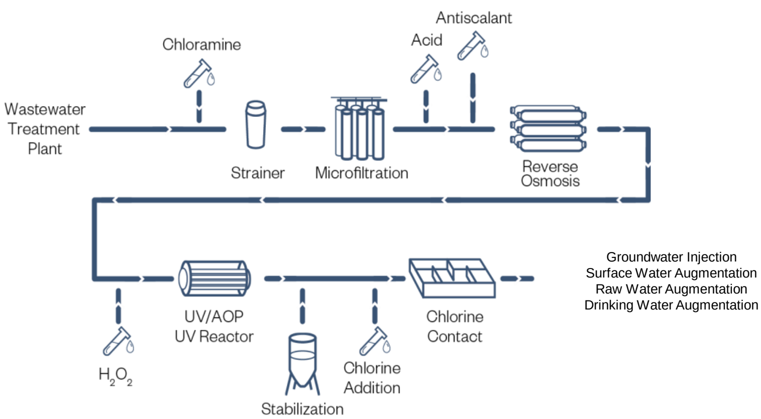
TREATMENT TECHNOLOGIES – RO BASED



Common in California – effectively mandated for groundwater injection & surface water augmentation.

Driven by requirement to remove dissolved salts.

RO brine disposal a challenge for inland facilities.

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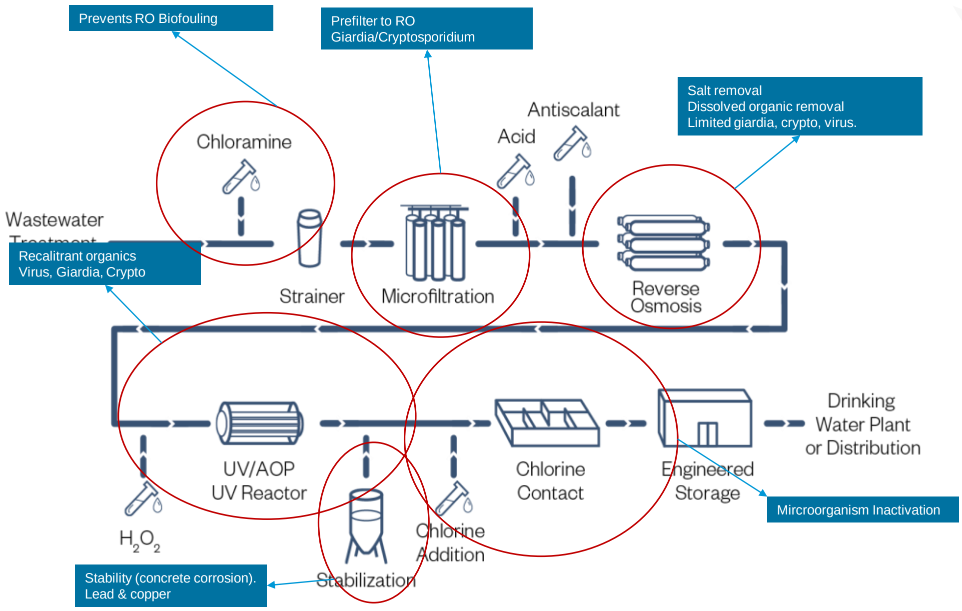
TREATMENT TECHNOLOGIES – RO BASED



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EXAMPLE RO BASED REUSE FACILITIES

Project	Geographic Location	Type of Potable Reuse	Year First Operational	Capacity	Treatment Process
West Basin Water Recycling Plant, CA	Coastal	GW recharge via direct injection	1993	18 mgd	MF-RO-UVAOP
Scottsdale Water Campus, AZ	Inland	GW recharge via direct injection	1999	20 mgd	MF-RO-Cl2
NEWater, Singapore	Coastal	Surface water augmentation	2000	146 mgd (5 plants)	MF-RO-UV Dis
Los Alamitos Seawater Intrusion Barrier, Long Beach, CA	Coastal	GW recharge via direct injection	2006	3 mgd	MF-RO-UV Dis
Groundwater Replenishment System, Orange County, CA	Coastal	GW recharge via direct injection and spreading basins	2008	70 mgd	MF-RO-UVAOP-SAT (spreading basins for a portion of flow)
Western Corridor Recycled Water Scheme, Queensland, Australia	Coastal	Surface water augmentation	2009	66 mgd (3 plants)	MF-RO-UVAOP
Cloudcroft, NM	Inland	Direct potable reuse through spring water augmentation	2009	0.1 mgd	MF-RO-UVAOP
Big Spring Reclamation Project, TX	Inland	Direct potable reuse through raw water blending	2013	1.8 mgd	MF-RO-UVAOP

BAC - Biologically activated carbon filtration; Cl2 - Chlorine disinfection; Coag - Coagulation; DAF - Dissolved air flotation; Floc/Sed - Flocculation followed by sedimentation; GAC - Granular activated carbon adsorption; GMF - Granular media filtration; H2O2 - Hydrogen peroxide; MF - Microfiltration; O3 - Ozone; RO - Reverse osmosis; UF - Ultrafiltration; UVAOP - Ultraviolet advanced oxidation process; UV Dis - Ultraviolet Disinfection

Source: Schimmoller, L. and Kealy M.J. "Fit for Purpose Water: The Cost of Overtreating Reclaimed Water," WateReuse Research Foundation, 2014

