



# Latest Developments and Trends in Water Reuse Research and Policies

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**Joint CWEA and CSAWWA Water Reuse Seminar  
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# About Water Environment & Reuse Foundation

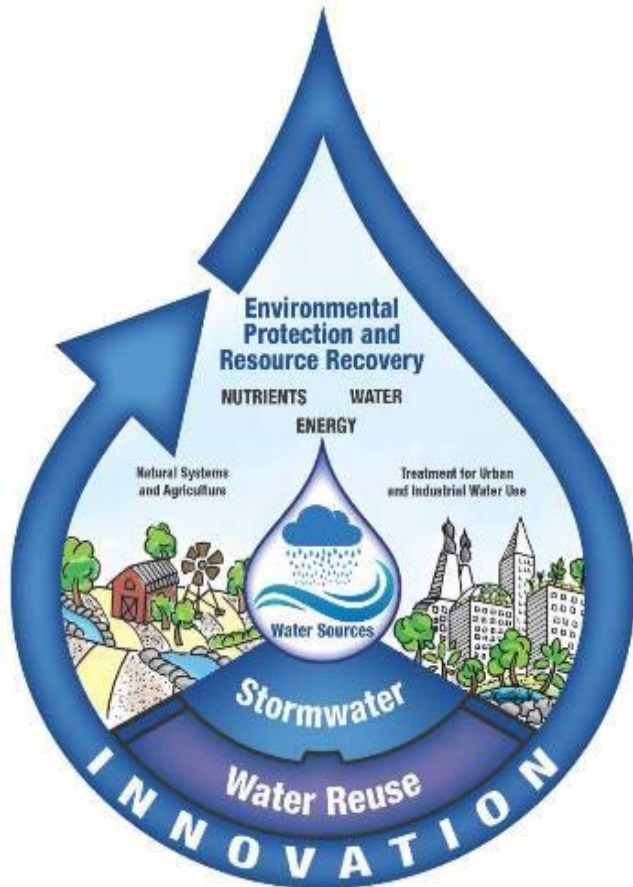
WERF and WRRF merged in May 2016

*WE&RF: Dedicated to research on renewable resources from wastewater, recycled water, and stormwater while maintaining the quality and reliability of water for the environment and communities.*

***New Focus: One Water.***

**WaterReuse** brings recycled water, desalination and related topics.

**WERF** brings wastewater, resource recovery, stormwater, receiving waters, climate change, and integrated water.



# About WE&RF

501(c)(3) nonprofit located in Alexandria, VA

## 1989-2016: Research portfolio

- >\$200 million on water, wastewater, recycled water, and stormwater

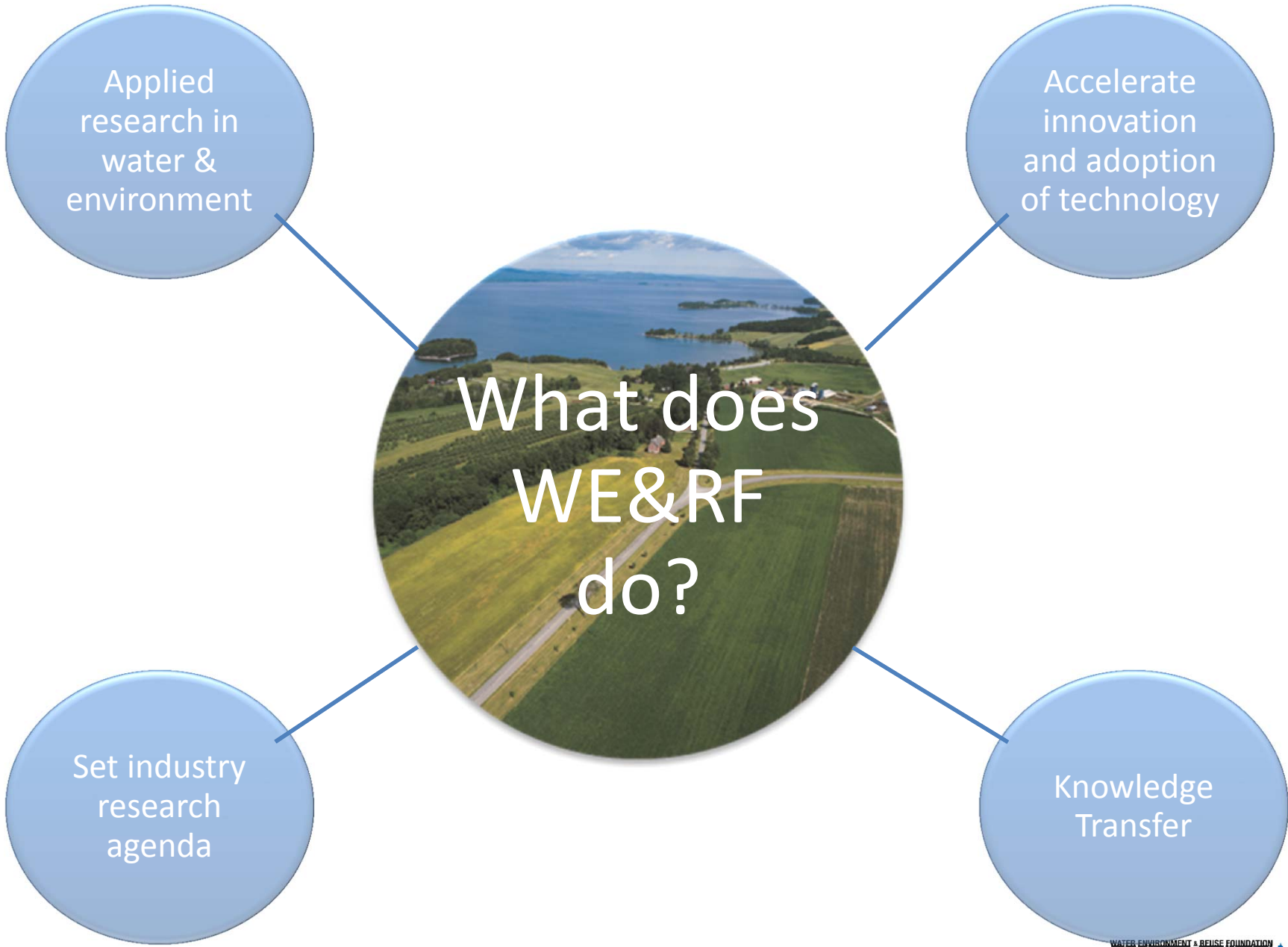
## Research organization

- >400 subscribers
- Partners: U.S. EPA, DOE, Bureau of Reclamation, CA State Water Board, other states
- 30 staff members (over half manage research)
- Broad focus on integrated water research

