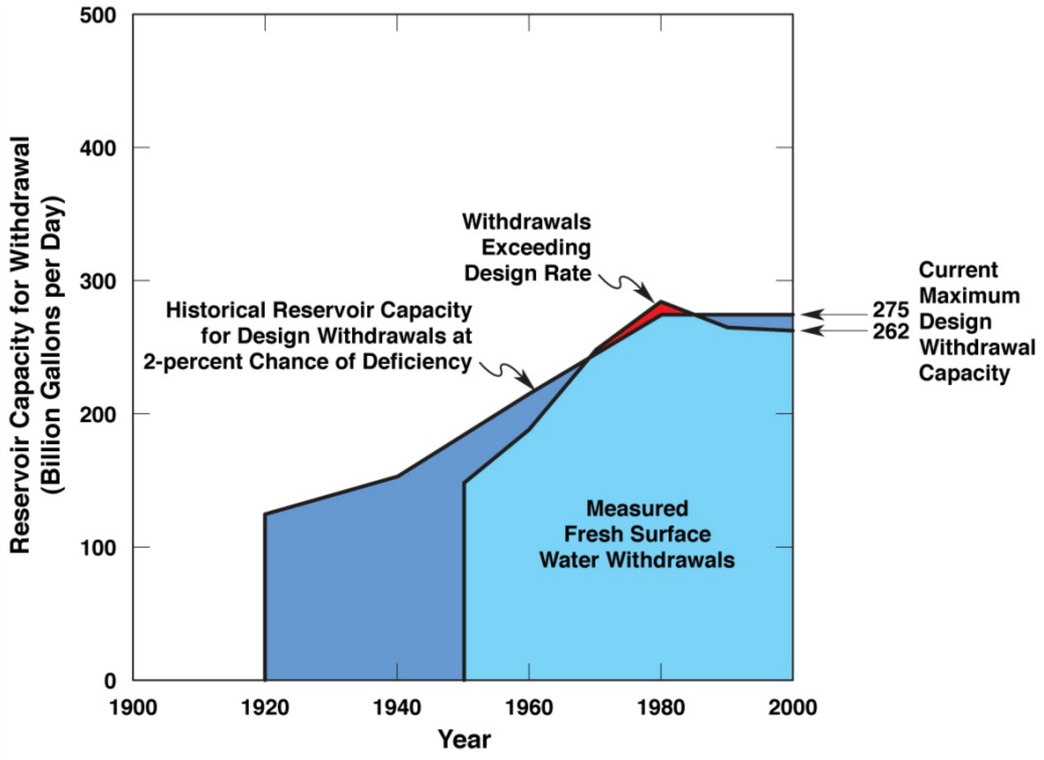
Produced Water Reuse and Protection of Groundwater

Mike Hightower, Program Director
Pei Xu, Research Director
Jeri Sullivan Graham and Deborah Dixon, Fellows
NM Produced Water Research Consortium

