California DPR Coalition

Jeff Mosher
Carollo Engineers

AZ Water Reuse Symposium
Flagstaff, AZ
July 29, 2019

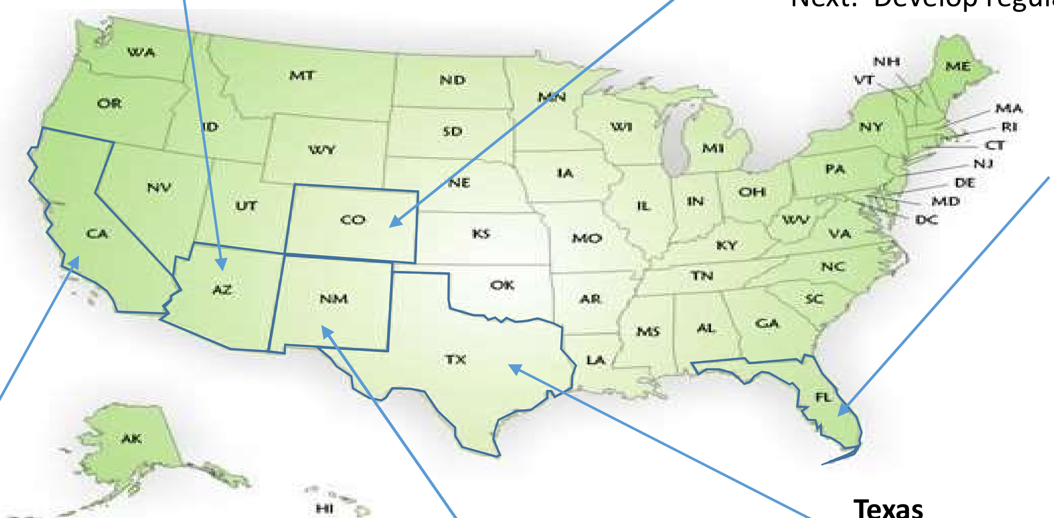
WATER
OUR FOCUS
OUR BUSINESS
OUR PASSION

carollo
Engineers...Working Wonders With Water®

Direct Potable Reuse Progress

Arizona
- WateReuse AZ and AZ Water DPR Initiative
- DPR Guidance Framework process (2018)
- Next: State to develop regulations

Colorado
- WateReuse CO – DPR stakeholder process (technical and outreach)
- Guidance developed
- Next: Develop regulatory approach (use of expert panel)



Florida
- WateReuse FL
  - Potable Reuse Commission
  - Create a Framework for DPR
- Clearwater IPR Project
- Hillsborough DPR Pilot
- Altamonte Springs DPR Pilot
- Daytona Beach DPR Pilot
- JEA DPR Pilots

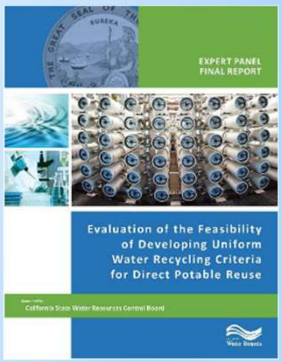
Texas
- TWDB - Direct Potable Reuse Resource Document (2015)
- Big Springs DPR and Wichita Falls DPR (Emergency Supply)
- El Paso DPR (in design)

California
- State Water Board (SWB) process
  - DPR Expert Panel Final Report (12/2016)
  - SWB Proposed DPR Framework (4/2018)
  - 6 DPR research projects
- Long history with IPR
- Legislation: DPR regulations by 2023

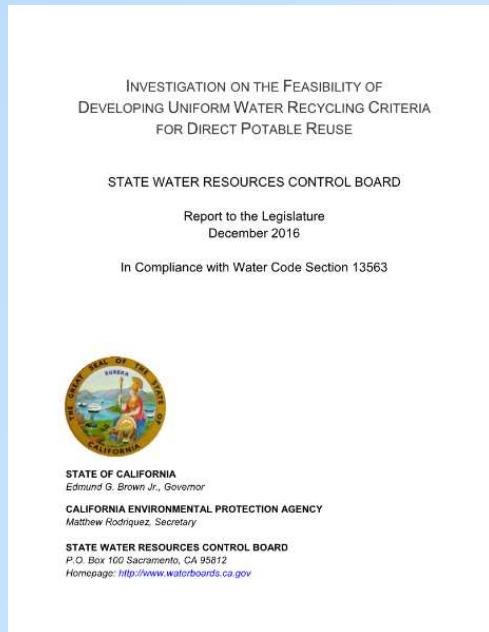
New Mexico
- State sponsored DPR Expert Panel
- State developed guidelines
- Village of Cloudcroft (still not completed)

California DPR Regulatory Development

Expert Panel (2016)



Stakeholder Panel (2016)



INVESTIGATION ON THE FEASIBILITY OF DEVELOPING UNIFORM WATER RECYCLING CRITERIA FOR DIRECT POTABLE REUSE

STATE WATER RESOURCES CONTROL BOARD

Report to the Legislature
December 2016

In Compliance with Water Code Section 13563

STATE OF CALIFORNIA
Edmund G. Brown Jr., Governor

CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY
Matthew Rodriquez, Secretary

STATE WATER RESOURCES CONTROL BOARD
P.O. Box 100 Sacramento, CA 95812
Homepage: http://www.waterboards.ca.gov

Report to CA Legislature (2016)

5 Research Studies
(2018-2021)

(QMRA, pathogens, chemicals, monitoring, surveillance)

DPR Regulation:

- Legislative Deadline – Dec 2023

“California DPR Coalition” – A Guide for California Water Utilities

- Challenge
  - DPR Regulations will not be completed until Dec 2023
  - The 2023 DPR regulations will be for “raw water augmentation” only
  - CA State Water Board Division of Drinking Water (DDW) are not able to comment on specific DPR provisions while regulations are being developed
- Need
  - CA utilities need to plan for DPR
- Solution
  - “A Guide for DPR for California Water Utilities”
  - Address “implementation” topics (not intended to be regulatory)

San Francisco Water Power Sewer

LA DWP Los Angeles Department of Water & Power

Valley Water

VENTURA WATER

SEAL OF THE CITY OF SANTA BARBARA CALIFORNIA

"California DPR Coalition" – A Guide for California Water Utilities

PROJECT TEAM

This Guide was developed by a group of utility leaders and technical specialists under the direction of NWRI, as follows:

NWRI TEAM

- Kevin Hardy, NWRI
- Suzanne Sharkey, NWRI
- Jeff Mosher, Carollo Engineers
- Andrew Salveson, Carollo Engineers
- Adam Olivieri, EOA, Inc.
- Charles Bott, Hampton Roads Sanitation District
- Daniel Gerrity, Southern Nevada Water Authority

3 Interagency Agreements

Potable reuse projects require strong interagency cooperation and responsiveness when different agencies operate the WWTP, the advanced purification treatment facility, and the drinking water treatment facility.