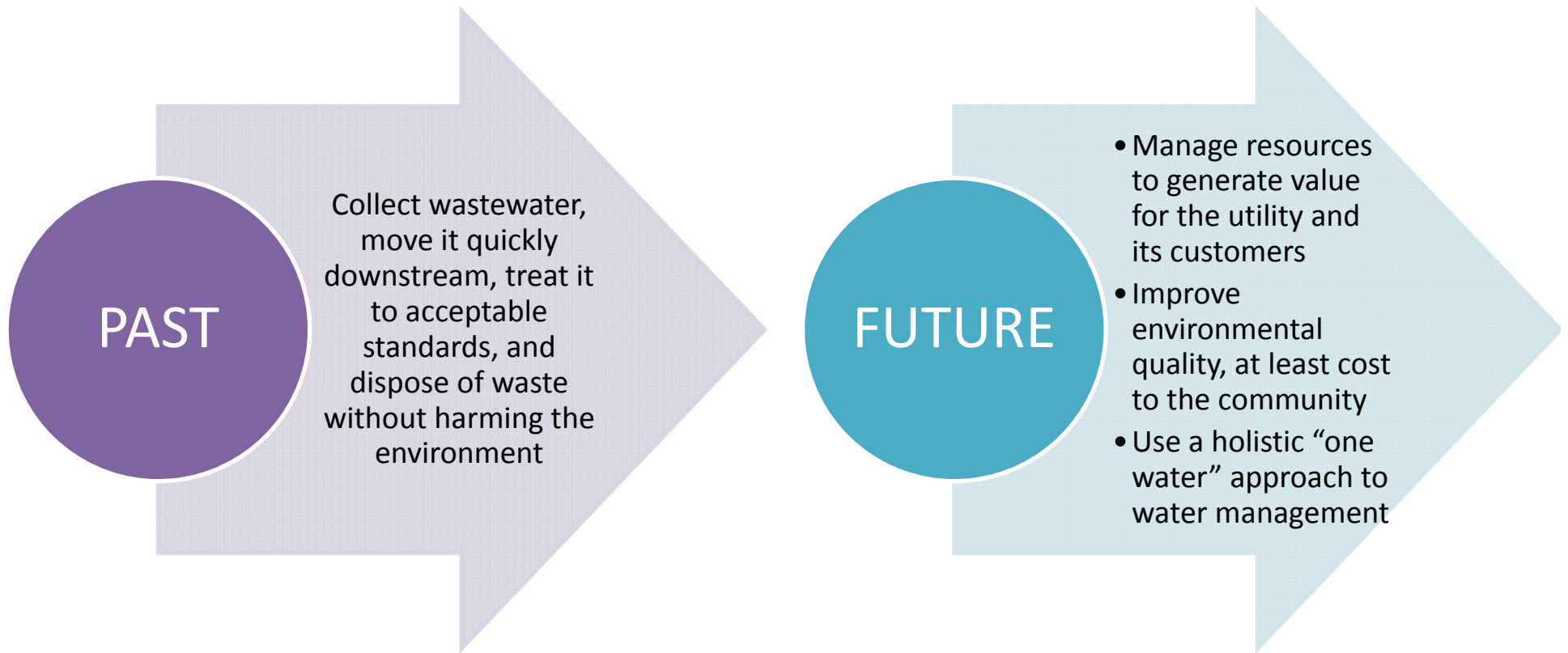
## Research Programs

- Solicited
- Unsolicited
- Tailored Collaboration and Subscriber Priority Programs
- Partnership Program

