

# Is There a Role for Produced Water Treatment in the Shale Plays?

Introduction: Open Discussion of Water Issues



# Water Use is Increasing: Reuse is Attractive

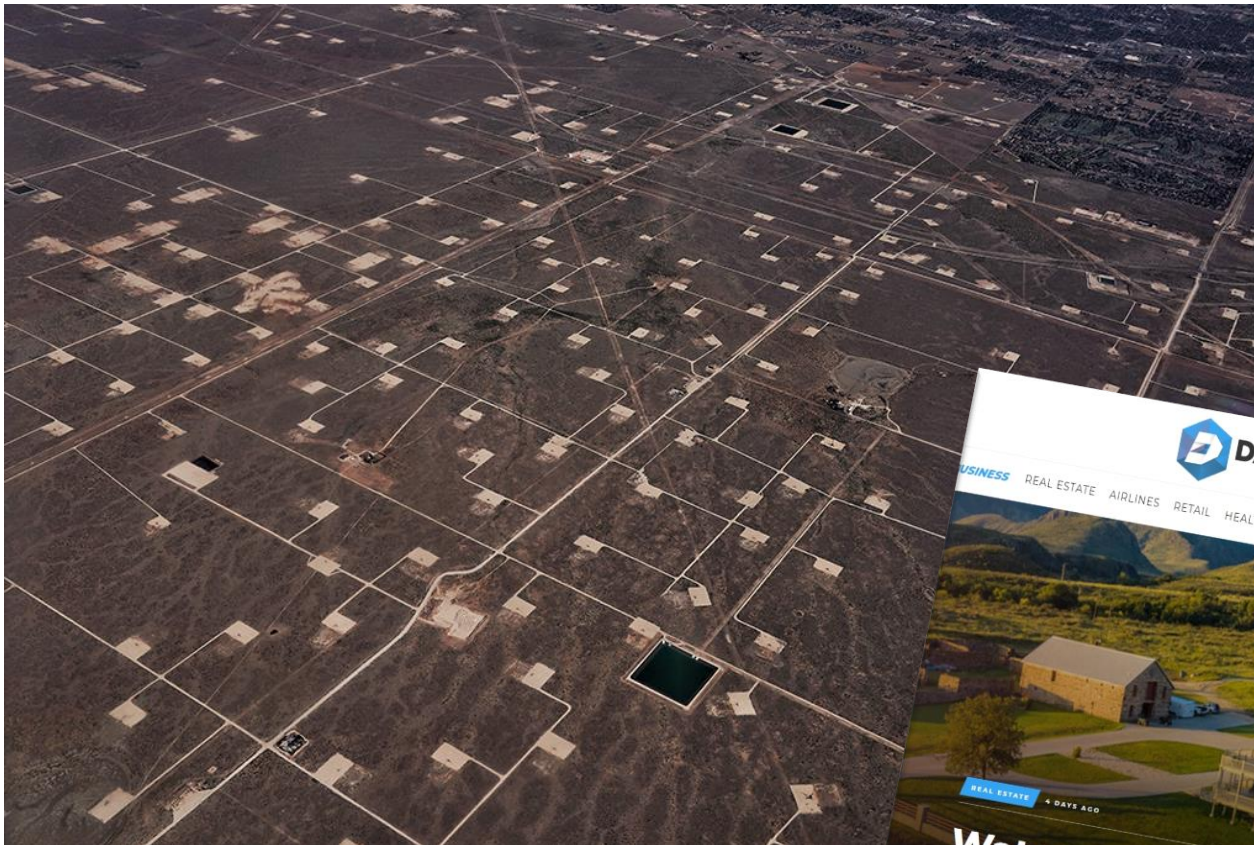
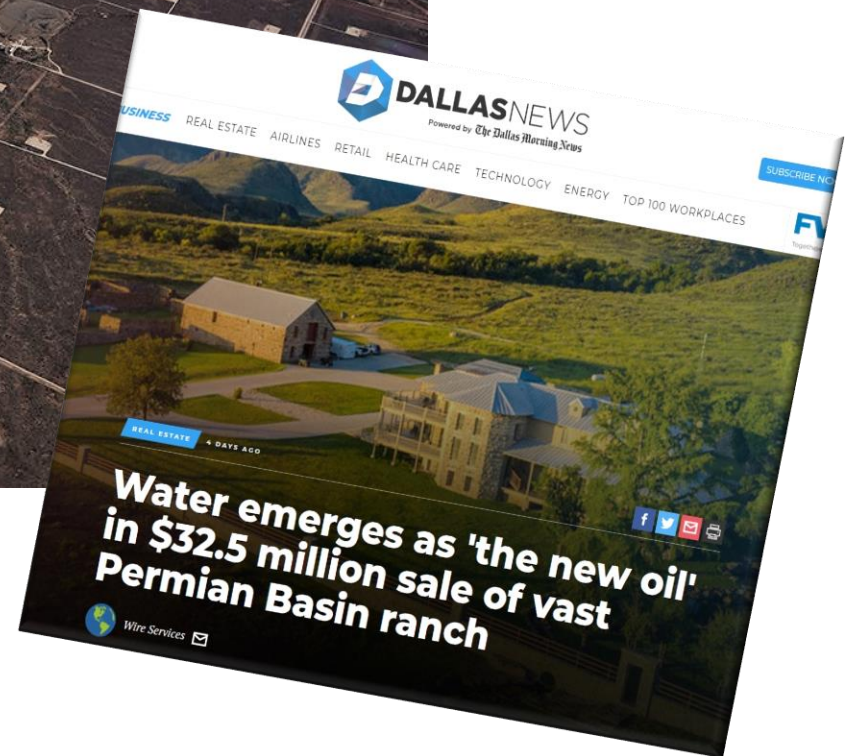


