



Produced Water Fit-for-Purpose Reuse Research Public Outreach and Dialogue

NMJC Hobbs
May 24-25, 2022

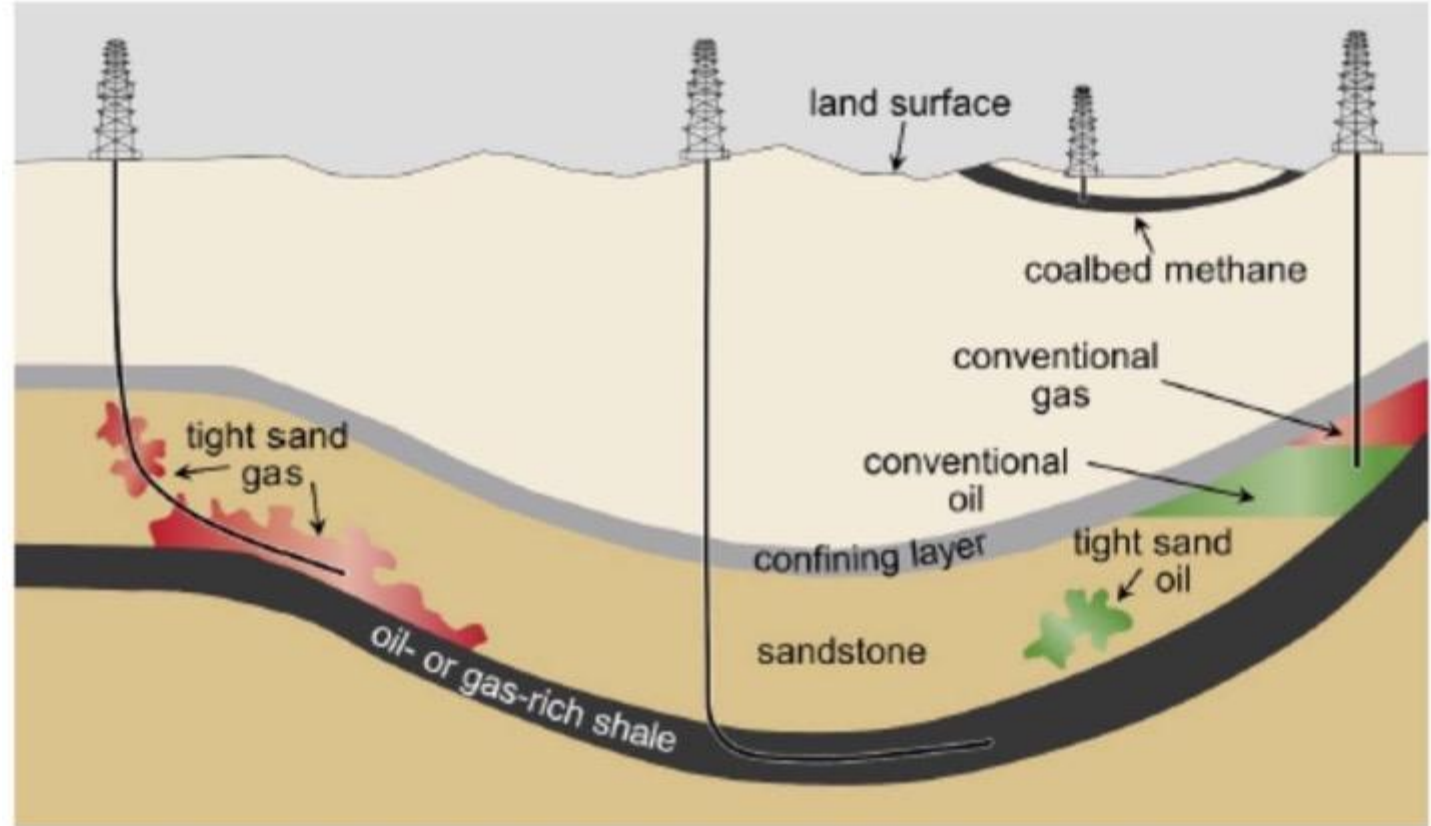


BE BOLD. Shape the Future.

NEW MEXICO PRODUCED WATER RESEARCH CONSORTIUM

What is Produced Water

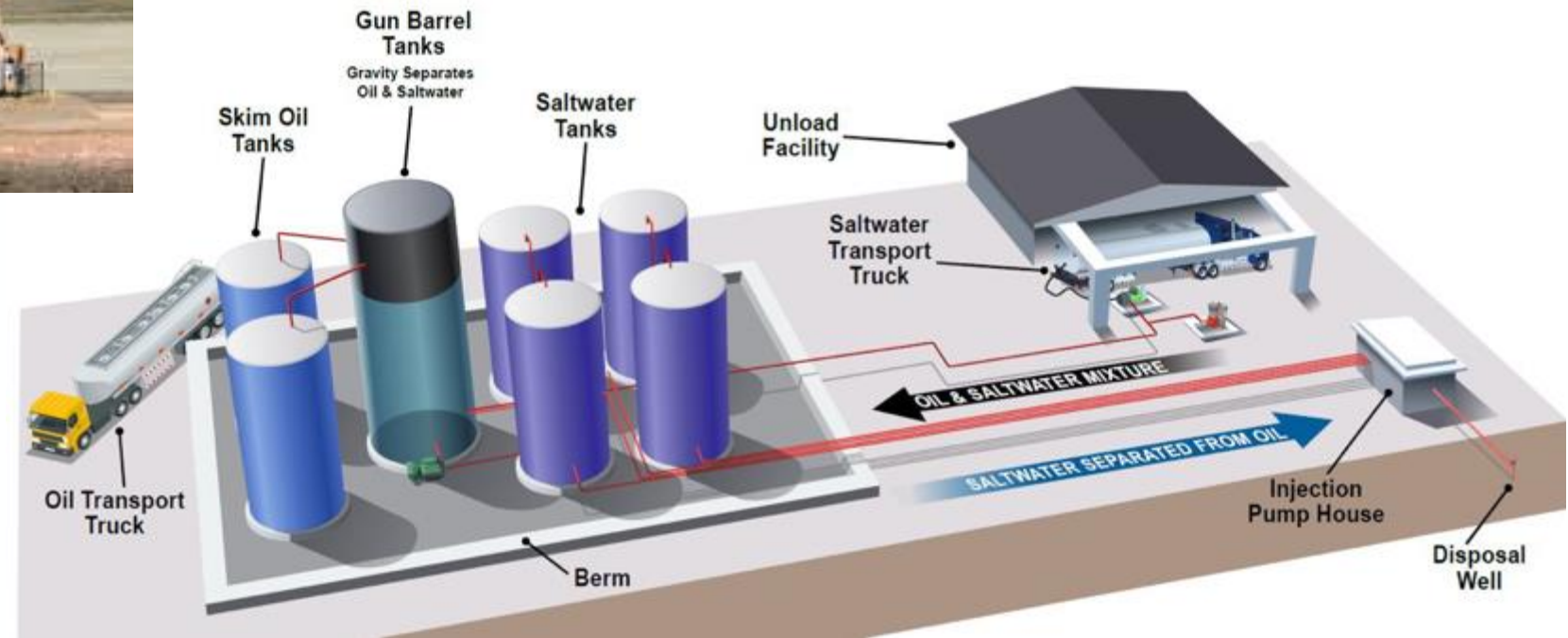
- Produced water is water produced in conjunction with oil and gas operations - drilling, development, pumping, and fracking
- Water can be 4-10 times the volume of oil produced (1 bbl oil = 4-10 bbls of water)
- Produced water often contains high levels of minerals and organic compounds due to geology and hydrocarbon contact



