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RECLAMATION

Produced Water Research at Reclamation

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Produced Water Mission Relevance

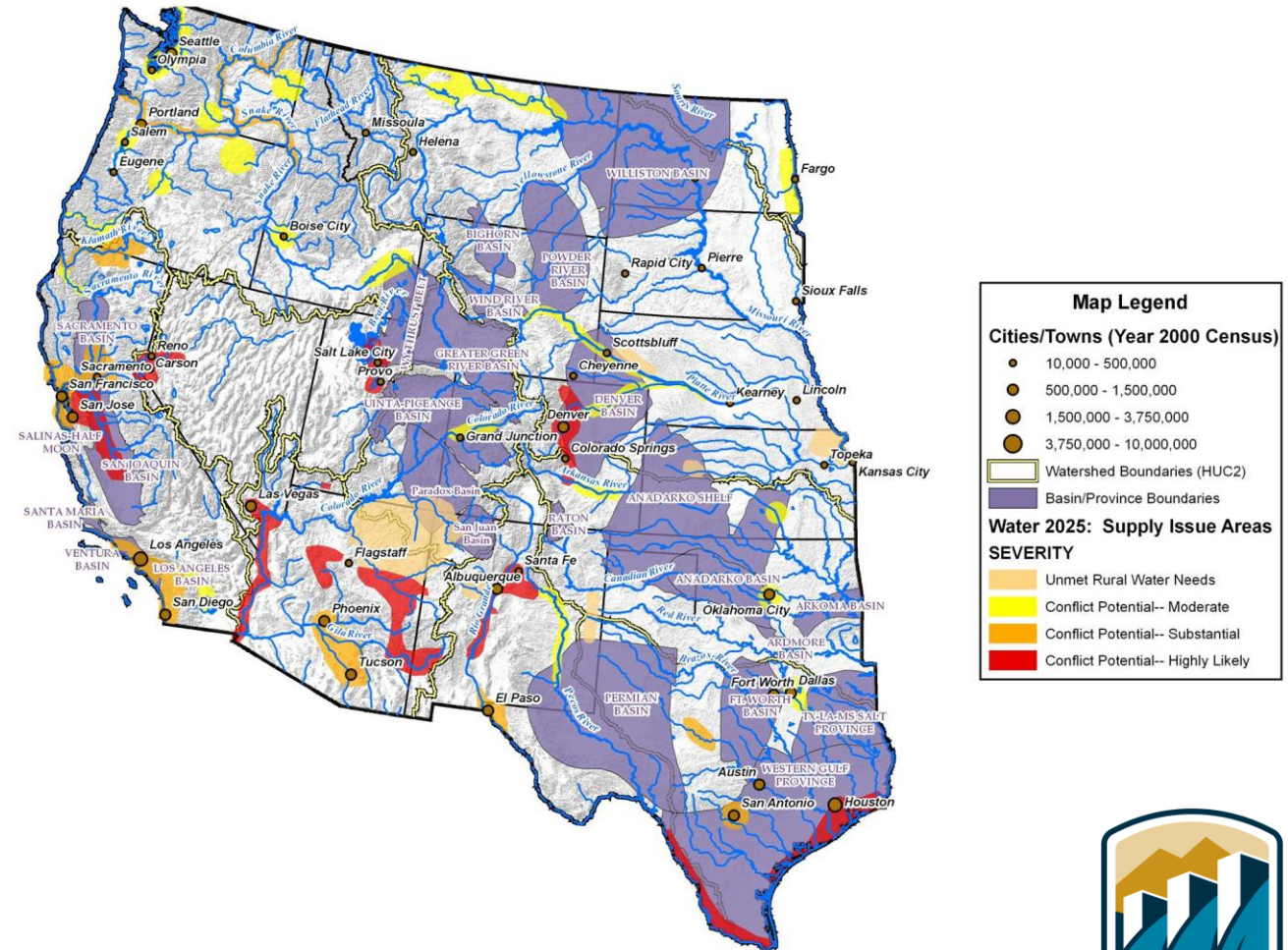
“The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.”



Augmenting Traditional Water Supplies

Beneficial use of produced water can...