Photo Source: Fortune Magazine



# The Upcoming Wall of Water



*Photo Source: Bloomberg.com*

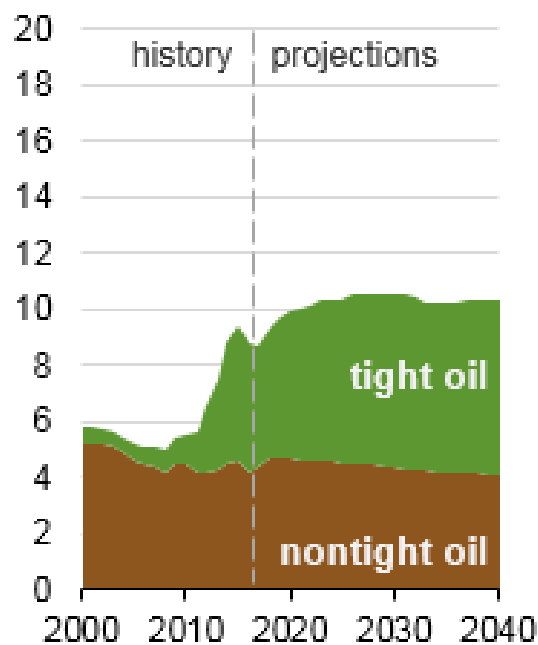


# Wall of Water Context



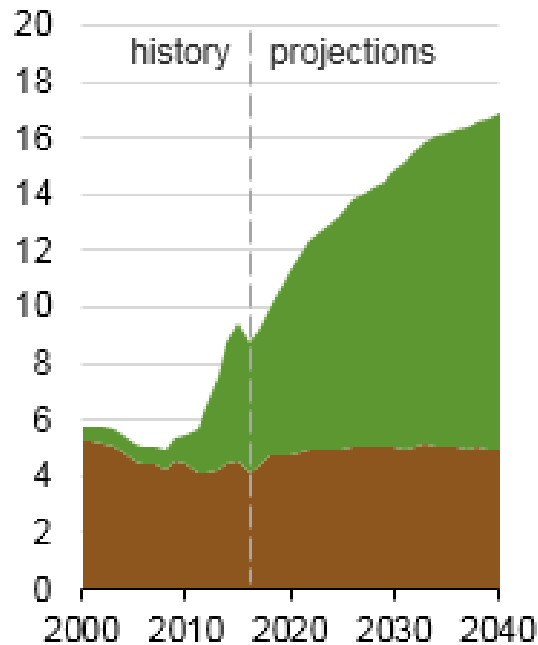
**U.S. oil production in three cases**

million barrels per day



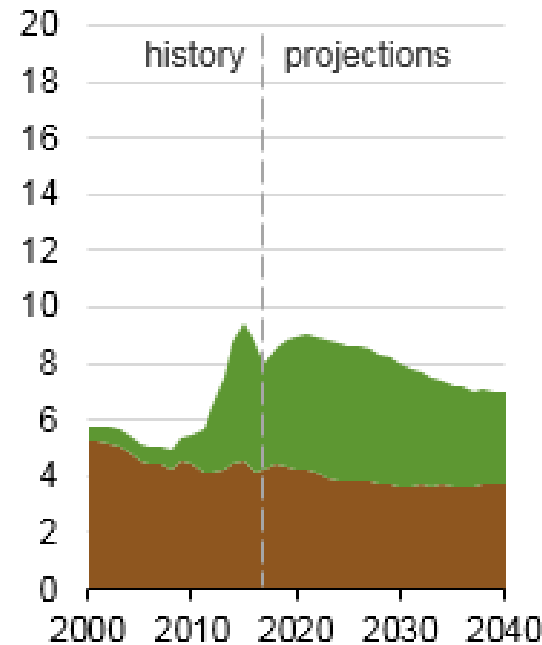
**Reference case**

million barrels per day



**High Oil and Gas  
Resource and Technology**

million barrels per day



**Low Oil and Gas  
Resource and Technology**



*Photo Source: EIA, US Energy Information*



# Other Key Drivers

Difficulty permitting SWDs and induced seismicity

Local environmental incentives and subsidies

Limited freshwater availability (Texas and New Mexico and Colorado)