As a result, an interagency agreement or memorandum of understanding between agencies is critical for institutional, planning, management, regulatory, and technical collaboration and cost sharing. These agreements define the roles and responsibilities of multiple utilities and/or jurisdictions and describe the methods the utilities and/or agencies would use to collaboratively plan and implement the DPR project. In general, these agreements can include the following areas:

- Institutional
  - Address separate or different jurisdictions
  - Costs and finance
  - Responsibility for risk and liability
  - Capital improvement programs
  - Project messaging
- Integrated Planning
  - Management responsibilities for water resources
  - Cooperative planning and feasibilities studies
- Technical and Operational
  - Quantity and quality of source
  - Operational responsibilities and requirements
  - Response to system failure and/or interruption
  - Meeting regulatory requirements

FORMING A FOUNDATION FOR SUCCESS

Potable water reuse projects are costly and often result in public challenges, including no-growth concerns, rate impacts, and uncertainty or outright alarm about the concept of potable water reuse. All of these concerns present political challenges, even more so for projects with multiple agencies and jurisdictions. A firm commitment from all participating agencies must be the foundation on which a project is built.

10 Water Quality Management

When introducing a new potable reuse supply, the impact on delivered water quality, distribution system stability, and blending location within the water treatment plant needs to be considered.

Flavor profile analysis (FPA) and consumer panels can be powerful tools to identify and plan for potential changes in the T&O characteristics following introduction of a new DPR supply.

Integration of a new potable reuse supply upstream of an existing drinking water treatment plant (WTP) can impact treatability and plant operations, including the required coagulant dose and optimal type, settled water quality, filter run times, residuals handling, and disinfectant dose and contact time requirements. Jar testing can be conducted to assess the impact of blending on coagulation and disinfection requirements. The WRF Project 4536 (Salveson et al., 2018b) outlines methods for conducting jar tests to evaluate the impact of blending reuse supplies in drinking WTPs.

Regardless of the blending location, introduction of a new potable reuse supply can affect the aesthetic quality of the delivered water, disinfectant residuals, DBP speciation and concentrations, and distribution system stability. While aesthetic characteristics such as taste and odor (T&O) and color do not pose public health concerns, experience has shown that public trust in a new water supply can be eroded by an adverse change in the aesthetics of the water, with major cost and public relations repercussions to the water system. Flavor profile analysis (FPA, Standard Methods (SM) 2170) and other methods of characterizing the T&O of the blended water can be used to identify and plan for any changes in the aesthetic quality of delivered water following introduction of a new potable reuse supply. Disinfectant demand and Simulated Distribution System (SDS; SM 5710C, APHA, WEF, and WEF, 2005; Koch et a., 1991) bench tests can be conducted to plan in advance for changes in disinfectant dose and DBP formation in the blended water.

…assist in the implementation of DPR projects…

…based on existing Federal and State resources on potable reuse…

…provides best practices and recommendations…

Introduction

National Water Research Institute (NWRI) in collaboration with Carollo Engineers developed this Guide for California Water Utilities to assist in the implementation of Direct Potable Reuse (DPR) projects in the State. NWRI sponsored this project along with five utilities in California (Ventura Water, the Los Angeles Department of Water and Power, the San Francisco Public Utilities Commission, the City of Santa Barbara, and the Santa Clara Valley Water District) interested in DPR as a water supply alternative. This Guide was based on existing Federal and State resources on potable reuse, including DPR, as well as experience at current Indirect Potable Reuse (IPR) projects and the results of published research and the research sponsored by industry foundations, including the Water Research Foundation. The Guide provides best practices and recommendations on the technical, operational, managerial, and regulatory issues pertaining to the implementation of potable water reuse projects, with a particular focus on DPR but useful information pertaining to IPR.

USING THIS GUIDE

DRAFT

This Guide can be used by utilities, consulting engineers, and regulators to support potable reuse efforts, including DPR, as follows:

- **Utilities.** Potable water reuse is a challenging and costly effort. Many components of developing a potable reuse project take substantial time and resources. This document contains a general summary (this Guide for Decision Makers) and a detailed Information Reference Table of the necessary components for a successful project (provided at the end of this document), allowing utility staff to cross check their own efforts for potable reuse (IPR and DPR) and develop an implementation plan and schedule.
- **Consultants.** This Guide provides reference material for many of the key challenges for potable water reuse implementation, and important context as to why each item in the checklist is either useful or necessary.
- **Regulators.** Although IPR regulations are in place in California for groundwater replenishment and surface water augmentation, regulations for DPR in California have not been developed. IPR projects have a long record of success in California. This Guide summarizes the many and diverse aspects of a successful potable reuse project and provides regulators with a reference document that can be use to support regulation development and the permitting of potable reuse project.

This Guide can be used from early in the development of a project all the way to the permitting and startup of the potable water reuse facility. Efforts on individual items should be tracked by utilities as progress is being made.

Terminology – California regulatory definitions

Either already established or as proposed in current legislation – AB 292

Groundwater Augmentation means the use of recycled water for replenishment of a groundwater basin or an aquifer that has been designated as a source of domestic drinking water supply for a public water system.

Reservoir Water Augmentation means placement of recycled water into a raw surface water reservoir used as a source of domestic drinking water supply for a public water system or into a constructed system conveying water to such a reservoir.

