



Energy & Environmental Research Center (EERC)

Project Update: Overview of Bakken Water Trends

EDTC Meeting

September 16, 2020

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Vice President for Strategic Partnerships

Outline

- Progress update on “Produced Water Management Through Geologic Homogenization Conditioning and Reuse” project (G-051-101)
- Preliminary review of produced water assessment results
- Introduction to GHCR Approach
- Concluding remarks and next steps

Objectives and Deliverables

- Evaluate produced water management methods, trends, and costs.
- Evaluate economic, regulatory, and technical considerations for implementation of recycling and reuse applications of produced water in ND.
- Assess techno-economic commercial viability of the GHCR concept:
 - Evaluate GHCR concept through water sample collection at an active commercial SWD site.
 - Simulate the performance of GHCR through geologic and geochemical models.
 - Through laboratory experiments, replicate the interaction between Bakken produced water and the Inyan Kara/Dakota formation.

Deliverable	Status
D1-Update of Water Management Report	<i>Submitted February 28, 2020</i>
D2-Produced Water Assessment Report	Due October 1, 2020
D3-Draft Final Report	Due November 30, 2021
D4-Final Report	Due January 31, 2022

Key Project Elements and Complementary Projects

1. Legislative mandate (Sec 19, ND House Bill 1014) to conduct a study on recycling of water used in oil & gas operations. Includes a compilation of data on methods of and considerations for regulatory, scientific, technological, and feasibility considerations associated with produced water management.
2. Leveraged DOE Fossil Energy—Oil & Gas Program co-funding to provide a proof of concept of a novel approach (GHCR) to recycling by using a geologic formation as a natural medium to homogenize and condition produced water for reuse as makeup water for hydraulic fracturing operations.

NDIC OGRP: \$300,000

U.S. Department of Energy (DOE): \$1,000,000

Complemented by:

BEST (DOE-funded): \$21 million overall, \$17 million (DOE share)

Schlumberger: \$2.8 million, CMG: \$1.4 million

Key Takeaways

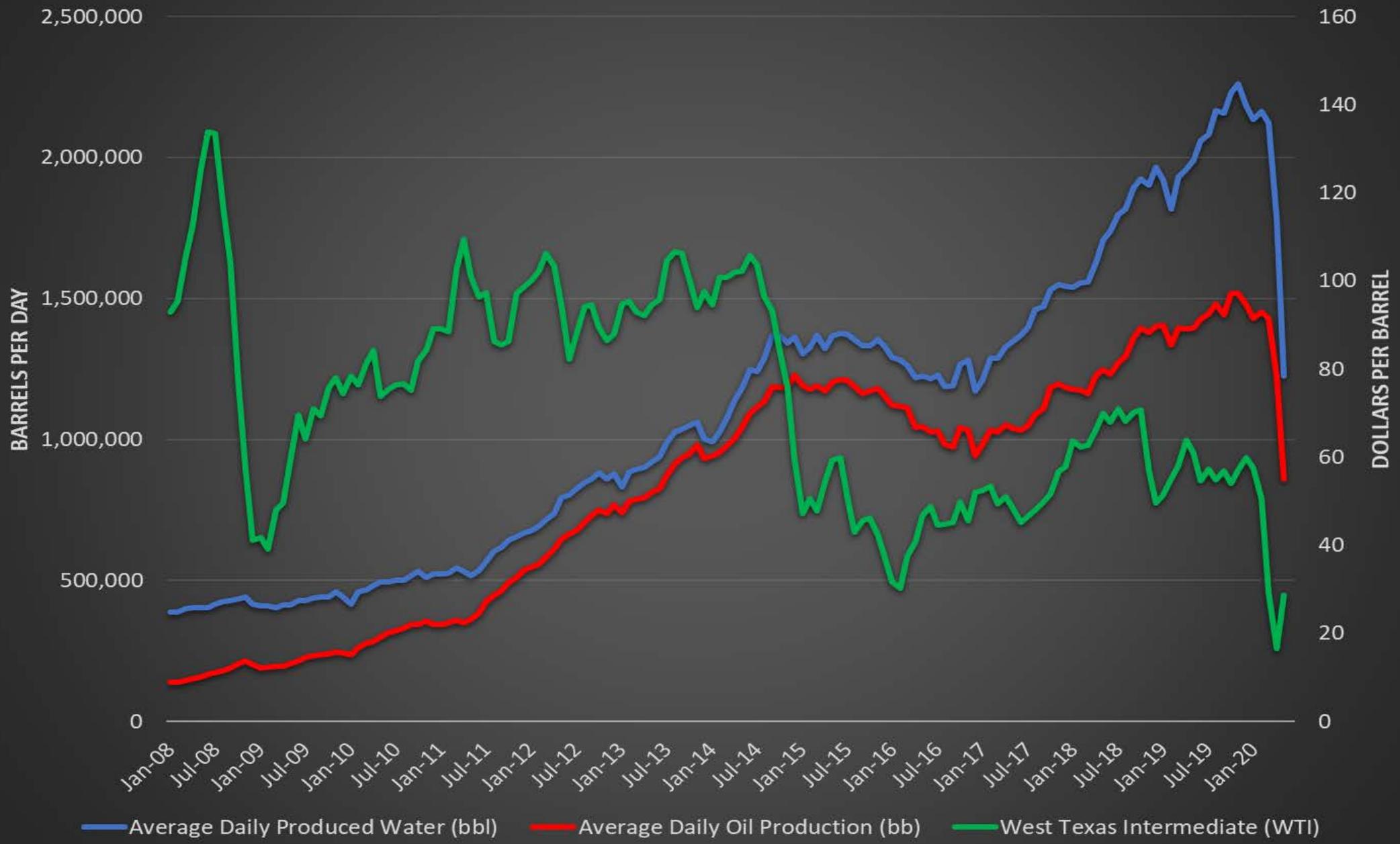
- Oil and gas industry continues to handle increasing volumes of water.
- Emerging need for alternative produced water handling options to supplement the Dakota.
- High TDS Bakken produced water is a primary challenge in treatment and reuse.
- New subsurface technique is being evaluated as an approach to recycling/reuse.

Overview of Progress to Date

- Completed D1: Update of Water Management Report.
- D2: Produced Water Assessment Report
 - To be submitted October 1st.
- Engaged operating partners via individual meetings and BPOP meeting (9/2).