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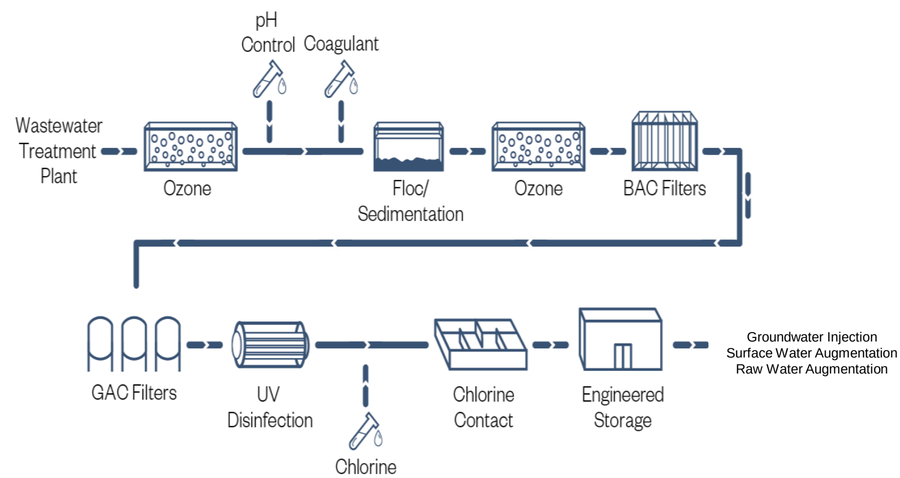
TREATMENT TECHNOLOGIES – CARBON BASED



Utilized where salinity levels in municipal effluent may be lower, or advanced treated water will be blended.

No brine disposal issue from RO. Strong driver in inland facilities.

Dissolved organic removal spread across multiple barriers.

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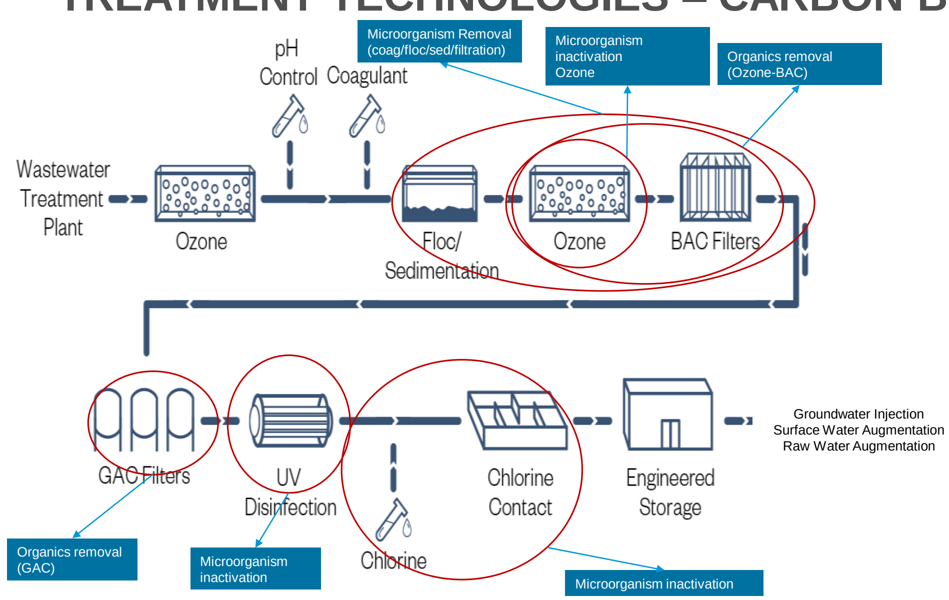
TREATMENT TECHNOLOGIES – CARBON BASED



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EXAMPLE CARBON BASED REUSE FACILITIES

Project	Geographic Location	Type of Potable Reuse	Year First Operational	Capacity	Treatment Process
Windhoek, Namibia	Inland	Direct potable reuse	1968	5.5 mgd	O3-Coag-DAF-GMF-O3/H2O2-BAC-GAC-UF-Cl2
Upper Occoquan Service Authority, Centreville, VA	Inland	Surface water augmentation	1978	54 mgd	Lime-GMF-GAC-Cl2
Hueco Bolson Recharge Project, El Paso, TX	Inland	GW recharge via direct injection and spreading basins	1985	10 mgd	Lime-GMF-O3-GAC-Cl2
Gwinnett County, GA	Inland	Surface water augmentation	2000	60 mgd	Coag-Floc/Sed-UF-O3-GAC-O3

BAC - Biologically activated carbon filtration; Cl2 - Chlorine disinfection; Coag - Coagulation; DAF - Dissolved air flotation; Floc/Sed - Flocculation followed by sedimentation; GAC - Granular activated carbon adsorption; GMF - Granular media filtration; H2O2 - Hydrogen peroxide; MF - Microfiltration; O3 - Ozone; RO - Reverse osmosis; UF - Ultrafiltration; UVAOP - Ultraviolet advanced oxidation process; UV Dis - Ultraviolet Disinfection

Source: Schimmoller, L. and Kealy M.J. “Fit for Purpose Water: The Cost of Overtreating Reclaimed Water,” WateReuse Research Foundation, 2014

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COST CONSIDERATIONS

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MANY CONSIDERATIONS ARE IN PLAY, BUT COSTS MATTER TOO!