Raw Water Augmentation means the placement of recycled water into a system of pipelines or aqueducts that deliver raw water to a drinking water treatment plant that provides water to a public water system.

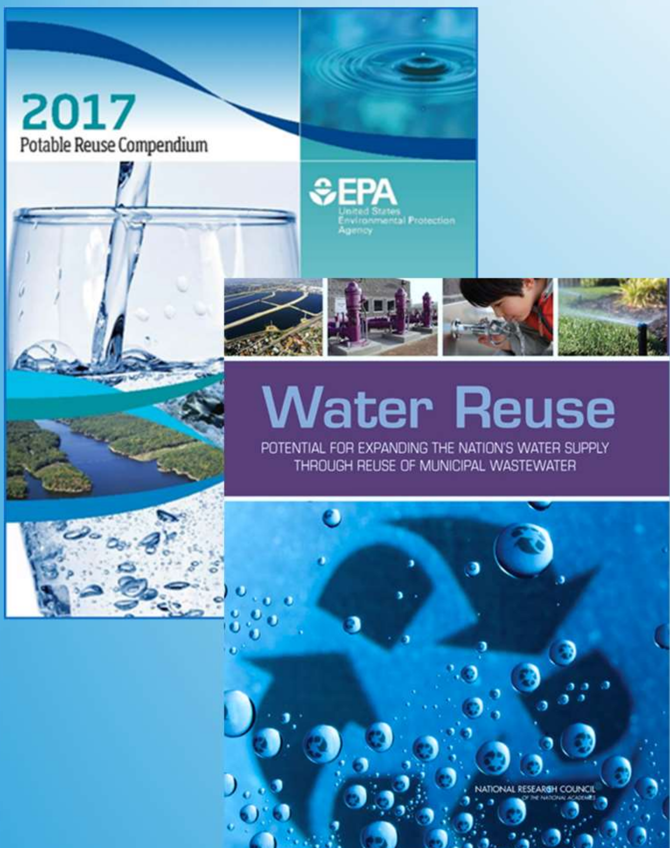
Treated Drinking Water Augmentation means the placement of recycled water directly into a finished water distribution system of a public water system.

Organization and Structure

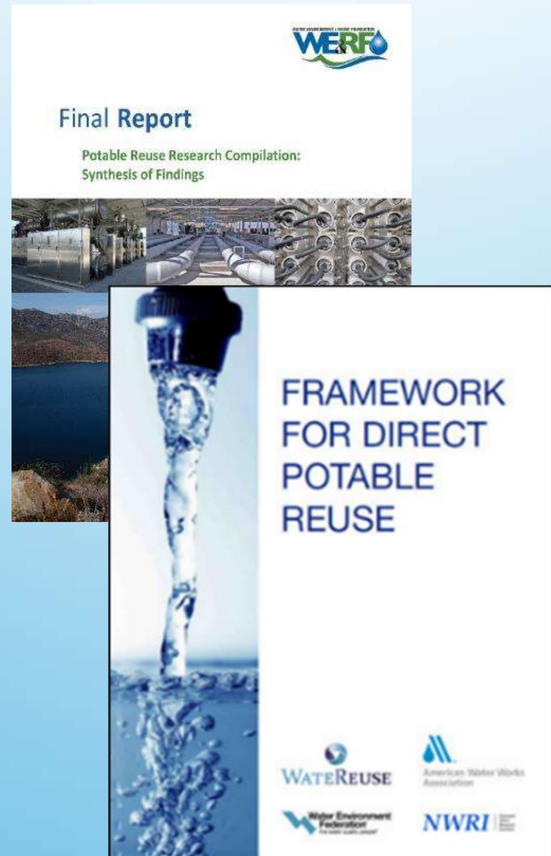
12 KEY COMPONENTS TO IMPLEMENT POTABLE REUSE PROJECTS

1. Project Definition
2. Technical, Managerial, and Financial Capability
3. Interagency Agreements
4. Outreach and Education
5. Wastewater Source Control
6. Multiple Treatment Barriers
7. Pathogen Control and Monitoring
8. Chemical Control and Monitoring
9. Operations
10. Water Quality Management
11. Emerging Issues
12. Collaboration to Spur Innovation

