

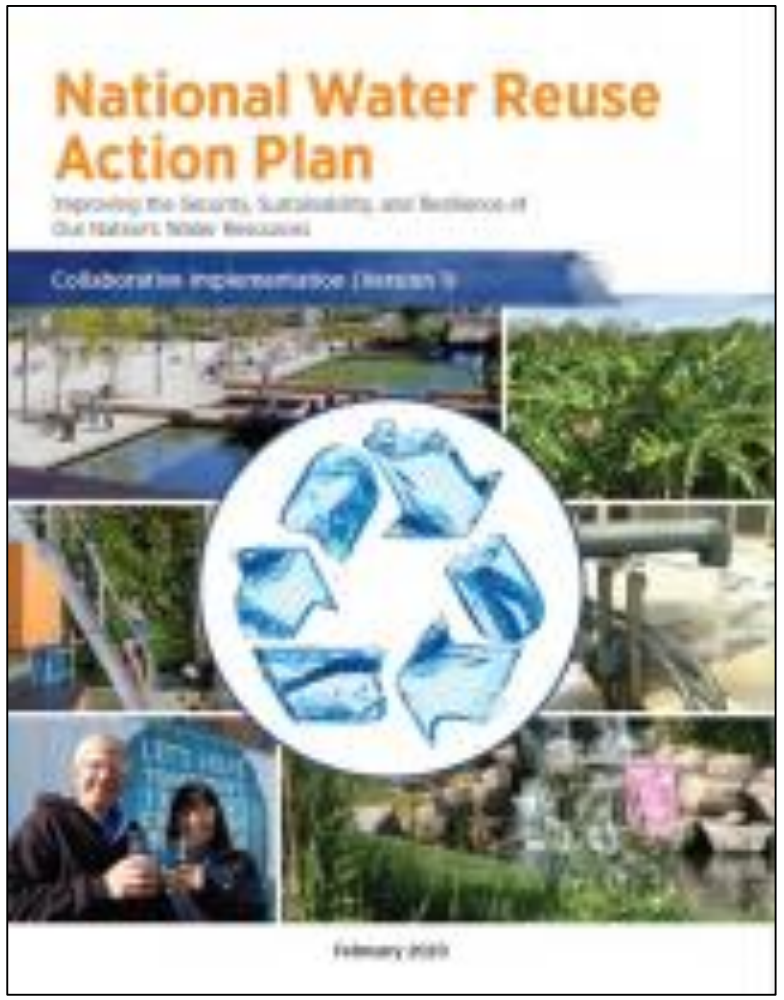

Produced Water Stewardship – A National Perspective

NEW MEXICO PRODUCED WATER CONSORTIUM
2023 ANNUAL MEETING
DECEMBER 13-14, 2023 – ALBUQUERQUE