Terms to know

- Construction – typically considered the contractors "bid" for the project
- Capital – includes construction cost plus engineering, permitting, land acquisition, etc.
- Operations and Maintenance (O&M) – electricity, staff salaries, chemicals, solids hauling, equipment maintenance, membrane replacement, GAC replacement, etc.
- Life Cycle (net present value) – Capital Cost plus the sum of O&M costs over the expected useful life of the facility, accounting for time value of money (interest rate, inflation)
- Escalation – Considering how much money will be needed at a certain point in time (escalation to midpoint of construction)

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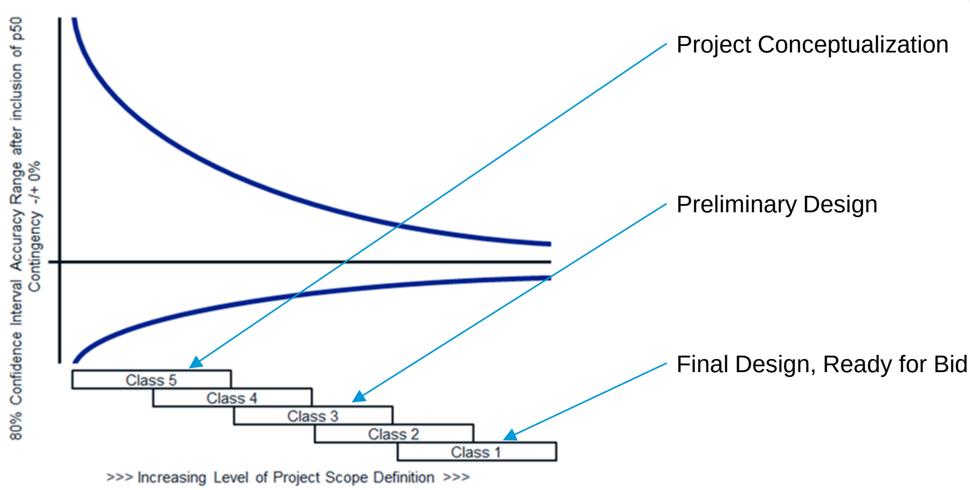
WHAT IS THE "CLASS" OF A COST ESTIMATE?

AACE INTERNATIONAL



Source: AACE International - http://library.aacei.org/pgd01/pgd01.shtml

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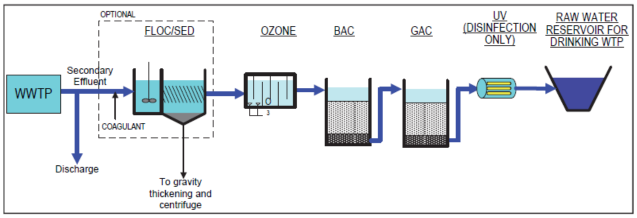
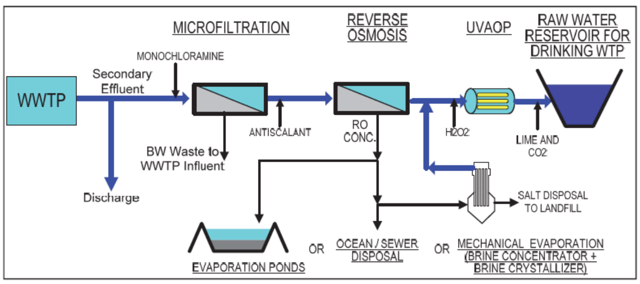
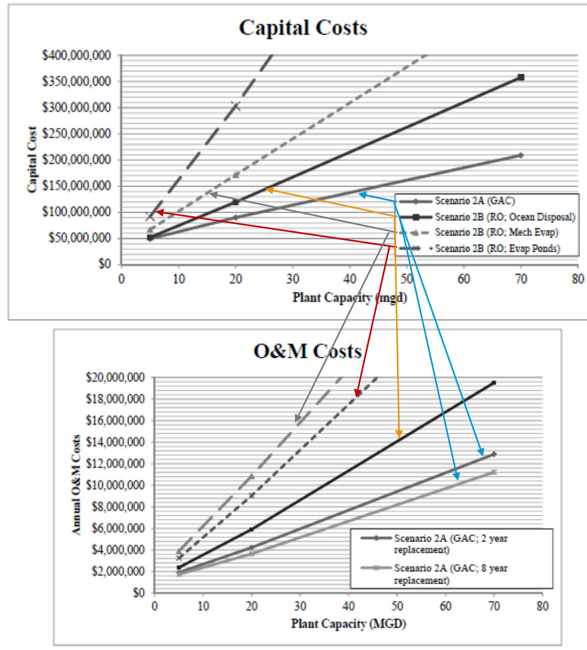
EXAMPLE COSTS







Source: Schimmoller, L. and Kealy M.J. "Fit for Purpose Water: The Cost of Overtreating Reclaimed Water," WateReuse Research Foundation, 2014

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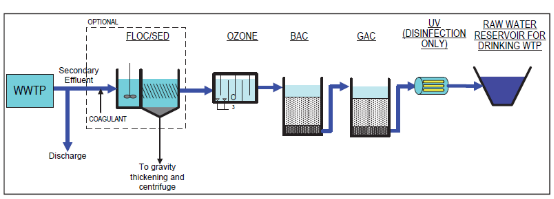
EXAMPLE COSTS



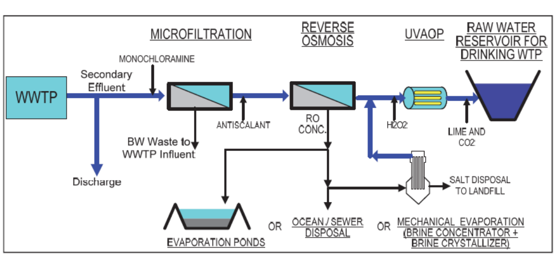


Table 4.8. NPV Results for Scenario 2: Potable Reuse ($2012; 3% discount rate)