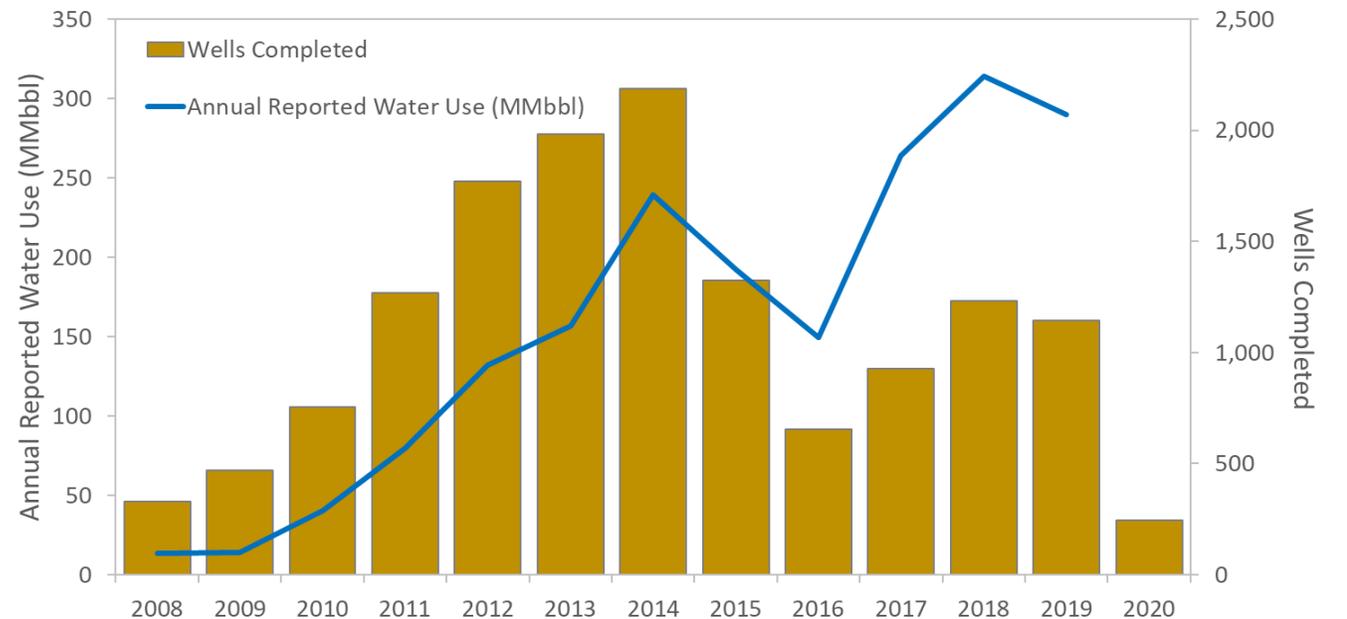
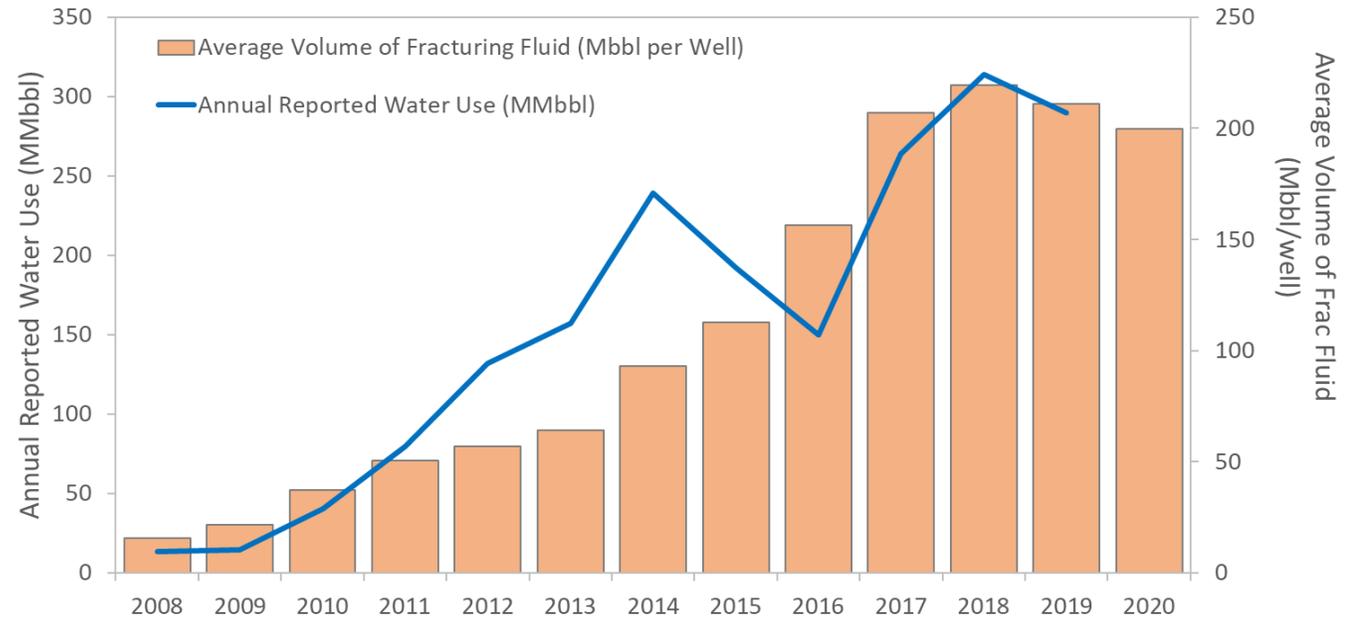
Average Daily Oil & Water Production and Market Price



*96% of current production is from Bakken and Three Forks.