- Reduce potential for conflict in water-short areas
- Improve environmental management of land and water supplies
- Enable oil and gas production where otherwise impractical due to water disposal challenges



Treated Produced Water as an Alternative Water Supply

- Drought proof
- Can free up potable water for other uses
- Water can continue to be mined after oil and gas production ceases, if necessary
- Treatment and use mitigates other environmental risks associated with disposal



Timeline of Reclamation PW Activities



UT Austin/Reclamation - Novel Membrane Development for Produced Water Applications

CSM - Beneficial Use of Produced Water using Membrane Treatment and CDI

Reclamation - Beneficial use of Produced Water in the West

Reclamation - CBM produced water beneficial use

Reclamation - Produced Water Treatment Primer

Reclamation - Summary and next steps

Title XVI-Feasibility Study-OWRB Potential Impacts of Alternative PW Scenarios

Title XVI Research-Kansas Water Office-Pilot Test Project for PW near Hardtner, KS

Framework for implementation: stakeholder needs, treatment capabilities, and regulatory analysis

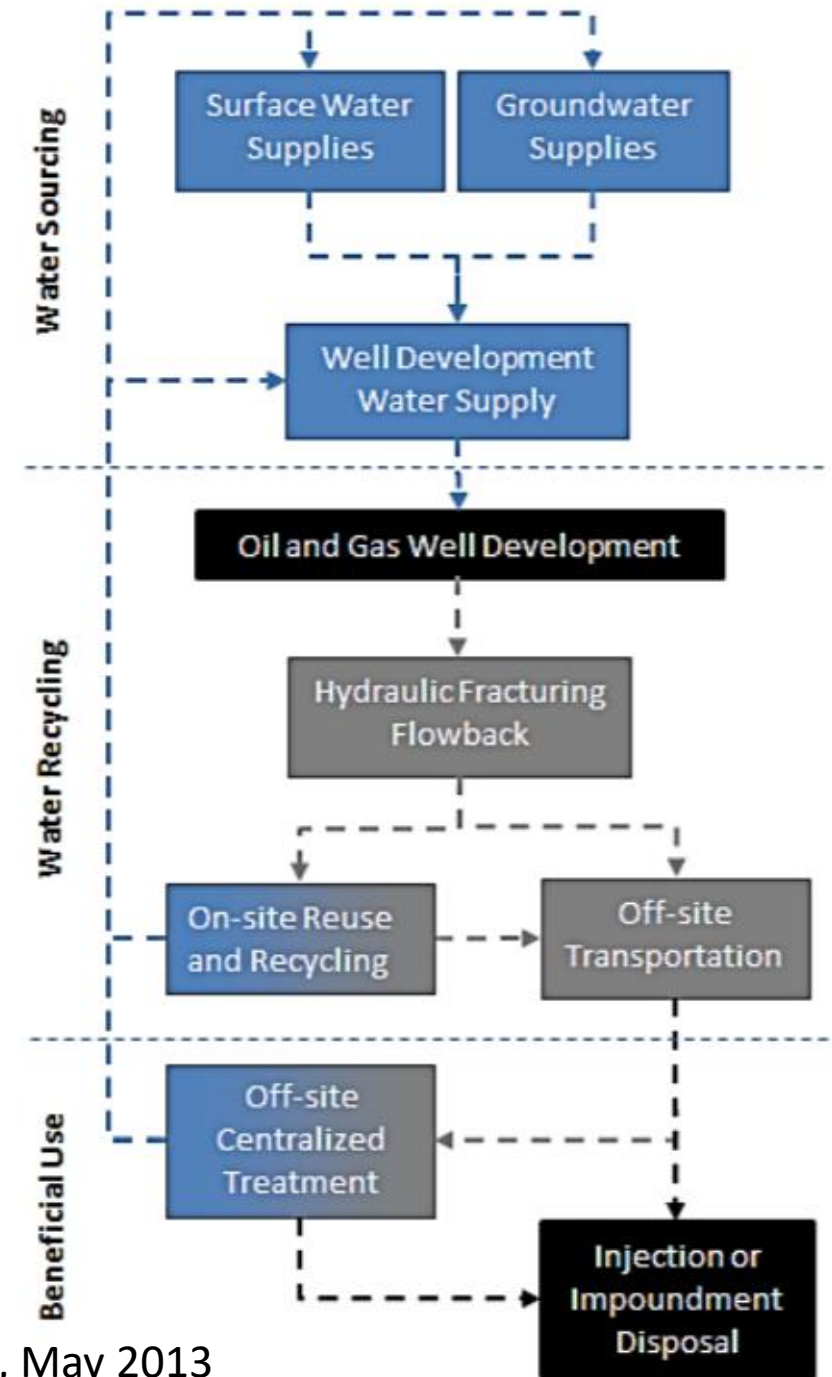
Water Management Perspective

Efficient water management

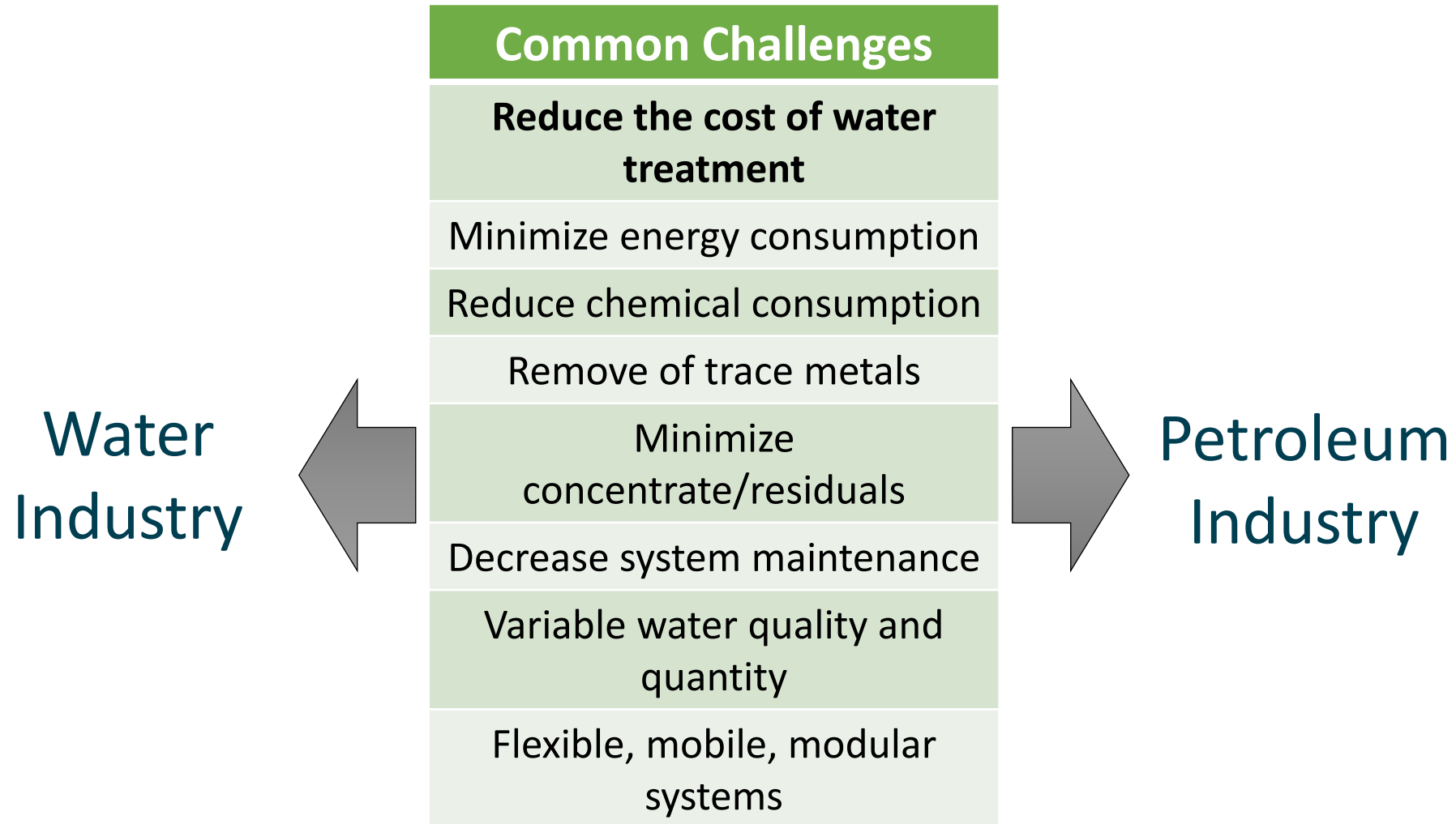
- Quantify locational value of water source
- Identify alternative sources for competing interests