NM STATE UNIVERSITY

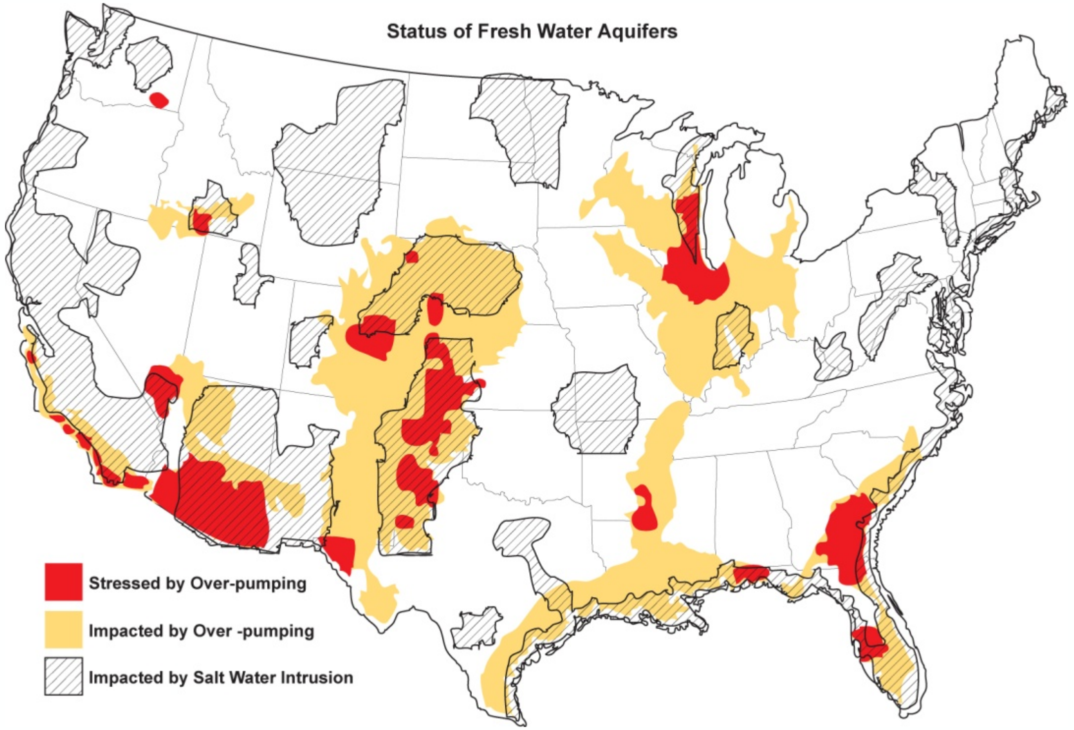
Fresh Water Availability Issues Driving Non-traditional Water Reuse



(Based on USGS WSP-2250 1984 and Alley 2007)

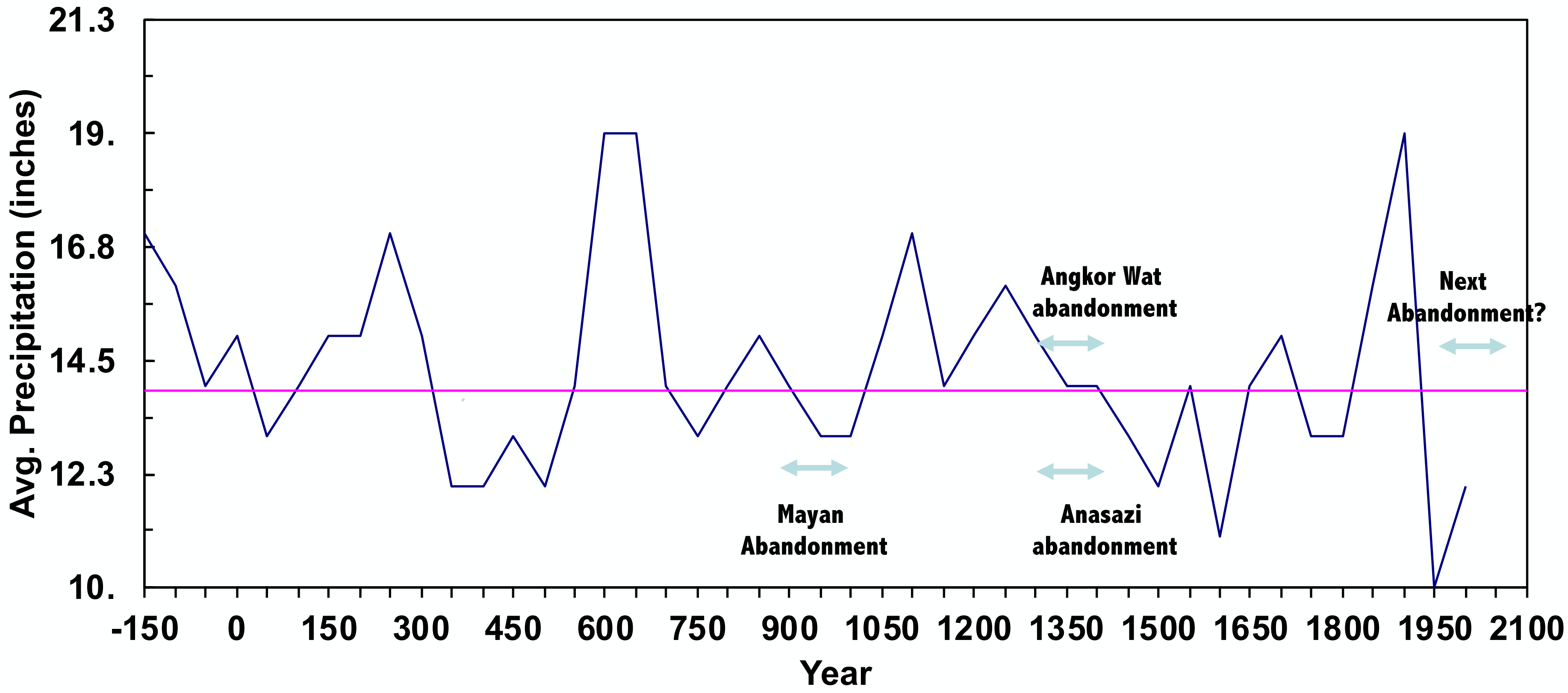
- No new surface water storage capacity since 1980