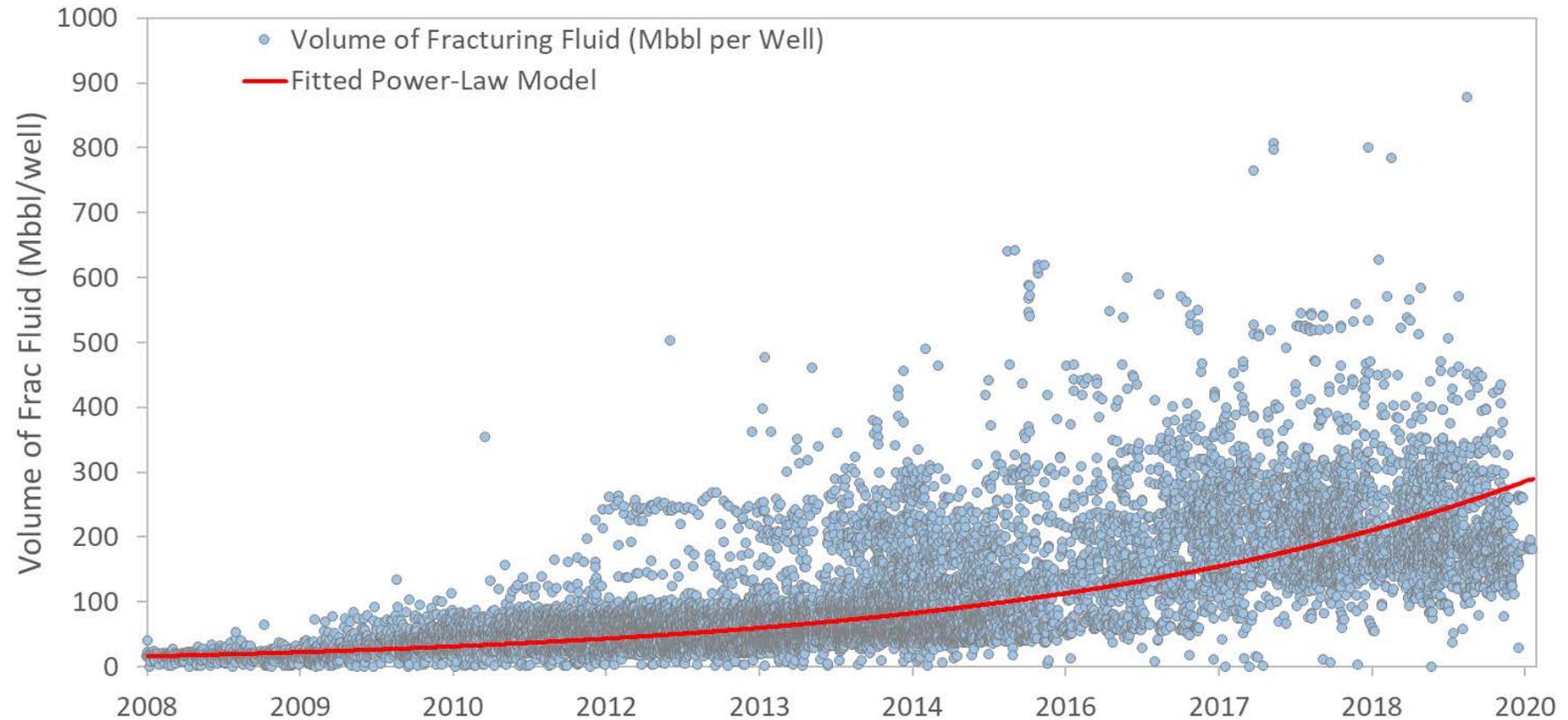
Fresh Water Use

- Industry freshwater use has increased:
 - 2008: 13.5 million bbl
 - 2019: 290 million bbl
- Fresh water used in drilling, fracturing fluid makeup, and well maintenance.
 - Makeup water: 87% of freshwater use for the last 5 years (based on Frac Focus reported clean water and ND SWC industrial water use)
 - Maintenance water: 15 bbl/day/well to 50 bbl/day/well.



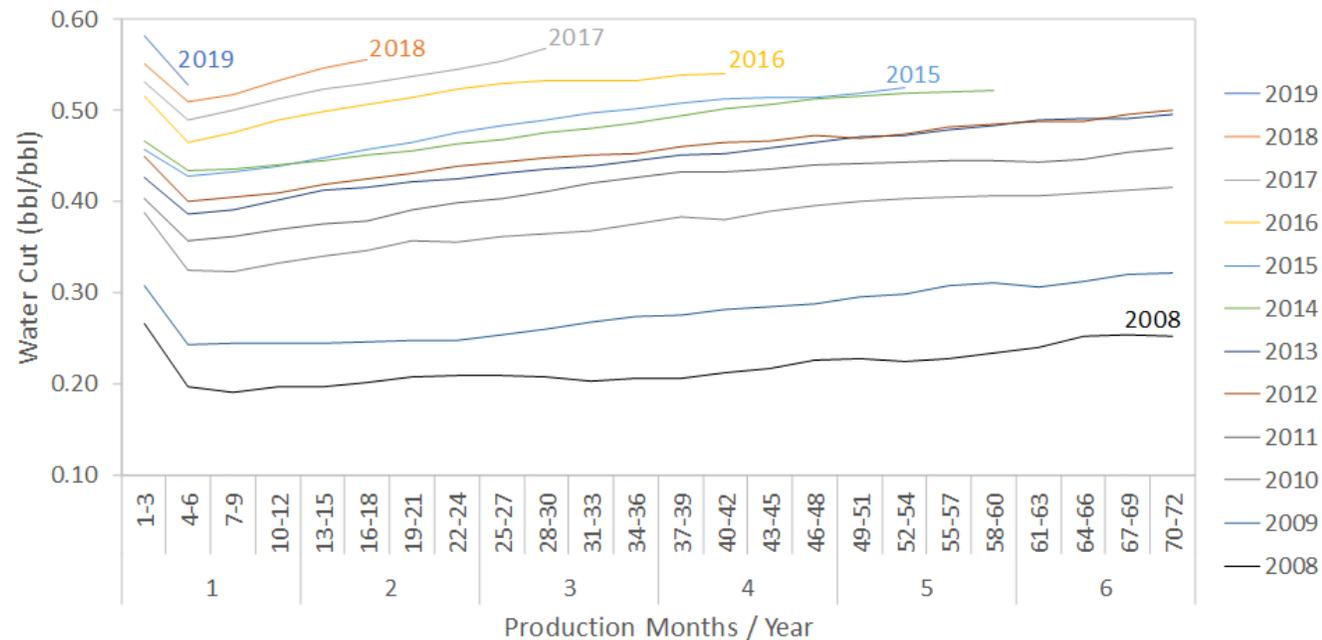
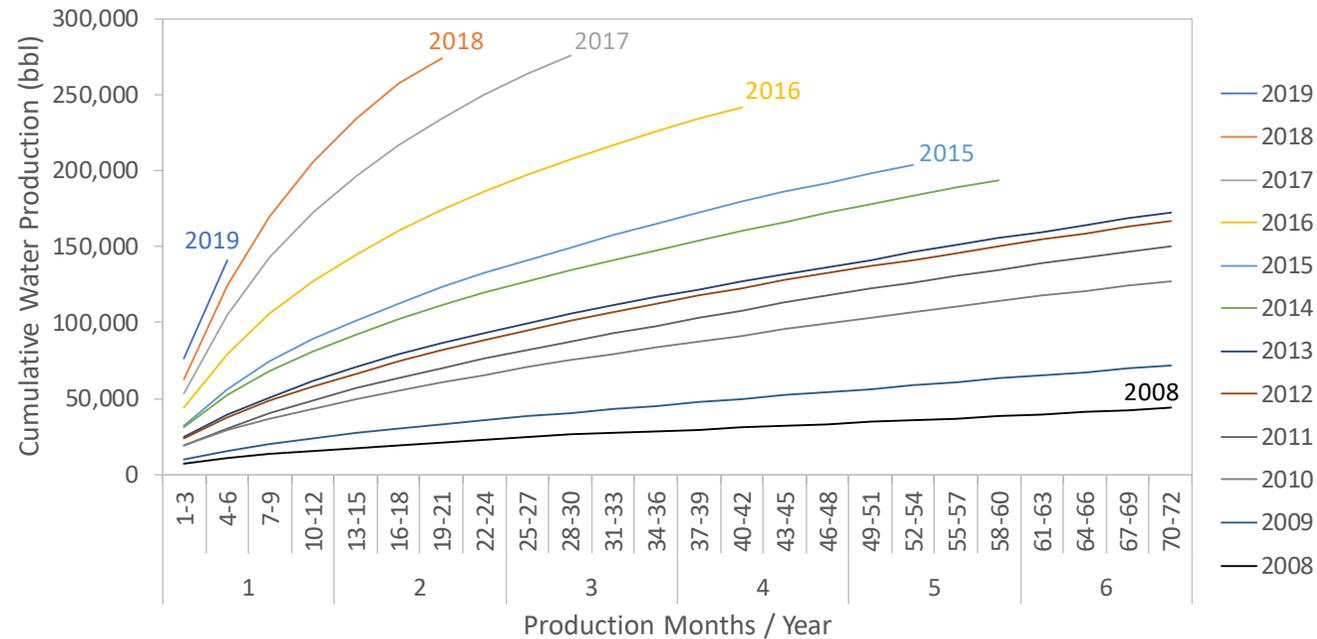
Fresh Water Use

