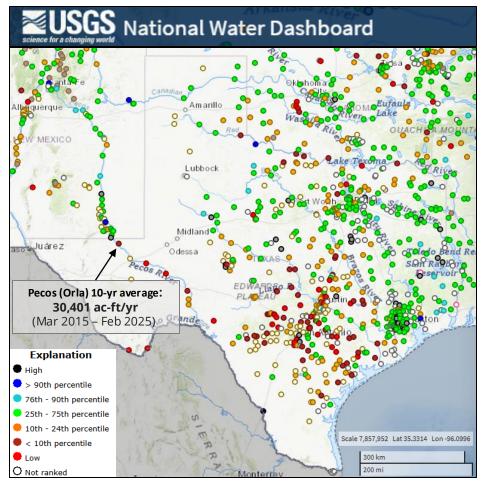
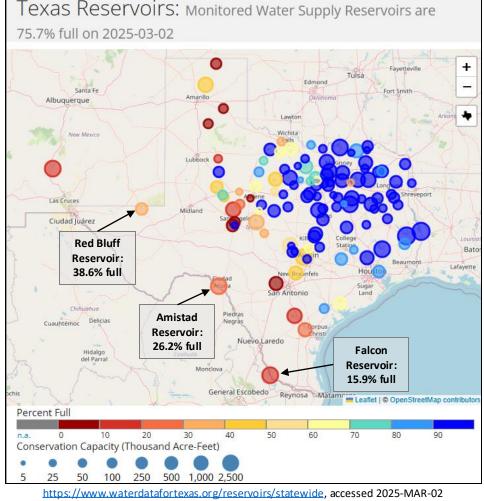
Permian Basin: Desalinated Produced Water

Current applications for TCEQ surface discharge permits: into or downstream of Red Bluff Reservoir



https://dashboard.waterdata.usgs.gov/app/nwd/en/, accessed 2025-MAR-02 https://waterdata.usgs.gov/tx/nwis/rt, accessed 2025-MAR-02



Water Data for Texas

https://www.waterdatafortexas.org/reservoirs/statewide, accessed 2025-MAR-02 https://www.waterdatafortexas.org/reservoirs/individual/red-bluff, accessed 2025-MAR-02





Produced Water Treatment Train To Reduce Toxicity

Bulk solids and oil/water separation

Oil, water, solids separation/bacteria and pH treatment

Desalination – reverse osmosis, thermal processes

GAC, zeolite filtration, ammonia removal/destruction

Human cell line and WET testing, Fate and Transport

Preliminary Treatment

"Raw Water" "Clear 200-500 ppm oils 30 p High salinity low TS



Pre-Treatment

"Clean Brine"
30 ppm oils,
low TSS and Fe,
low bacteria,
balanced pH



Treatment

"Permeate/Distillate"
99.5% solids removal
90% organics removal
99.5% inorganics
removal



Post-Treatment

"Polished Water"
NTU<10
Org compounds <2 ppb
TDS – 100-800 ppm
Ammonia <2 ppm



EPA Fit-for-Purpose Application

"Wholesale Water"
Industrial,
Commercial,
Agricultural,
Ecological,
Recreational,
Domestic

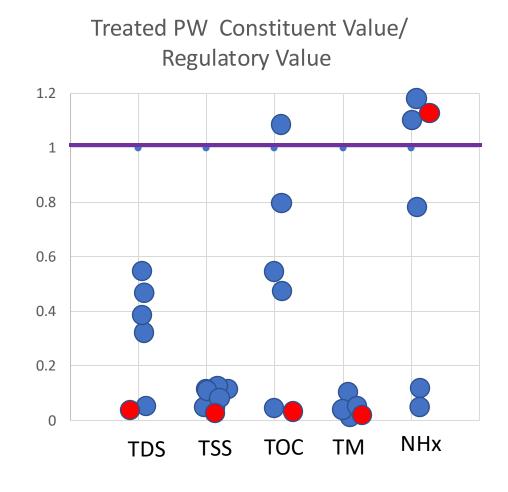
Current Regulatory Values vs. Treatment Data Values (Curated collaborative data by NMPWRC)

NMPWRC Curated Pilot Data

- Permian Basin (~120,000 ppm TDS)
- San Juan Basin (~20,000 ppm TDS)

Fresh Water Limit of 1,000 ppm TDS

Data suggests post-treatment needed to meet regulatory requirements for organics and ammonia which is helped by using a "Clean Brine"



Produced Water Drivers for Risks and Benefits

- Dirty Dozen
 - TDS
 - TOC, TPH
 - BTEX, Benzene
 - NORM
 - Total metals
 - Alcohols methanol (replace it)
 - Ammonia
 - Dioxins
 - PCBs
 - Acetone/butanone
 - Arsenic
 - PFAS (ban it)

- Good Dozen DD of PW
 - Metals Cr, Co, Ti, Ni, Li, Mg, etc.
 - Ammonia
 - Minerals barium, strontium
 - Chlor/alkali
 - Rare earth elements

Suggests need to collect 'select' raw and treated produced water data to:

- Understand treatment needs
- Support techno-economic analysis to optimize treatment trains and concentrate recovery revenue
- Drive real-time treatment monitoring