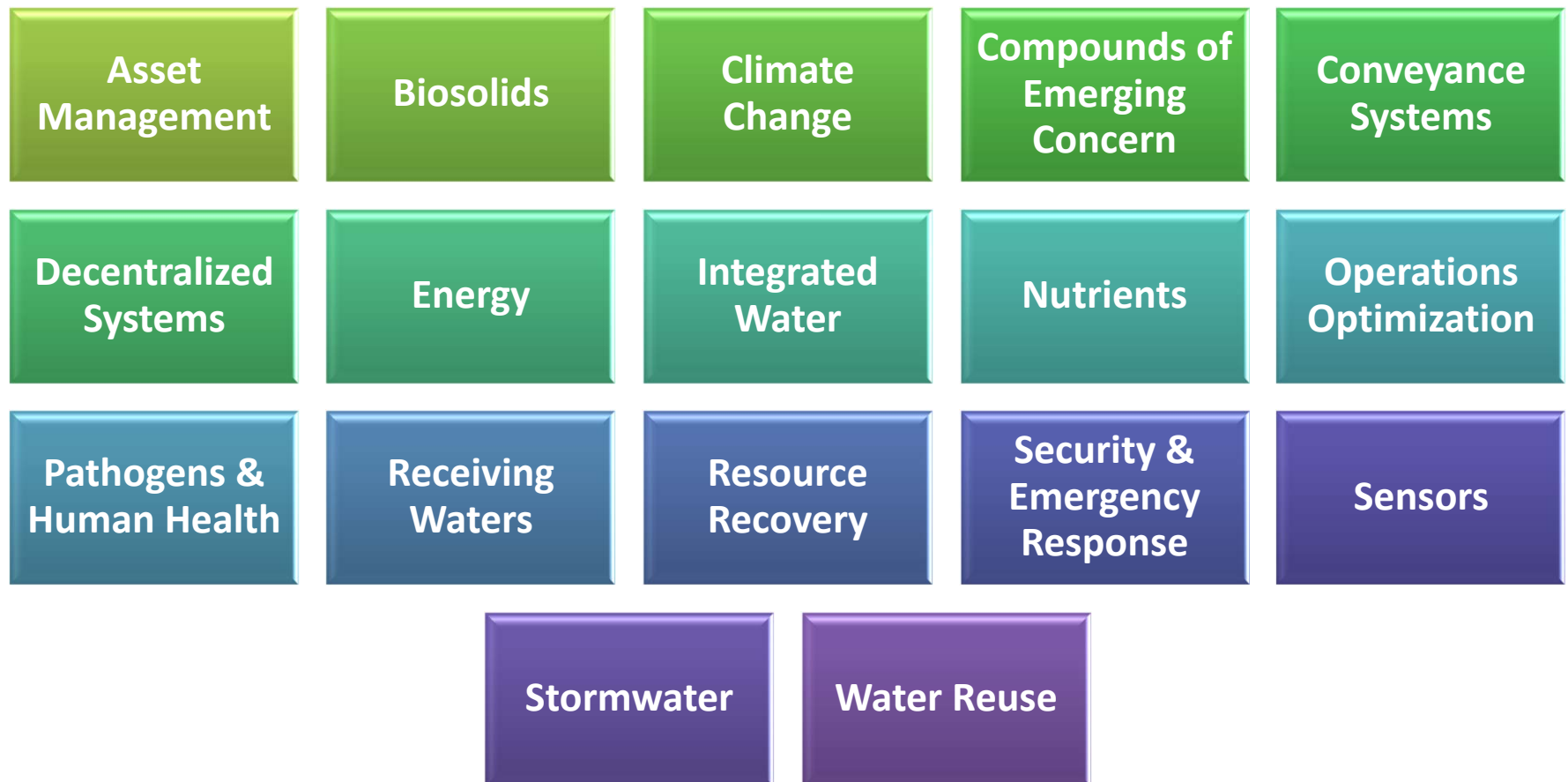




# Bottom Line: Major Paradigm Shift



# Areas of Research



# Different Reasons – One Solution

## West Coast

- Main Driver: Water scarcity
  - Reuse provides local supply to prevent costly importing
- Type: DPR, IPR (often GW recharge)
- Treatment: often includes RO (TOC requirement in CA)

## East Coast

- Main Driver: Environmental
  - stringent nutrient requirements for Chesapeake, Everglades
- Type: IPR (often SW augmentation), DPR?
- Treatment: alternatives to RO

# The Full Spectrum



Urban Irrigation

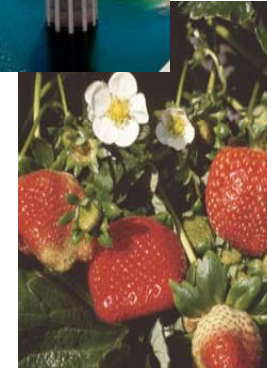
Industrial Reuse



Potable Reuse

Food Crop Irrigation

Wetland/  
Habitat  
Restoration





# Fit for Purpose

## The right water for the right use

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### Agricultural Reuse

Great potential for enhanced utilization of recycled water



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Ongoing research: WRRF-15-08 - State of Irrigated Agricultural Water Reuse - Impediments and Incentives

Upcoming research to identify existing uses, characterize potential, and develop strategies for overcoming barriers and incentivizing greater use of recycled water

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Will evaluate existing governance frameworks and develop recommendations

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New research: Evaluating Economic and Environmental Benefits of Water Reuse for Agriculture

# Fit for Purpose

## The right water for the right use

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### Industrial Reuse

Private businesses and government have different mandates and priorities

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Different industrial sectors have different needs for water quality and quantity

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Completed research seeks to bridge the gap between business and government as well as identify the similarities and differences between sector and end-use

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Ongoing research to develop a framework for onsite reuse and a decision support tool for evaluating the economics of potential projects

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WRRF-13-04 - Drivers, Successes, Challenges, and Opportunities of Onsite Industrial Water Reuse: a Path Forward for Collaboration and Growth

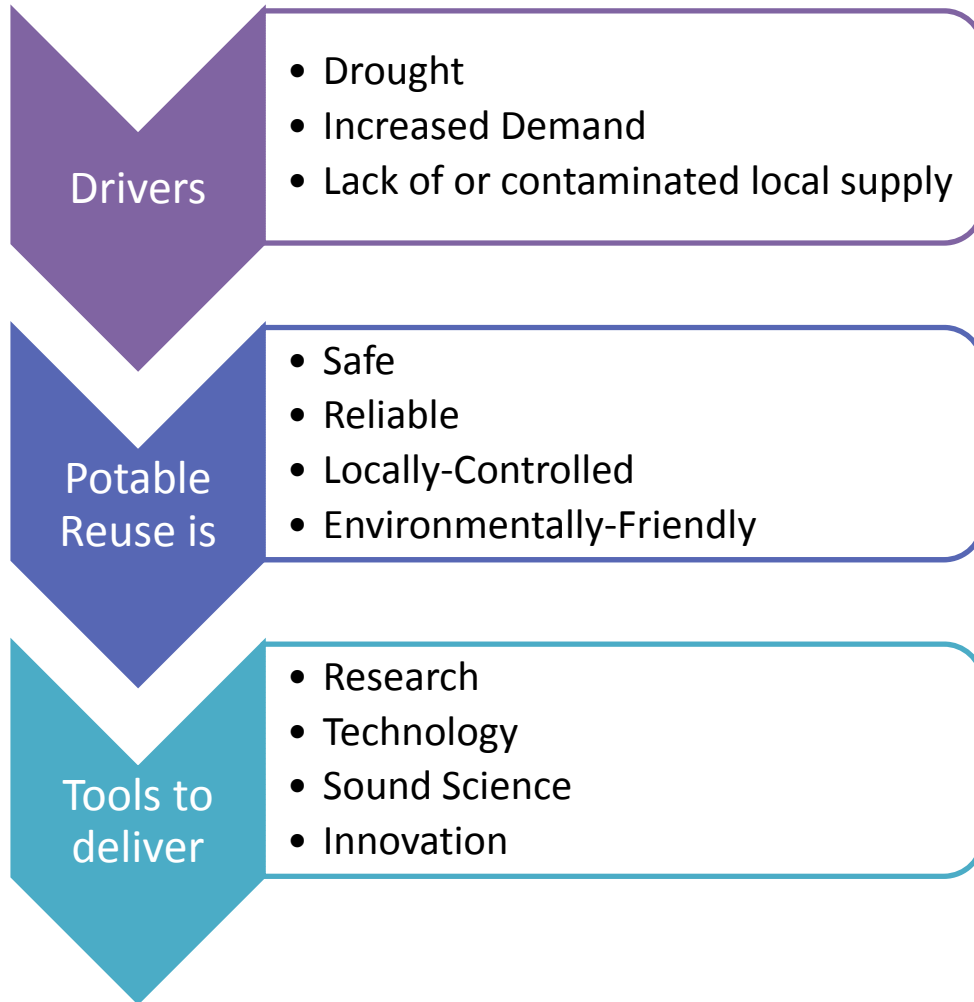
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WRRF-14-04: A Framework for the Successful Implementation of Onsite Industrial Water Reuse