- Hydraulic fracturing volumes:
 - 2008: 15,000 bbl/well
 - 2020: 200,000 bbl/well



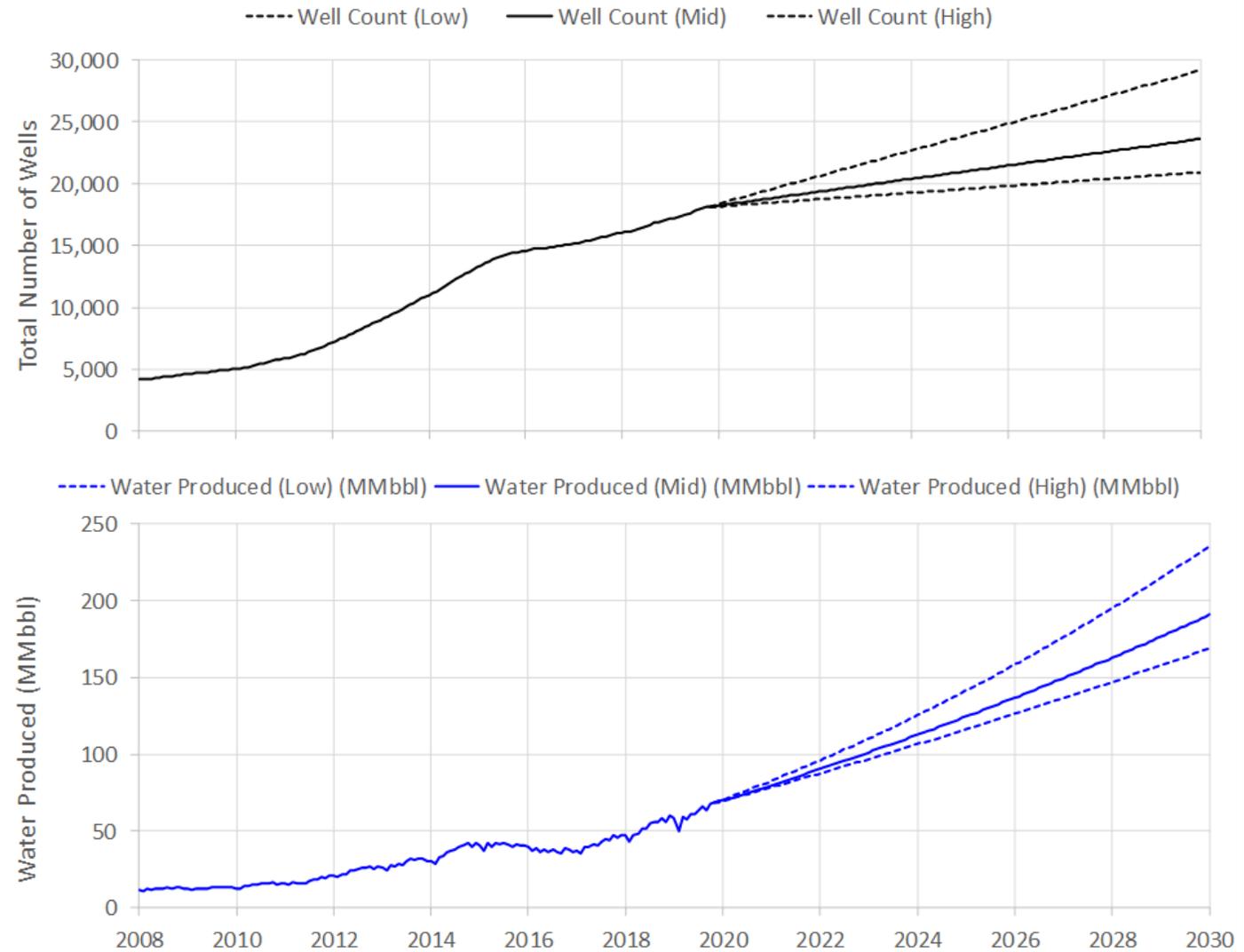
Produced Water

- State produced water volumes increased four-fold since 2008 to ~740 million bbl/yr.
- Increasing volumes per well and increasing water cut.
- Total dissolved solids (TDS) up to 350,000 mg/L.