- All major groundwater aquifers overstressed



(Shannon 2007)

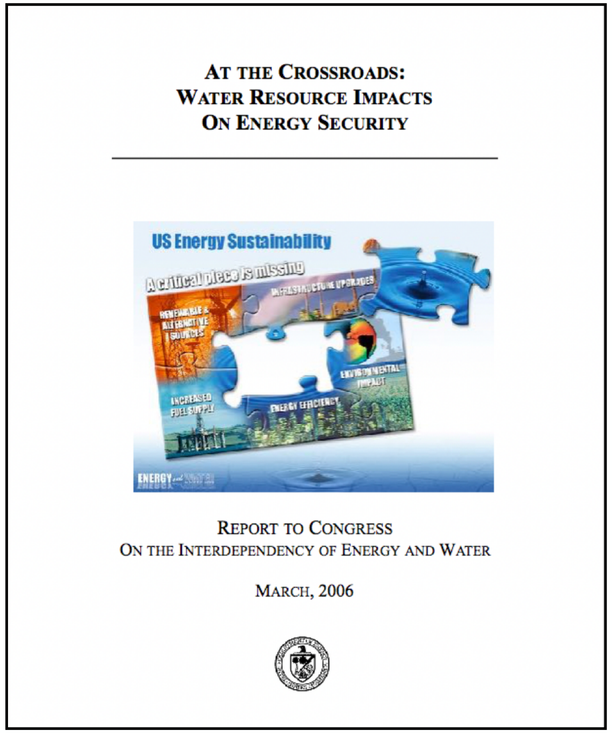
Southwest Climate History from Tree Ring Data



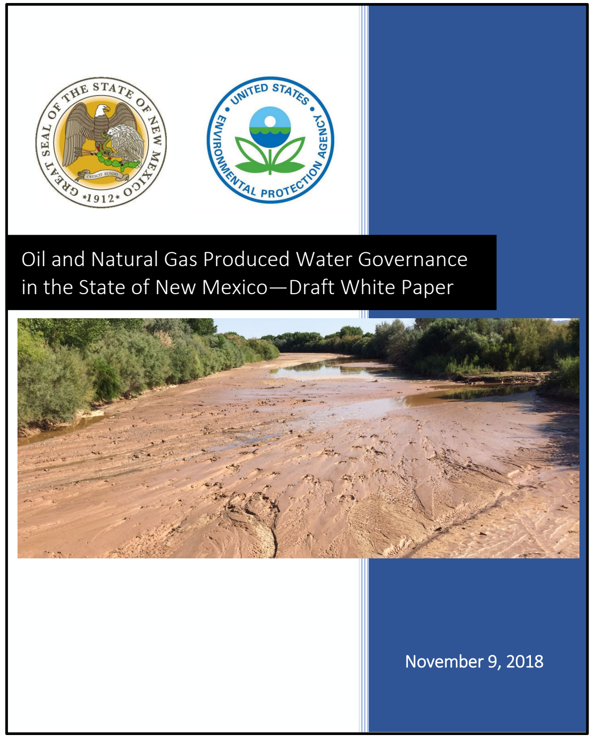
Univ. of Arizona – Tree Ring Lab – 50 year averages

The southern U.S. and the mid-latitudes are in the 130th year of a 300 year arid cycle - not a drought