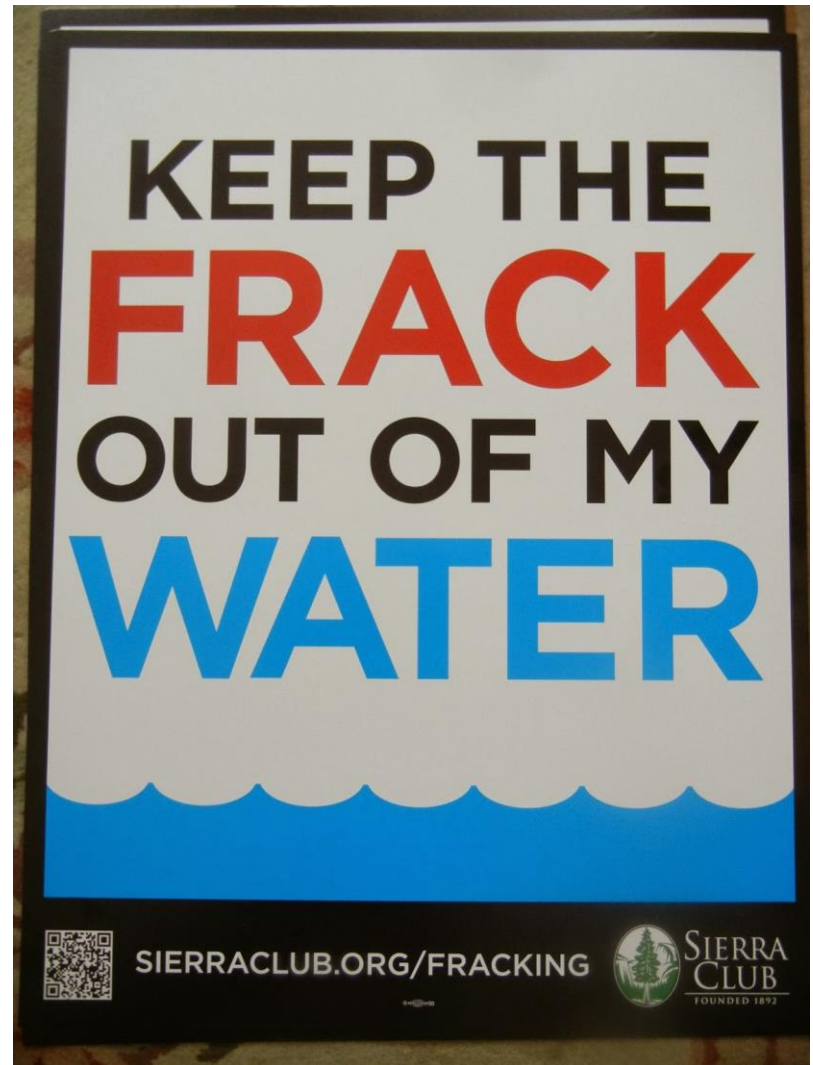
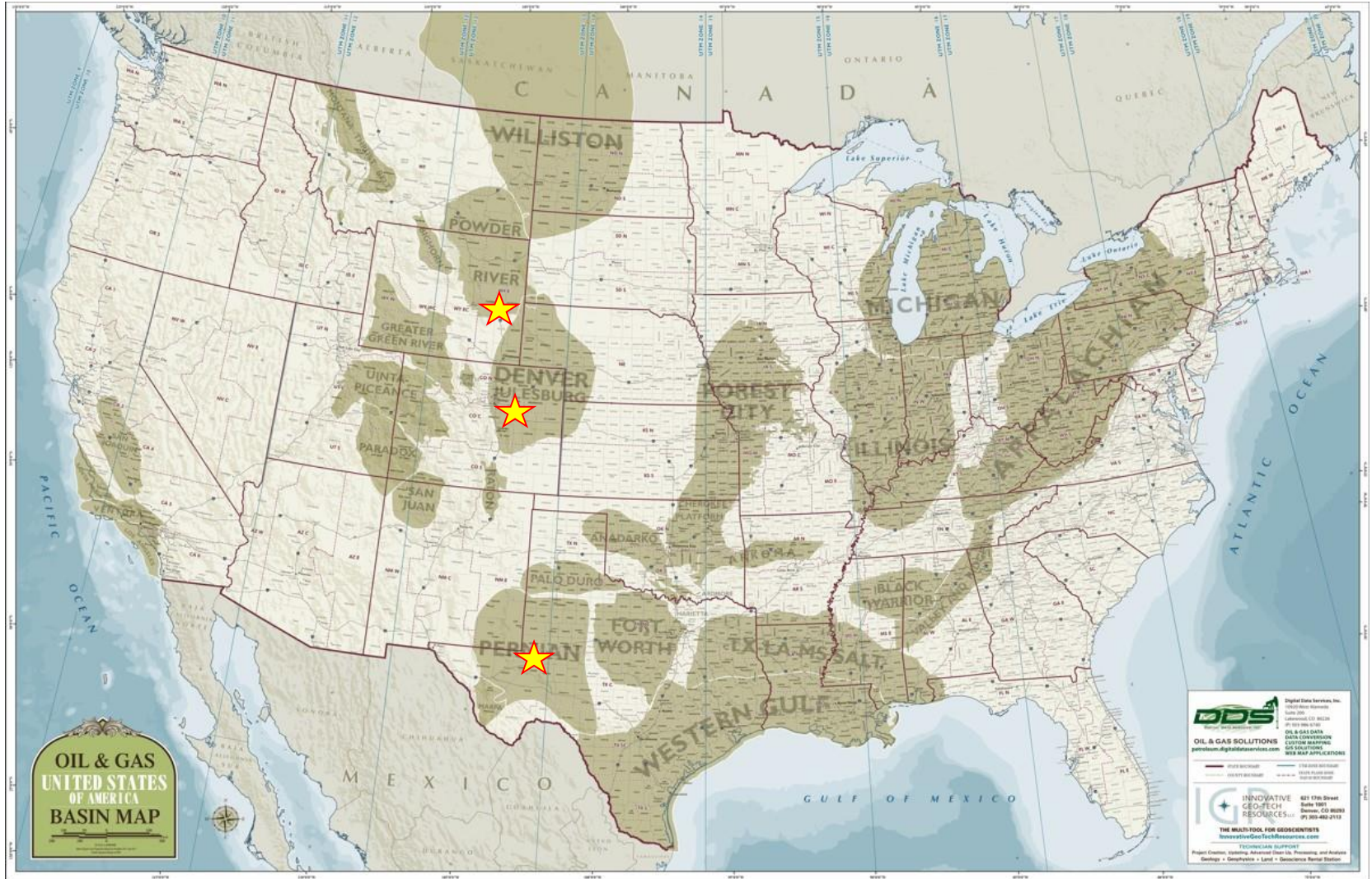