Oil and Gas Production

All oil and gas production includes water because production is from deep ancient seas, shallow plays, or adds water

Collection and Separation of Produced Water

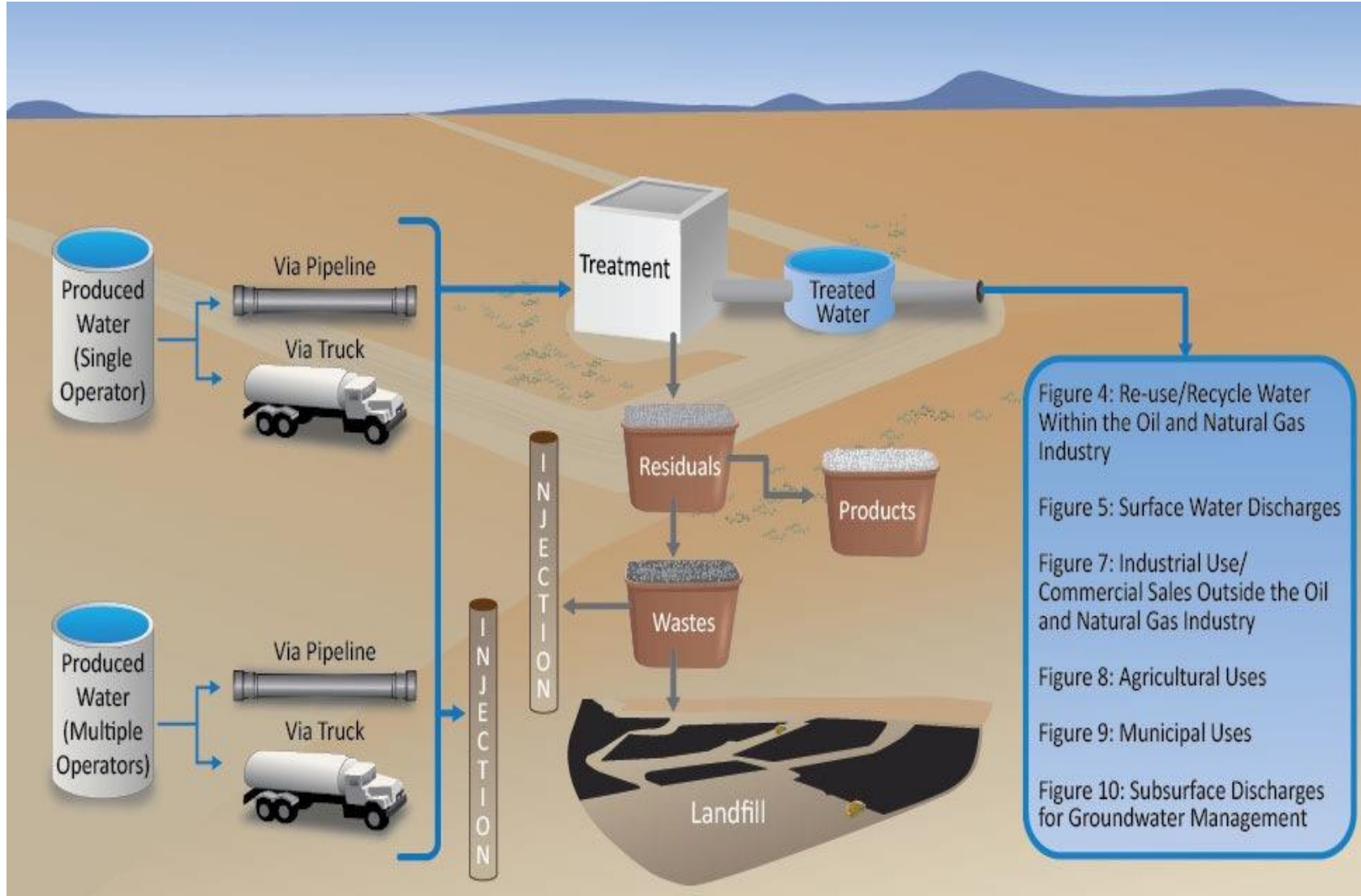


Use of Produced Water – Today and Tomorrow

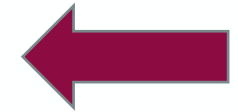
Today



Salt water Disposal (SWD)