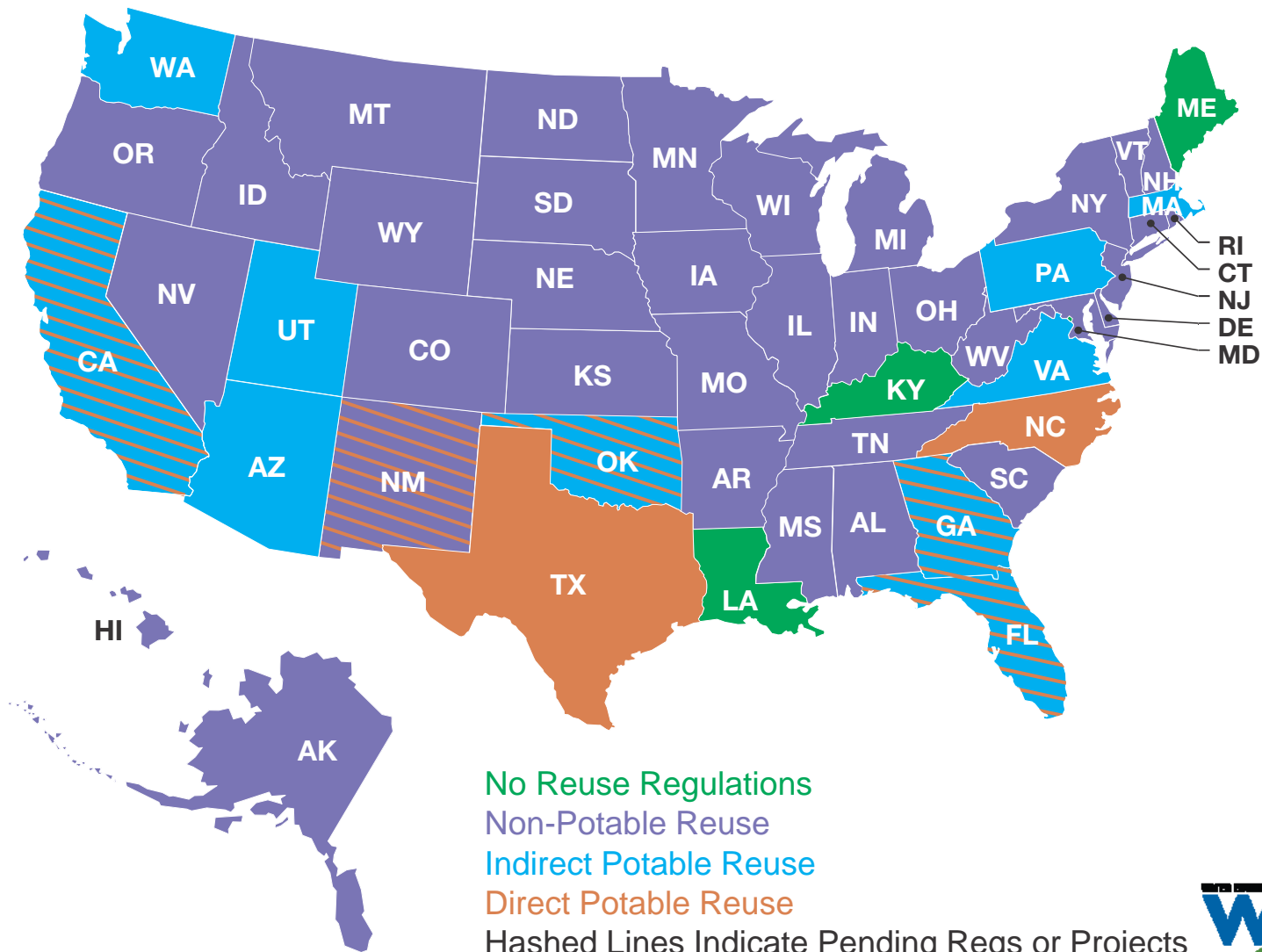
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# Potable Reuse



# The “State” of Reuse: Developing Consensus on Public Health Protection





# DPR: The Key Questions

- **Treatment requirements**
  - Need for criteria for pathogen and chemical control
- **On-line monitoring**
  - Performance monitoring
- **Treatment technologies**
  - Defining reliability
- **Source control**
  - Managing the collection system
- **Operations and operators**
- **Response time** (respond to off-spec water)
- **PUBLIC ACCEPTANCE**

