

Contract No. G-051-101
“Legislative Directed Study of Water Quality Assessment” &
“Produced Water Management Through Geologic Homogenization, Conditioning, and Reuse
(GHCR)”

Submitted by: Energy and Environmental Research Center
Principal Investigator: Kyle A. Glazewski

PARTICIPANTS

Sponsor	Cost Share
U. S. Department of Energy	\$ 999,993.00 (Cash)
North Dakota Industrial Commission/OGRC Funding	<u>\$ 300,000.00</u> (Cash)
Total Project Cost	\$1,299,993.00

Project Schedule – 24 months
Contract Date – January 27, 2020
Start Date – January 1, 2020

Project Deliverables:
Water Management Update (D1): March 1, 2020
Status Report: April 30, 2020
Status Report: July 30, 2020
Water Quality Assessment (D2) Final Report: Oct. 1, 2020
Status Report: October 30, 2020
Status Report: January 30, 2021
Status Report: April 30, 2021
Status Report: July 30, 2021
Status Report: October 30, 2021
Draft Final Report: November 30, 2021
Final Report: January 31, 2022

OBJECTIVE/STATEMENT OF WORK:

Excerpt from House Bill 1014: Section 19. *“...the industrial commission shall use \$300,000 or so much of the sum as may be necessary, from the oil and gas research fund to contract with the sponsor of the proposal selected for the studies. The industrial commission shall issue a request for proposals for a study regarding the recycling of water used in oil and gas operations, also known as produced water, from oil and gas-producing regions of North Dakota. The study must include the development or compilation of data regarding methods for the recycling of produced water specific to this state, and must examine the relevant objective economic, regulatory, scientific, technological, and feasibility considerations. The contractor shall provide reports on the status of the study at the request of the legislative management during the 2019-20 interim and shall provide a final report to the legislative management by October 1, 2020.”*

The objective of this project is to assess the techno-economic viability of using the Inyan Kara Formation as a geologic solution for produced water treatment and recycling, with the benefit of providing a potential solution to pressurization of the Inyan Kara due to saltwater disposal. The first phase of the project will be updating prior work done by the EERC and providing current information on the recycling of produced water. Building on this information the EERC will investigate the economic, regulatory, scientific, and technological considerations to assess the commercial viability of a concept referred to as geologic homogenization, conditioning and reuse (GHCR) for produced water management. It is anticipated that the field work will be done at the Johnsons Corner SWD site (Brine Extracted and Storage Test (BEST) site).

Deliverables will include:

- 1) a produced water assessment report to legislative management,

- 2) a report of findings from laboratory and field validation on the GHCR concept including GHCR modeling and simulation,
- 3) and a techno-economic assessment of the relevant economic, regulatory, financial, scientific, and technological considerations governing commercial viability of the GHCR concept.

Pending a favorable techno-economic disposition, this Stage 1 work will provide the requisite information and confidence for project partners to progress the GHCR concept to a Stage II pilot demonstration of beneficial end use of GHCR water.

STATUS

Contract has been executed.

March 1, 2020 Status Report has been received. The executive summary states:

This report provides a snapshot of water management practices and trends associated with oil production in the North Dakota portion of the Bakken Petroleum System (Bakken). The report provides an interim update to the Energy and Environmental Research Center's (EERC) Bakken Water Management Practices and Potential Outlook¹ by summarizing changes that have occurred across the Bakken region since ~2015. The EERC has been awarded funding through the North Dakota Industrial Commission Oil and Gas Research Program and the U.S. Department of Energy's National Energy Technology Laboratory to assess the techno-economic viability of using geologic homogenization, conditioning, and reuse (GHCR) as a means of addressing the challenges associated with produced water management in the Williston Basin. This report updates water management practices, identifies changes in water management trends since the prior report, and identifies information gaps as a starting point in evaluating the current oil and gas industry water management practices associated with Bakken oil production as part of the project's techno-economic assessment.

From 2008 to 2020, North Dakota oil production has risen from ~35,000 barrels (bbl)/day to over 1.5 million bbl/day,² and continues to rise. With that increased oil production, there has been a commensurate increase in freshwater demand, Bakken produced water generation, and subsequent disposal. This update presents data through 2018, the most recent year of record with a complete data set available. Freshwater demand for oil and gas activity has increased from approximately 13.5 million bbl/yr in 2008 to 314 million bbl/yr in 2018.³ Over the same time, in North Dakota produced water volumes from the Bakken have increased from 6.4 million bbl/yr to 485.6 million bbl/yr and saltwater disposal (SWD) related to conventional and unconventional oil and gas production has increased from 106.8 million bbl/yr to 601.9 million bbl/yr.² Despite increases, current state resources and infrastructure have adapted to manage the increased injection volumes. However, SWD injection has resulted in localized areas of high pressure in the Inyan Kara Formation, the primary geologic formation used for SWD,⁴ which increases the economics and risk associated with drilling new Bakken production wells. As a result, alternative methods for managing produced water could improve long-term techno-economic sustainability of oil and gas production in North Dakota.

If viable, using a geologic formation as a natural medium for managing produced water recycling and reuse would represent a significant breakthrough in produced water management. A comprehensive produced water assessment will build upon the information contained in this report to provide an understanding of water management challenges and opportunities facing the Bakken region in western North Dakota. The water assessment will delve deeper into produced water

chemistries, volumes, management practices, costs, and forecasts and will be reported in October 2020 via a produced water quality assessment report. This information will provide the metrics to evaluate the techno-economic viability of the GHCR concept, and inform key conditions that will limit or drive the commercial adoption of GHCR.

¹Kurz, B.A., Stepan, D.J., Glazewski, K.A., Stevens, B.G., Doll, T.E., Kovacevich, J.T., and Wocken, C.A., 2016, A review of Bakken water management practices and potential outlook: Final report prepared for members of the Bakken Production Optimization Program, EERC Publication 2016-EERC-03-11, Grand Forks, North Dakota, Energy & Environmental Research Center, March.

²North Dakota Mineral Resources, 2020, Director's cut, December 2019 production, [www.dmr.nd.gov/oilgas/directorscut/ directorscut-2020-02-14.pdf](http://www.dmr.nd.gov/oilgas/directorscut/directorscut-2020-02-14.pdf) (accessed February 2020).

³North Dakota State Water Commission, 2019, www.swc.nd.gov/info_edu/state_water_plan/archives/pdfs/2019_Water_Development_Plan.pdf (accessed February 2020).

⁴Schmidt, D.D., Mackay, B.A., Williams, B.L., Beck, F.E., Bell, A.B., McMahon, B.W., Bradley, H., Lian, E.G.W., 2015, Overcoming obstacles for produced water in Bakken well stimulations: Society of Petroleum Engineers, Presented at the SPE Hydraulic Fracturing Technology Conference, The Woodlands, Texas, February 3–5, 2015, SPE Paper: 173372-MS.

Updated 4/9/2020