Large body of resources is available…



U.S. EPA and National Academy of Sciences



Research Foundation Reports

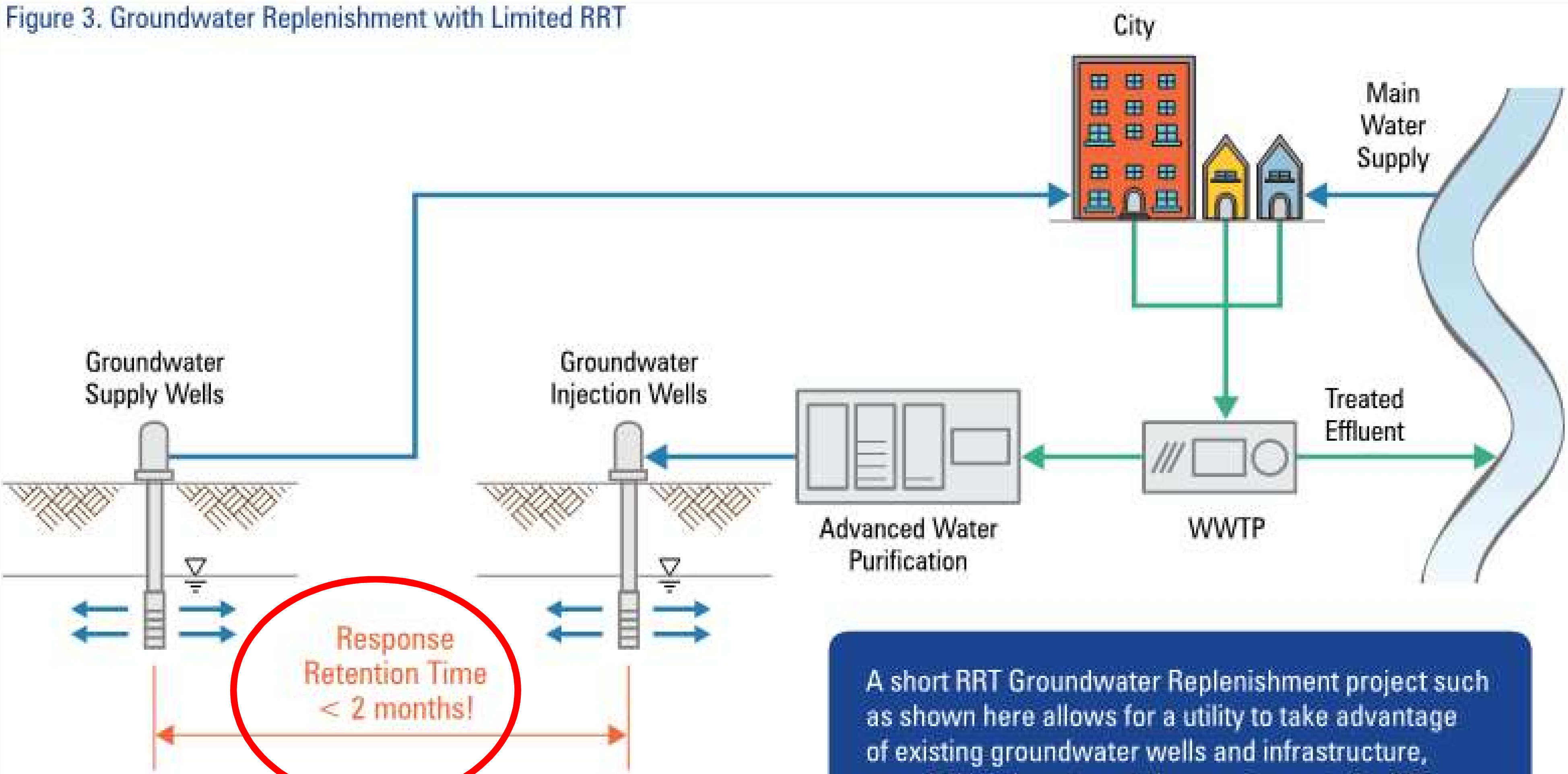
State Guidance: TX, AZ, CA

RRT: Response Retention Time

1 Project Definition

Is there any type of environmental buffer? Maybe a short groundwater storage time (e.g., a short RRT)? Possibly limited dilution in a surface water reservoir? Or, maybe your project is a clear cut Raw Water Augmentation or Treated Drinking Water Augmentation project.

Figure 3. Groundwater Replenishment with Limited RRT



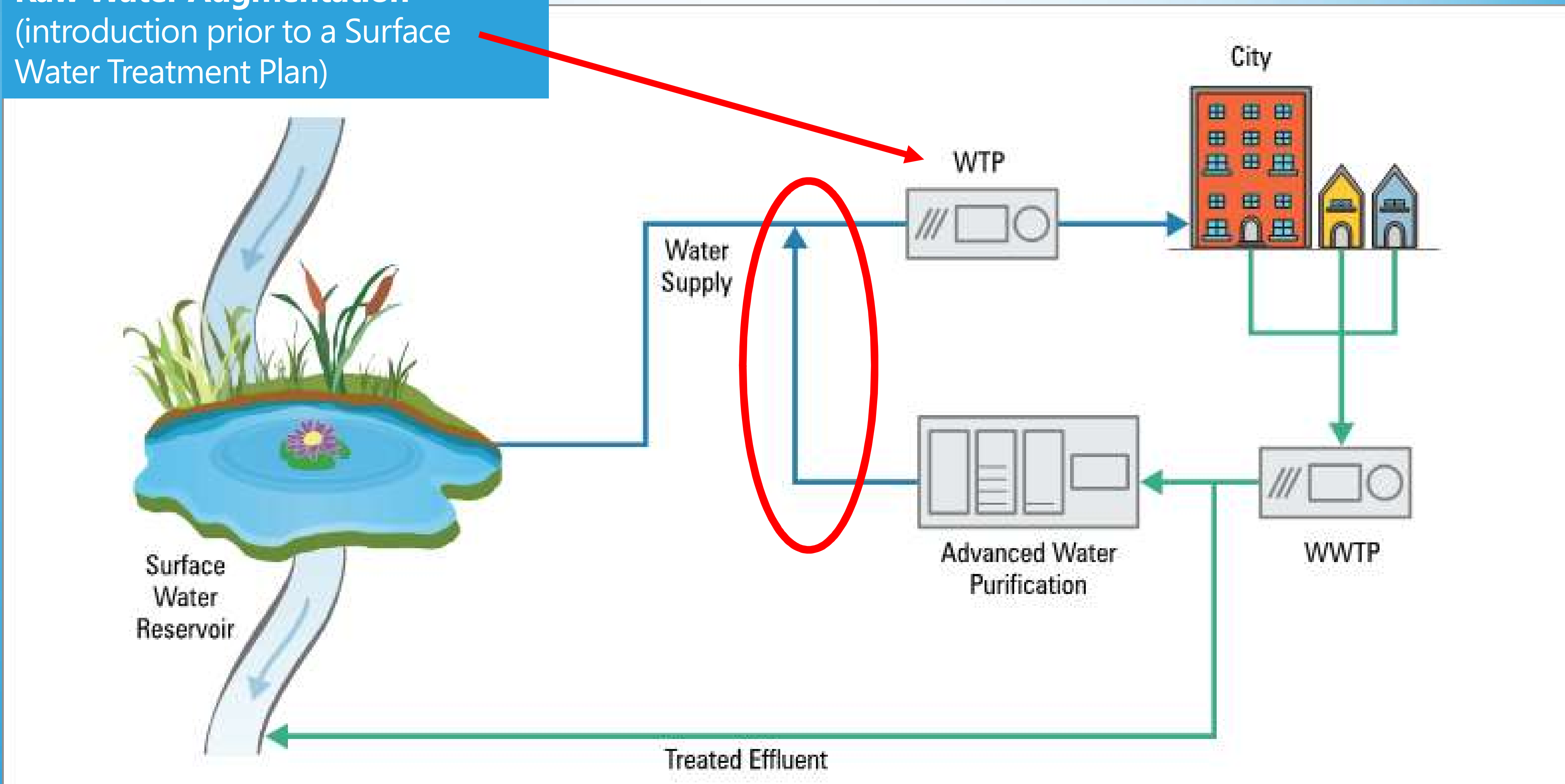
A short RRT Groundwater Replenishment project such as shown here allows for a utility to take advantage of existing groundwater wells and infrastructure, even if they do not meet the requirements for IPR Groundwater Replenishment projects.