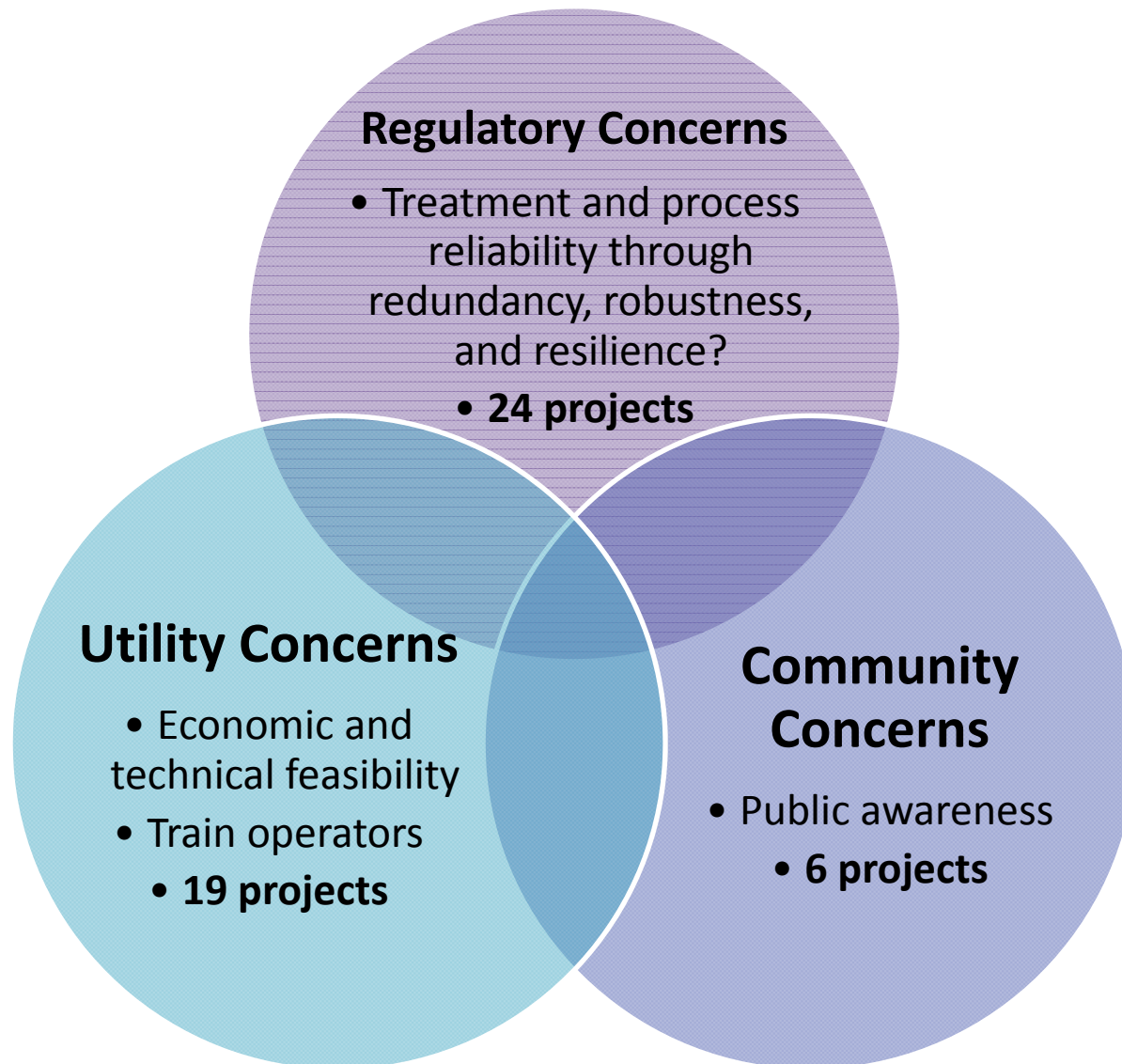
# WaterReuse DPR Research Initiative

- ❖ California: “Feasibility of developing criteria for DPR”
- ❖ \$6M raised to the need to fill knowledge gaps – leveraged to \$24M
- ❖ Funded 34 projects on topics
  - Reliability of treatment trains
  - Microbial and chemical water quality
  - Monitoring
  - Operations

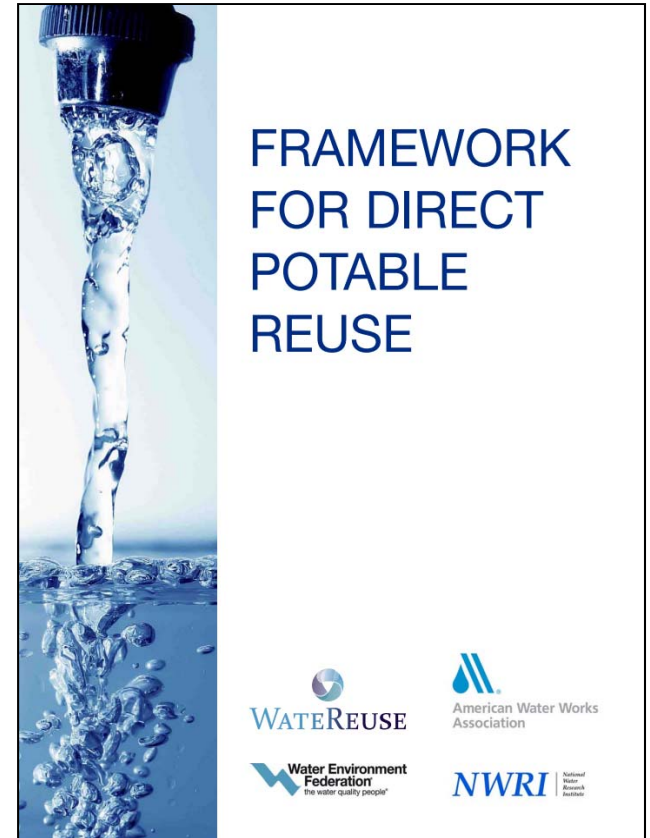
“The Expert Panel is impressed by the research that has been funded by the WRRF and supports the continuation of such research.”

- June 30 letter to DDW from Expert Panel Chairs

# DPR Initiative Research



# Project: Framework for DPR



Purpose: To provide an overview of the key elements that make up a DPR program.



# Coming Soon!

## Potable Reuse Research Compilation: Synthesis of Findings (15-01)

This project summarizes and synthesizes the research results, pulling from outside research where needed, and package this information by topic into a cohesive document.

### WATER REUSE Direct Potable Reuse Research: Synthesis of Findings

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 Julie Hinton - WaterReuse Research Foundation | 1199 Acorn Parkway St, Suite 418, Alhambra, CA, USA | [jhinton@waterreuse.org](mailto:jhinton@waterreuse.org)  
 Gloria Varkas - National Water Research Institute, Fountain Valley, CA, USA  
 Jeff Mosher - National Water Research Institute | Fountain Valley, CA, USA



#### INTRODUCTION AND OBJECTIVE

- In response to stressed water supplies in some regions of the United States, some communities are looking toward direct potable reuse (DPR), where treated wastewater is used to augment potable water supplies. As interest in potable reuse has grown, so has the need for providing guidance for DPR. In response, the California Legislature is requiring a report on the feasibility of developing reference criteria for DPR based on a review by an Expert Panel.
- To inform this panel, the WaterReuse Research Foundation launched the DPR Research Initiative in 2012 to advance DPR as a water supply option. This initiative includes 34 research projects to value at over \$20 million.
- The Expert Panel is scheduled to produce a final report on the Feasibility of Developing Criteria for Direct Potable Reuse in 2016. To fulfill its charge and finish the report, the Panel will need the most up-to-date information on current research and activities pertaining to DPR in the United States.

#### TOPICS ADDRESSED

##### UTILITY CONCERNS

How do we address the economic and logistical feasibility of DPR? How do we train operators to run these advanced systems?