Photo Source: Sierra Club



# The search for one size fits all?



# Unconventional Water Variability is High



# Treatment Objectives

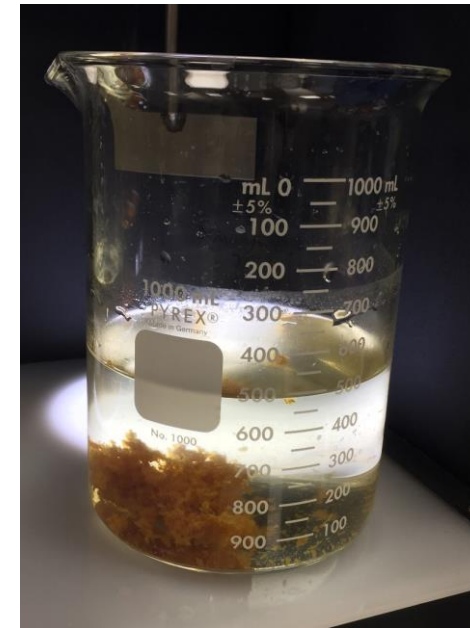
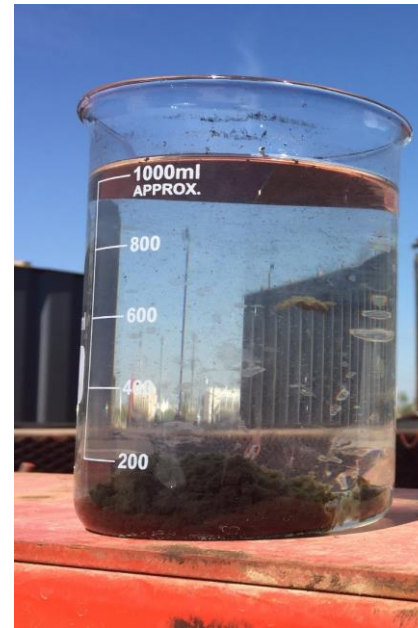
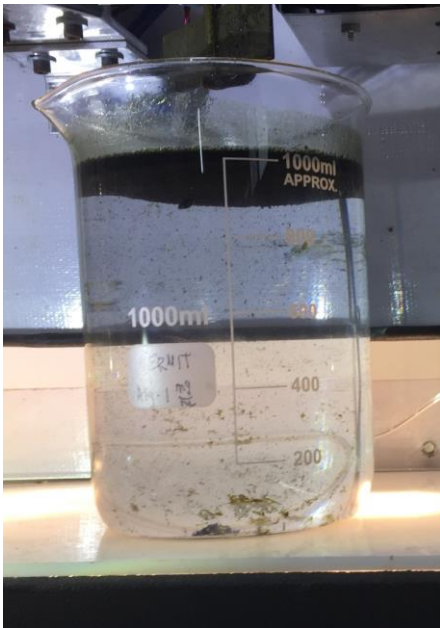


For drilling/stimulation reuse:

Focus on TSS, metals and disinfection

For agricultural and surface water:

Include TDS, TIN and TOC controls





# Reuse in Hydraulic Fracturing

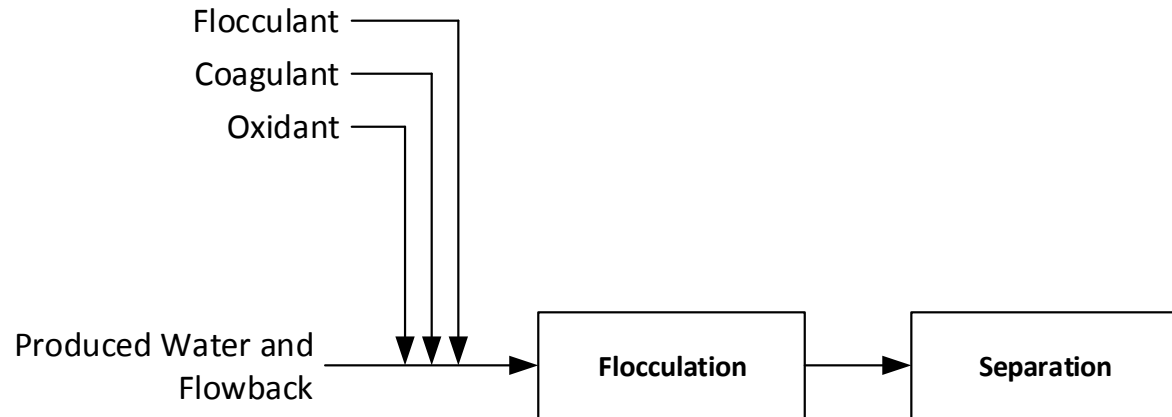


## Conventional Treatment Approach

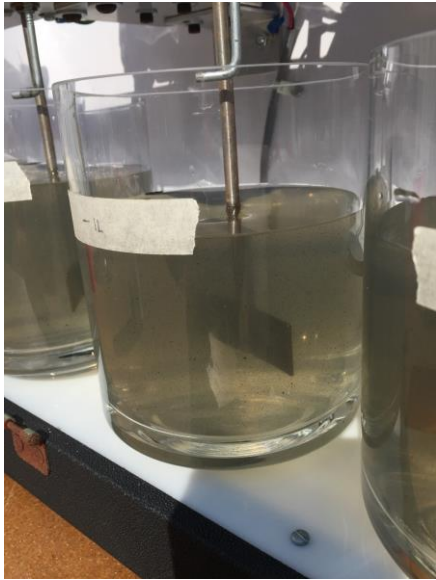
Already have widespread adoption. Permian companies achieving as much as 85% produced water reuse.

Typical reported cost range: \$0.30-\$0.50/bbl

Economics are entirely dependent on ability to manage upsets and optimize throughput.



# Visual Process Overview



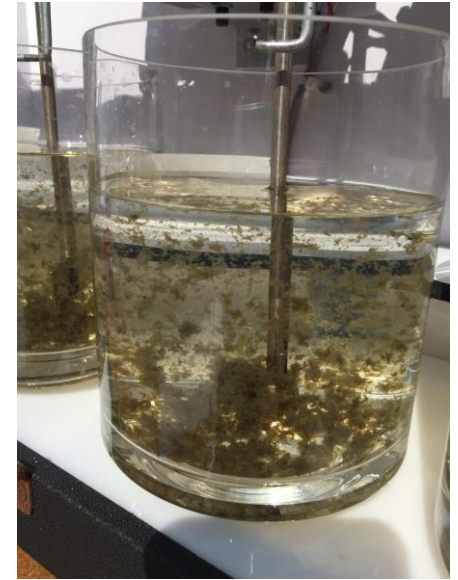
Raw PW



Oxidized PW



Coagulated PW

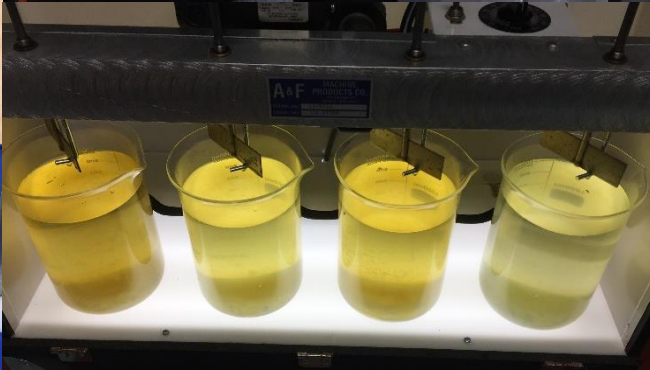
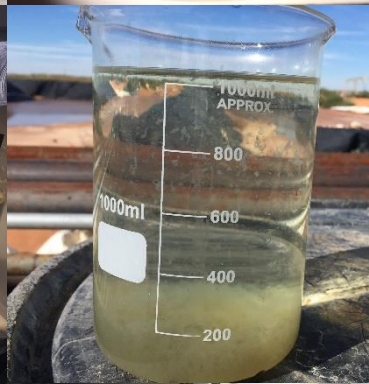