Looking Ahead

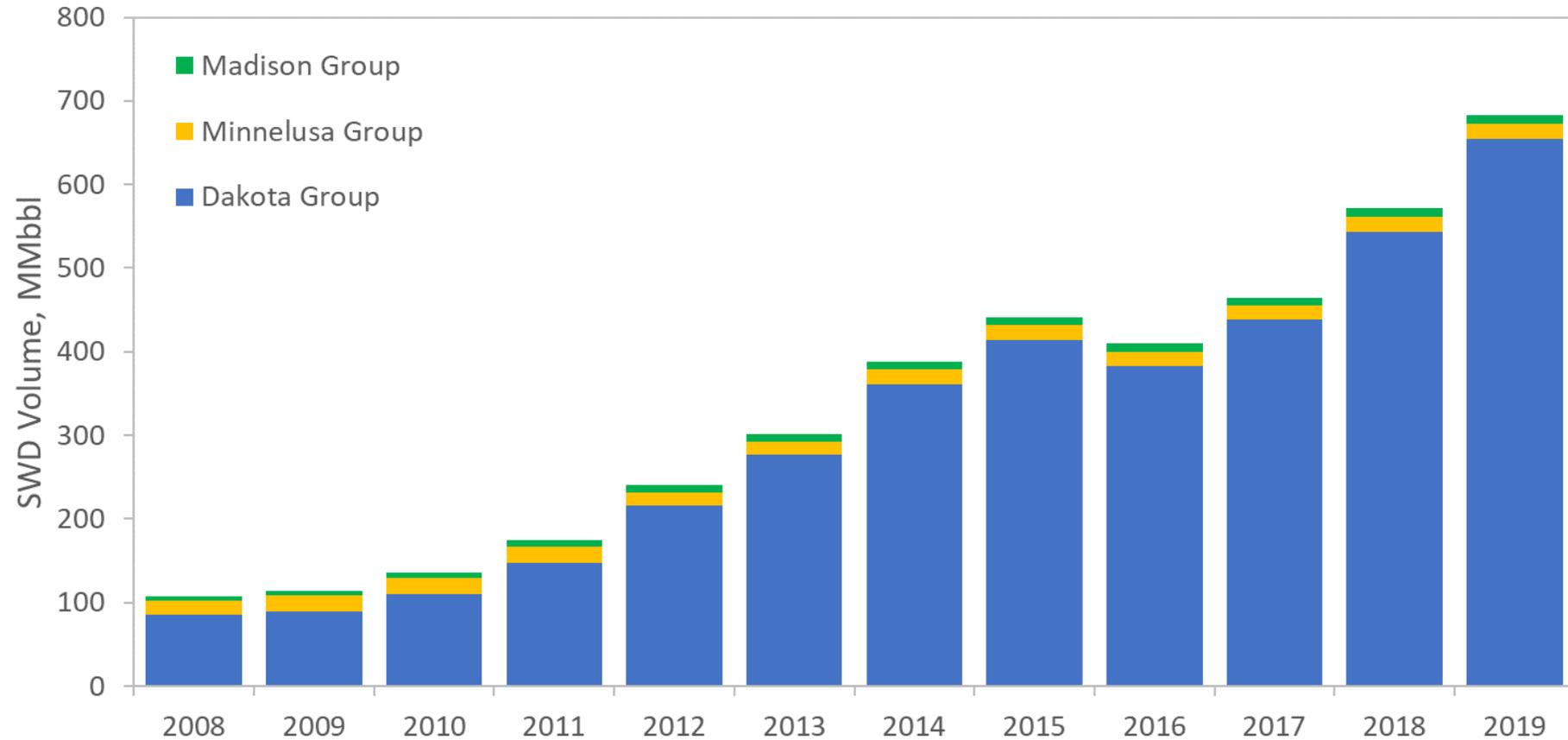
- Forecast more than double volumes of produced water by 2030.
- Based on data trends from 2017-2019.
- With 96% of current oil production, Bakken primary driver of these projections.



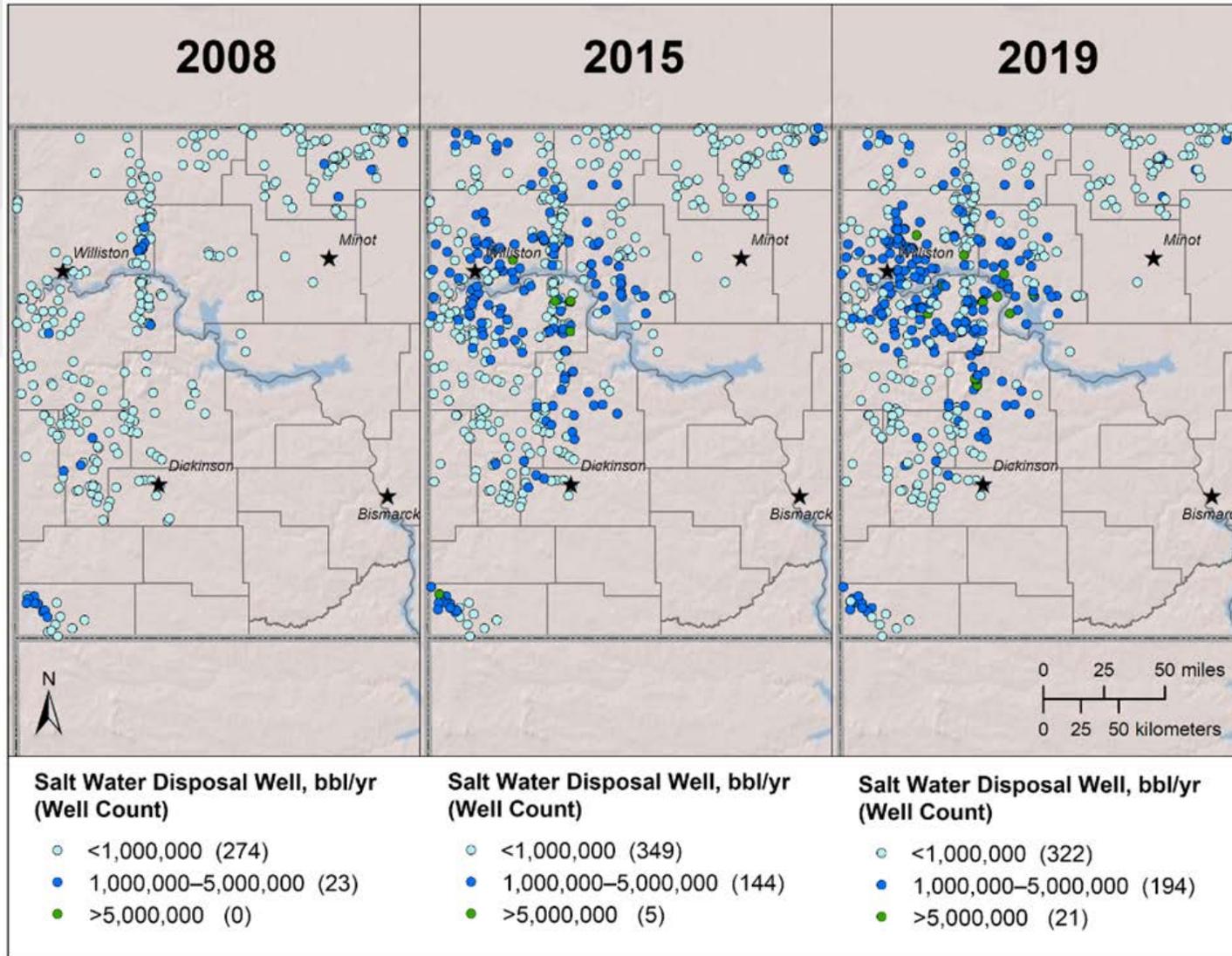
Actual (2008-2019) and projected (2020-2030) well counts under three different growth assumptions (top) and the associated monthly produced water volumes (bottom).