19 projects

##### REGULATORY CONCERNS

How do we show the public awareness of the water cycle and ensure the safety of DPR to lead to acceptance?

23 projects

##### COMMUNITY CONCERNS

How do we create public awareness of the water cycle and ensure the safety of DPR to lead to acceptance?

6 projects

#### KEY ISSUES | FINDINGS BY TOPIC

##### SOURCE CONTROL PROGRAM

- Identify nonpoint source, business, and industry
- Minimize sources of toxic compounds entering the sewerhead
- Evaluate contaminant sources suitable those investigated as part of the existing wastewater pretreatment program
- Contaminants found in source waters often times do not originate from conventional industrial sources, such as solvents, metals, NEMA, bromates, and disinfection byproducts

##### MONITORING OF PATHOGENS

- Rapid and continuous monitoring for pathogen detection is an onerous challenge due to small water flows, method sensitivity and the low concentrations of pathogens
- Limited options available for rapid on-line pathogen monitoring with current technologies in the wastewater treatment
- Difficulty in detecting viruses in water due to size and lack of sensitive technologies, limiting the credits awarded to wastewater re-usage
- Local systems need include high specificity, rapid time-to-online capability, high sensitivity, accuracy, and robustness with low false alarm rates along with simplicity and affordability for operation and maintenance

##### OPERATIONS AND MAINTENANCE

- Early operations activities include startup testing, commissioning, operator training, and final acceptance
- Requirements to operate in plants with AEC and operator procedures are needed to support facility resiliency
- Standards for maintenance plans that preserve and manage performance of facilities, equipment, and monitoring are lacking
- Knowledge gaps exist in operator training and certification programs that specifically address wastewater, water treatment, and water distribution rather than using a consolidated approach

##### POTENTIAL DPR TREATMENT TRAINS

- Characterization of source water, including variations in flow and load
- Evaluation of design and operation of the WWT including conditions that can degrade treatment quality for advanced treatment
- Identification of water quality goals and aesthetic requirements
- Identification of multiple treatment barriers for pathogens and organics to meet regulatory requirements and water quality goals
- Determine the capability and redundancy metrics for treatment process, including the ability to address WWP capacity
- Determine required system redundancy based on WWP effluent compared to 3.0 water production goals
- Identify waste disposal concerns or shipping of high salinity waste
- Determine if space constraints for the construction of treatment train
- Estimate capital and operating costs

##### CHEMICALS

- Occurrence
  - Contaminants of Emerging Concern (CECs) are present in secondary and tertiary treated effluent
  - New CECs are expected to be found in the future
- Treatment
  - Different treatment processes have different efficacies in removing CECs
  - Advanced water treatment does an excellent job removing the majority of known CECs, below detection limits
- Risk
  - The risks associated with CECs likely come from very low concentrations
  - Persistence of the risks associated with CECs is greater than the actual risk

##### FAILURE AND RESILIENCE

- The applicability of resilience practices to advanced processes is a relatively new endeavor
- The two required functions of resilience practices are (1) recognition of new (or) emerging risks to resilience or failure
- With respect to resilience, the two main components of failure response are: (1) failure detection and (2) failure mitigation

##### PATHOGENS

- Improved understanding of pathogen treatment can be made in the following areas:
  - Methods to quantify determine the concentration of pathogens or identify surrogates
  - Greater understanding of pathogen levels in untreated wastewater and their inactivation/removal through advanced treatment processes
  - Improved methods to verify pathogen inactivation and/or removal for more accurate log removal values of inactivation credits
  - Improved understanding of the impact of finished water on the presence of opportunistic pathogens in drinking water distribution systems

##### MONITORING DPR SYSTEMS AND THE CRITICAL CONTROL POINT APPROACH

- The transition from indirect potable reuse (IPRU) to DPR results in an increased response time to disruptions in water quality
- The critical control point (CCP) approach is a systematic way to anticipate and respond to human health through monitoring and control strategies related to physical locations within the treatment process. The CCP approach focuses on the exchanging and control of treatment processes for acute health risks and operational parameters
- Monitoring strategies are now available for DPR, increasing confidence and providing opportunity for improved efficiency

##### CONCLUSION, NEXT STEPS, AND ACKNOWLEDGEMENTS

- Initial draft of the synthesis of findings provided to the Expert Panel in March 2015. The Expert Panel is using the initial draft to commission the research for developing their recommendations
  - Final synthesis report of all the topics will be completed in August 2016
  - The information will be used to inform and regulate in the U.S. and abroad intended for implementing DPR as a source of water supply
- ACKNOWLEDGEMENT** - WaterReuse acknowledges the funding support of Inyonego Public Utilities Board as well as the California State Water Resources Control Board under Contract No. 13-05-010 with the direction of the WWRP Project Manager, Dawn Wagoner.

##### DEMONSTRATION OF RELIABLE, REDUNDANT TREATMENT PERFORMANCE

- Prediction of high quality advanced treated water can only be achieved through the coupling of reliable and redundant treatment processes
- To achieve reliable performance, individual treatment processes must be selected that are known to target specific contaminants for removal
- To achieve redundancy, the entire treatment system must contain multiple barriers for any given contaminant
- A barrier can be technical, operational, or managerial in nature
- Verification of whether a barrier can be used to mitigate or reduce identified human health risks is of critical importance. The two main components of failure response are: (1) detection and (2) mitigation

Process / Contaminant	Human Health Risk		Operational		Management	Total
	High	Low	High	Low		
Physical Barrier	High	Low	High	Low	High	High
Operational Barrier	High	Low	High	Low	High	High
Managerial Barrier	High	Low	High	Low	High	High
Technical Barrier	High	Low	High	Low	High	High