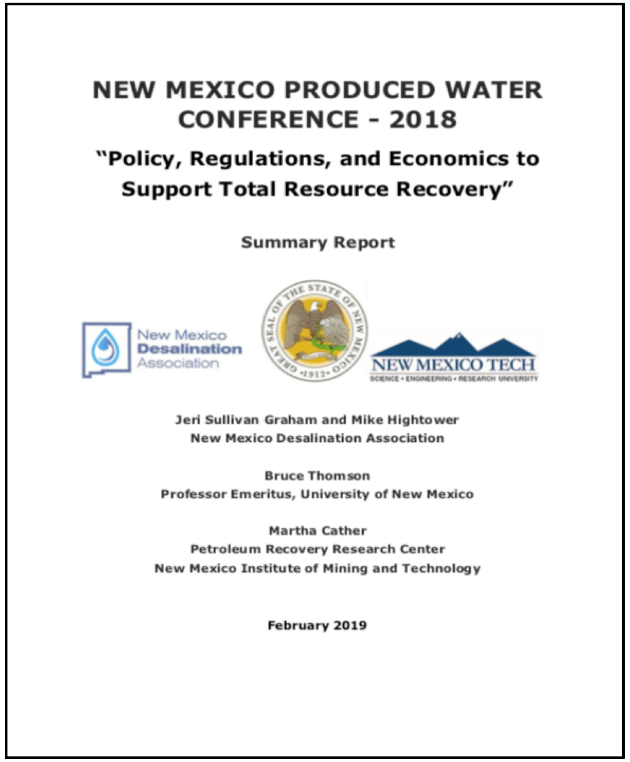
Recent New Mexico Efforts on Produced Water Treatment and Reuse