Produced Water Disposal

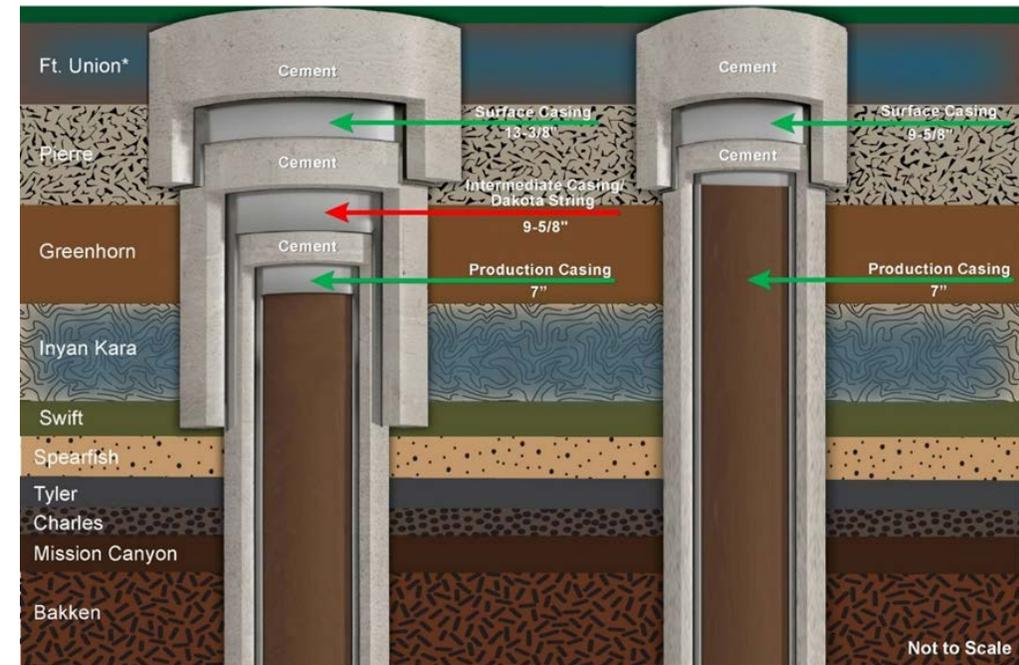
- Disposal volumes five-fold increase since 2008 to ~680 million bbl/yr.
- Over 95% of saltwater disposal (SWD) targets the Dakota Group.
- Primarily transported by pipeline.



Produced Water Disposal



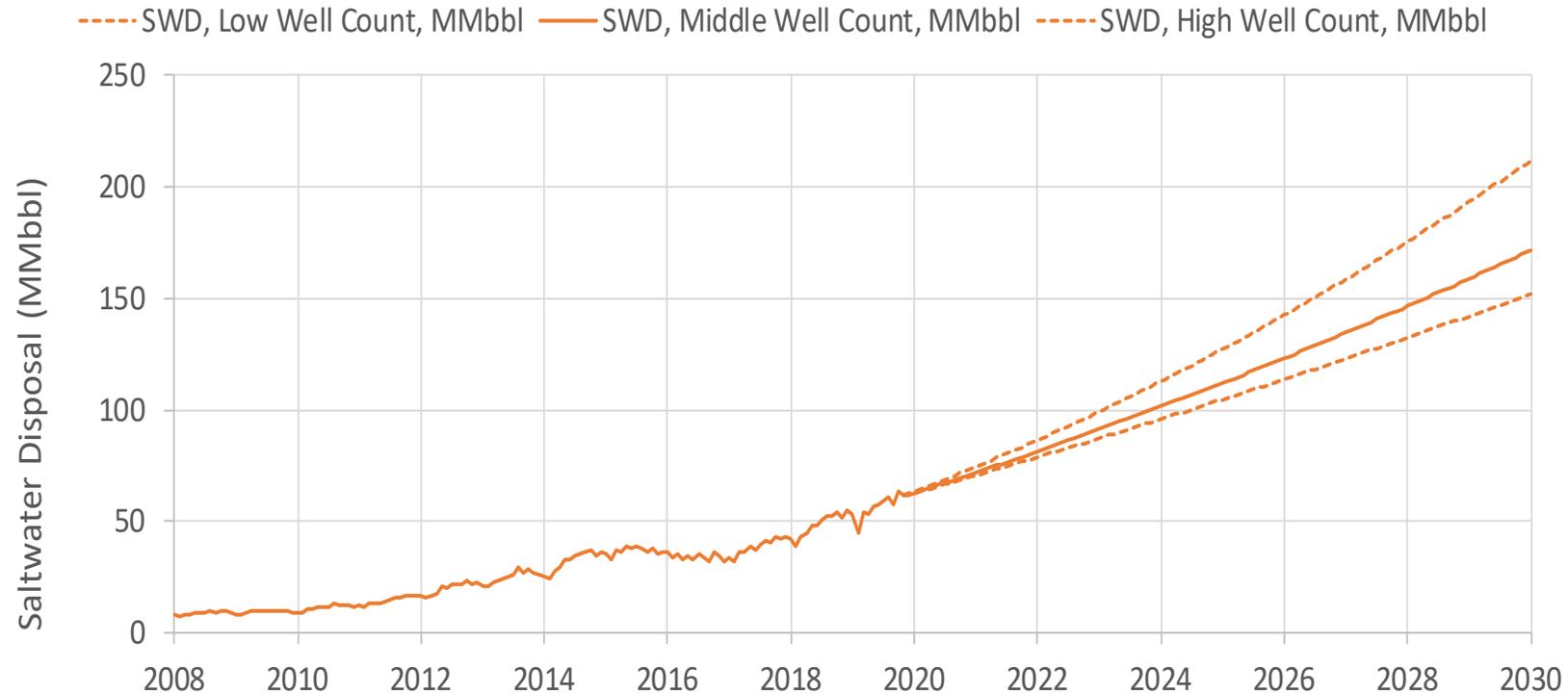
- Pressure increases in the Dakota causing changes to drilling operations, costing ~\$0.5 million/well.
 - Affects operator decisions.
 - Identified ~200 wells thus far with additional casing string.