Flocculated PW



# Floc and Float Video

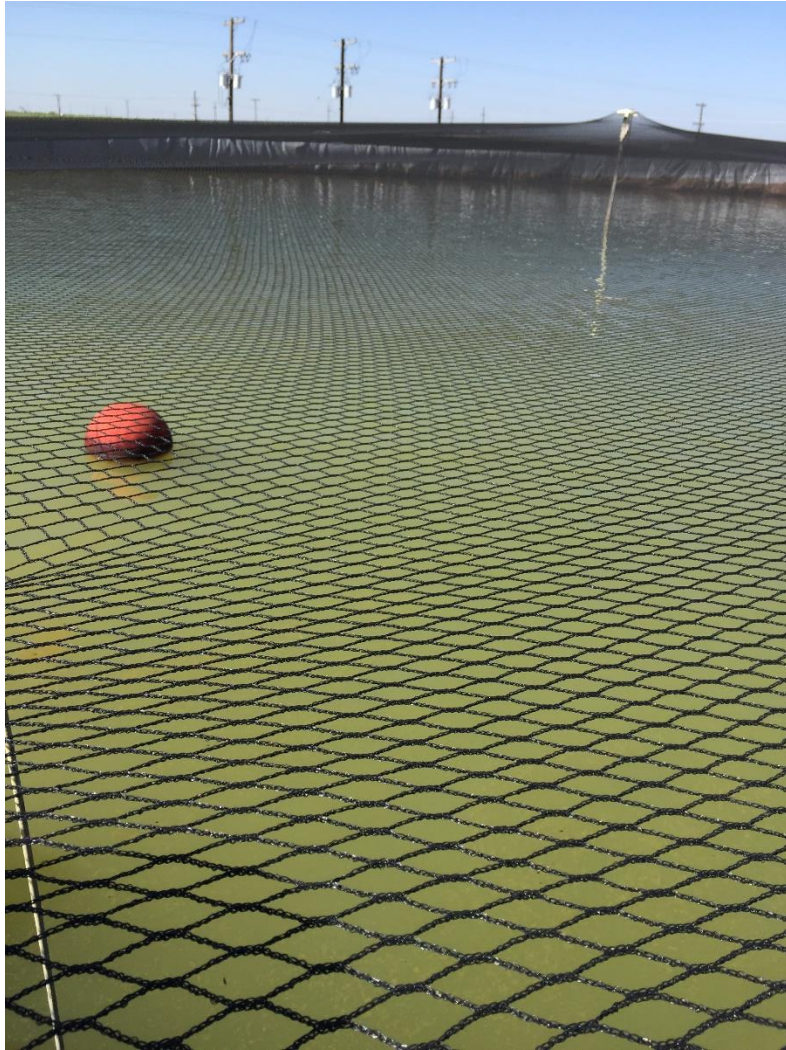




# Portable Reuse Site Concept: 30 kbpd



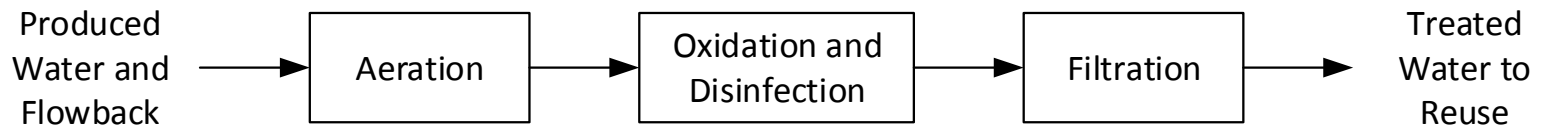
# Treatment Target: Frac Reuse Quality



# Modern Reuse Approaches



## Focus: Simplification and Cost Optimization



# Considerations for Fracs



## Biogrowth in Topsides