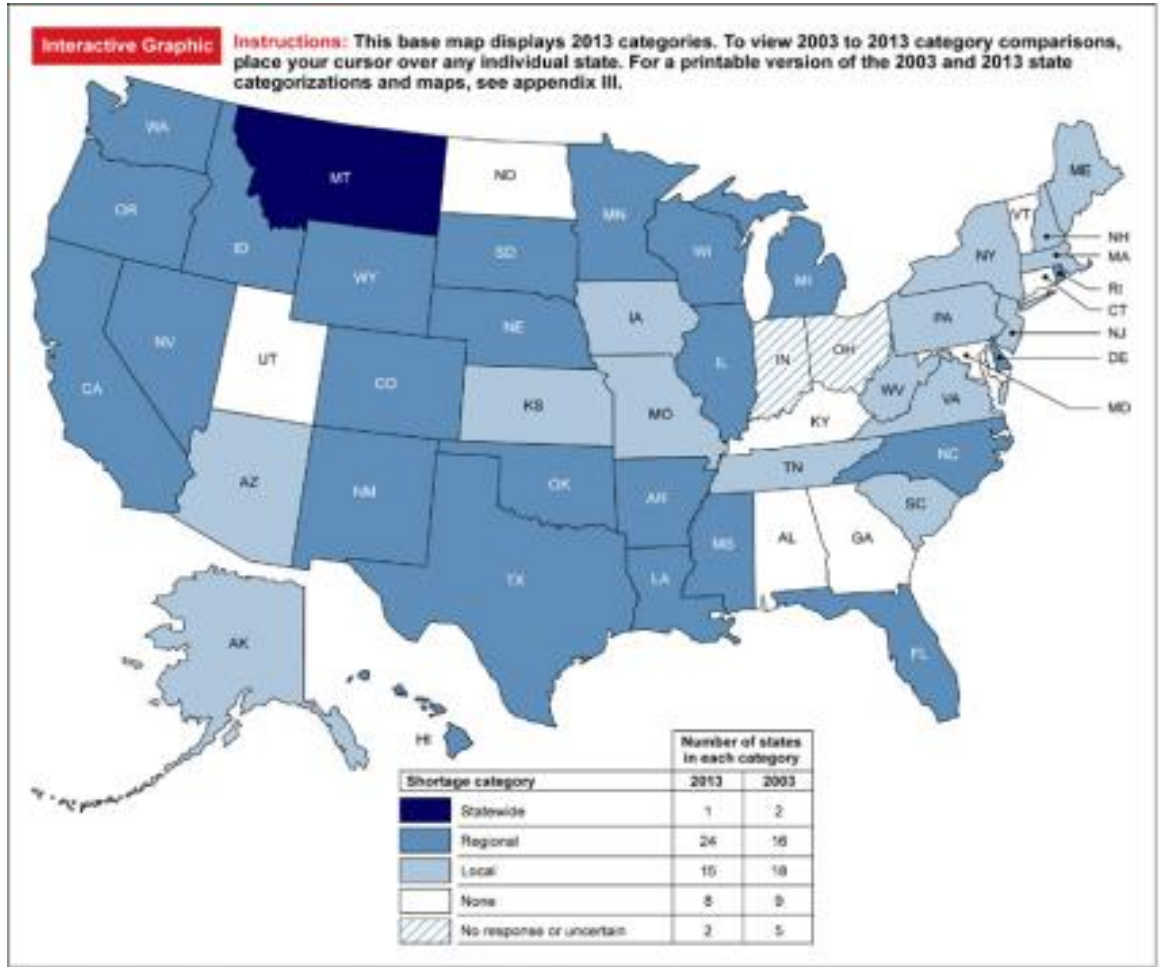


Tomorrow

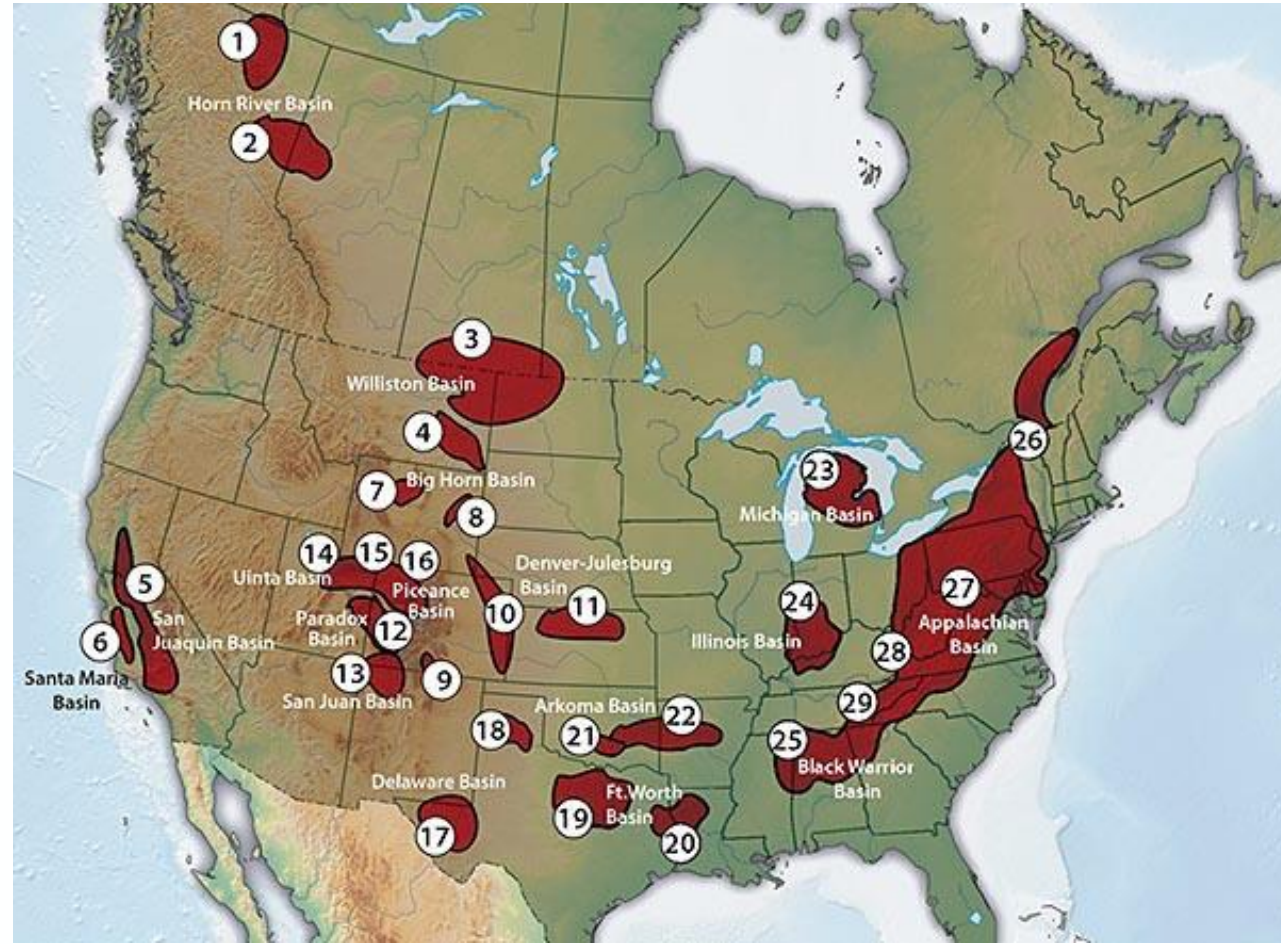


Fit-for-purpose treatment and reuse of produced water

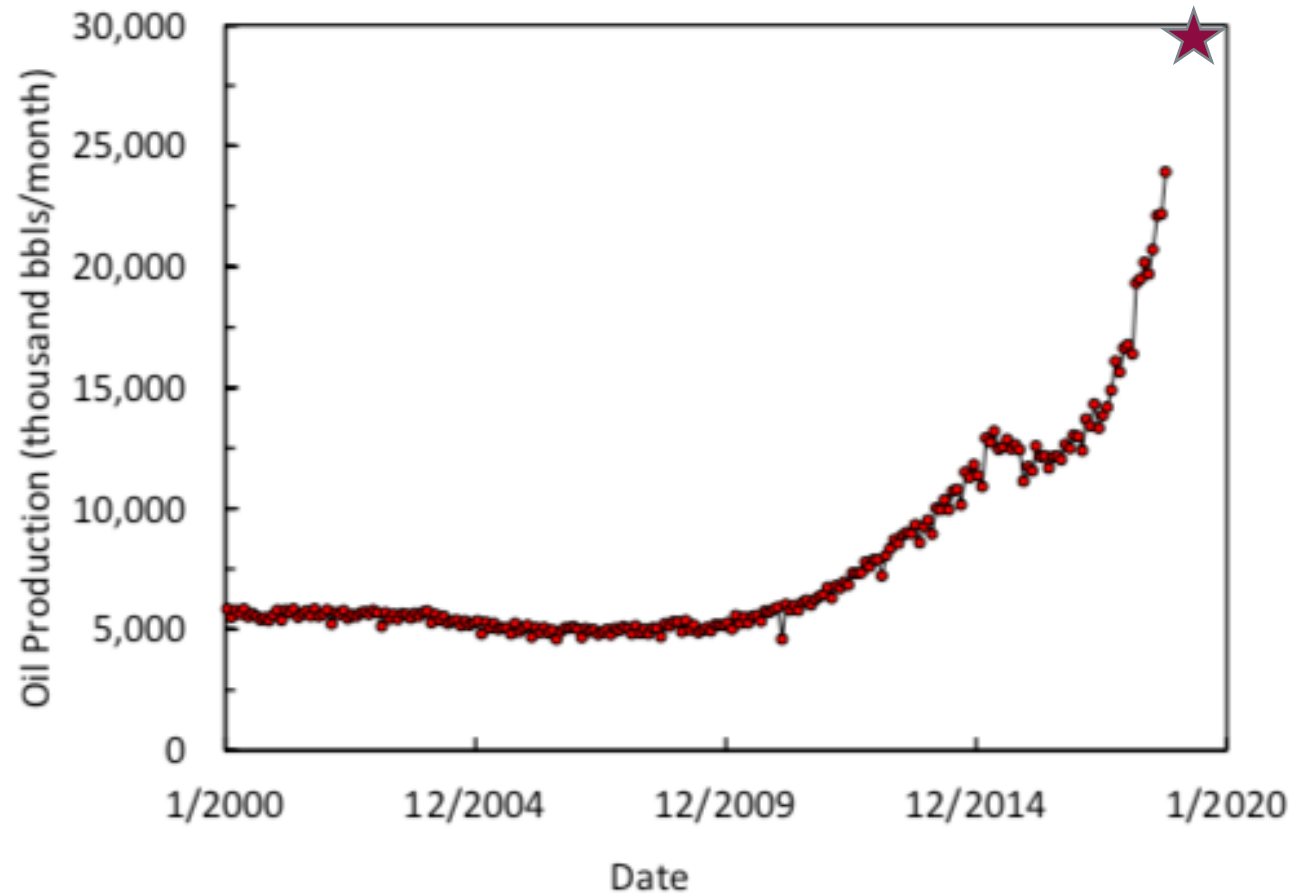
State Water Stress Driving Produced Water Reuse



Sources: GAO analysis of state water managers' responses to GAO survey; Map Resources (ms).