Increase usable water resources

- Identify impaired resources
- Employ treatment for impaired water

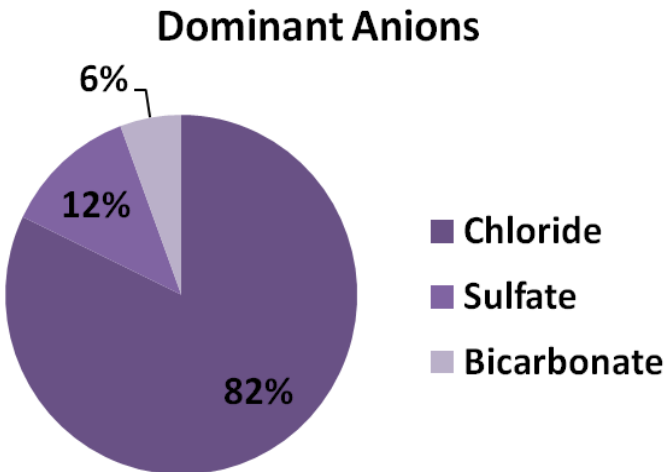
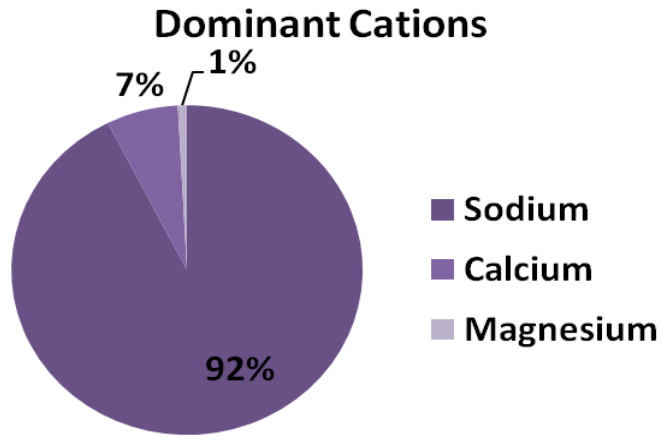


Mutual Benefits to Water and O&G

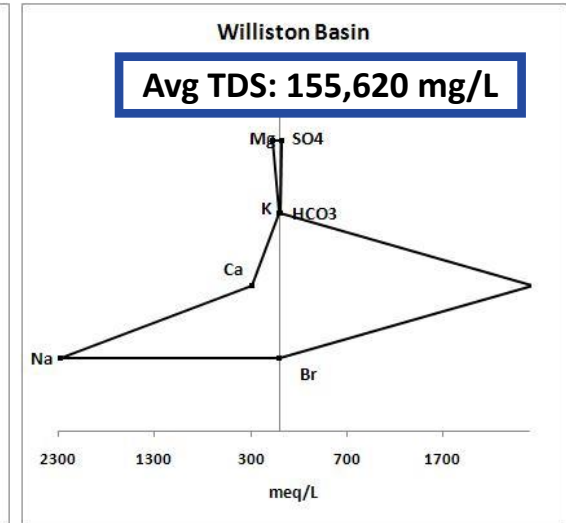
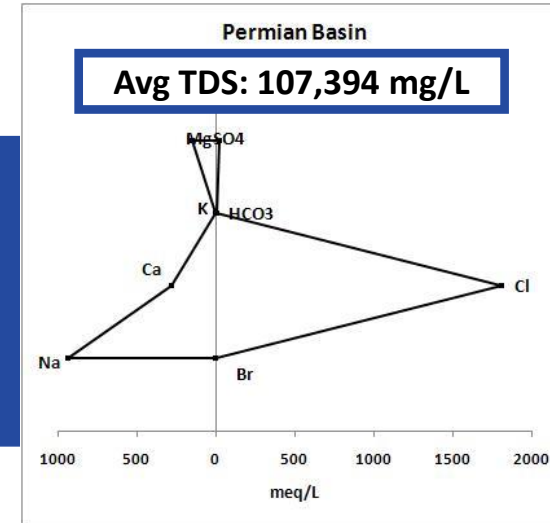