# WRRF 15-01 Topics

Demonstration of reliable, redundant treatment performance

Critical control points

Operations, maintenance, training/certification

Pathogens: surrogates and credits

Pathogens: rapid/continuous monitoring

Failure and resiliency

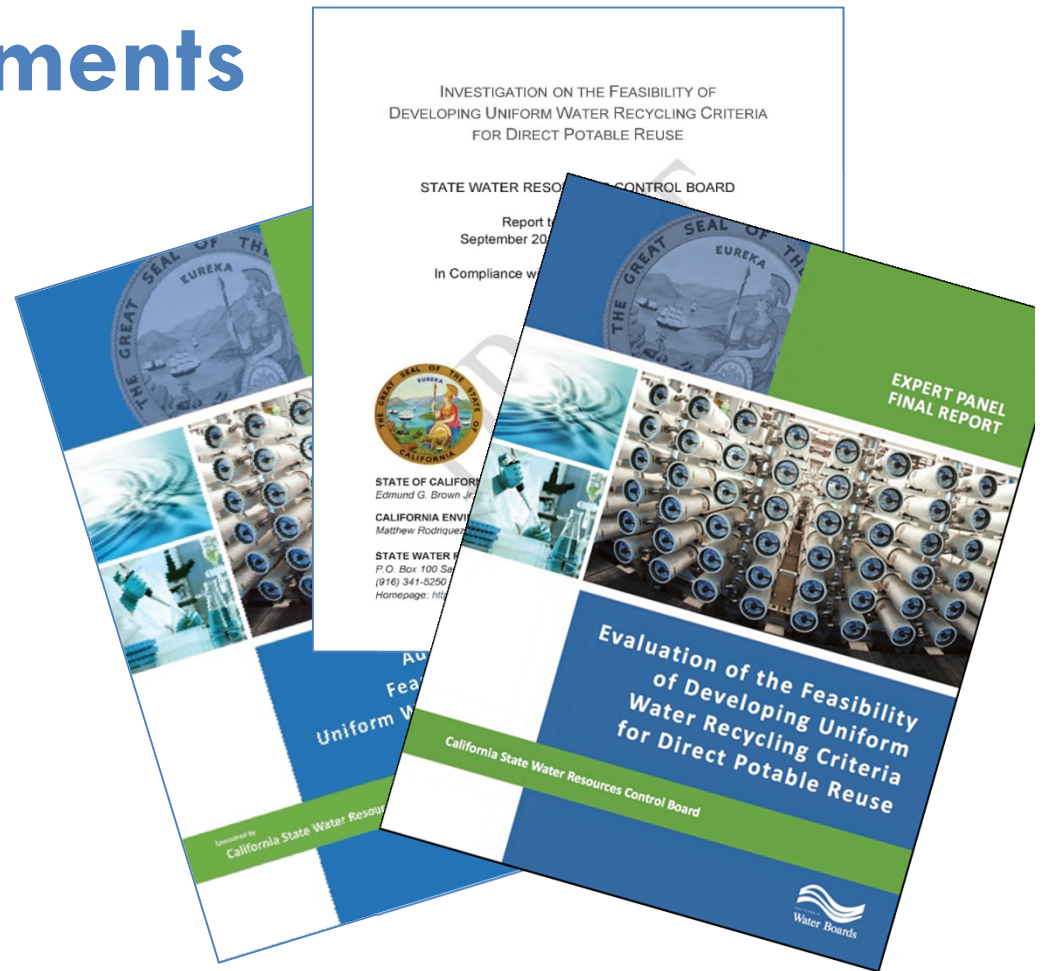
Removal and risk of constituents of emerging concern

Evaluation of potential DPR trains

Source control

# Recent CA Documents

- SWRCB Feasibility Report
- Expert Panel Report
- Advisory Group Report



Released on Sept 8, 2016:

[http://www.waterboards.ca.gov/drinking\\_water/certlic/drinkingwater/rw\\_dpr\\_criteria.shtml](http://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/rw_dpr_criteria.shtml)

# Overall CA Expert Panel Finding

**It is feasible to develop uniform water recycling criteria for DPR that would incorporate a level of public health protection as good as or better than what is currently provided in Calif. by conventional drinking water supplies and IPR systems.**



# Research Needs: Potable Reuse

## Treatment

- Non-RO treatment trains
- Optimization of treatment
- Technology validation
- Assessment of treatment performance
- Reliability of treatment

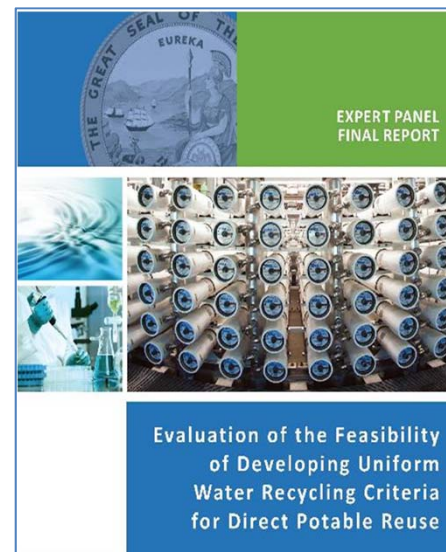
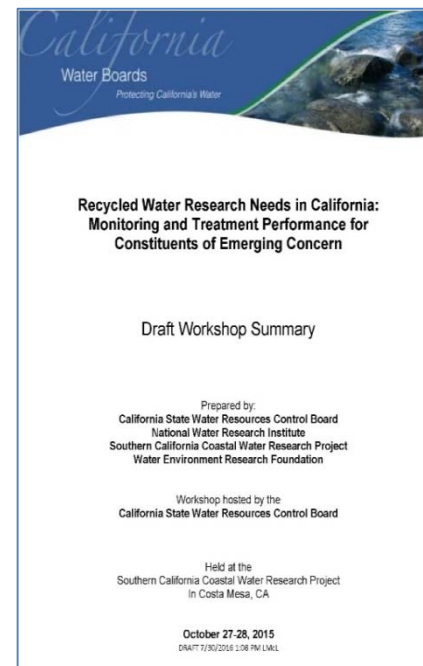
## Monitoring for pathogens and chemicals

- Surrogates and indicators
- Chemical monitoring
  - Chemicals – CECs, knowns and unknowns
  - Non-targeted analysis; Bioassays
- Pathogen monitoring
  - Emerging pathogens
  - Molecular methods; Next generation sequencing

## Operations

# Research Needs: Potable Reuse

Interest across the country!  
Significant opportunities to advance recycled water  
Build on ongoing research planning efforts



# Next Steps for Reuse Research



We are in the process of working on contract for ~\$3.0M with CA State Water Board to fund potable reuse research