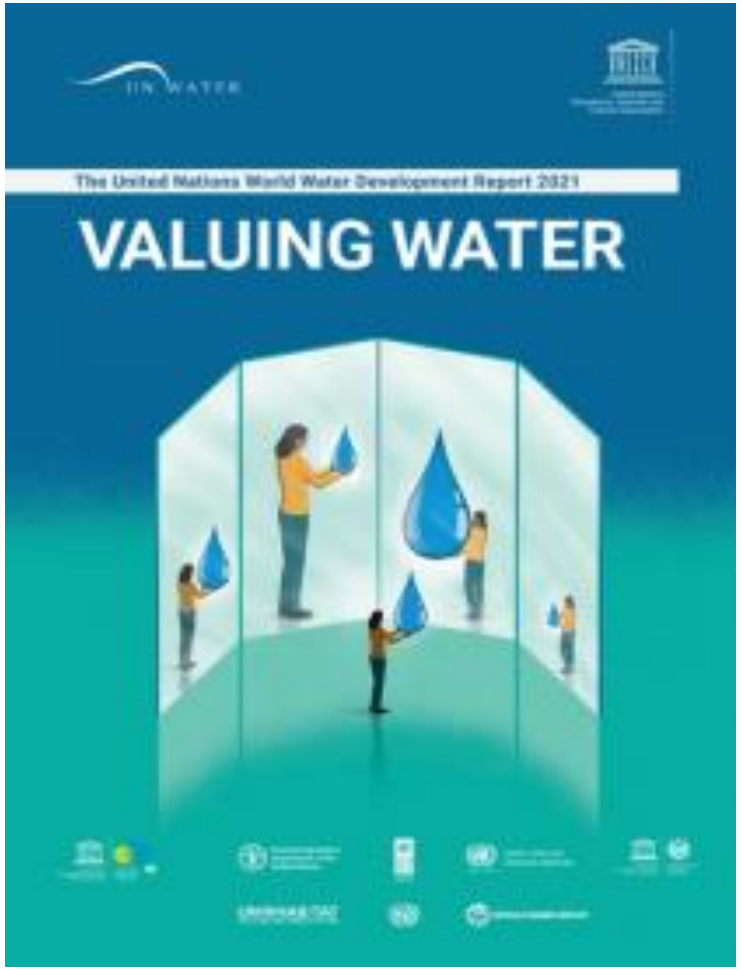
State Coordinating Council Update

NM STATE
NEW MEXICO PRODUCED WATER RESEARCH CONSORTIUM

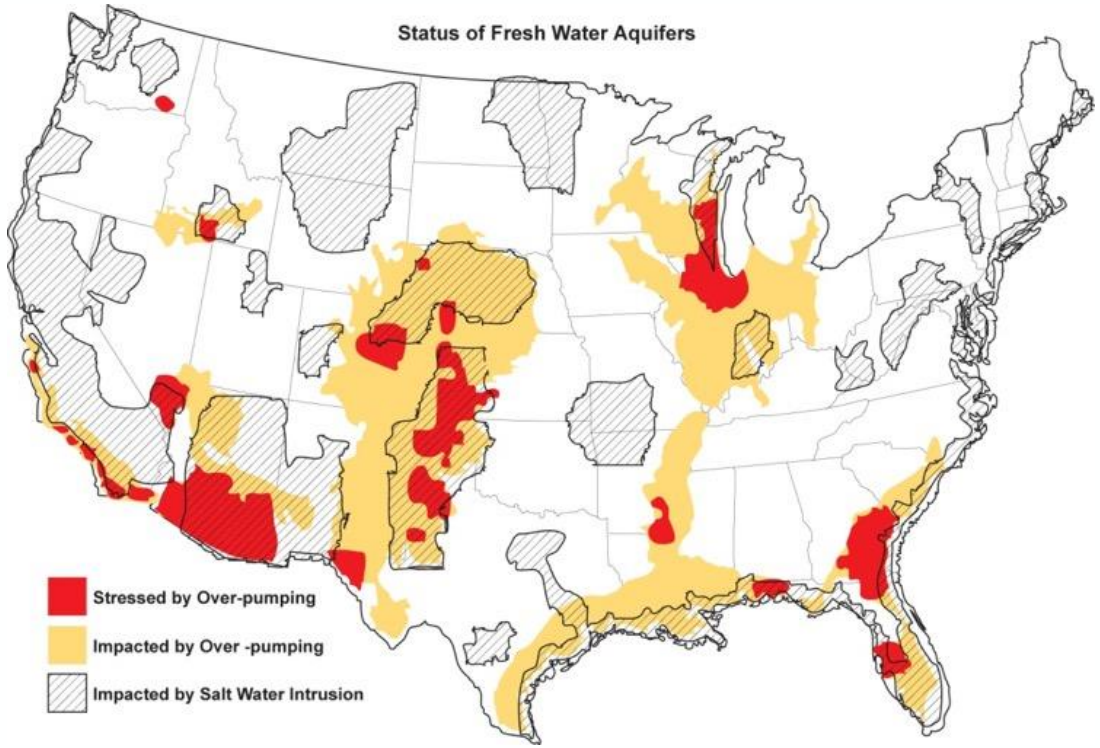
New Driver - Water Reuse for Water Sustainability