Water treatment— flow of expertise, knowledge and innovation between industries

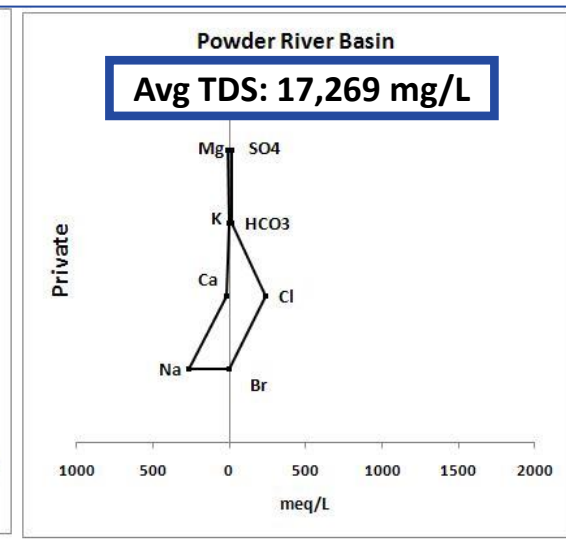
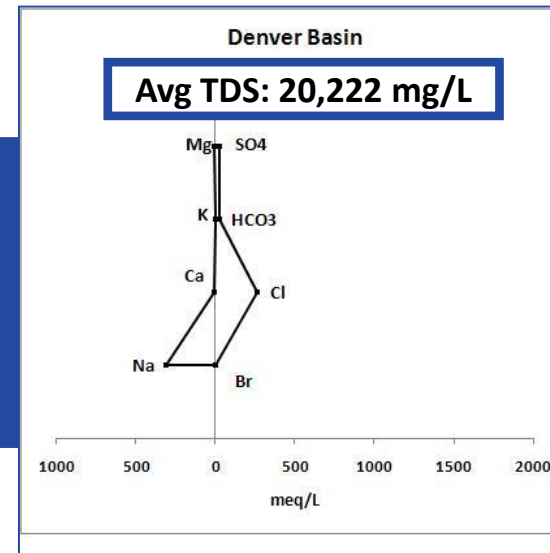
Understand WQ Characteristics to Optimize Treatment for Specific Beneficial Uses



Bicarbonate dominate anion, basins characteristically lower TDS



Decreased calcium and magnesium, basins characteristically lower TDS



Compare Treatment Technologies Based on Key Design and Performance Criteria

Technology	Overall Process Recovery (%)	Contaminants removed	Organic matter removal	Particulate removal (min size removed)	Heavy Metals	Low Chemical Demand	Low Energy Demand	Minimal Maintenance	Ease of Operation	Minimal posttreatment requirement	Low Cost	Robustness ¹	Reliability ²	Flexibility ³	Mobility ⁴	Modularity ⁵	Waste Disposal Requirements	Small Footprint
Settling pond	100%	particulates, iron, manganese	NA	+++	++	+++	+++	+++	+++	+++	+++	+++	+++	++	-	-	+++	-
Air Stripping	100%	TOC, volatile organics	+++	NA	-	+++	++	++	++	+++	++	+++	+++	+	++	+	+++	++
Surfactant Modified Zeolite Vapor Phase Bioreactor	95%	TOC, volatile organics	+++		++	++	+++	+++	+++	+++	?	?	?	?	?	+++	++	++
Constructed wetlands	100%	TOC, dissolved organic compounds (increased calcium and slightly increased TDS)	+++	+++	++	+++	+++	+++	+++	+++	+++	+++	+++	++	-	-	+++	-
Granular Activated Carbon Fluidized Bed Reactor	100%	TOC, volatile organics	+++	++	+++	+++	+++	++	+++	+++	+	+++	+++	+++	+++	+++	+	+++
UV Disinfection	100%	inactivation of microbial contaminants	NA	NA	NA	+++	+	+	+++	+++	+	+	+++	+++	+++	+++	+++	+++
Ceramic MF/UF membrane	85 to 95%	particulates, dissolved (with coagulation) and suspended organics, biological	++	0.01 um	-	++	++	++	++	+++	++	+++	++	++	+++	+++	++	++

Excellent	Good	Fair	Poor
+++	++	+	-

https://www.usbr.gov/research/projects/download_product.cfm?id=324

This led to work by CSM through NETL on the CBM Produced Water Management Tool:
http://aqwatec.mines.edu/produced_water/tools/

Case Studies of Existing Hydraulic Fracturing Flowback and Produced Water Treatment Facilities

- Facility Description
- Location
- Feed Water
- Capacity
- Treatment Process
- Treated Water Use
- Concentrate Disposal
- Operational experience
- Performance data
- Permits