Produced Water Volumes are Significant – 4 bbls of water/bbl of oil



Average ~4 million bbls produced water/day (3 ABQ's worth of produced water availability)

Long History in NM on Produced Water Reuse Research

- Sandia and Los Alamos conference on CBM produced water reuse in Denver for DOE – 2002 (20 oil companies)
- Permian Produced Water Reuse Workshop at NMJC in Hobbs with NM WRRRI - 2003 (140 attendees, eight projects ongoing- Reed & Stevens, Yates, Devon, Chevron, Conoco, Sandia, LANL)
- NM Tech PRRC Produced Water Treatment Effort – 2003 -2007
- Significant industry, national lab, and university efforts - 2004-2015
- NM EMNRD working group on streamlining produced water reuse - 2015
- EPA signs MOU with NM to explore produced water reuse options - 2018
- NM Desal Association Workshop on Produced Water Reuse – 2018 (160 attendees)
- DOE and BOR expand desalination research funding to include produced water 2019



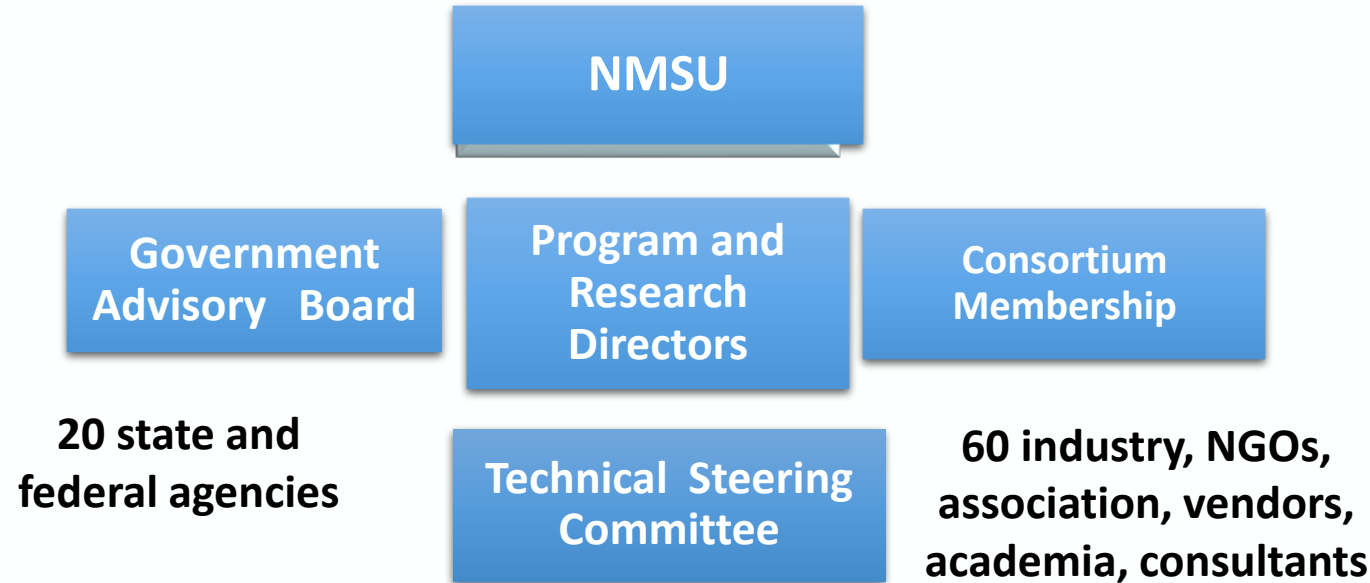
NM 2019 Produced Water Act

- Through the Act, statutory and regulatory authority for the reuse of produced water was modified:
 - Reuse inside oil and gas sector remains under the Oil Conservation Division (OCD) of the NM EMNRD,
 - **Reuse outside the oil and gas sector, was designated to the NM Environment Department (NMED).**
- The Act encourages produced water reuse outside oil and gas to:
 - enhance fresh water sustainability,
 - reduce or eliminate fresh water use in the oil and gas sector,
 - support new economic development opportunities,
 - maintain public and environmental health and safety.

Emerging trend in the oil and gas sector – PA, WY, OK, TX, AZ, UT, CA

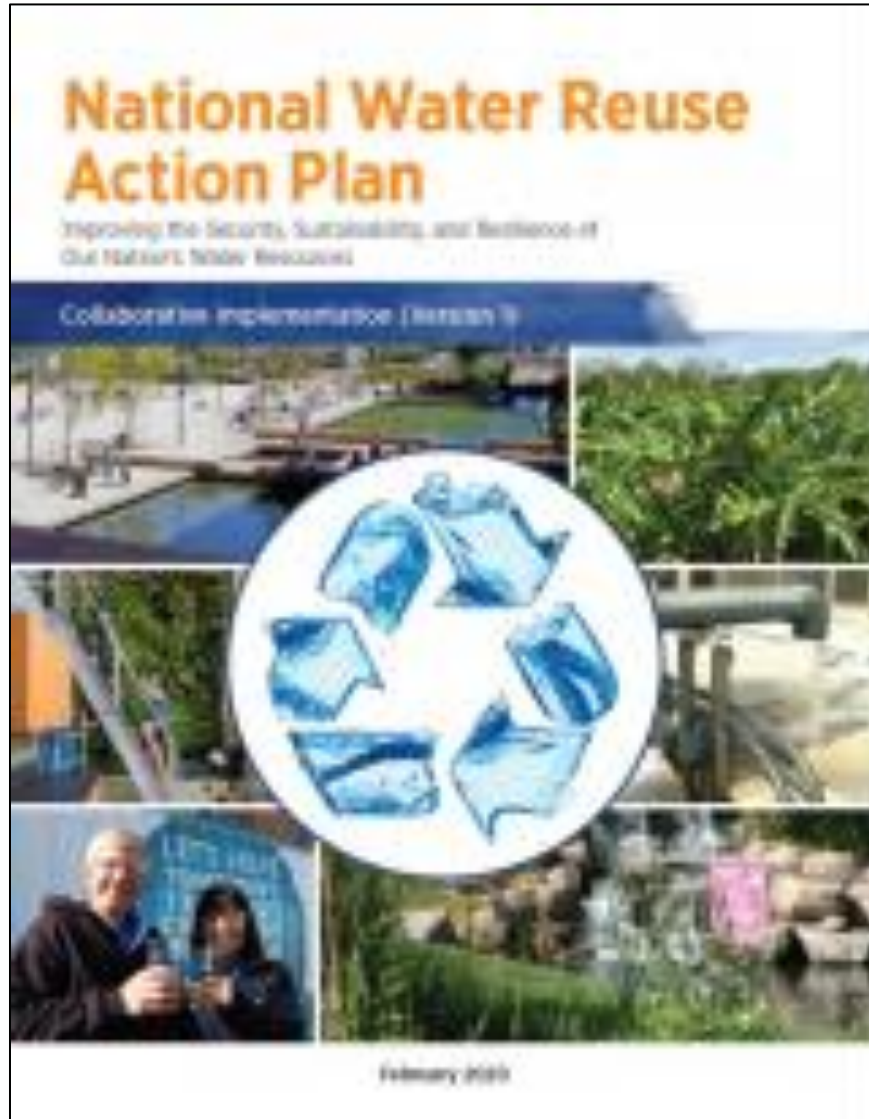
NM Produced Water Research Consortium Overview