	Treatment Trains			
Flow	**2A (GAC-Based)**	**2B1 (RO-Based w/ Ocean Disposal)**	**2B2 (RO-Based with Mechanical Evaporation)**	**2B3 (RO-Based with Evaporation Ponds)**
Financial NPV (Capital and O&M costs)				
5 mgd	$80,960,000	$92,170,000	$ 133,430,000	$145,240,000
20 mgd	$161,140,000	$219,925,000	$ 358,190,000	$449,570,000
70 mgd	$428,970,000	$ 690,610,000	$ 1,128,780,000	$ 1,556,730,000

Source: Schimmoller, L. and Kealy M.J. "Fit for Purpose Water: The Cost of Overtreating Reclaimed Water," WateReuse Research Foundation, 2014

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EXAMPLE COSTS (CONTINUED)

TABLE 4. Total Capital Costs for the Combined Process Trains

	Process Trains and Capital Costs[a] ($M)				
Capacity (MGD)	O_3-BAC	MF-O_3-BAC	MF-RO	MF-RO-UV/H_2O_2	MF-O_3-RO (O_3-MF-RO)
1	$5.2	$9.0	$11	$11	$13
5	$11	$24	$38	$40	$42
10	$16	$38	$65	$69	$71
25	$31	$75	$132	$142	$142
50	$50	$126	$226	$245	$240
80	$71	$180	$327	$356	$344

Notes: [a]Capital costs include contractor OH&P and contingency.

TABLE 5. Total Annual O&M Costs for the Combined Process Trains

	Process Trains and Annual O&M Costs ($M)				
Capacity (MGD)	O_3-BAC	MF-O_3-BAC	MF-RO	MF-RO-UV/H_2O_2	MF-O_3-RO (O_3-MF-RO)
1	$0.1	$0.4	$0.5	$0.6	$0.5
5	$0.3	$1.4	$2.6	$2.7	$2.6
10	$0.6	$2.4	$4.8	$5.1	$4.8
25	$1.4	$5.1	$11	$11	$11
50	$2.8	$9.0	$19	$21	$19
80	$4.0	$13	$29	$31	$29

Source: Plumlee et al. "Cost of Advanced Treatment in Water Reclamation," Ozone: Science & Engineering: the Journal of the International Ozone Association, 2014

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WRAP UP

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SUMMARY AND CONCLUSIONS

- Potable reuse is a viable option for many communities
  - Not just a solution in arid regions, or coastal regions
- Much research is ongoing, but there are also many long-term operations that have successfully demonstrated potable reuse
- Know your customers and their potential concerns
- Leverage the industry knowledge to inform your decisions
- Many resources, including AWWA, are available to you
- Know your regulatory environment, which differs state to state

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THANK YOU!

JASON CURL
JCURL@HAZENANDSAWYER.COM

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ASK THE EXPERTS

Alan Rimer
EnviroTechNovations LLC

Jason Curl
Hazen and Sawyer

Bruce Chalmers
Metropolitan Water District

Enter your **question** into the **question pane** on the right-hand side of the screen.

Please specify to whom you are addressing the question.

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INSTITUTIONAL BARRIERS AND PERMITTING CHALLENGES TO WATER REUSE

Bruce Chalmers

Program Manager

Metropolitan Water District of Southern California

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AGENDA

- Introduction
- Benefit/Risks
- Management
- Project Development and Execution
- Regulatory Acceptance
- Miscellaneous
- Schedule
- Summary

Groundwater Replenishment System Reverse Osmosis Building. Courtesy of Larny Mack Photography 61

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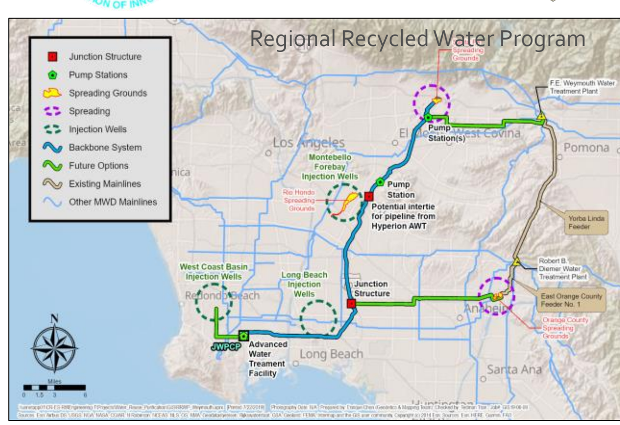
INTRODUCTION

- Reuse Experience (since 1998 - 2019)
  - GWR System (OCWD) – completed in 2007, 70 mgd
  - Leo J. Vander Lans WTP (Water Replenishment District) – 8 mgd/ two phases, completed in 2015
- Metropolitan Water District
  - MWD (2019 - Present)
  - Regional Recycled Water Program
  - 150 mgd/2 phases for potable reuse
- Implement the RRWP
  - Program vision & leadership
  - Agency coordination
  - Budgets/staffing/schedule



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BENEFITS/RISKS

PROJECT BENEFITS

RISK MANAGEMENT

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PROJECT BENEFITS

Primary Project Benefits	Orange County GWR	WRD Vander Lans WTP	Proposed MWD RRWP
New, reliable source	✓	✓	✓
Local, sustainable resource	✓	✓	✓
Lower groundwater salinity	✓		
Seawater intrusion barrier	✓	✓	
Maintain high basin production	✓		✓
Use less energy than imported	✓	✓	✓
Reduce discharges to ocean	✓		✓
Raw Water Augmentation			✓