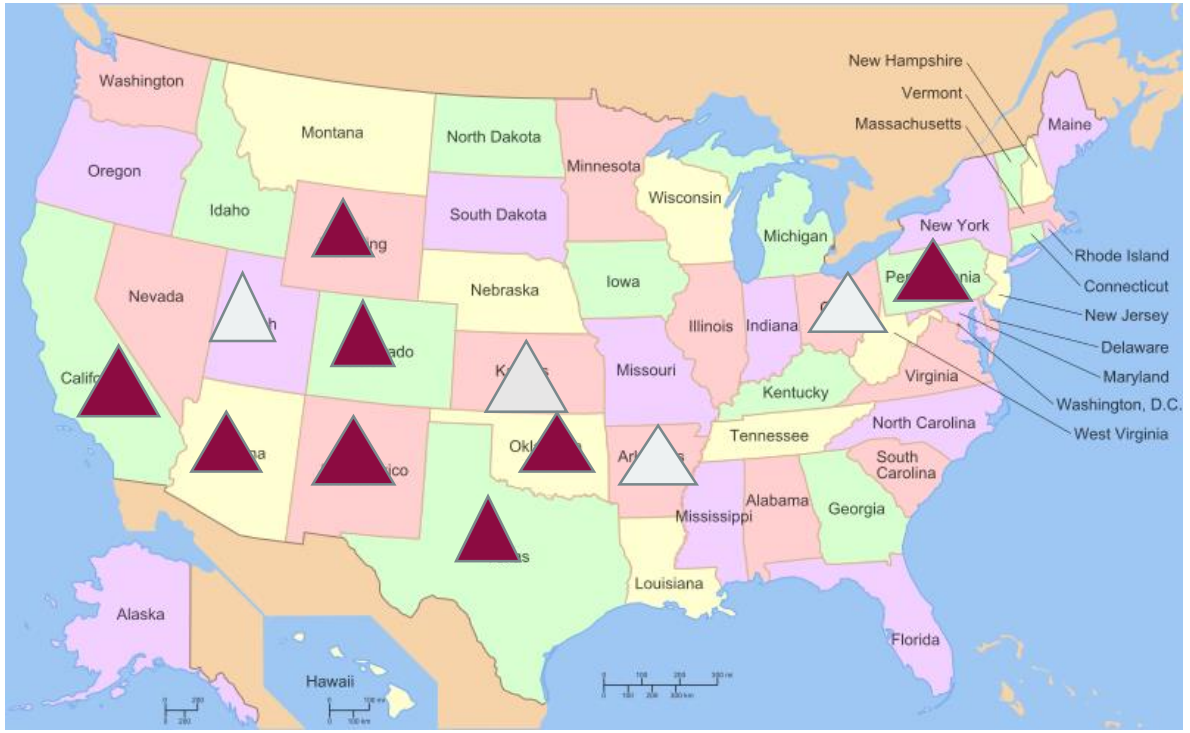


- Two of the United Nations' Sustainable Development Goals identify **water reuse as key to a more sustainable water future.**
- EPA national focus on fit-for-purpose treatment and waste water reuse - **includes produced water as a top five priority.**
- Specifically identifies the NMPWRC to help coordinate national efforts



States Participating with the NMPWRC on the Produced Water Coordinating Council





Regular

Shown interest/have regs

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Summary of On-shore Produced Water Surface Discharge

Table 1: On-Shore Oil and Natural Gas Wastewater (Except Coalbed Methane)

Discharging Facility	Surface Discharge Purpose	Applicable ELGs	TBELs
On-shore oil and natural gas extraction facility	General discharge	40 CFR part 435, subpart C	No discharge of pollutants to surface waters
On-shore oil and natural gas extraction facility	West of the 98th meridian for specific uses in livestock or wildlife watering	40 CFR part 435, subpart E	Must be of good enough quality; also, daily maximum effluent limit for oil and grease of 35 mg/L
Stripper wells	General discharge	40 CFR part 435, subpart F	No specified limitations; TBELs developed by permitting authority on a BPJ basis
Coalbed methane (CBM) extraction facility	General discharge	40 CFR part 435, subpart H	No specified limitations; TBELs developed by permitting authority on a BPJ basis
Centralized waste treatment (CWT) facility	N/A	40 CFR part 437	For specific pollutant and limitations, see 40 CFR part 437

Ref: Oil and Natural Gas Produced Water Governance in New Mexico – Draft White Paper November 2018

Federal Guidelines on Produced Water Reuse

- 40 CFR 435 Subpart C– Oil and Gas Extraction Point Source Category
  - Defines produced water as “the water brought up from the hydrocarbon-bearing strata during the extraction of oil and gas, and can include formation water, injection water, and any chemicals added downhole or during oil/water separation process”
  - Unconventional produced water prohibited through a POTW
  - Zero discharge of produced water unless sent to a centralized water treatment (CWT) facility, **with one exception, west of the 98th Meridian**