Mitigation for GW Project with limited RRT

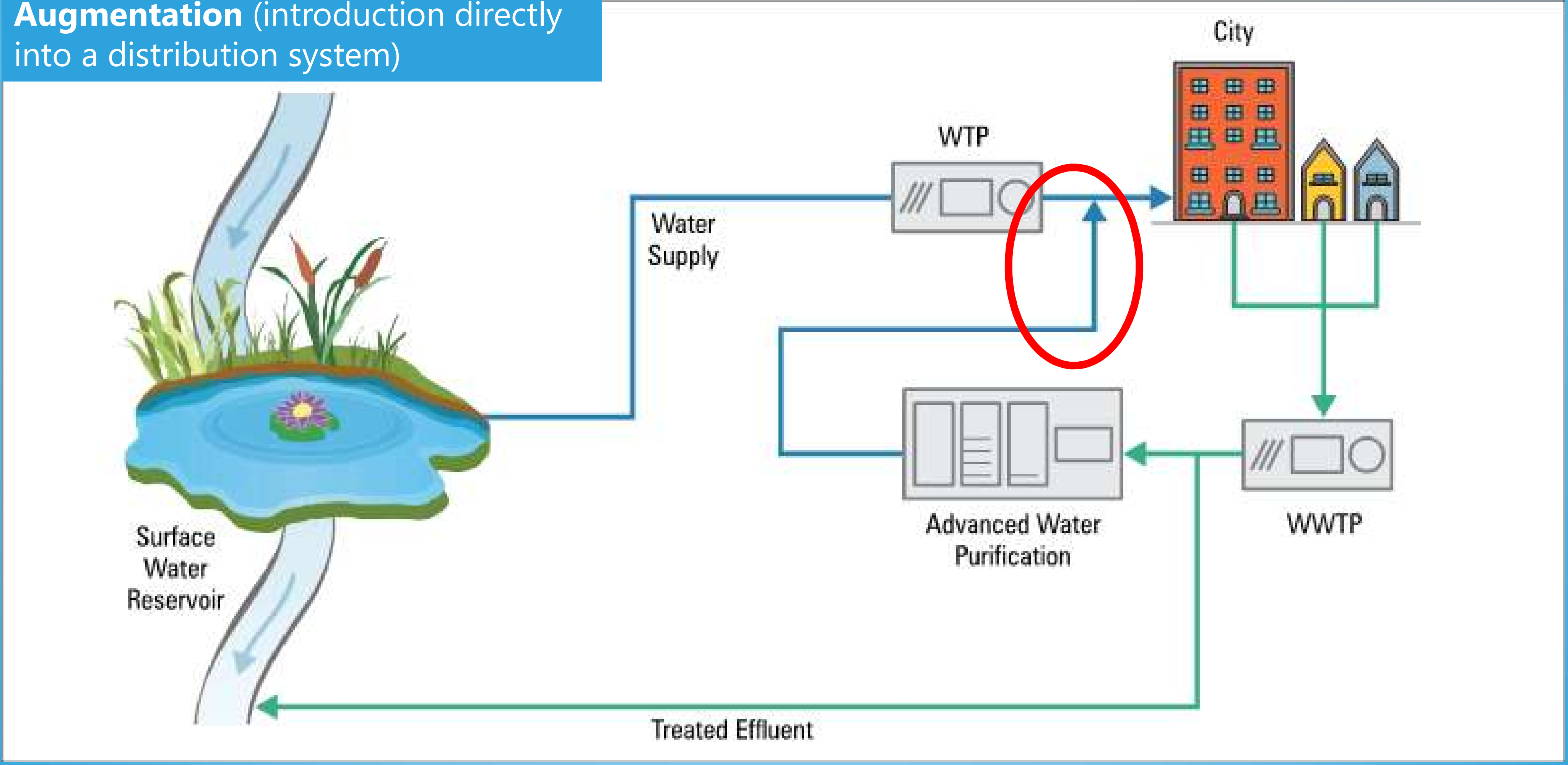
Table 3. Water Quality Concerns for Groundwater Replenishment with Limited RRT

REGULATORY CONCERN	MITIGATION
Short RRT results in less virus reduction.	Add an additional virus reduction barrier as redundancy.
Short RRT results in insufficient time to detect and respond to chemical pollutant breakthrough.	Provide for additional online monitoring for organic pollutants. Add additional treatment barrier for chemical pollutants.

Raw Water Augmentation
(introduction prior to a Surface Water Treatment Plan)



Treated Drinking Water Augmentation (introduction directly into a distribution system)



2 Technical, Managerial, and Financial Capability

Utilities must demonstrate an appropriate level of technical, managerial, and financial (TMF) capability to ensure compliance with regulations and to successfully implement and manage a DPR project [NWRI (2016), SWRCB (2018)].

The objective of demonstrating this capability to regulatory authorities ensures that utilities identify specific needs and capacity gaps. In general, developing these capabilities for a potable reuse project will allow utilities to achieve the following:

- Build, operate, manage, and sustain a potable reuse program for the long-term.
- Plan, achieve, and maintain regulatory compliance.
- Provide effective public health and environmental protection.
- Make efficient use of public funds and sustainable public investments.

CAPABILITY	DESCRIPTION
Technical	Addresses the performance and operation of the treatment process.
Managerial	Addresses governance (e.g., administrators must understand the responsibilities of overseeing the AWTF; employees and contractors must understand their roles; adequate time is needed to conduct all required tasks).
Financial	Addresses financial ability to operate and maintain existing infrastructure and financial planning for future needs. Assessed through budget statements, asset management, and financial audits.