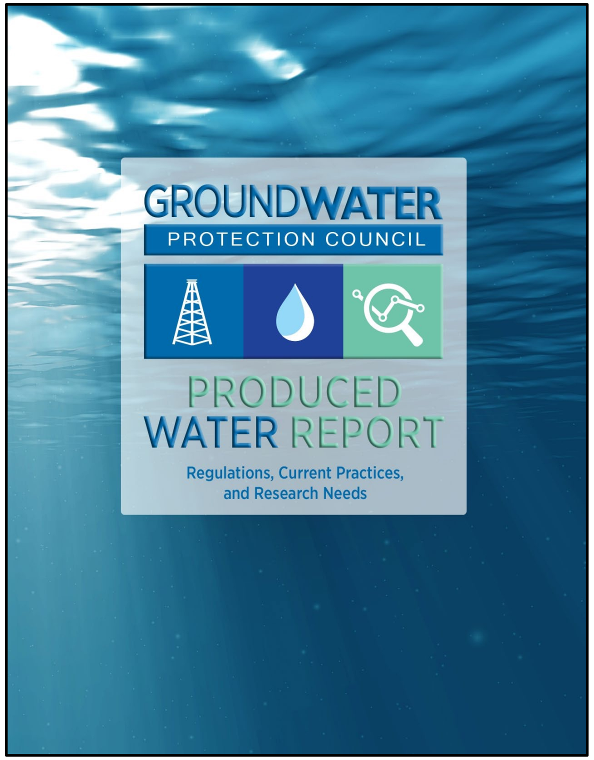
Sandia, Los Alamos, DOE
2004-15



NMED, OSE, EPA 2017-18



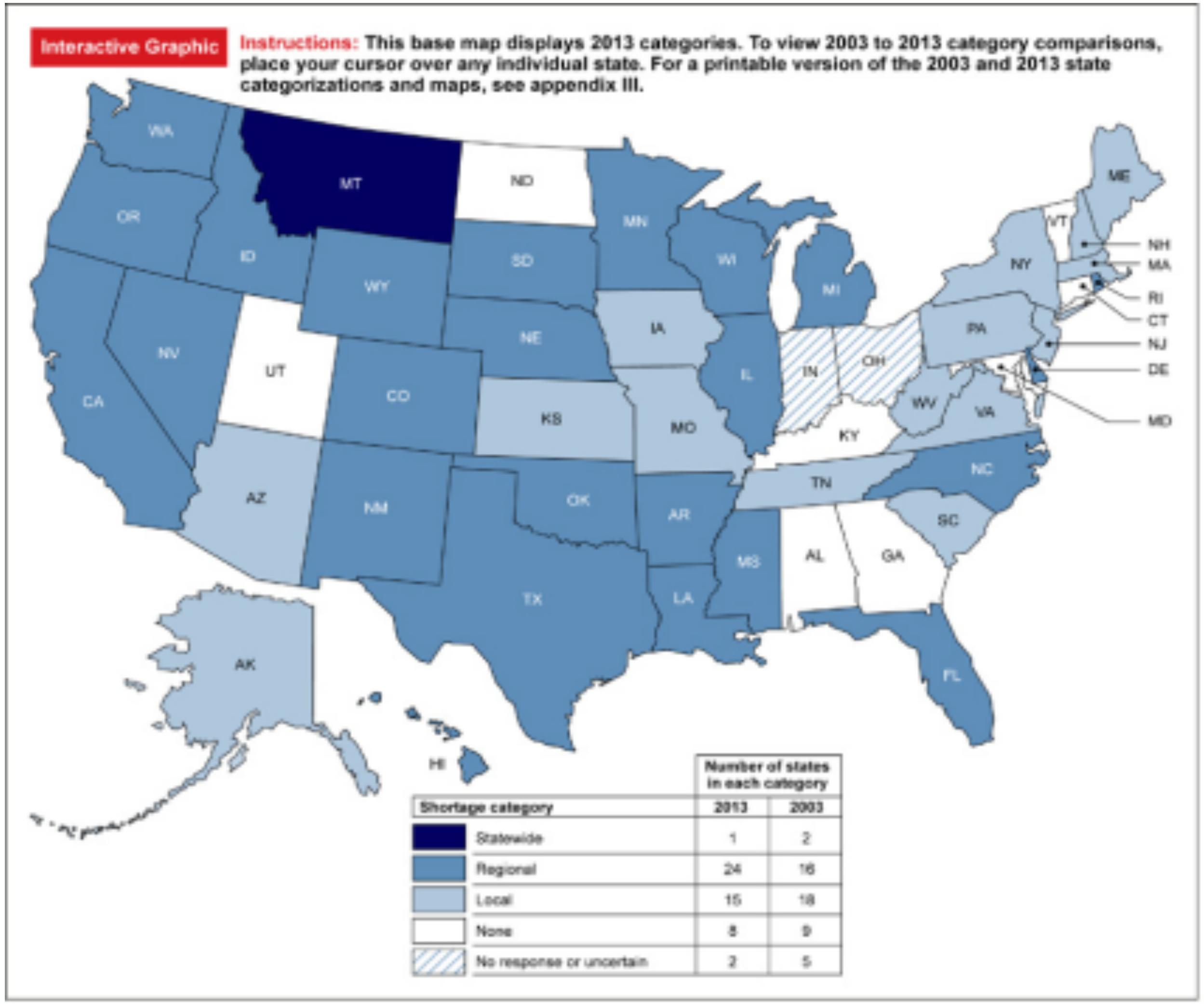
NMED, OSE, EMNRD
2017-19



EMNRD 2016-19

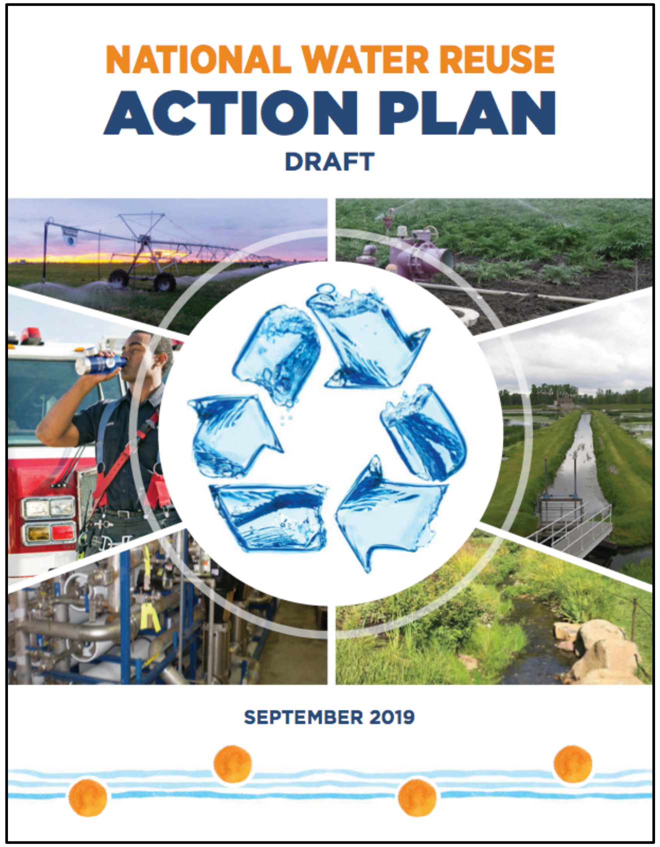
National Initiative in Non-traditional Water Reuse