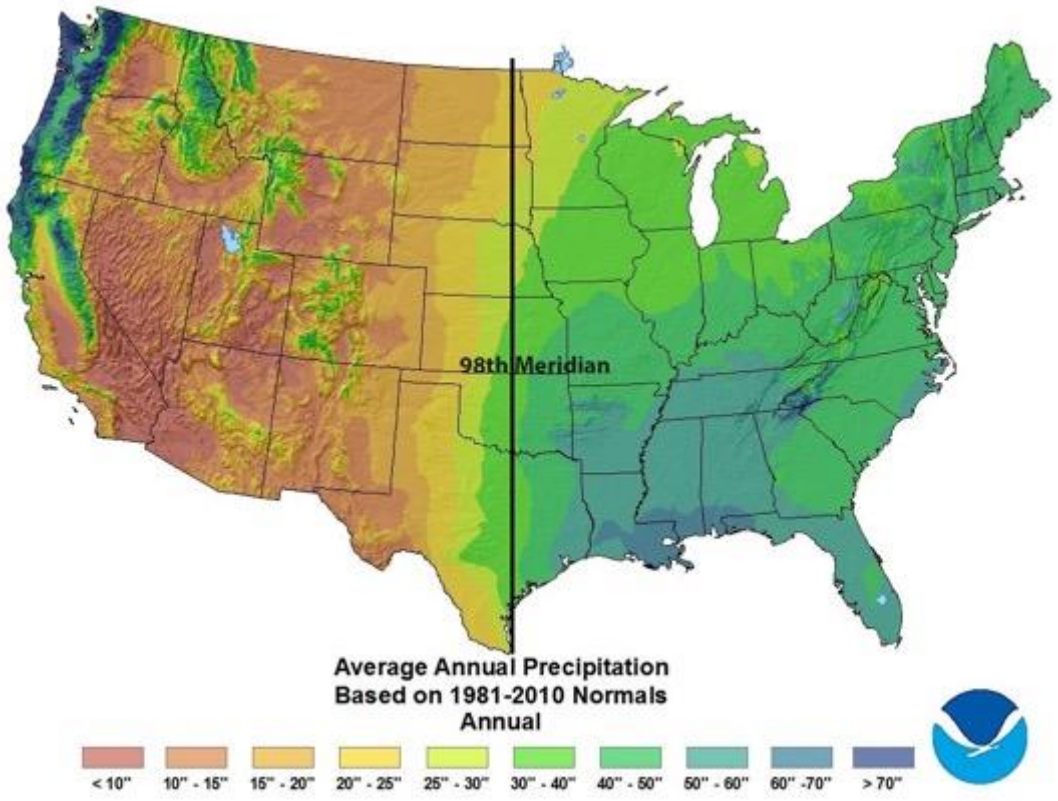
General Oily Waste Water Discharge Regulations

- 40 CFR 437 Centralized Water Treatment Point Source Category
  - Generally, produced water for reuse must be sent to a centralized water treatment (CWT) facility.
- 40 CFR 437 Subpart B – Oily Waste Water Treatment and Reuse
  - Minimum requirements in table at right, pH 6-9, all others mg/L
- EPA interest - will technologies that can reach “Clean Brine Standards” create a better industrial waste water for easier treatment and reuse

Regulated parameter	Maximum daily[1]	Maximum monthly avg.[1]
Conventional Parameters		
O&G	127	38.0
pH	([2])	([2])
TSS	74.1	30.6
Metal Parameters		
Arsenic	2.95	1.33
Cadmium	0.0172	0.0102
Chromium	0.746	0.323
Cobalt	56.4	18.8
Copper	0.500	0.242
Lead	0.350	0.160
Mercury	0.0172	0.00647
Tin	0.335	0.165
Zinc	8.26	4.50
Organic Parameters		
Bis(2-ethylhexyl) phthalate	0.215	0.101
Butylbenzyl phthalate	0.188	0.0887
Carbazole	0.598	0.276
n-Decane	0.948	0.437
Fluoranthene	0.0537	0.0268
n-Octadecane	0.589	0.302

Produced Water Reuse In the West

- 40 CFR 435 (Subpart E) – On shore facilities west of the 98th Meridian can discharge produced water if it has a use in agriculture or wildlife propagation when discharged to waters of the U.S.
- 40 CFR 435.51(c) "can be used if produced water is of good enough quality for wildlife or livestock water or other agricultural uses and is actually put to such use during periods of discharge"



Produced Water Treatment and Reuse in the U.S.