California regulators have written TMF capability into groundwater and surface water IPR regulations

3 Interagency Agreements

Potable reuse projects require strong interagency cooperation and responsiveness when different agencies operate the WWTP, the advanced purification treatment facility, and the drinking water treatment facility.

Interagency Agreement Areas:

- Institutional
  - Address separate or different jurisdictions
  - Costs and finance
  - Responsibility for risk and liability
  - Capital improvement programs
  - Project messaging
- Integrated Planning
  - Management responsibilities for water resources
  - Cooperative planning and feasibilities studies
- Technical and Operational
  - Quantity and quality of source
  - Operational responsibilities and requirements
  - Response to system failure and/or interruption
  - Meeting regulatory requirements

Specific topics that can be addressed through interagency agreements

- Water rights associated with the wastewater effluent.
- Appropriate WWTP effluent water quality and quantity.
- Implementing an enhanced source control program and pretreatment for managing constituents in the wastewater collection systems.
- Development of response plans between the entities operating the WWTP, AWTF, and the drinking water treatment facility to ensure effective planning, communication, and collaboration on technical, engineering, operational, and management topics.
- Assignment of funding of capital and operational expenses.
- Cooperation on addressing regulatory questions.
- Submission of joint grant proposals for project funding.
- Cooperation on public outreach and engagement efforts.

4 Outreach and Education

Public outreach and engagement is a critical component of successful potable reuse projects.

BEST PRACTICES IN A POTABLE REUSE OUTREACH PROGRAM

- Design the outreach program to be strategic, transparent, and thorough.
- Start outreach early and continue to engage the public throughout the lifetime of the project.
- Use proven techniques and tools to listen to and communicate with the community, engage the media, and address public concerns.
- Provide useful, accurate information that builds awareness of potable reuse and builds confidence in the quality of reclaimed water.
- Develop consistent messages to communicate to the entire community, including different audiences in the community.
- Build relationships with opinion leaders, educators, and other influential community members.
- Create transparency in all aspects of the project, including costs, water quality, and safety.
- Prepare for tough questions and addressing misinformation.

ROLE OF PUBLIC OPINION RESEARCH

Public opinion research, including focus groups, phone and online surveys, and one-on-one interviews with stakeholders, can provide critical information on the public's view of a DPR project:

Phone/Online Surveys. Phone surveys involve collecting data by trained interviewers. Phone surveys can be supplemented with online surveys. The information collected from these surveys is quantitative and provides the ability to conduct statistical analyses and present the information based upon a wide range of demographic metrics.

Focus Groups. Focus groups allow members of a selected group to interact though an open discussion. The groups are moderated and can be general or specific to different demographic groups (gender, race, geographic location). Focus groups produce qualitative research results which can identify feelings, perceptions, and thoughts on a topic.

One-on-One Interviews. In-depth interviews with stakeholders produce qualitative market research. The interviews allow for stakeholders to give more detailed responses to questions.

6 Multiple Treatment Barriers

The concept of the multiple barriers has long been known to be important for potable water reuse (Sakaji et al., 1998). Potable reuse systems should be redundant, resilient, and reliable

Table 11. Reliability as Defined by Redundancy, Robustness, and Resiliency

TERM	DEFINITION AS PERTAINING TO DPR	NOTES
Redundancy	The use of multiple unit processes to attenuate the same type of constituent.	More unit processes in series, even with reduced individual performance, can result in improved overall performance.
Robustness	The combination of technologies that address a broad variety of constituents.	Broad spectrum treatment is required because wastewater is the source water.
Resiliency	The ability to adapt successfully or restore performance rapidly in the face of treatment failures and threats.	Includes the ability to correct single- or multiple-process performance failures.

Source: Adapted from Pecson et al., 2015.

Multiple Treatment Barriers

Table 12. Multiple Barriers for Chemical and Pathogen Control

TARGET CONSTITUENT	MANAGEMENT BARRIER	SECONDARY TREATMENT	O3	BAC	UF	GAC	UV
Regulated Chemical Pollutants	⦿	⦿	⦿	⦿		⦿	⦿
Virus		⦿	⦿	⦿			⦿
Protozoa		⦿	⦿	⦿	⦿		⦿
Other Chemicals of Interest (e.g., PFAS, pharmaceuticals)	⦿	⦿	⦿	⦿		⦿	⦿

8 Chemical Control and Monitoring

THE CHALLENGE

We can now detect a broad range of chemical pollutants at the nanogram per liter level (ng/L). These include both regulated chemicals (regulated as Maximum Contaminant Levels (MCLs)) as well as Chemicals of Emerging Concern (CECs) such as pharmaceuticals, personal care products, consumer chemicals, flame retardants, and others. Some of these CECs have potential endocrine disrupting, carcinogenic, and/or other potentially harmful endpoints ***at sufficiently high concentrations.***

California Recycled Water Policy: Required CEC monitoring

Monitoring Trigger Level

CONSTITUENT	RELEVANCE	MTL (IN µG/L)
1,4-dioxane	Health	1
NDMA(1)	Health and Performance Indicator	0.010
NMOR(2)	Health	0.012
PFOS	Health	0.013
PFOA	Health	0.014
Sulfamethoxazole(2)	Performance Indicator	–
Sucralose(2)	Performance Indicator	–
Dissolved Organic Carbon(2)	Performance Surrogate	–
UV Absorbance(2)	Performance Surrogate	–
EC(2)	Performance Surrogate	–
Estrogen receptor-alpha bioassay(2)	Bioanalytical Screening	–
Aryl hydrocarbon bioassay(2)	Bioanalytical Screening	–

Notes:
(1) Health-based CECs and Bioanalytical Screening to be monitored following treatment.
(2) Performance indicator CECs and surrogates to be monitored before RO and after treatment.