GAO 2003 and 2013



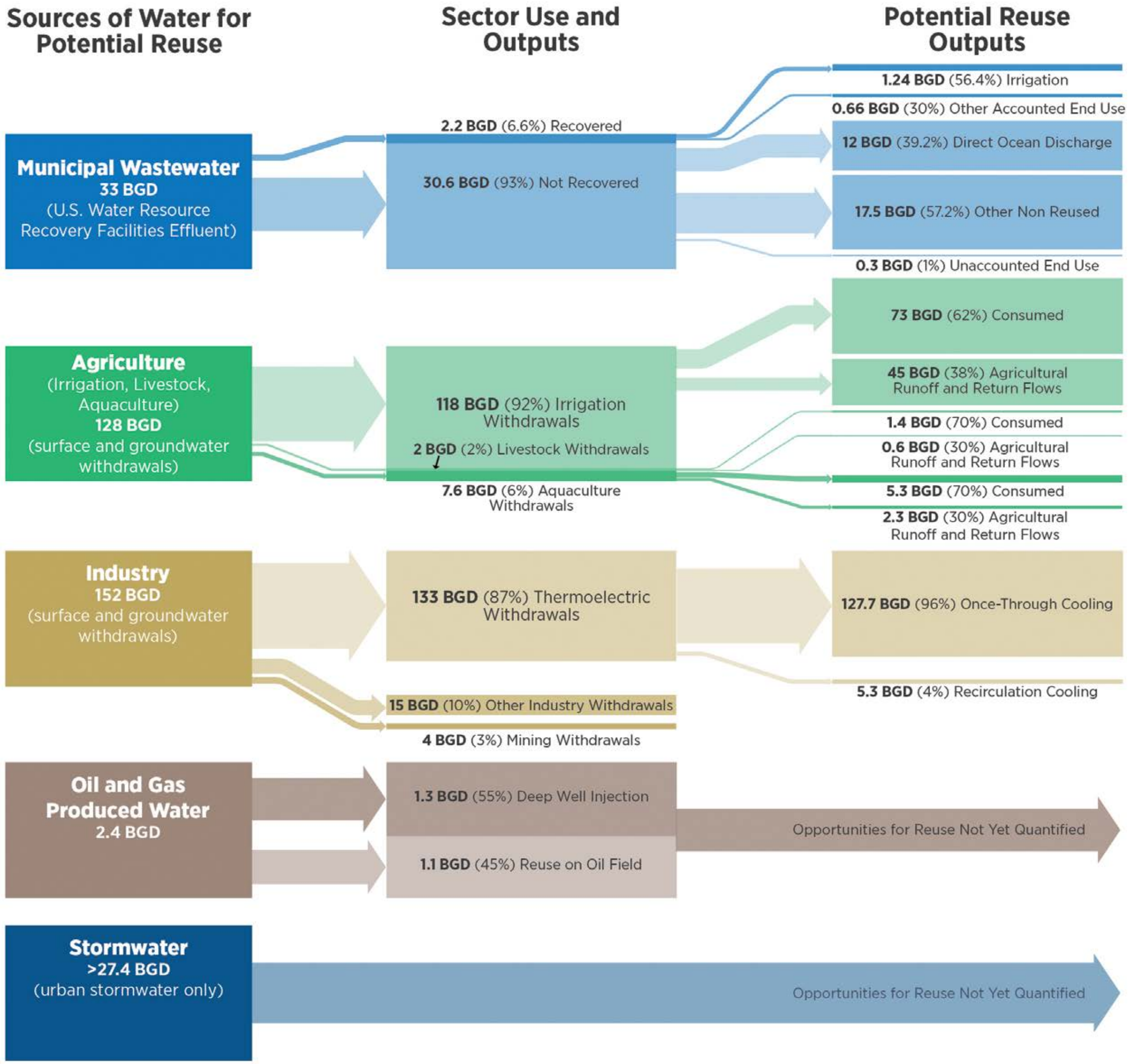
Sources: GAO analysis of state water managers' responses to GAO survey; Map Resources (map).