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RISK MANAGEMENT

Administrative Risks	Technical Risks
Obtaining Board Approval	Water quality
Economic impacts of COVID-19	Selection of AWT treatment processes
Commitment from customers/partners	Optimum pipeline alignments
Staffing and stability	Conveyance pipeline ROW
Public acceptance - DPR	Environmental documentation/mitigation
Public acceptance - NIMBY	Obtaining regulatory approval/permits
Cost/Funding/Cash flow	Quality contract documents
Reduced water demands	New technologies
Program costs/scope creep	Timely decision to implement DPR

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MANAGEMENT

AGENCY SUPPORT

AGENCY IMPACTS

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AGENCY SUPPORT

Project Support

- Does the Project have sufficient support?
  - Board, GM, Senior Management Support/Staffing
  - Rate payers, community, NGOs
- Ownership: Water Agency vs Wastewater Agency
- Is funding available & from whom?
- Project needs to stand on its own merit
  - Economics (as compared to what?)
  - Benefits (reliability, TDS reduction, energy savings)

Agreements

- Inter-agency Agreements
  - Number of agreements/LOI/MOU
  - Previous Working Relationships
  - Mutual Benefits
  - Contract Term
  - Impacts to partners, facilities or operations
- What types of issues are covered?
  - Source water (maximum/minimum flows, water quality, reject streams)
  - Shared facilities (site, connections)
  - Operations (upsets, cross training)
  - Financing (capital, O&M)

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AGENCY SUPPORT

- Collaboration with interested agencies
- Joint technical studies
- Future purified water purchase
- Potential funding
- Regional partners
- Agreements
  - Letters of Intent (LOI)
  - Memorandum of Understanding (MOU)
  - Formal Agreements
- RRWP example

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AGENCY SUPPORT LOS ANGELES COUNTY SANITATION DISTRICTS

- Project Coordination
- Technical reports and studies
- AWT site remediation
- Source water pipelines
- WQ sampling
- AWT site CEQA
- Cost sharing contribution

- Main agency partner in the RRWP
- MOU in 2010 for collaboration on pilot studies/feasibility reports
- Agreement signed in 2015 for the demonstration & full scale projects
  - Site for the AWT
  - Demonstration Plant support
  - Assisting on nitrification removal investigations
- LACSD is currently investigating incorporation of secondary MBR treatment
- Preparing an amendment to the 2015 agreement for PEIR phase
  - Environmental documentations, engineering support, public outreach

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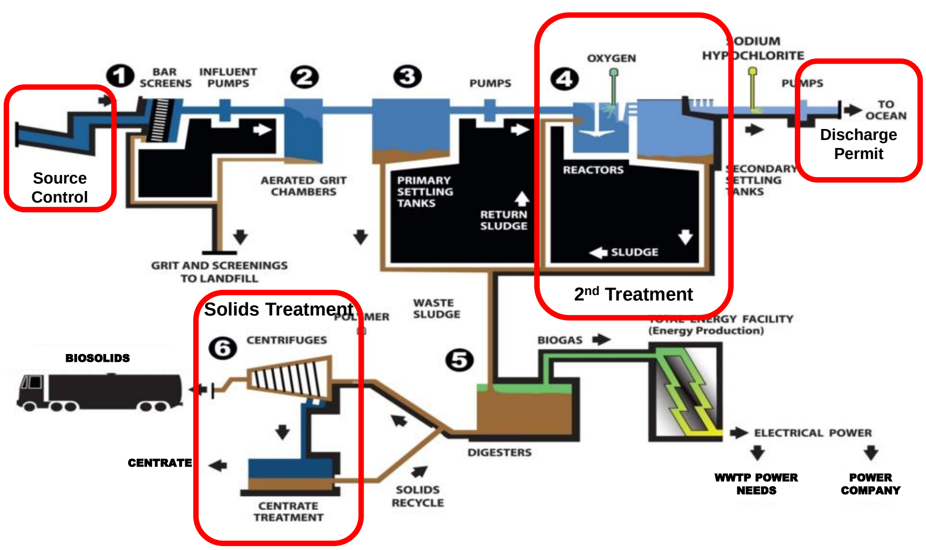
AGENCY IMPACTS

Source Control Program
- WQ, permits, discharges, monitoring

Planning Impacts
- Pumping, collection areas, diversions

Facility Impacts
- Secondary treatment, connections, nutrient management

Operational Impacts
- Recycle streams, polymers



Courtesy of LACSD

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PROJECT DEVELOPMENT & EXECUTION

PROJECT GOALS

PROJECT PLANNING AND DESIGN

PILOT & DEMONSTRATION TESTING

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PROJECT GOALS

Goal Setting	Common Reuse Goals
• Project goals often mirror project benefits • Goals should be specific for your project • Lead agency and stakeholders should agree on the goals • Goals should be broad enough to not limit good ideas • Goals can change over time • All projects should protect public health • Should you consider DPR?	• Provide a new local source of reliable, high quality, and climate-change resilient water • Diversify water supply sources and supply to meet future demands • Increase regional water reserves • Contribute to groundwater basin water quality benefits • Fully functional and cost-effective, stand-alone project • Meet future regulations

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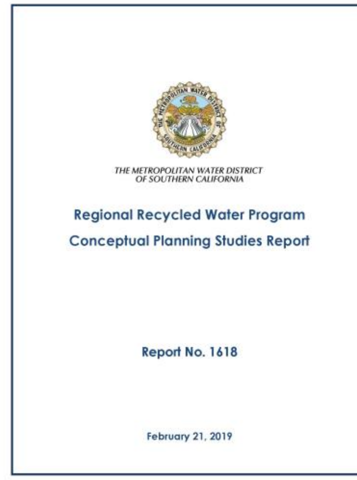
PROJECT PLANNING AND DESIGN