McKean County, PA



San Ardo, CA



Clarion County, PA



Wellington, CO



Pinedale, WY



Powder River Basin, WY

https://www.usbr.gov/research/projects/download_product.cfm?id=1214

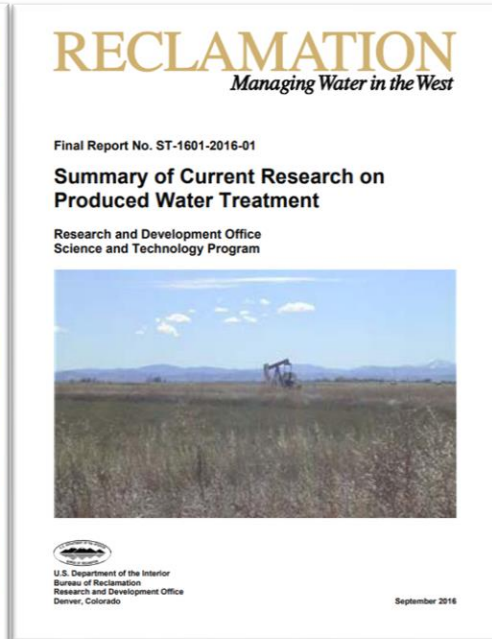
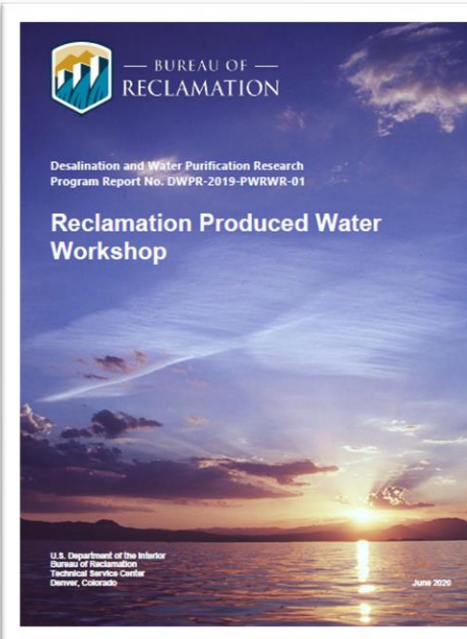
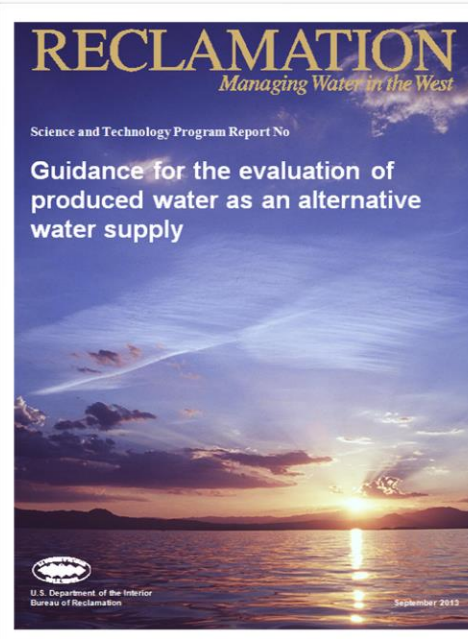
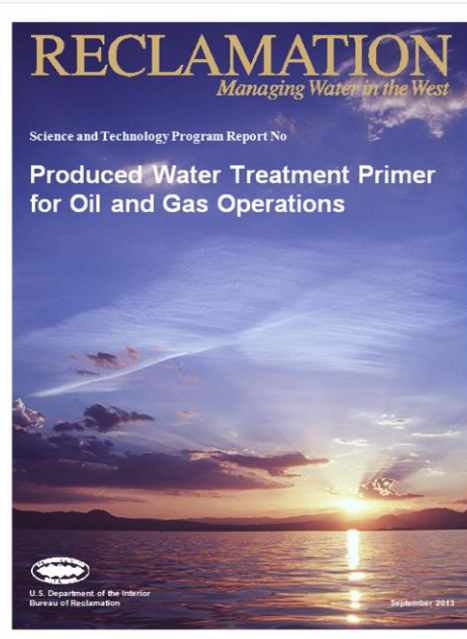
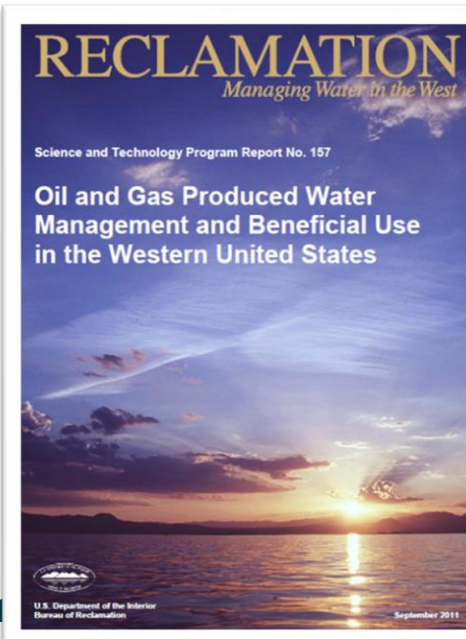