EPA 2019



EPA National Water Reuse Action Plan Focus Areas

- Clear potential to reclaim more waste waters for beneficial use
- Sources of water for priority reuse:
  - ➢ 33 BGD - Municipal wastewater
  - ➢ 128 BGD - Agriculture
  - ➢ 152 BGD - Industry
  - ➢ 2.4 BGD - Oil and gas produced water
  - ➢ >27.4 BGD – Storm water
- Focus on treatment for beneficial reuse
- Leads selected for each area - GWPC and NMPWRC selected to lead produced water efforts



NM 2019 Produced Water Act, HB 546

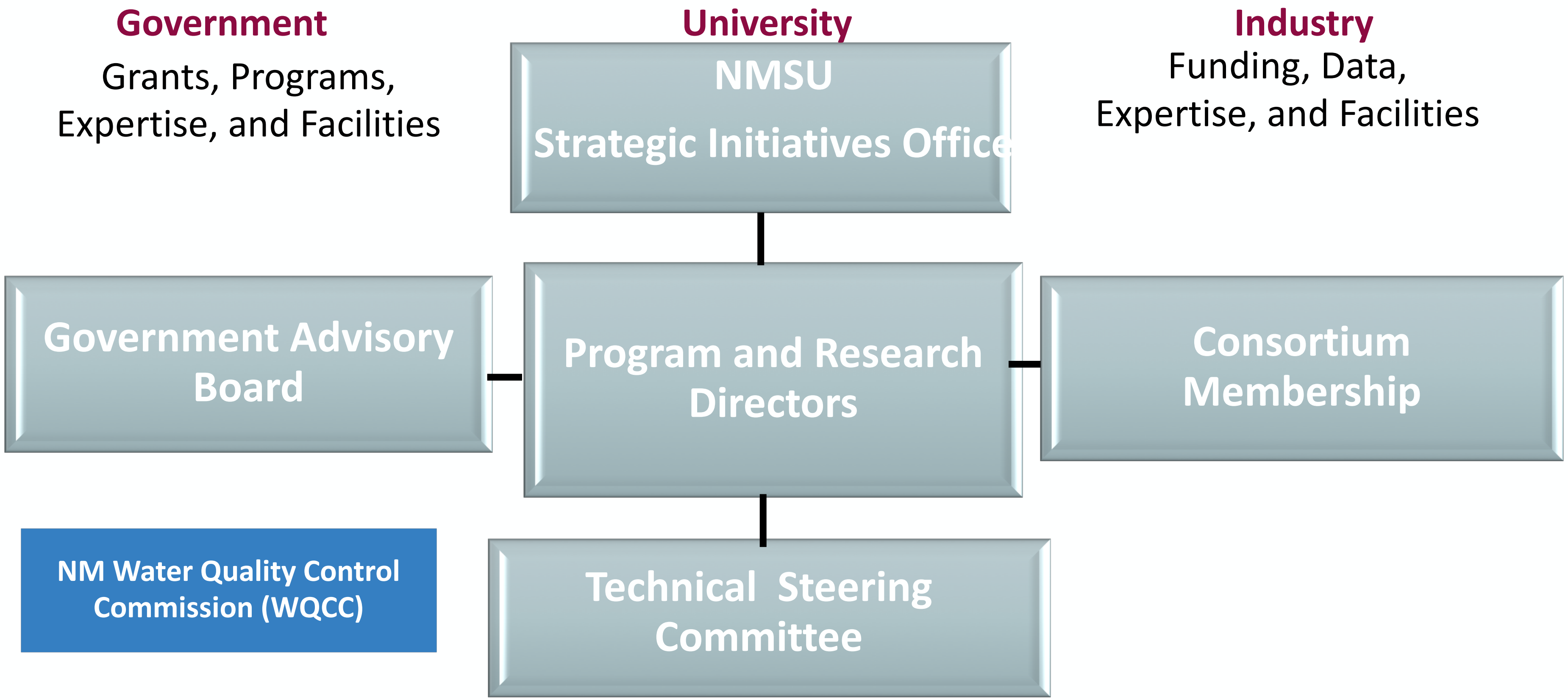
- Through the Act, statutory and regulatory authority for the reuse of produced water was modified:
  - Reuse inside oil and gas sector remains under the Oil Conservation Division (OCD) of the NM EMNRD,
  - **Reuse outside the oil and gas sector, was designated to the NM Environment Department (NMED).**
- 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.