- Formed through an MOU between the NMED and NMSU
 - Support NMED and other state agencies in assessing produced water
 - Coordinate research and development of fit-for-purpose reuse of produced water outside oil and gas
- Fill science and technology gaps
 - Use collaborative process of government, industry, public
 - **Assure reuse is protective of public and environmental health and safety**
- Initial 3-year program, 2020-2022, funded by sponsorships
- Currently 60 organizations with 200 participants



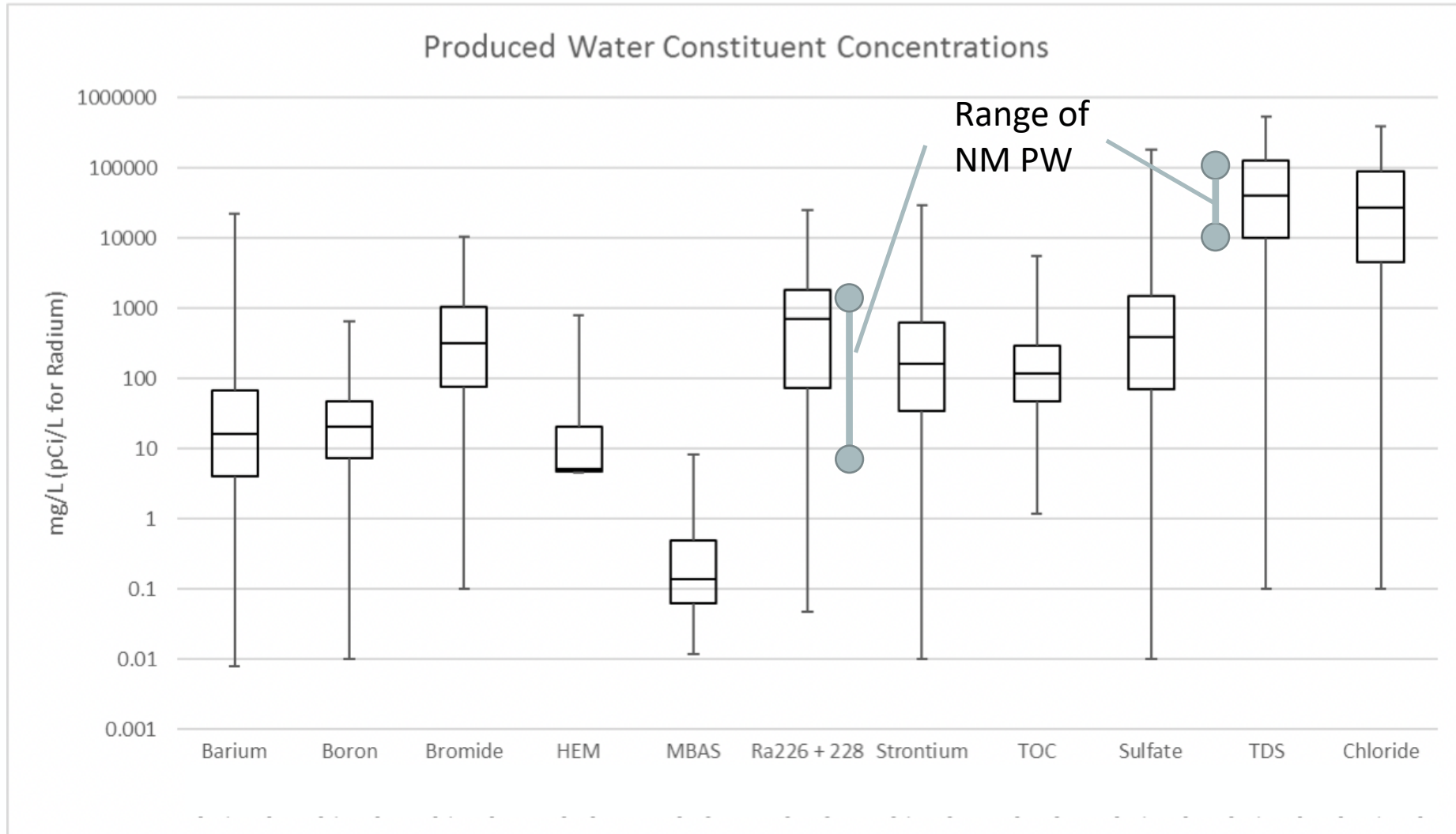
**Modeled after DOE and EPA
Environmental Treatment Technology
Verification Programs**

EPA National Water Reuse Action Plan – Feb 29, 2020



- Focus on fit-for-purpose treatment and reuse of waste water
- In five major areas:
 - Thermo-electric cooling water
 - Agricultural waste water
 - Municipal waste water
 - Produced water
 - Storm water
- EPA selected NMPWRC and GWPC to lead the national program in produced water reuse

Produced Water Must be Treated to Be Reused



[EPA-821-S19-001]

“Overcoming fear requires making the unknown known”

Georgia O’Keeffe

“we oppose even entertaining the idea of using this on crops.” “Because it’s chemically altered, we believe it can never be returned to the evolutionary process as water.” **NM Desal, 2018 Produced Water Forum Protestor.**

Wash Post Dec 8, 2018

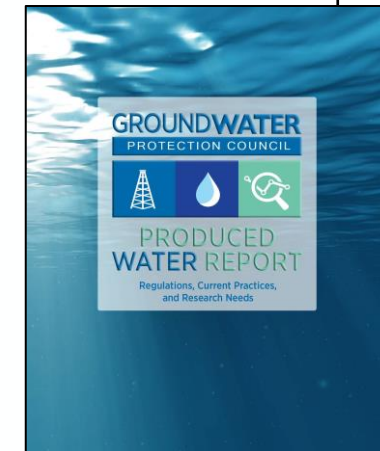
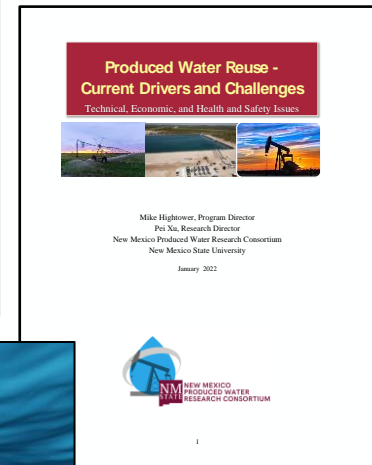
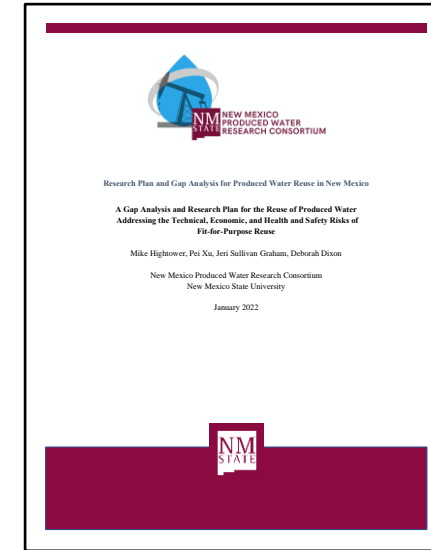
“Unknown, poisonous, and hazardous proprietary chemicals”
Public Meetings 2019

“... we have been using treated waste water for 40 years, we are not afraid of it, what we want to do is protect our fresh water resources...”