Equipment

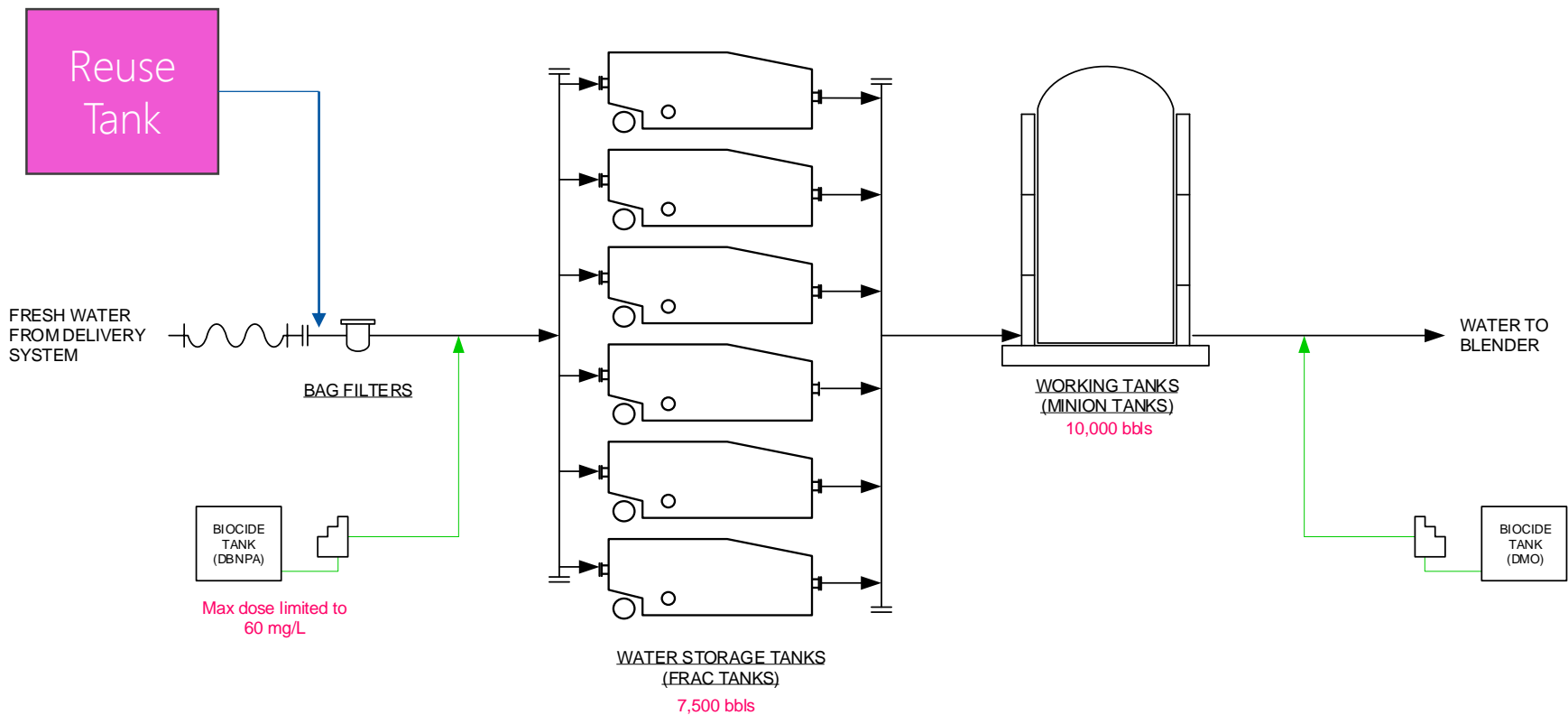




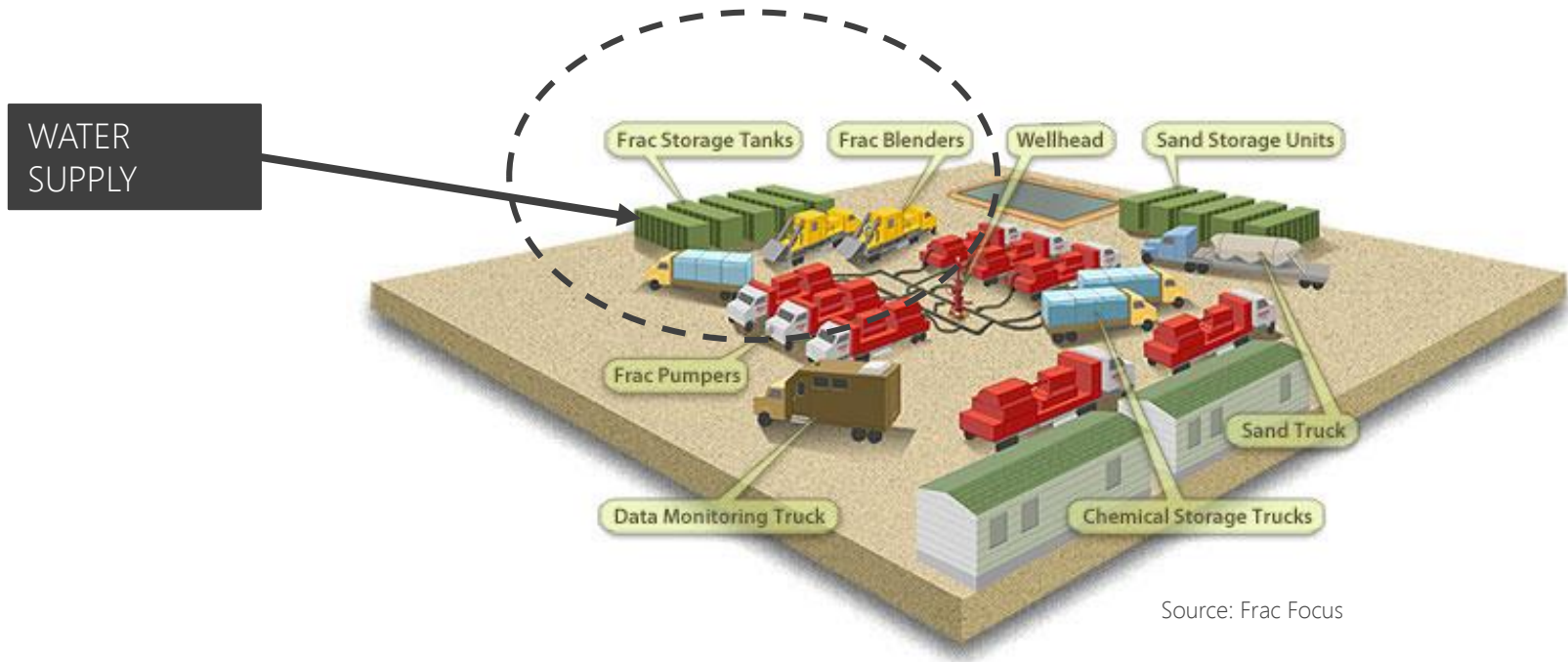
# Considerations for Fracs



## Topsides Water Process - DJ



# Considerations for Fracs



# Managing The Wall of Water



## The Future of Produced Water Management

Once in a lifetime opportunity to return treated PW to the hydraulic cycle.