Note: Horizontal/lateral section is not included in this illustration
 *Lowest Underground Source of Drinking Water (USDW)

Produced Water Disposal

- SWD volumes projected to more than double by 2030.
- Based on data trends from 2017-2019.



Actual (2008-2019) and projected (2020-2030) saltwater disposal under three different growth assumptions.

Produced Water Recycling Challenges and Opportunities

Challenges

- High TDS
- Economics need to work
- Prevention of spills
- Waste handling
- Centralized infrastructure
- Surface storage

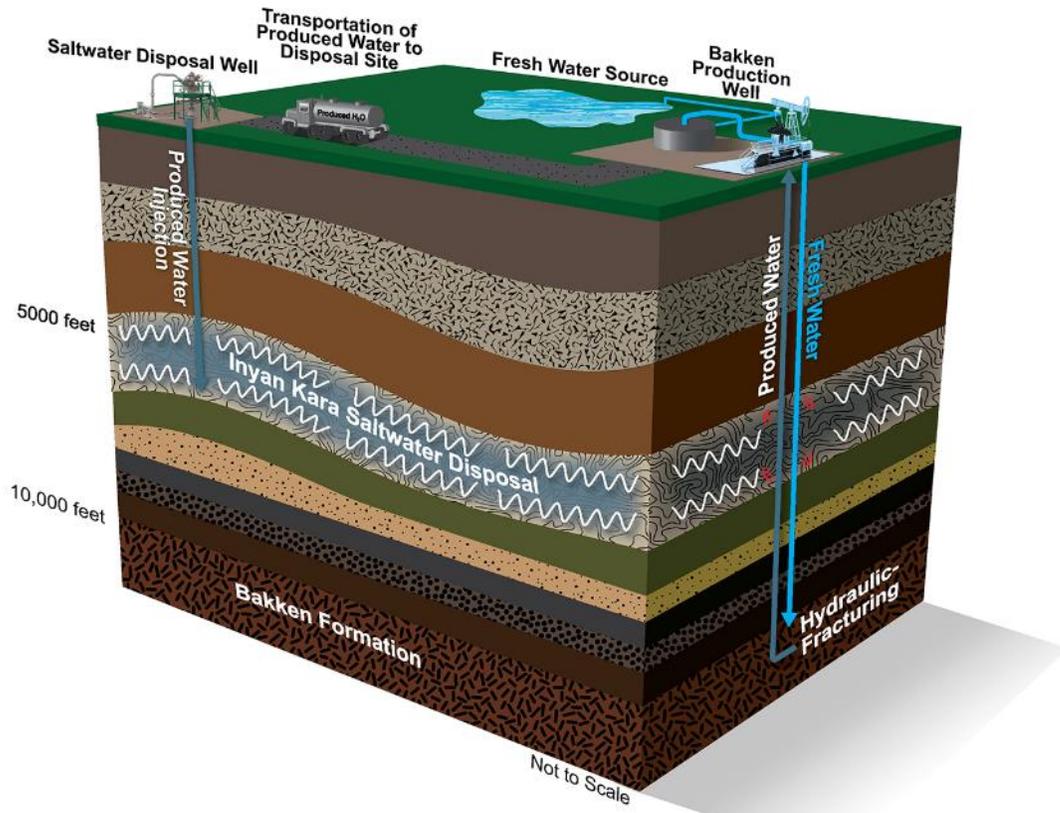
Opportunities

- Relieve capacity constraints in Dakota.
- Reduce localized pressure that has increased drilling costs.
- Reduce freshwater consumption.
- Value-add products: turning produced water from waste to a valued product.