Region	PW Production (2017)	PW Disposal (Deep Well Injection)	PW Reuse Inside O&G Field	PW Reuse for EOR	PW Reuse/ Dispose Outside O&G Field	Examples of PW Reuse Outside O&G Field
Appalachian Basin	105 MMbbls (16.8×10^6 m^3)	PA: 1.1%, WV: 56%, OH: 89%.	PA: 96%, WV: 29%, OH: 9.1%.	PA: n/a, WV: 14%, OH: 1.3%.	PA: 1.6%, WV: n/a, OH: n/a.	n/a
Oklahoma	2844 MMbbls (455×10^6 m^3)	41.7%	n/a	44.9%	13.4%	n/a
Texas	9895 MMbbls (1583×10^6 m^3)	36.2%	n/a	46.1%	17.6%	n/a
California	3100 MMbbls (496×10^6 m^3)	22.4%	5.1%	59.3%	11.1%	Irrigation
Colorado	310 MMbbls (49.6×10^6 m^3)	47.1%	8.9%	32.5%	11.5%	Dust control; aquifer recharge and recovery; pits and surface water discharge.
Wyoming	1700 MMbbls (272×10^6 m^3)	14%	n/a	46%	37%	Surface water discharge; groundwater injection; dust control and road application; irrigation; land application; impoundment.
New Mexico	1240 MMbbls (196.9×10^6 m^3, 2019)	51%	10%	40%	n/a	n/a

Note(s): PW: produced water; MMbbls: million barrels; PA: Pennsylvania; OH: Ohio; WV: West Virginia; n/a: not available.

Jiang, W., Lin, L., Xu, X., Wang, H., Xu, P. (2022) Analysis of regulatory framework for produced water management and reuse in major oil and gas producing regions in the United States. Water 14 (14), 2162. https://www.mdpi.com/2073-4441/14/14/2162

Excerpt of Current NM Surface Water Discharge Standards by Use

- Current starting point for the Consortium for fit-for-purpose treatment and reuse of produced water
- Could be modified or constituents added based on treated produced water risk and toxicology data
- Need a spectrum of treatment studies of different produced waters and technologies

J. Numeric criteria. The following table sets forth the numeric criteria adopted by the commission to protect existing, designated and attainable uses. Additional criteria that are not compatible with this table are found in Subsections A through I of this section.

Pollutant total, unless indicated	CAS Number	Domestic Water Supply µg/L unless indicated	Irrigation µg/L unless indicated	Livestock Watering µg/L unless indicated	Wildlife Habitat µg/L unless indicated	Aquatic Life		Human Health µg/L	Cancer Causing (C) or Persistent (P)
						Acute µg/L	Chronic µg/L		
Aluminum, dissolved	7429-90-5		5,000			750	87		
Antimony, dissolved	7440-36-0	5.6						640	P
Arsenic, dissolved	7440-38-2	2.3	100	200		340	150	9.0	C,P
Asbestos	1332-21-4	7,000,000 fibers/L							
Barium, dissolved	7440-39-3	2,000							
Beryllium, dissolved	7440-41-7	4							
Boron, dissolved	7440-42-8		750	5,000					
Cadmium, dissolved	7440-43-9	5	10	50		see 20.6.4.900.I	see 20.6.4.900.I		
Chlorine residual	7782-50-5				11	19	11		
Chromium, dissolved	18540-29-9	100	100	1,000		see 20.6.4.900.I	see 20.6.4.900.I		
Cobalt, dissolved	7440-48-4		50	1,000					

5 additional tabular pages and over 40 pages total in the standards

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Example of Current Western Water Discharge Criteria

- Most irrigation standards developed by western ag research centers
  - NMSU, Utah State, Texas A&M, Colorado State, UC Davis
- Surface water discharge is more complicated, but similar reaches often have similar standards
- Information provided to TX along with treatment data to support discharge criteria for ag and Pecos River surface water discharge in 3-8/2023