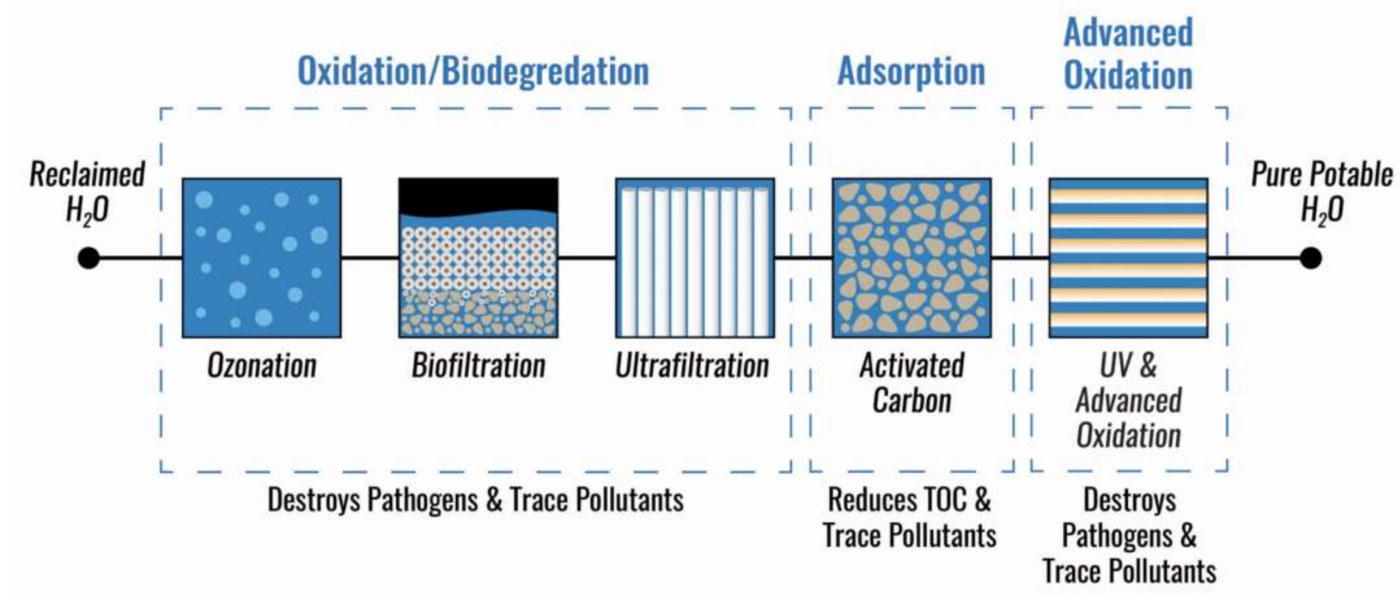
8 Chemical Control and Monitoring

California "Full Advanced Treatment"

PARAMETER	WASTEWATER SOURCE CONTROL	BIOLOGICAL TREATMENT (SECONDARY)	ULTRAFILTRATION	REVERSE OSMOSIS	UV ADVANCED OXIDATION
Many Regulated MCLs	⦿	⦿	–	⦿	
Select Disinfection Byproducts	⦿	–	–	⦿	⦿
Salt	⦿	–	–	⦿	
Unregulated CECs	marginal	⦿	–	⦿	⦿

Alternative DPR Treatment Train:

Pilot project: Altamonte Springs, Florida

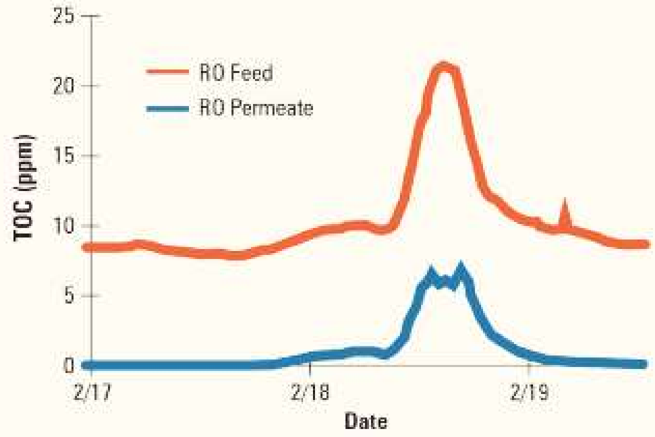


11 Emerging Issues

CHEMICAL PEAK AVERAGING

SWRCB will be sponsoring a research project to identify suitable options for final treatment processes that can provide some "averaging" with respect to potential chemical peaks, particularly for chemicals that have the potential to persist through advanced water treatment.

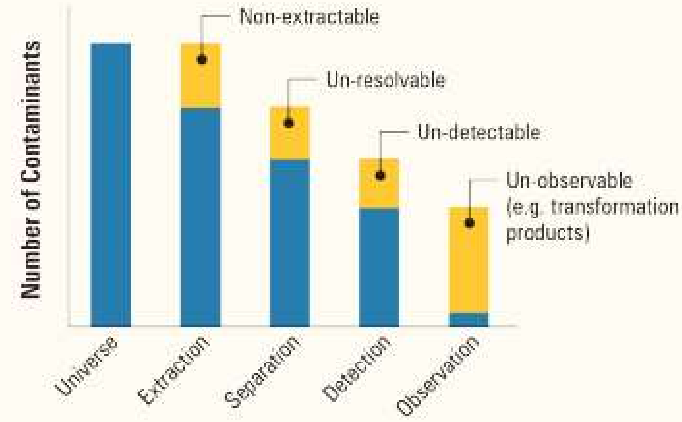
Water quality excursions have been observed at advanced treatment facilities (e.g., acetone). For DPR, these excursion will become more important. Established laboratory and quality control techniques, such as online TOC, have the ability to identify "peaks." However, specific control strategies need to be developed to control for chemical peaks. Source control may provide some value; however, additional sewershed monitoring could provide early warning. Additional measures including blending, source control, monitoring, and treatment will need to be considered. (Debroux et al., 2019)