Regulatory work required to ensure stakeholder safety

Process safety and reliability are critical

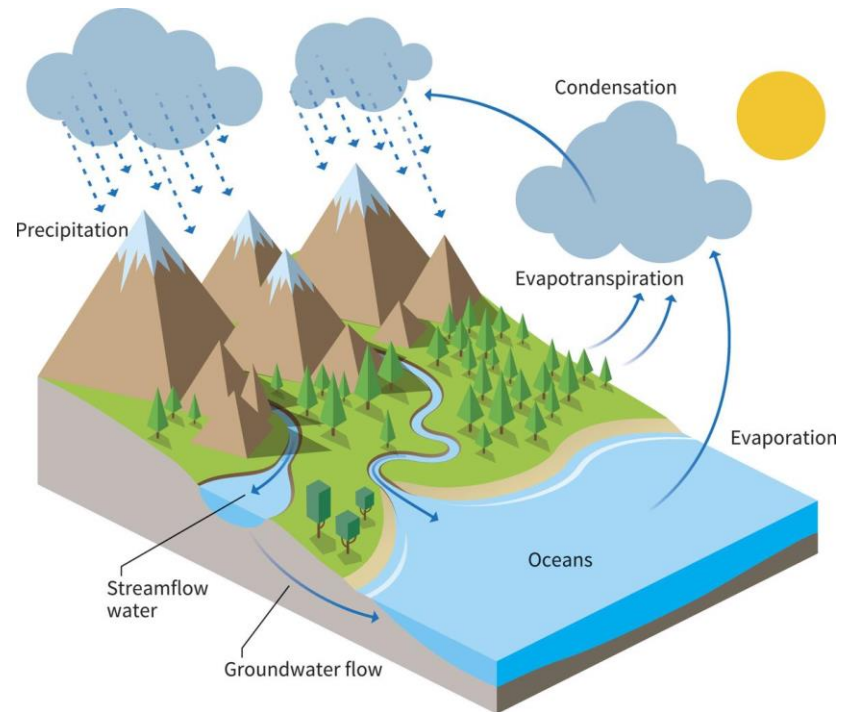
Combination projects with industrial reuse component are beneficial.

New regulations focus on more challenging constituents:

Total Inorganic Nitrogen

Whole Effluent Toxicity

Sodium Adsorption Ratio



# Moderate Salinity Approach



(25,000-40,000 ppm TDS)

<b>Constituent</b>	<b>Technology Options Piloted</b>
Free oil	Flocculant, Dissolved Air Flotation (DAF), Nutshell Filter (NSF)
Iron and metals	Oxidant, Flocculant, DAF, NSF
TSS	Oxidant, Flocculant, DAF, NSF
BTEX	NSF, Granulated Activated Carbon (GAC), Advanced Oxidation Process (AOP), MBR, RO
Bacteria	Oxidant
Nitrogen	Ammonia, Nitrate, Nitrite at MBR, RO, AOP
Radionuclides	Flocculant, DAF, RO
Inorganic salts	RO



# Delaware Basin Focus

## Texas vs. New Mexico and Colorado



The screenshot shows a web browser window displaying the Wikipedia article for "Texas v. New Mexico and Colorado". The browser's address bar shows the URL: [https://en.wikipedia.org/wiki/Texas\\_v.\\_New\\_Mexico\\_and\\_Colorado](https://en.wikipedia.org/wiki/Texas_v._New_Mexico_and_Colorado). The page title is "Texas v. New Mexico and Colorado". Below the title, it states "From Wikipedia, the free encyclopedia". The main text of the article begins: "Texas v. New Mexico and Colorado, 141-orig, \_\_\_ U.S. \_\_\_ (2018), was a Supreme Court case argued and decided during the 2017 term of the Supreme Court of the United States. The case involved an interstate dispute regarding New Mexico's compliance with the Rio Grande Compact of 1938, an agreement which established a plan for equitable apportionment of the water in the Rio Grande Basin among the states of Colorado, New Mexico, and Texas.<sup>[1]</sup> The Court considered the question of whether the US federal government had a legal right to join litigation against New Mexico; the Court ruled that the federal government was within its rights when it did so.<sup>[1]</sup>"

The page includes a sidebar on the left with navigation links such as "Main page", "Contents", "Featured content", "Current events", "Random article", "Donate to Wikipedia", "Wikipedia store", "Interaction", "Help", "About Wikipedia", "Community portal", "Recent changes", "Contact page", "Tools", "What links here", "Related changes", "Upload file", "Special pages", "Permanent link", "Page information", "Wikidata item", "Cite this page", and "Print/export".

On the right side of the article, there is a summary box titled "Texas v. New Mexico and Colorado" with the Supreme Court of the United States seal. Below the seal, it states "Supreme Court of the United States", "Argued January 8, 2018", and "Decided March 5, 2018". The summary box also lists the full case name, docket number, citations, holding, and court membership.

The "Background" section is titled "The Rio Grande Compact" and states: "The interstate agreement that the case centered around, the Rio Grande Compact, arose from multiple concerns regarding apportionment of water during the early 20th century. According to the terms of the Convention Between the United States and Mexico for the Equitable Distribution of the Waters of the Rio Grande for Irrigation Purposes, a treaty that the United States signed with Mexico in 1906, the U.S. must supply Mexico with at least 80,000 acre feet of water from the Rio Grande each year."<sup>[2]</sup>



# Delaware Basin Provides a Unique Opportunity



*Photo Source: Green Sahara*





The right solutions for your water treatment challenges



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