Current Ag Discharge Criteria

NM - 30 Constituents

CO, WY, OK, CA, BoR– 35-43 Constituents

Current Pecos River Discharge Criteria

NM – 41 aquatic impact constituents

110 - human impact constituents

State line quality goal– 3600 ppm TDS

TX – 45 aquatic impact constituents

110 – human impact constituents

Below Red Bluff quality goal – 4000 ppm TDS

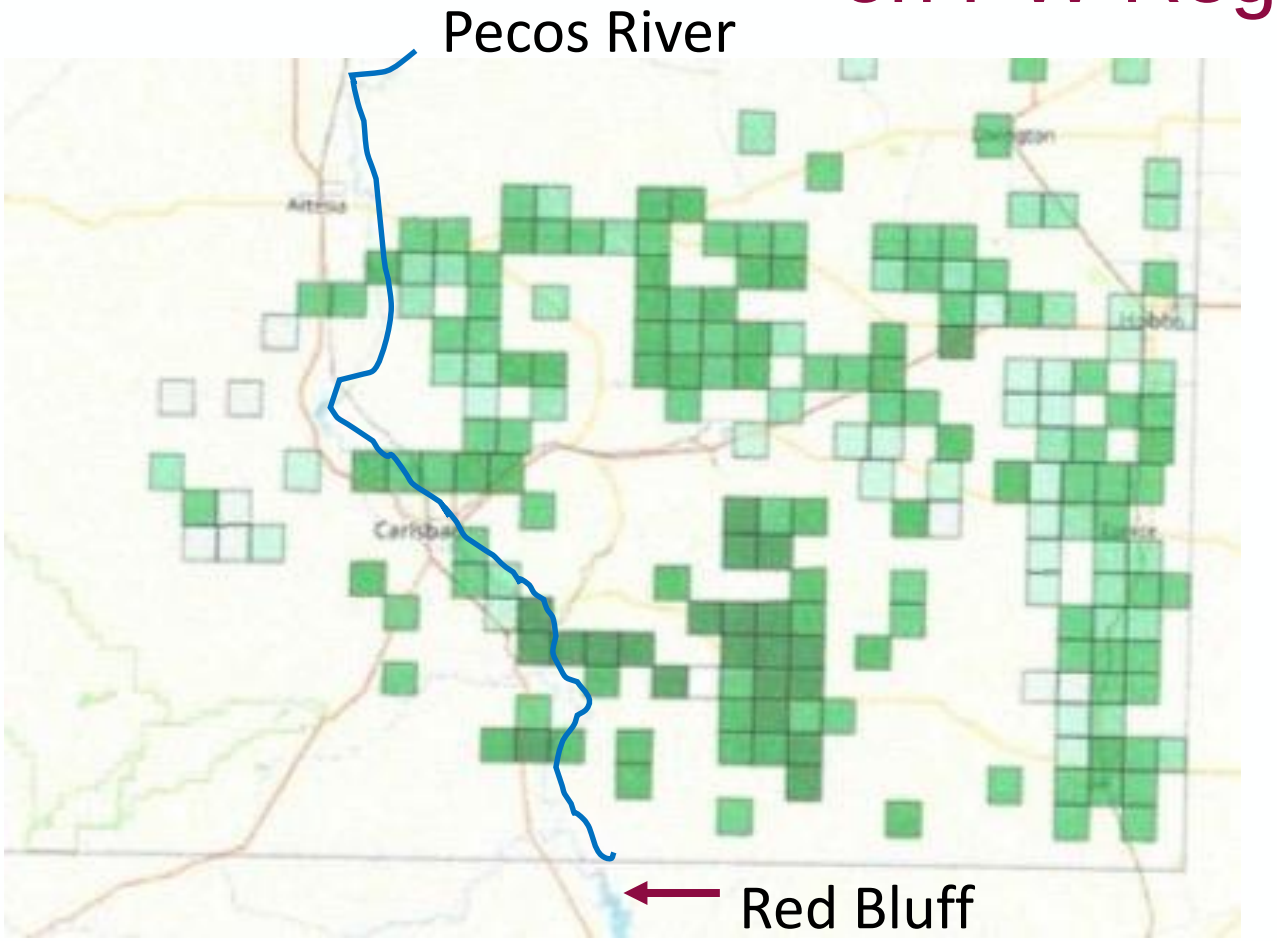
Pursuing Opportunities for Common Discharge Criteria

- Ag water quality standards are rather consistent in the West – CO, NM, OK, TX, BoR
- Emerging standards generally developed by western ag centers
  - NMSU, Utah State, Texas A&M, Colorado State, UC Davis
- Interest also in industrial non-discharge reuse treatment standards