NON-TARGET ANALYSIS

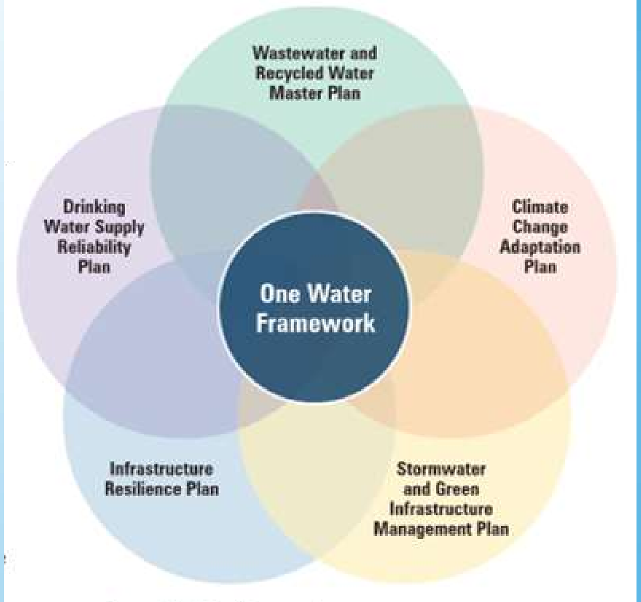
SWRCB will sponsor a research project to look at developing more comprehensive analytical methods to identify unknown contaminants called Non-Target Analysis (NTA). NTA includes low molecular weight compounds that occur in wastewater and may not be removed by advanced treatment and are not currently detectable by current monitoring approaches.

Targeted monitoring methods are limited in coverage. Non-targeted methods using advanced instrumentation techniques may provide a more comprehensive analysis for unknown chemicals.

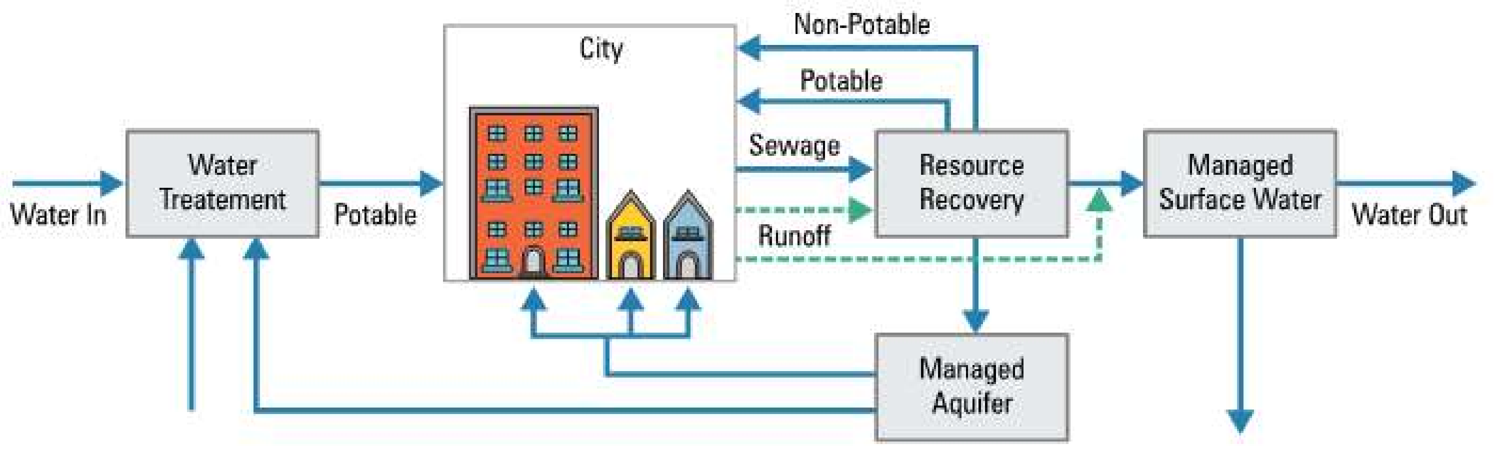


12 Collaboration to Spur Innovation

Utilities are embracing the concepts of integrated planning and One Water to better manage water resources due to increasing challenges associated with population growth, water scarcity, competition for limited supplies, water pollution, and impacts of climate change.



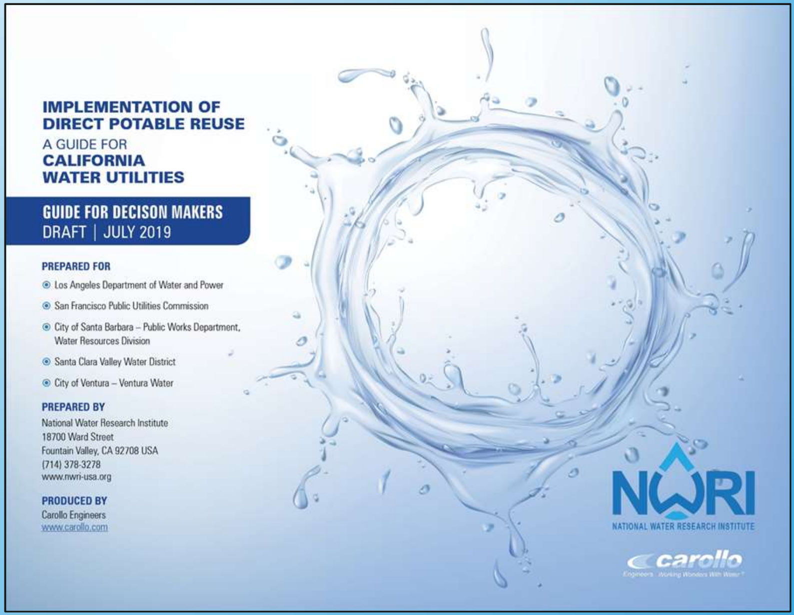
Source: One Water Framework (Water Research Foundation, 2017).



Implementation of DPR: A Guide for California Water Utilities

- Purpose of Guide:
  - Help utilities in California plan for future DPR projects
- Benefits of Guide:
  - Use for IPR and DPR
  - User-friendly
  - Suitable for explaining concepts to managers, elected officials, and stakeholders
- Guide + **Information Reference Table**
  - "Table" will include detailed steps
- Timing: Early Fall 2019

Coming soon!



Thank you for listening!

Jeff Mosher
jmosher@carollo.com