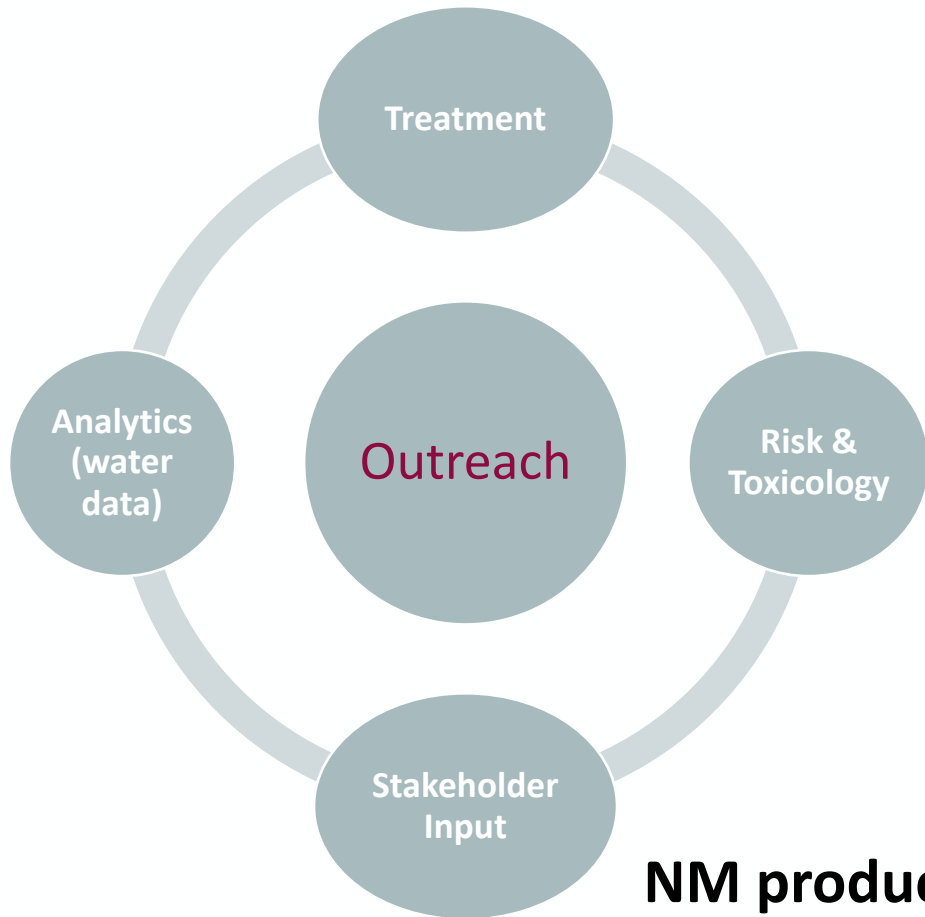
**NMPWRC, NM Elected Officials Forums,
July-August, 2021**

Consortium Science and Technology Gaps Research

- What's in produced water and where and how could it be used
- Can produced water be easily treated and to what levels
- What are the human and environmental toxicology and risks of using treated produced water
- What are the socio-economic and ecological costs and benefits of using treated produced water



Public Education and Outreach is Important for the Success of Produced Water Reuse



“... we have been using treated waste water for 40 years, we are not afraid of it, what we want to do is protect our fresh water resources...”

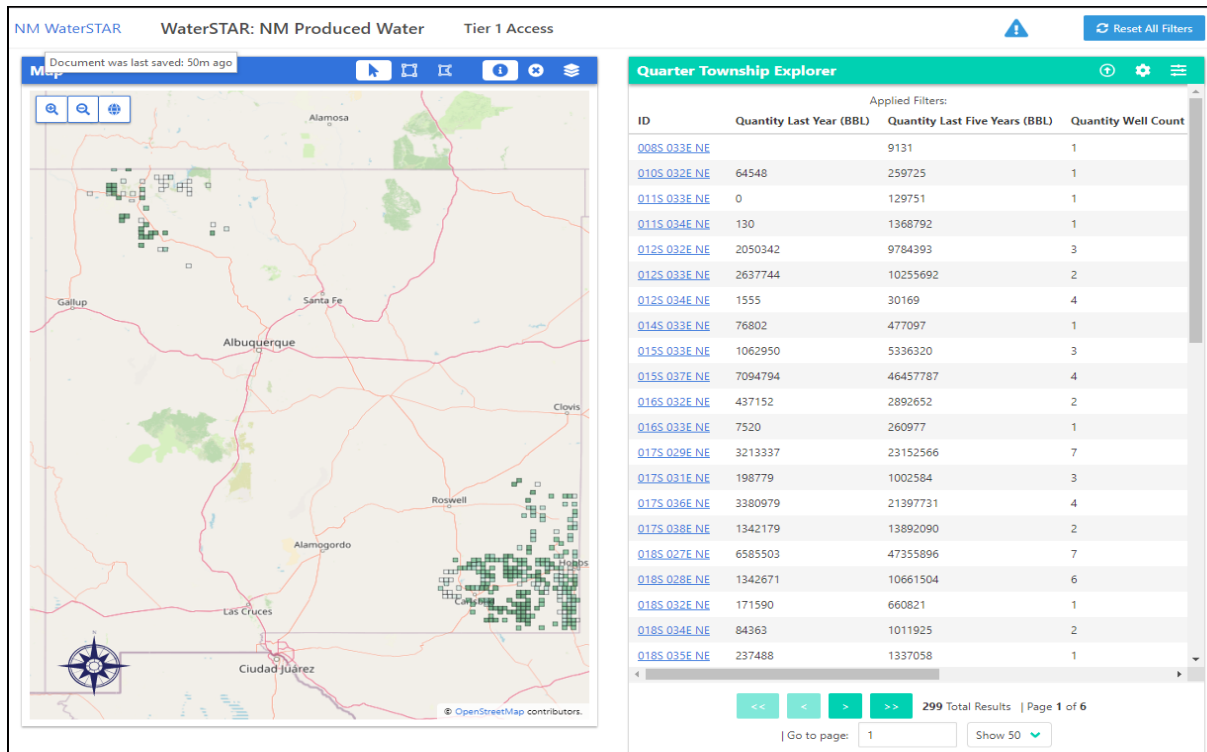
NMPWRC, NM Elected Officials Forums, July-August, 2021

Outreach and Education efforts are shaped by consortium activities and informed by key stakeholder input.

Technical, Economic, and Risk and Toxicology assessment are a key consideration for all outreach and education activities and plans.

NM produced water treatment and reuse could approach \$1 Billion per year in economic development in oil and gas producing counties

NM Produced Water Data Portal



<https://nmpw.waterstar.org/>

**Cooperative effort with the
Ground Water Protection Council**

Disposal Water Quality and Quantity data by ¼ Township.

- Integrated data from OCD, USGS, NM Tech, NMSU

Four levels of data:

- Tier 1 - General Info (online)
- Tier 2 – Detailed Info
- Tier 3 – Advanced Applications
- Tier 4 – Regulatory Access (NTK)

Includes Produced Water Data Dashboard

- Total injected, monthly injected
- Graphs of constituent quality values by month

Waste Water Reuse is Both an Opportunity and a Challenge



Raw Municipal Waste Water

~60 major constituents
(many unknowns)



Raw Pecos River Water

~70 major constituents
(some unknowns)