- Feasibility Study proves the project is achievable
- Conceptual Report defines the needed project facilities
- Environmental documentation (Alternatives, mitigation measures, NIMBY)
- Project criteria definition
  - Base assumptions – water quality, flows, source water, demands
  - Treatment processes – TDS, nitrogen, phosphorus, boron, CECs
  - “Recharge” facilities – ponds, injection wells, reservoir, potable WTP, potable water system
  - Residuals management – RO brine, backwash, WWTP return streams
  - Miscellaneous - energy use/supply, permit requirements



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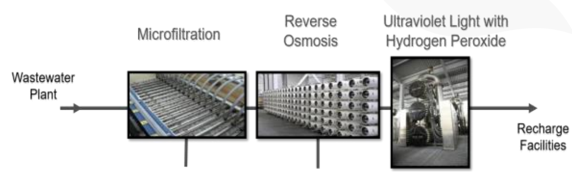
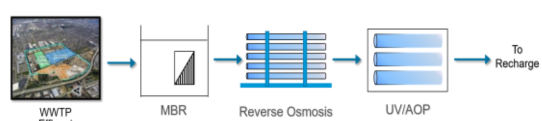
PROJECT PLANNING AND DESIGN

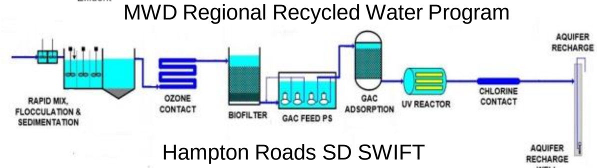
- Owner’s responsibilities – engineers, operators
- Designer’s qualifications - previous projects, quality, teaming arrangements, relationships, price, people
- Facilities/Process Selection – BIM, buildings, redundancy, process control system, LEED
- Product water stabilization – lime, chemicals, blending
- System procurement - pre-purchase/pre-selection of proprietary systems, long lead items, sole source
- Pilot or demonstration testing



OCWD Groundwater Replenishment System



MWD Regional Recycled Water Program



Hampton Roads SD SWIFT

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PILOT AND DEMONSTRATION TESTING

- Why would I want to do a Pilot Test?
  - Regulatory Approval
  - Process Selection & Equipment Qualification
  - Process Validation & Optimization
  - Public Outreach
- Types of Pilot Testing
  - Bench scale testing
  - Pilot testing
  - Demonstration testing
  - Full scale testing

Project	Equipment Qualification	Design Criteria	Regulatory Approval	Proof of Process	Process Evaluation	Public Outreach
San Diego	Yes	Yes	Yes	Yes	Yes	Yes
Jacksonville	No	Yes	Yes	Yes	Yes	Yes
Upper Occoquan	No	Yes	Yes	Yes	Yes	No
Hampton Roads	No	Yes	Yes	Yes	Yes	Yes
Miami	Yes	Yes	Yes	Yes	Yes	No
WRD	No	Yes	No	Yes	No	No
Eastern Municipal WD	No	Yes	No	Yes	No	Yes
City of Los Angeles	Yes	Yes	Yes	Yes	No	Yes
Metropolitan	No	Yes	Yes	Yes	Yes	Yes

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CONSTRUCTION

- Keep up with paperwork
- Work as a team to resolve issues
- Accurate Record Drawings

$100 sample pump failure shut down whole plant

- Construction delivery methodology (DBB, DB, self perform)
- Number of contracts - GWR (11), VLWTP (3)
- Comprehensive CM methodology – agency, designer, independent
- Acceptance testing proves performance
- Attention to detail
  - AWTFs are complex and highly automated
  - Small items can cause big problems
- Some problems don't show up immediately

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REGULATORY ACCEPTANCE

REGULATORY AGENCIES

REGULATIONS

DIRECT POTABLE REUSE

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REGULATORY ACCEPTANCE

Required Information

- GW modeling
- Treatment technologies
- Water quality requirements
- Monitoring
- Blending, well protection zone
- Source Control
- Security/safety
- Engineer's Report/BODR

- Start early & build on past experiences/similar projects
- Maintain good relationships
- Operating permit from State regulator:
  - Water Quality Control Board
  - Departments of Environmental Protection

Input from other agencies
  - Health departments
  - Local agencies

- Different agencies interpret regulations differently
- Anti-degradation policy
- Direct potable reuse

CALIFORNIA WATER BOARDS State Water Resources Control Board

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

ENVIRONMENTAL PROTECTION DIVISION

ADEQ Arizona Department of Environmental Quality

DEQ Virginia Department of Environmental Quality

Florida Department of Environmental Protection

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WATER QUALITY REQUIREMENTS

Parameter	GWRS (PH1) (mg/L)	Vander Lans (mg/L)	Big Spring (TX) Wichita Falls (TX)	Hampton Roads (VA)
$CBOD_5$	(20)	(15)	6	N/A
TOC	0.5/RWC	0.5/RWC		N.R.
TSS	(20)	(15)	10	None
TDS	500	500		N/A
Total Nitrogen	5	5		Avg: <5 mg/L Max: 8 mg/L
Total Nitrite + nitrate	3			
Nitrate	3			
Nitrite	1	1		
Ammonia			1	
Phosphorus			0.5	
NDMA (ppt)	10	10		<10 ng/L other CECs as well

