

Contract No. G-018-036
“Bakken Water Opportunities Assessment”
 Submitted by **Energy & Environmental Research Center**
 Principal Investigator: Daniel J. Stepan

PARTICIPANTS

Sponsor	Cost Share
<u>Phase I</u>	
North Dakota Petroleum Council	\$10,000
EERC/DOE Funds	\$25,000
North Dakota Industrial Commission	<u>\$25,000</u>
	\$60,000
<u>Phase II*</u>	
Industry Match	\$ 85,000
North Dakota Industrial Commission	<u>\$ 85,000</u>
	\$170,000
 Total Project Cost	 <u>\$230,000</u>

Project Schedule – 12 months*	Project Deliverables:
Revised to 22 months**	
Contract Date – June 19, 2009	Final Report Phase I: March 15, 2010**
Start Date – April 1, 2009	Phase II Work Plan Submitted: March 31, 2010**
Completion Date Phase I – March 15, 2010**	Status Report: July 31, 2010**
Phase II Work Plan Submitted – 3-31-2010**	Final Report: January 31, 2011**
Completion Date Total Project – January 31, 2011**	

OBJECTIVE/STATEMENT OF WORK:

To investigate the recycling of water flowed-back after Bakken fracture stimulation. The project has the following two phases under the Northern Great Plains Water Consortium program:

- Phase 1: Assess the technical and economic potential of recycling frac flowback water.
- Phase 2: Field demonstration of a mobile frac flowback water recycling technology.

*The Council recommended and the Commission approved the funding of Phase I and stated that the applicant did not need to resubmit an application for the funding of Phase II. However, the applicant must show that Phase I has been successful and has obtained industry match funding for Phase II prior to the Council considering, at a future meeting, the funding for Phase II.

** The Council recommended at their January meeting and the Industrial Commission subsequently approved the funding for Phase II noting that the scope of work has been revised from what had originally been proposed. Rather than recycling frac flowback water the focus will be on treatment of nonpotable groundwater. A Phase II Work Plan is to be submitted in March along with confirmation of match funding. A no-cost extension has also been requested and the final completion date has been extended to January 31, 2011. The reporting schedule has been revised to reflect the new project completion date.

STATUS

The contract has been executed. EERC provided a report at the North Dakota Petroleum Council's meeting in September, 2009 regarding the status of the project. Seven tasks were outlined under this project:

- Task 1 – Inventory Industry Freshwater Use
- Task 2 – Assess Flowback Quality with Time and Location
- Task 3 – Evaluate Current Water Handling Costs
- Task 4 – Evaluate Feasibility of Recycle/Reuse Technologies
- Task 5 – Assess Current State of Existing Recycling Technologies
- Task 6 – Develop Detailed Plans for Phase II
- Task 7 – Project coordination, outreach and reporting

As of the September 2009 Petroleum Council meeting the project status was:

- Samples have been analyzed and/or data has been collected from four of five producers participating in the assessment.
- Extensive, but not comprehensive, frac flowback water chemistry data has been analyzed.
- Technology review and capabilities assessment underway.
- Preliminary economic assessment underway.

A presentation was given at the January 20, 2010 Oil and Gas Research Council meeting. The Principal Investigator Daniel Stepan stated:

- Under Phase I samples have been analyzed and/or data have been collected from five producers participating in the assessment.
- Extensive, but not comprehensive, frac flowback volumes and water chemistry data compiled and evaluated.
- Technology review and capabilities assessment complete.
- Preliminary economic assessment ongoing.
- Phase 1 final report in preparation.

He stated that they are ready to proceed to Phase II. A Frac Flowback Water Treatment system has been identified – Mechanical Vapor Recompression (MVR). It is oil field-compatible, robust, mobile, uses existing technology and shows high treated water recovery.

He noted that Bakken Flowback Water-Recycling has significant challenges:

- Slow recovery of flowback water.
- Relatively low-volume initial recovery.
- Extremely high dissolved salts early in the flowback.
- Treatment very challenging, even with the most robust technologies.
- Treatment very likely not cost-effective in most cases.

He noted that for Phase 2 the following is underway:

- EERC has identified an oil industry partner for a pilot-scale demonstration of marginal-quality water treatment by reverse osmosis.
- Groundwater samples from a brackish aquifer have been collected, analyzed and shared with several technology vendors.
- EERC is currently awaiting bids from the vendors to supply the pilot equipment.
- Pilot test is tentatively scheduled to begin in March or April.
- Duration: 6 weeks minimum

- After 6 weeks of operation, the EERC will work with the technology vendor to determine projected treatment costs for a large-scale reverse osmosis plant
- EERC will also evaluate this approach as a water supply option for other industrial and/or municipal uses.

The Phase I Final Report was received in April, 2010. A link to the Phase I Final Report is available on this website.

Under Phase I treatment and recycling of frac flowback water was investigated as a means to reduce the demand for freshwater and provide a supplemental supply near drilling and fracturing activities. The character of the frac flowback water with respect to both quantity and quality presented significant challenges for widespread water-recycling opportunities. A relatively small percentage (17% to 47%) of the water used in hydraulic fracturing in the Bakken is typically recoverable in a reasonable time (2 to 10 days). Further, the dissolved solids levels in the frac flowback water increase rapidly and to levels as high as 220,000 mg/L. These factors provide significant challenges for developing cost-effective treatment strategies, even with the most robust technologies. While there will certainly be niche opportunities using certain technologies to recycle frac flowback water, widespread recycling will not likely be economically viable.

The regional and national importance of providing sufficient volumes of water for such an extremely high-value use cannot be overstated. These water supplies will need to come from a variety of resources. One opportunity is to upgrade marginal-quality groundwater resources to satisfy a portion of the demand. An evaluation of a membrane technology for the treatment of nonpotable groundwater to supply water for hydraulic fracturing in the same geographic area is being conducted as a Phase 2 Bakken Water Opportunities Assessment project.

The Commission is currently waiting to receive the Phase II Work Plan.