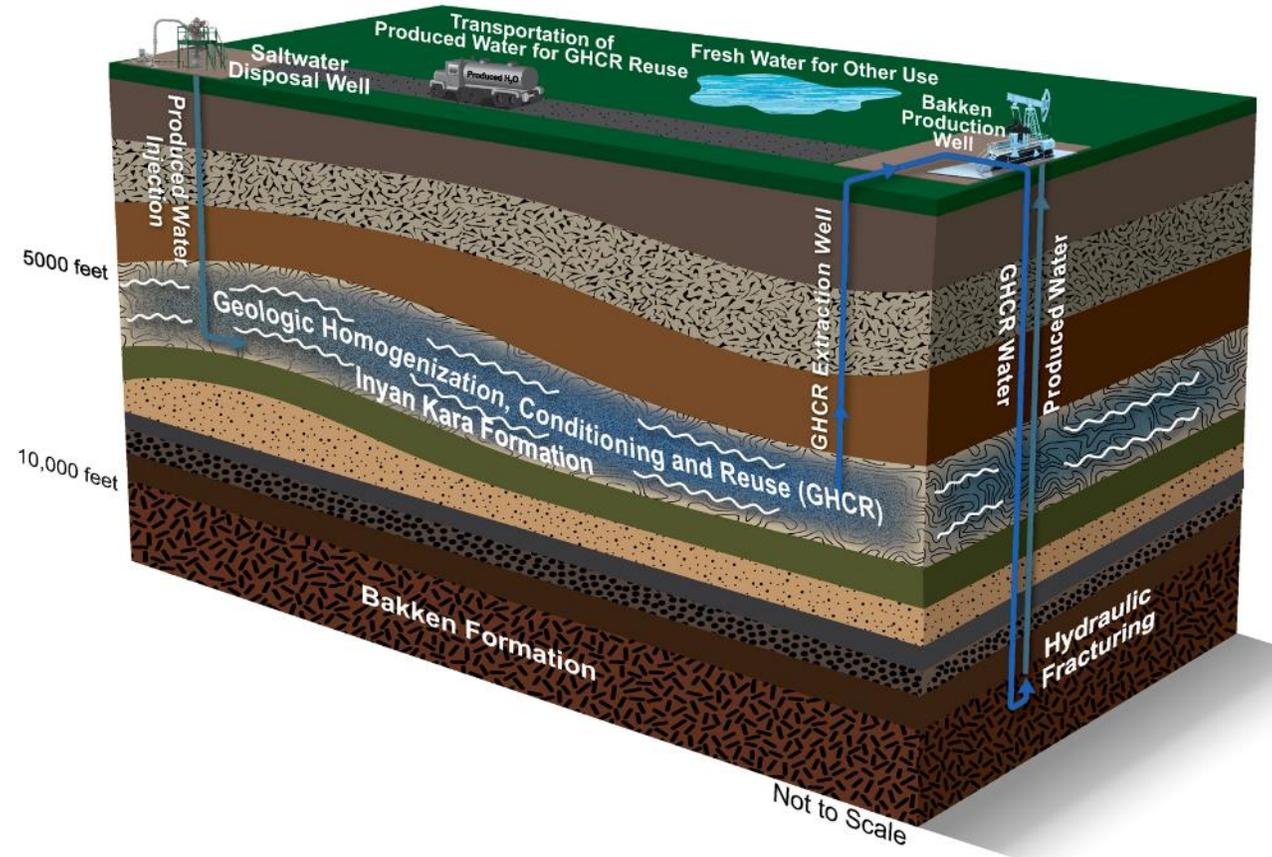


GHCR Approach

Traditional Approach



GHCR Approach

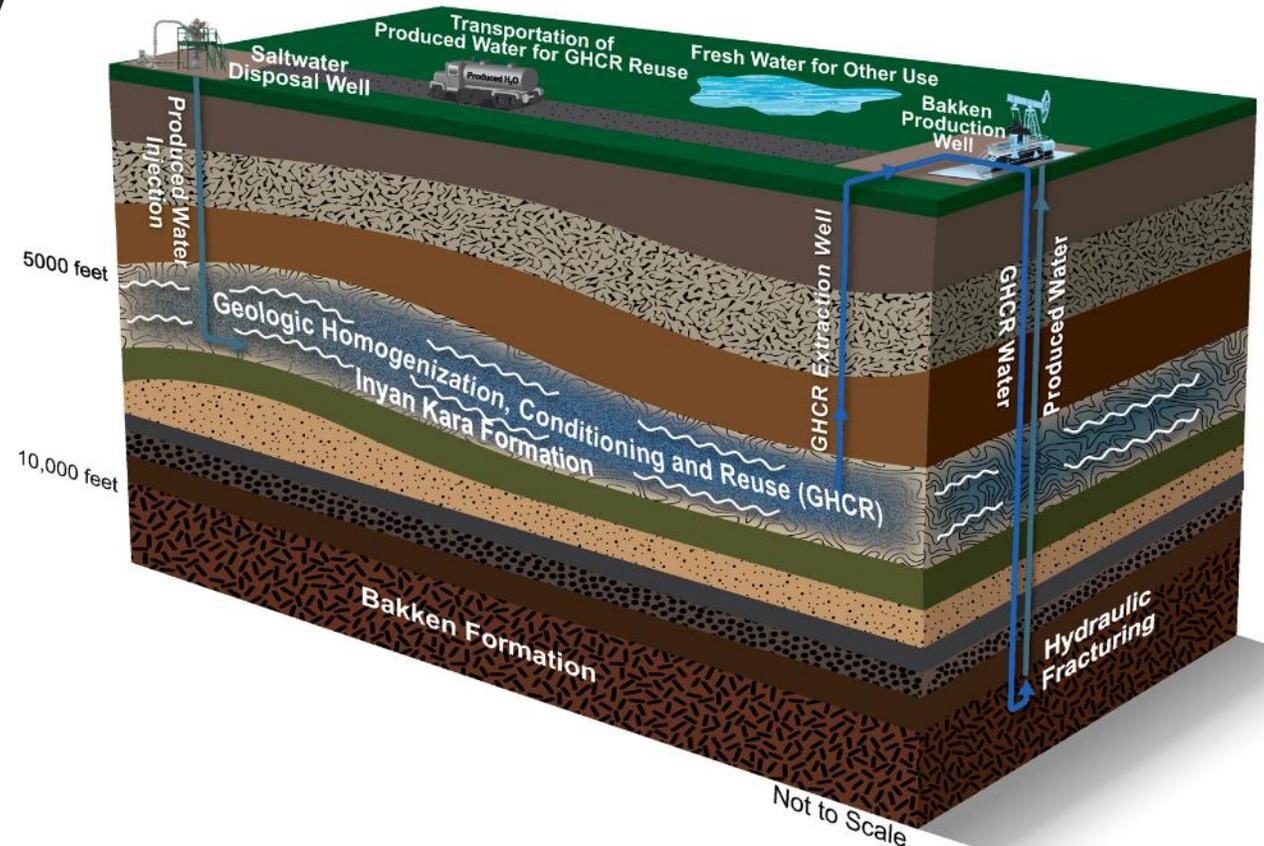


GHCR Approach

Potential Benefits

- Use of existing infrastructure and industry techniques.
- Formation as a storage container.
- Natural treatment reducing contaminants.
- Reduction in freshwater demand.

GHCR Approach



Key Takeaways

- Oil and gas industry continues to handle increasing volumes of water.
- Emerging need for alternative produced water handling options to supplement the Dakota.
- High TDS Bakken produced water is a primary challenge in treatment and reuse.
- New subsurface technique is being evaluated as an approach to recycling/reuse.

Next Steps

- Should we achieve proof of concept on the GHCR, we recommend proceeding to a field pilot to demonstrate the use of GHCR water for use in hydraulic fracturing.
- Opportunity to address produced water management challenges.
 - Further geologic characterization of alternative SWD targets such as the Minnelusa or Madison.
 - Integrated produced water pipeline systems to transport to more suitable SWD locations.
 - Surface storage alternatives to reduce cost and risk for recycling.



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A wide-angle photograph of a university campus at sunset. The sun is low on the horizon, casting a warm glow over the scene. In the foreground, there is a large green lawn. In the middle ground, a parking lot is filled with cars. In the background, several large, multi-story brick buildings are visible, along with some trees that have yellow autumn leaves. The sky is a mix of orange, yellow, and blue.

THANK YOU

Critical Challenges. Practical Solutions.