(X) Indicates WWTP effluent/AWT influent limit

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MISCELLANEOUS

PROJECT COSTS
FUNDING SOURCES
PUBLIC OUTREACH

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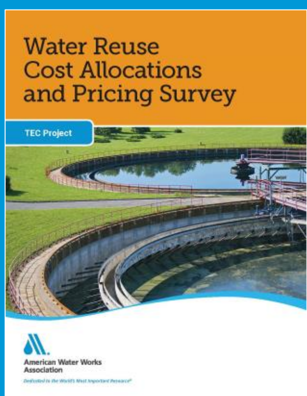
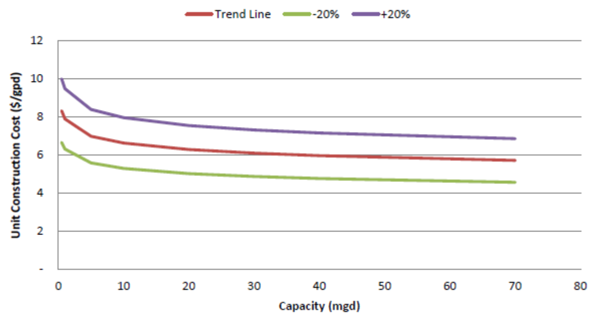
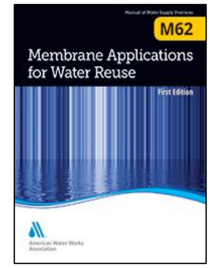
PROJECT COSTS







Potable Reuse Treatment Plant Construction Cost (MF/RO Based Facility, 2018)

- Cost Estimating
  - AWWA - M62 for Membrane Applications in Water Reuse
  - EPA - Drinking Water Treatment Technology Unit Cost Models
  - Vendors/Consultants/historical databases/cost manuals
- Control cost creep
- **No two projects are alike**

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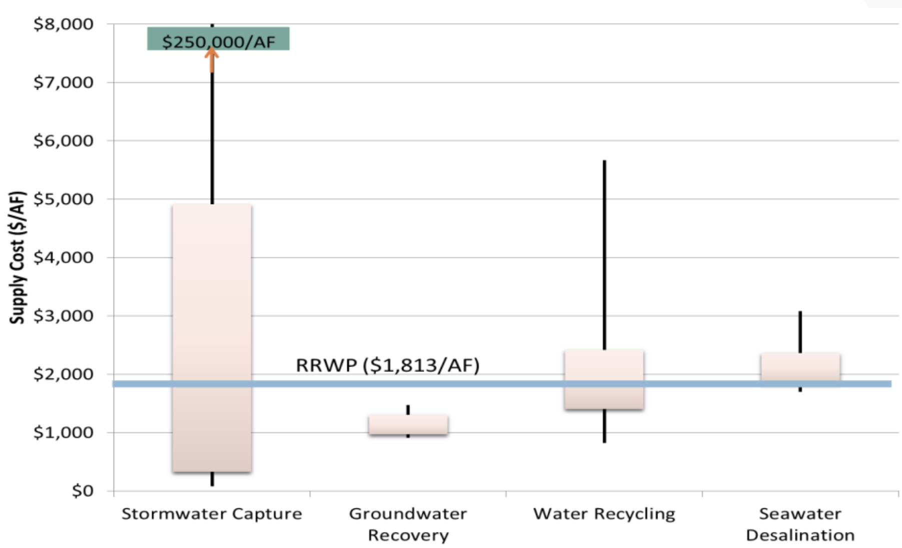
PROJECT COSTS



Source: MWD (2019)

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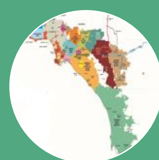
FUNDING

- Grants (Stimulus funds, Bureau of Rec, State bonds, other)
- Partners (OCSD @ $189M)
- Regional Agencies (LRP subsidy from MWD)
- Loans (State Revolving Funds, Federal WIFIA)

Direct Recipients



Everyone

Area Tax Base

Hybrid

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PUBLIC OUTREACH

- Plan, research, execute and evaluate
- Inform the public early, before start-up
- Be active in generating an up-to-date list of supporters with written support letters
- Public education should address:
  - Health and safety, testimonials
  - Women/mothers/elderly are key support groups
  - Face to face meetings work best, don't use jargon
- Key messages:
  - Reliability, sustainability, supplies are threatened, diversity of supply
- Stress multiple safeguards, proven technology & processes are checked continuously for safety

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SCHEDULE

SCHEDULE REQUIREMENTS

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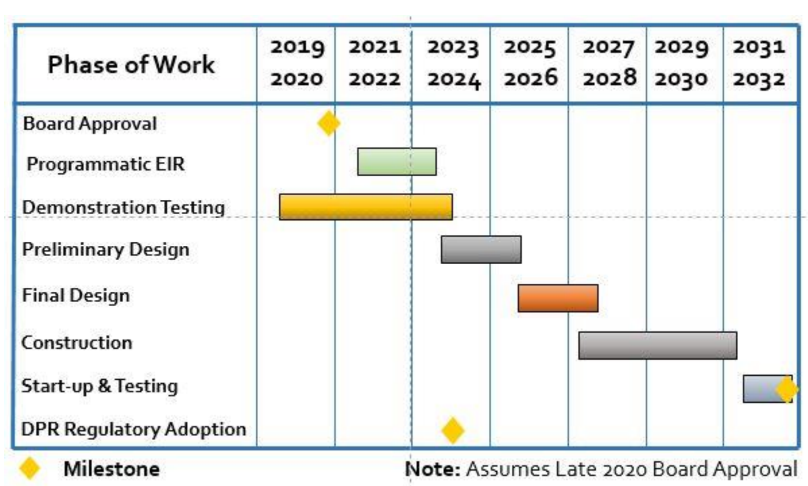
SCHEDULE