We are looking to leverage those funds inside CA **and across the country**

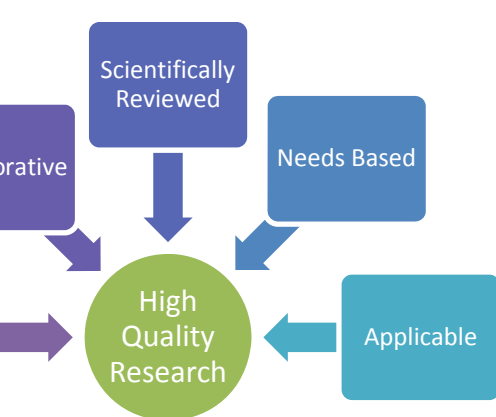
- That will ensure regional considerations are addressed

WE&RF research process (Board, RAC, IAT) to be used in 2017 to prioritize research – PACs to develop RFPs

Research

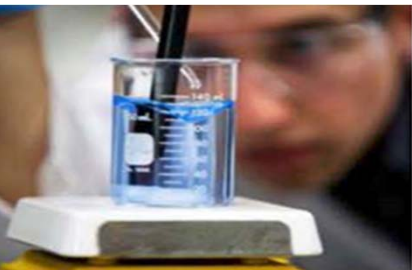
Technology & Innovation

Public Acceptance



### LIFT<sup>2.0</sup> 7 STRATEGIC AREAS OF FOCUS

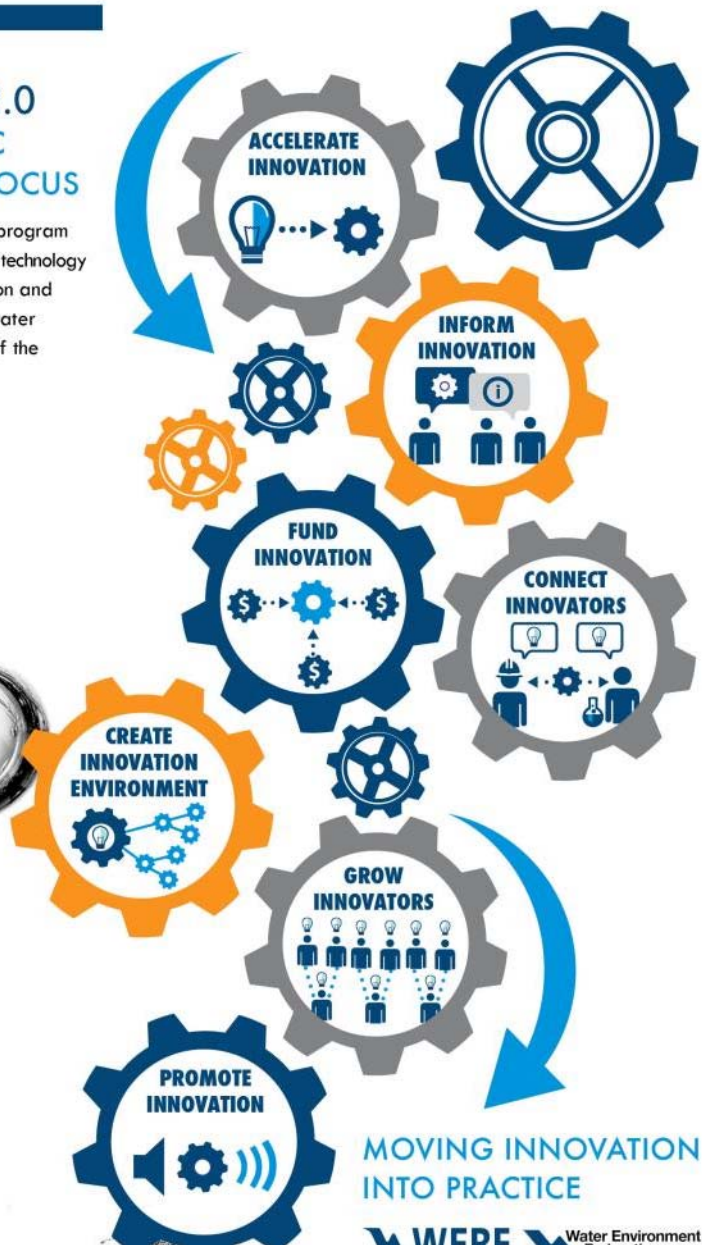
LIFT is a WERF-WEF program that accelerates water technology demand and adoption and engages the entire water sector in all phases of the innovation process.





## LIFT<sub>2.0</sub> STRATEGIC AREAS OF FOCUS

The WERF-WEF program accelerates water technology development and adoption and supports the entire water innovation process.



# LIFT

Leaders Innovation Forum  
for Technology

[www.werf.org/lift](http://www.werf.org/lift)

## Program Components

1. Technology Evaluation Program
2. People and Policy
3. Communication
4. Informal Forum for R&D Managers

# Public Acceptance

Is “public attitude” the biggest challenge to potable reuse?



# Public Perception

Water Reuse 101 Advocacy



Model Communication Plans  
for Increasing Awareness and  
Fostering Acceptance of  
Direct Potable Reuse

Project: 13-02  
Status: Completed Research  
Released: 2015

WATER REUSE FOR DRINKING | AROUND THE WORLD

HOME LOCATIONS FAQ HELP

WELCOME TO THE GLOBAL CONNECTIONS MAP

Access to clean, reliable, and adequate water supply is paramount to any community's future. Communities around the world face pressure from population growth, climate change and the impact of water management decisions by upstream jurisdictions or countries.

This global connections map spotlights some of the ways in which water is used and reused across the globe for potable reuse. Of course, we must not forget that it is often the case that downstream communities are using the treated used water from upstream communities. This commonplace use and reuse of water for drinking is not shown on the map.

The global connections map brings innovative water purification projects into focus to open the door to more sustainable management. The needs, benefits, safety and technologies of these key projects are highlighted.

The map will evolve over time as more and more projects are added from around the world.

EXPLORE

WATER REUSE Australian Water Recycling Centre of Excellence

ment Technology animations

Reverse Osmosis

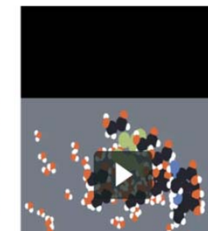


## Think & Drink Water

Sustainability

Systems Thinking

Designed for Purpose



# Changing minds... One pint at a time



**Start a conversation about reuse and the nature of water**

**\*\*\***

**Demystify water purification and the urban water cycle**

**\*\*\***

**Showcase innovative water technology to inform how water can be used**



**Thank you for listening!**  
**Questions?**

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