Conclusions From Past Work

Beneficial use: In areas with competing water resource needs, treatment and beneficial use of produced water will benefit water users and energy producers

Treatment: Technologies exist to treat PW, but selecting the appropriate technology for an application remains a challenge

Partnerships: Collaboration between producers/service providers, government (Fed/State/Local), and stakeholders is essential for treatment and beneficial use of produced water



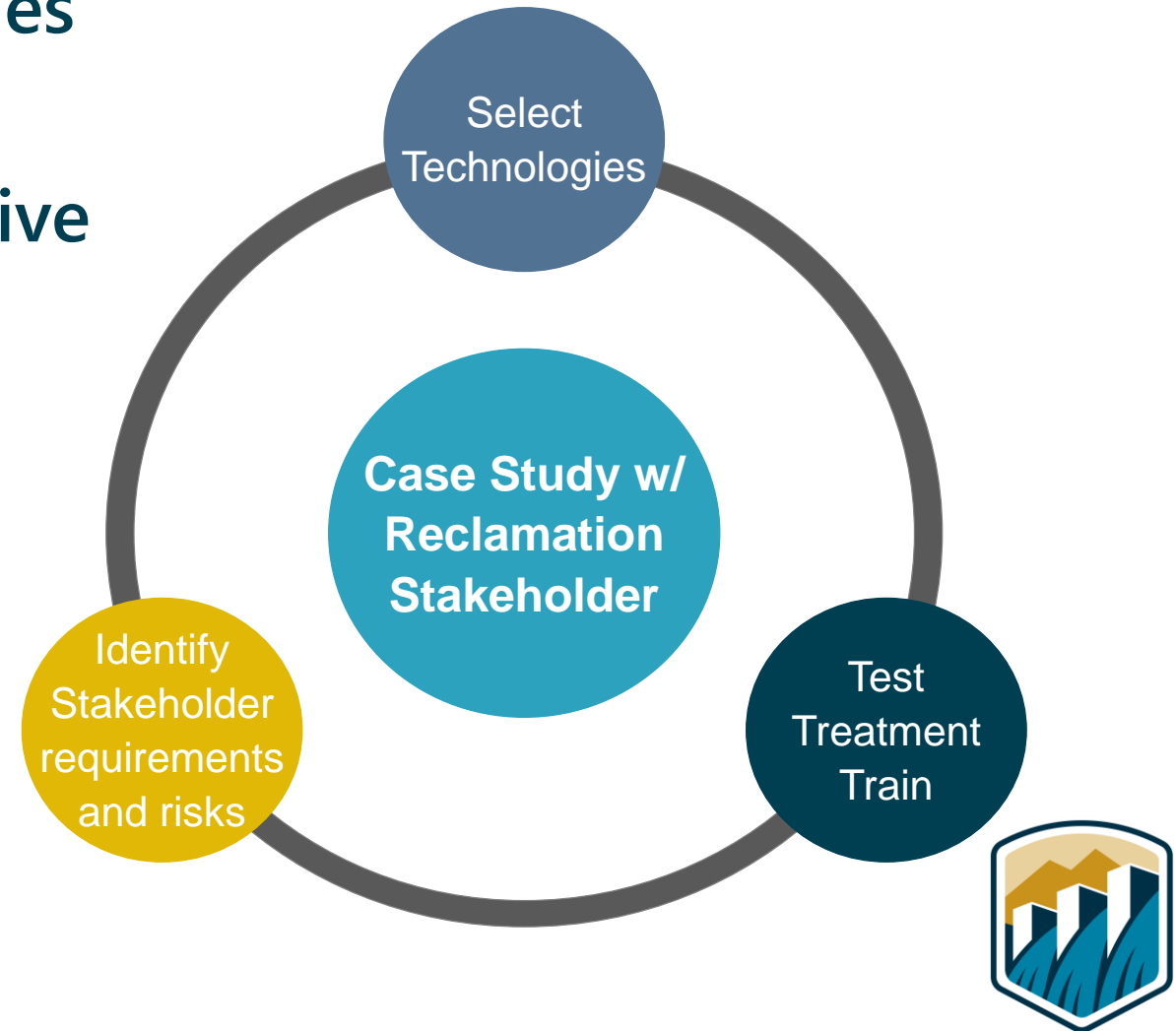
Next Steps

Evaluation of Produced Water Treatment Technologies and Applications to Increase Water Supplies