This regulatory transition is an emerging trend in the oil and gas sector – OK, TX, CA

NM Produced Water Research Consortium Roles

- The Consortium was formed in an MOU between the NMED and NMSU to:
  - Coordinate a collaborative research, development, and evaluation program for produced water reuse outside the oil and gas sector,
  - include state and federal health and resource management agencies, academia, industry, and NGOs and their technical experts.
- Will fill science and technology gaps to accelerate innovative technology cost and performance testing to:
  - address fit-for-purpose treatment for various applications - industrial, road construction, agriculture, rangeland, municipal, aquifer storage, surface supplies.
- Make sure treatment requirements are protective of public, environmental, ecological, and watershed health and safety.

Consortium Organization



Modeled after DOE Innovative Treatment Remediation Demonstration Program and EPA Environmental Technology Verification (ETV) Program

Local Produced Water Treatment Challenges

- Produced water quality varies by depth, location
  (10,000 mg/L to > 300,000 mg/L)
- Often Na, Ca, Cl, CO3,and SO4, high scaling
- Can contain hazardous constituents such as: Ra, Ba, Sr, U, heavy metals, organics,
- Fracking chemicals –
  Water and sand –99% to 99.5% by volume
  Friction reducer, Biocide, Surfactants,
  Thickeners, Scale and Corrosion inhibitors, and
  <u>other trace chemicals</u>
- Surface storage
- Concentrate management and disposal issues and costs – solid, hazardous, radioactive, or mixed waste
- Potentially 100-150 MGD of excess produced water available

Requires safe transport, handling, treatment, storage, and residuals management and disposal

Water Quality Requirements for Various Reuse Applications

Produced Water Quality (ppm) TDS	Application	Common Water Quality Requirements (ppm) TDS	Typical Treatment Process
Conventional **10K to 50K** **50%<35K** **50%>35K**	Drinking	500-600	Chemical/membrane/thermal
	Aquifer Storage & Recovery	300-5,000	Chemical/membrane/thermal
	Agriculture and livestock	Class 1 <700, <60% Na, B<0.5 Class 2 2000, 60-75% Na, B<2.0 Class 3 >2000, 75% Na, B~2	Chemical/membrane/thermal
	Rangeland	4,000 – 10,000	Chemical/membrane/thermal
Unconventional **60K to 300K** **25%<100K**	Surface Flow	600-2000	Chemical/membrane/thermal
	Mineral Recovery	>100K (no discharge)	Chemical/thermal
	Road Constr.	Up to 100,000	Chemical/membrane/thermal

Consortium Research Focus for 2021

- Current research priorities are on:
  - Technical risks
    - Bench and pilot-scale treatment technology cost and performance,
    - Sampling, monitoring, and chemical analysis improvements,
    - Produced water quality and quantity data management,
    - Socioeconomic, environmental, ecological cost-benefit analyses of reuse
  - Environmental, ecological, and public health and safety risks
    - Quantitative toxicology evaluations, analyses, and assessments using WET and greenhouse-based bioaccumulation studies
    - Treated produced water relative risk analysis – NPDES+ or NPDES- vs other treated waste waters
  - Public education and outreach
- The Consortium charter is through 2022, so encouraging interested parties, associations, groups, or agencies to participate

Contact Information

Mike Hightower P.E., Program Director
NM Produced Water Research Consortium
New Mexico State University
mmhightower@q.com, 505-859-1563

Dr. Pei Xu, Research Director
NM Produced Water Research Consortium
New Mexico State University
pxu@nmsu.edu

Dr. Jeri Sullivan Graham, Research Professor
University of New Mexico
Fellow, NM Produced Water Research Consortium
ejsgraham@unm.edu

Deborah Dixon, P.E.
Fellow, NM Produced Water Research Consortium
ddixon@dkdixonengineeringinc.com

https://nmpwrc.nmsu.edu