- Develop realistic schedule for all phases
- Keep the project on schedule
- Timing is important
- Delays can increase project cost

Regional Recycled Water Program Schedule



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SUMMARY

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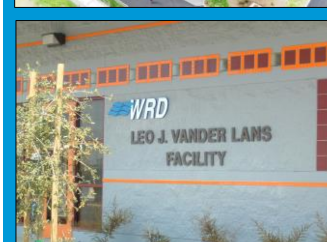
SUMMARY

Pure Water San Diego



- AWTFs are now regularly implemented successfully
- Projects must stand on their own merits
- A supportive Agency management structure is necessary to push the project to completion
- Good relationships and communication are essential for permitting and resolving issues
- Experience and networking provide immeasurable benefit and direction
- Develop a reasonable schedule and keep it
- Even though the cost is significant, the benefits can outweigh the costs
- No matter where you are in the process, its worth it

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QUESTIONS

Additional Resources

AWWA Reuse Committee
AWWA M24 – Planning for the Distribution of Reclaimed Water
AWWA M62 – Membrane Applications for Water Reuse
AWWA et. al. - Framework for Direct Potable Reuse
EPA - Guidelines for Water Reuse
EPA - Water Reuse Action Plan
EPA – Potable Reuse Compendium

https://www.awwa.org/Resources-Tools/Resource-Topics/Reuse
https://www.epa.gov/waterreuse/basic-information-about-water-reuse

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ASK THE EXPERTS

Alan Rimer
EnviroTechNovations LLC

Jason Curl
Hazen and Sawyer

Bruce Chalmers
Metropolitan Water District

Enter your **question** into the **question pane** on the right-hand side of the screen.

Please specify to whom you are addressing the question.

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FINAL CONCLUSIONS

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EMERGING ISSUES

- Major issues
  - Public perception/acceptance
  - Perceived chemical risks
  - The media's understanding of reuse
  - Lack of political support
  - Better understanding of economics
  - Funding
  - Climate Change
  - Energy/Water Nexus

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THE FUTURE

OF WATER REUSE!

- INDIRECT POTABLE REUSE IS INEVITABLE
- INCREASED DESALINATION – BOTH BRACKISH GROUNDWATER AND SEAWATER – ALSO IS INEVITABLE
- EDUCATION & OUTREACH/ STAKEHOLDER INVOLVEMENT IS KEY TO ACCEPTANCE
- SHOULD NOT HOLD RECLAIMED WATER TO A HIGHER STANDARD THAN POTABLE WATER
- EFFICACY OF TECHNOLOGY IS NOT AN ISSUE
- CONCERNS ABOUT EDCS/PHACS, OTHER "MICROCONSTITUENTS" MUST BE ADDRESSED

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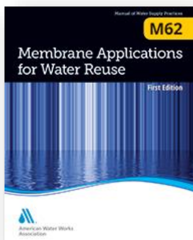
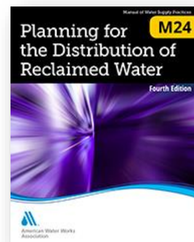
ADDITIONAL RESOURCES

- AWWA's Water Resources Planning & Sustainability Resource Community
- AWWA Reuse Resource Community



M62 Membrane Applications for Water Reuse
AWWA Catalog No: 30062



M24 Planning for the Distribution of Reclaimed Water, Fourth Edition
AWWA Catalog No: 3024-4E

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AWWA
WATER SCIENCE

TOPICAL COLLECTION ON
POTABLE REUSE

AWWA's peer-reviewed research journal, *AWWA Water Science,* has an upcoming topical collection on potable reuse aiming to capture the present state of the science on potable water reuse.

Check out the compilation of articles in October!

awwa.org/reusecollection

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Oct 7 - Adding Utility Benchmarking to Your Continuous Performance Improvement Toolbox

Oct 14 - Applying Real-Time Hydraulic Models to Everyday Operations

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- Until next time, keep the water safe and secure.

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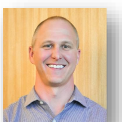
PRESENTER BIOGRAPHY INFORMATION

Alan retired from Black & Veatch several years ago where he managed the firm's water reuse program. He continues to consult for Black & Veatch as well as other public and private clients around the world on water reuse matters. His technical expertise includes studies involving potable and non-potable reuse treatment technologies and he has managed the design of over one billion gallons of water reuse treatment facilities.

Mr. Chalmers has 40 years of design and managerial experience in the fields of water and wastewater engineering. He has been involved in projects encompassing the planning, design, and construction management of water storage and distribution facilities, sewage collection systems, sewage lift stations, water booster stations, chemical systems, and water and wastewater treatment plants. Mr. Chalmers is the Program Manager for the Metropolitan Water District's Regional Recycled Water Program. Mr. Chalmers has extensive large project experience managing multiple firm project teams. Mr. Chalmers has been responsible for the numerous water and sewer projects, including four recycled water plants, including the 70-million-gallonsper-day (mgd) Groundwater Replenishment System (GWRS) for the Orange County Water District, currently the largest Indirect Potable Water recycled water project in the world. Mr. Chalmers has a BS from UCLA and a master's degree in civil engineering from Cal State Long Beach. He is a professional engineer in California, Florida and Nevada.



Jason is a senior associate with Hazen and Sawyer, and has been located in Denver for the duration of his 17 year career. His technical expertise includes drinking water, potable and non-potable reuse treatment technologies and implementation. Jason has been technical lead, project manager and design manager for large and complex projects for dozens of projects throughout the US totalling more than 500 mgd of installed treatment capacity.

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