Raw Produced Water

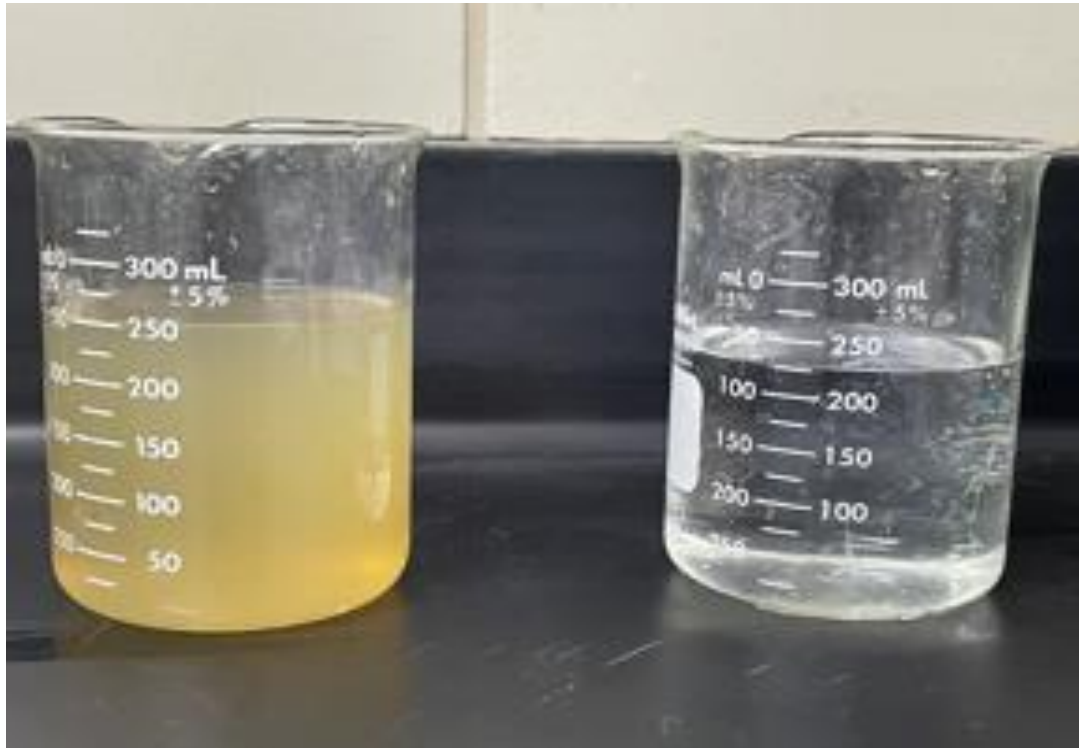
~90 major constituents
(few unknowns)

May need to ban certain recalcitrant chemicals in many waste waters to better support recycling and reuse

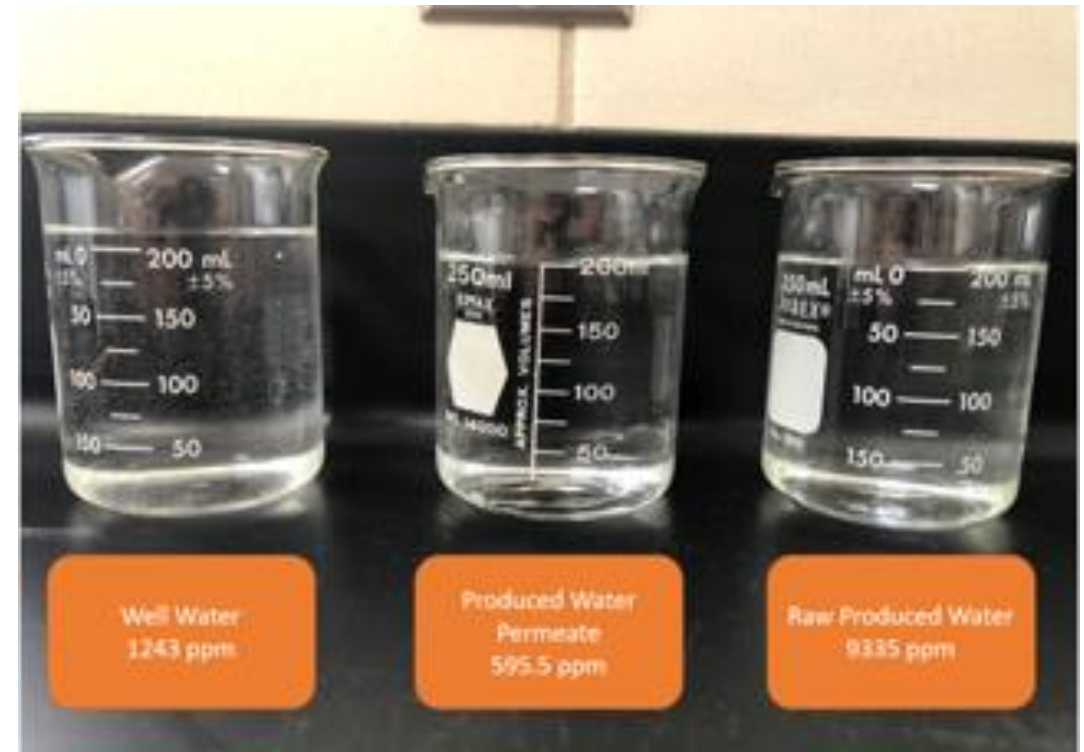
Water Quality Requirements for Various Uses

Produced Water Quality (ppm) TDS	Application	Common Water Quality Requirements (ppm) TDS	Typical Treatment Process
Conventional 10K to 50K 50%<35K 50%>35K	Water Supply Augmentation	300-3,000	Chemical/membrane
	Agriculture	Class 1 <700, <60% Na, B<0.5 Class 2 2000, 60-75% Na, B<2.0 Class 3 >2000, 75% Na, B~2	Membrane
	Rangeland	4,000 – 10,000	Membrane
Unconv. 60K to 300K 25%<100K	Rangeland	4,000 – 10,000	Thermal
	Surface Flow	600-2,000	Thermal
	Mineral Recovery	>100K (no discharge)	Pretreatment
	Road Construction	Up to 100,000	Pretreatment

Examples of Raw and Treated NM Produced Water



Permian Basin -100,000 TDS PW (left)
w/pre-treatment to remove oil, grease,
suspended solids (right)



San Juan Basin -10,000 TDS PW (right)
w/RO treatment to remove TDS (middle)
Alamogordo Groundwater (left)

Summary of General Results to Date

- Thermal treatment technologies for Permian Basin
 - Common treatment quality of 300-800 ppm TDS
 - Some carry over of ammonia and organics – suggests post treatment needed
 - Expected full-scale costs of \$0.80-\$1.10/bbl
- Pre-treatment systems
 - Both new membranes systems tested can meet PWS ‘clean brine’ standards at < \$0.20/bbl
- Membrane treatment for San Juan
 - Treatment results obtained for both BWRO and SWRO membranes
 - Data is very encouraging – can get very high quality water
- Green house studies of treated produced water
 - Range grass growth with treated produced water very encouraging



Summary Data on Oil and Gas Operation Impacts on Public and Environmental Health and Safety



< 0.25 miles from oil and gas operations

- Highest level of acute public health impacts and concerns
- Highest occurrence of environmental impacts - noise, air, land, and water pollution and contamination



0.25 - 0.50 miles from oil and gas operations

- Significantly reduced public health impacts
- Significantly reduced environmental impacts or damage from operations or accidents