Parameter	Units	NM Regulatory Value	BoR Recommended Ag Values
pH			6.5-8.0
Temperature	°C		25-30
Turbidity	NTU		30 max
Total dissolved solids (TDS not damage or impair animal, plant ,or aquatic life)	mg/L	100 -5000	500-?*
Chlorides	mg/L		<100
Sulfates	mg/L		
Alkalinity	mg/L		<500*
Nitrates	mg/L		10-45
Total Metals	mg/L	~ <10	~<25
Aluminum	mg/L	5.0	5.0 long-term. 20.0 short-term
Arsenic	mg/L	0.1	0.1 - 2.0
Beryllium	mg/L		0.1 - 0.5
Boron	mg/L	0.75	0.75 - 5.0
Cadmium	mg/L	0.010	0.01 - 0.05
Chromium	mg/L	0.100	0.10 - 1.0
Cobalt	mg/L	0.050	0.05 - 5.0
Copper	mg/L	0.200	0.20 - 5.0
Fluoride	mg/L		1.0 - 15.0
Iron	mg/L		5.0 - 20.0
Lead	mg/L	5.0	5.0 - 10.0
Lithium	mg/L		2.5
Manganese	mg/L		0.20 - 10.0
Molybdenum, dissolved	mg/L	1.0	0.01 - 0.05
Nickel	mg/L		0.20 - 2.0
Selenium	mg/L	0.050	0.02
Vanadium, dissolved	mg/L	0.100	0.1 - 1.0
Zinc	mg/L	2.0	2.0 - 10.0
Naturally Occurring Radioactive Material	pCi/L	~ <30 *	
Adjusted gross alpha	pCi/L	15*	
Radium 226+228	pCi/L	30*	
Total Oils and Grease	mg/L		35*
Ammonium (NH_4^+)	mg/L		10-40*

* Federal guidelines or common state guidelines based on wildlife and health issues

EPA Interest - Opportunities For State Cooperation on PW Regulations



NM Permian PW quantity data by ¼ township

- All NM oil and gas basins (Permian, San Juan and Raton) are transboundary basins
- Similar produced water quality in each different transboundary basin
- Transboundary regulatory and supply cooperation would be a novel concept
- Cooperation supports improved produced water and overall water stewardship, mineral recovery, and economic development

2023 and 2024 Water Reuse Association Annual Conference Presentations

- 2023 NMPWRC State Coordinating Committee Panel on Produced Water Reuse
  - Presentation by EPA on current produced water toxicity screening
  - Presentation of NMSU paper on summary of current state approaches and allowed applications of treated produced water and regional perspective
  - Presentations by California, Texas, and Pennsylvania's journeys to establish standards for produced water treatment and reuse
- 2024 State Coordinating Committee Panel on State's Permitting Process
  - Show permitting process and timeframe in various states
  - Provide states with lessons learned and best practices to emulate from current states – EPA and WRA interested in coordinating a consistent national approach

NM Transboundary Produced Water Basin Cooperation

- Cooperative Efforts with Texas
  - Provided TX regulatory agencies with treatment technology data and information on western water quality regulations
  - Agreed with TXPWC in cooperating on technology testing, data collection, and treated produced water quality testing
  - Agreed to leverage efforts to support regional water and produced water stewardship and local economic development
- Cooperative Efforts with Colorado
  - Interactions on San Juan and Raton Basins discussion of produced water treatment and reuse
  - More coordination envisioned as they move forward.
- Cooperative Efforts with Arizona
  - Providing information on San Juan treatment technology cost and performance associated with irrigation and rangeland options for helium production.

Priority Efforts in 2024

- Provide technical information to NMED and WQCC on regulations and definitions to support consistent application of EPA Water Reuse Action Plan fit-for-purpose treatment and reuse approaches.
- Integrate risk and toxicology information into recommendations and suggestions both at WRA for EPA use and WQCC for NM.
- Articulate risk mitigation or reduction strategies to consider for treatment and reuse pilot projects and studies in various states.
- Coordinate risk and toxicology protocol use of treated produced water with other states to assess differences in risk and hazards and mitigation approaches if needed – helping to standardize treatment standards.
- Expand website to be a national clearing house for produced water information and regulations, per our lead role for EPA on Produced Water treatment for fit-for-purpose reuse.