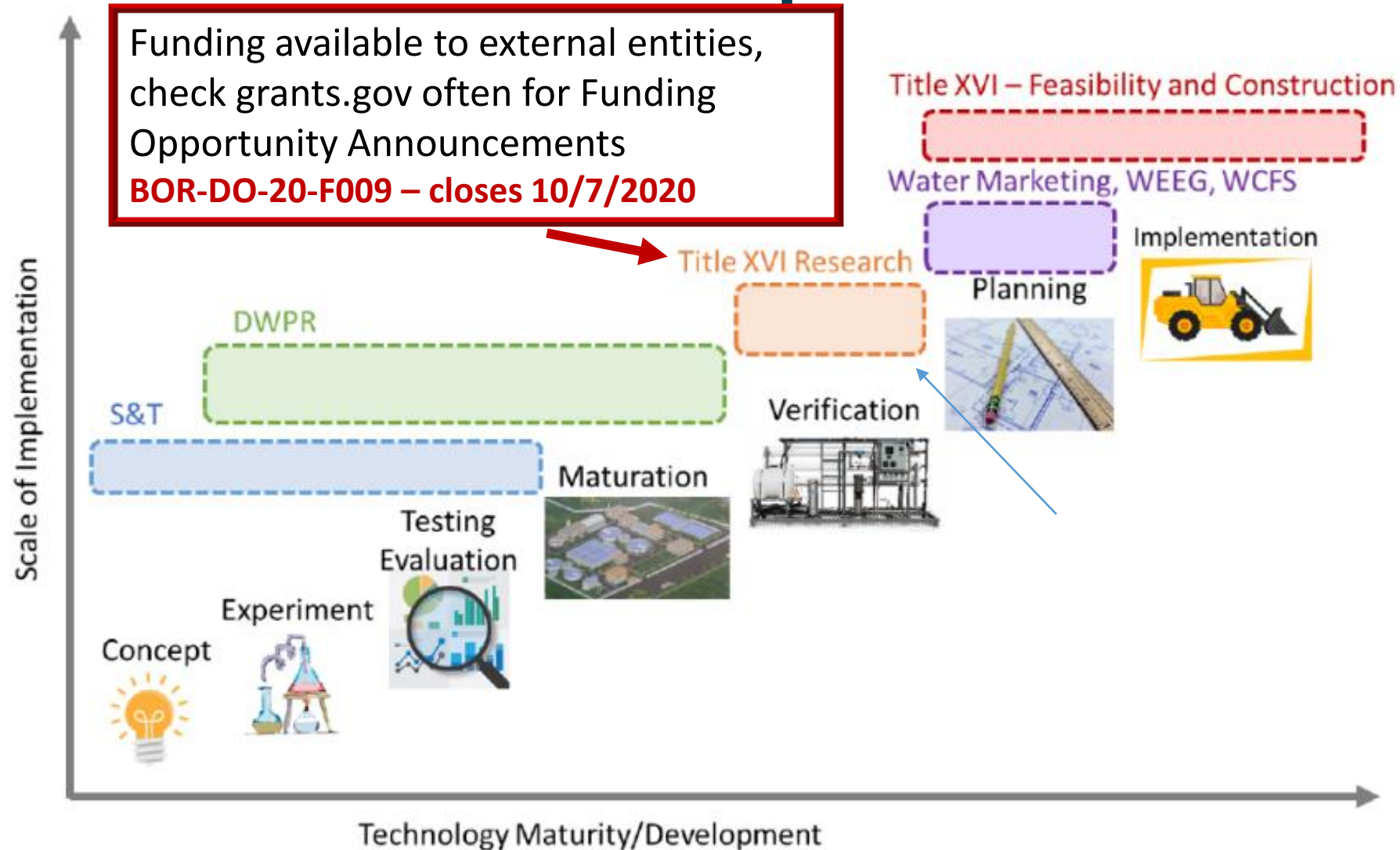
Leverage the following:

1. New ideas and fresh perspective
2. Treatment expertise
3. Testing facilities
4. Stakeholder needs
5. Partnerships

Upcoming: Reclamation Research Roadmap – public comment in 2021



Reclamation Programs Fund Advanced Water Treatment from Concept to Construction



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Research reports can be found at:
www.usbr.gov/research/dwpr



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