> 0.50 miles from oil and gas operations

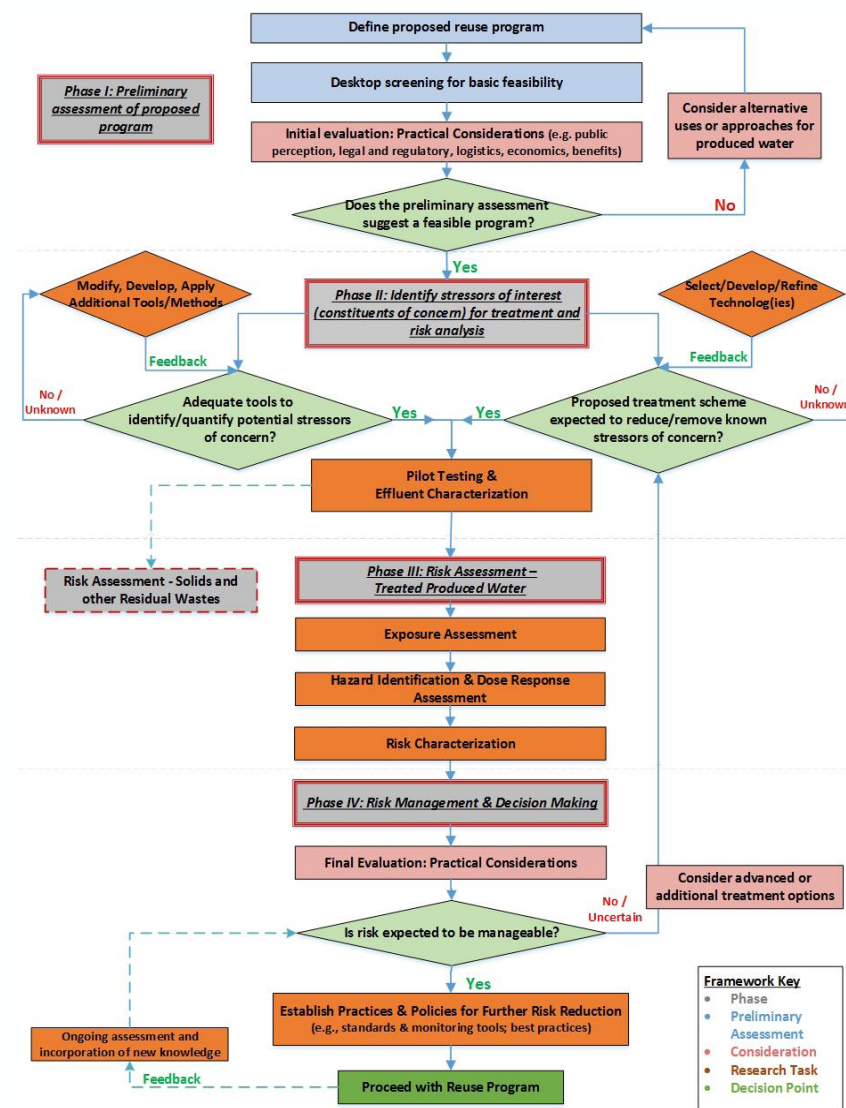
- Little observed acute or chronic public health and safety or environmental impacts
- Especially in open, flat, and non-wooded operational areas

- Highest impacts in populated areas, especially in wooded, rolling terrain
- Highest impacts to permanent residents on small private land parcels in closely aggregated operations
- NM DOH has no record of fracking damaging a personal water supply

Physicians for Social Responsibility-Colorado Symposium - Health Effects of Oil and Gas Development, December 4, 2020.

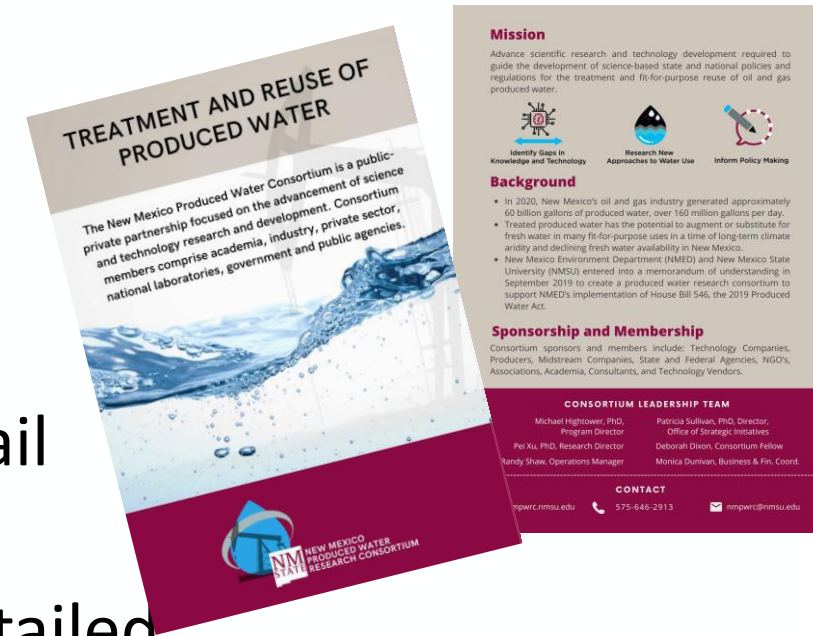
Risk and Toxicology Analysis

- Using an industry and EPA accepted approach to do a quantitative public and environmental risk and toxicology analysis of treated produced water
- Coordinated with industry, academia, USEPA, NMDOH, and UNMH
- NMSU full-time post-doc hired for two years to support HRLCMS 'unknown' finger printing
- Coordinating produced water sampling for human gnome testing at USEPA in of paired produced waters (raw and treated) from around the country and whole effluent toxicity (WET) testing
- Evaluating initial results from 2021 sampling



2022 Consortium Public Information Availability

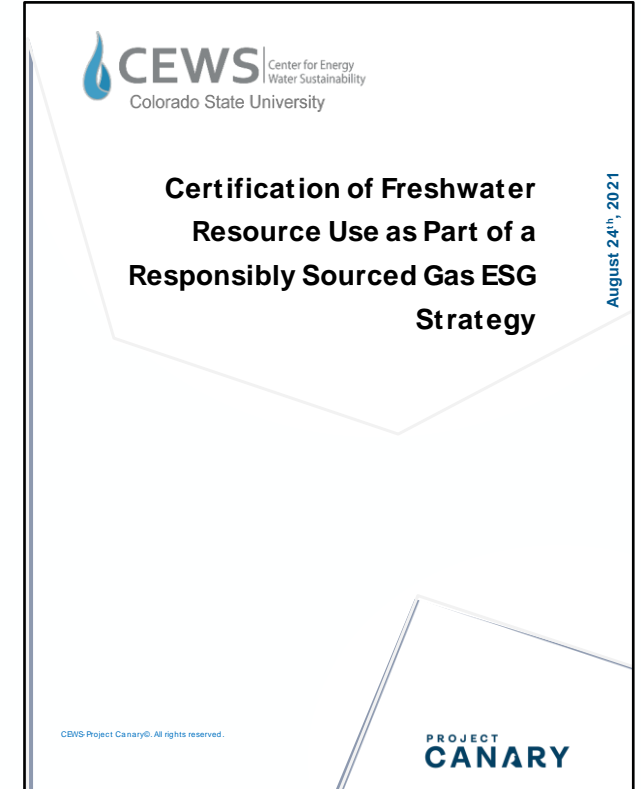
- Web site
 - Google – nmpwrc or <https://nmpwrc.nmsu.edu>
 - Updated bi-weekly
 - [Home](#) [About Us](#) [Membership](#) [Research](#)
 - [Resources](#) [News and Events](#) [Sponsorship](#)
- Several different Fact Sheets
- Workshops – 2 hours to discuss several topics in detail with multiple breakout sessions
- Some suggestions for ½-day workshops for more detailed information, especially on water reuse opportunities
- Technical presentations and overviews



Socio-economic Cost Benefit Analysis

- Developed quantitative ESG model with Sandia Labs
- Utilizes PW data portal, NMSU treatment analysis model, and economic impact model from UNM
- Provides socio-economic, health and safety, Cost Benefit Analysis
- Available for SE New Mexico
- Considering other simple models and metrics
- Replacing qualitative ESG analysis approaches

Potential NM Economic Impact of produced water reuse – \$2-3 Billion per year



Fresh Water Replacment Ratio (FR2) = (WW NC + PW R + PW D + CC) / WW C

Questions?

Access our resources and learn more at:
<https://nmpwrc.nmsu.edu> (or search **NMPWRC**)

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