House Energy and Natural Resources Committee

January 10, 2019

Lynn D. Helms, Director
Department of Mineral Resources
North Dakota Industrial Commission
AGENCY OVERVIEW
2017 LEGISLATION REVIEW
ACTIVITY & 2019 SESSION ISSUES
OIL & GAS DIVISION
GEOLOGICAL SURVEY DIVISION
The Industrial Commission has jurisdiction over the investigation and publication of geological information and the regulation of coal exploration, geophysical exploration, geothermal energy, paleontology resources, subsurface minerals, and the production of oil and gas in North Dakota through the Department of Mineral Resources Geological Survey and Oil and Gas Division.

The Industrial Commission appoints the Director of the Department of Mineral Resources, who serves as Director of the Oil and Gas Division and appoints the State Geologist and Assistant Director of the Oil and Gas Division.
NORTH DAKOTA OIL AND GAS DIVISION

The Oil and Gas Division, headed by the Director, was formed in 1981 to provide the technical expertise needed for enforcement of Industrial Commission jurisdiction over statutes, rules, regulations, and orders pertaining to geophysical exploration, drilling, production of oil and gas, restoration of drilling and production sites, and proper disposal of oil field brine and other oil field wastes in North Dakota.

The Division facilitates the electronic storage of and provides access to oil and gas production, reservoir, well, and geophysical exploration data for use by industry, royalty owners, and other governmental agencies and citizens.

In 2009, regulation of carbon dioxide storage was added to the Oil and Gas Division responsibilities. In 2013, regulation of underground gathering pipeline infrastructure was added to the Oil and Gas Division’s responsibilities. In 2015, this authority was broadened to include bonding requirements on underground gathering pipelines.
The North Dakota Geological Survey was created by an act of the North Dakota Legislature in 1895. After more than 120 years, the Survey still serves as the primary source of geological information in the state. Its mission over the years has grown and is now three-fold: to investigate the geology of North Dakota; to administer regulatory programs and act in an advisory capacity to other state agencies; and to provide public service to the people of North Dakota.

The Geological Survey publishes maps and reports on the mineralogical, paleontological, and geochemical resources of North Dakota, including oil and gas, coal, uranium, rare earth elements, clay, sand and gravel, volcanic ash, potash and other salts, etc. In addition to the mapping of subsurface resources such as the Inyan Kara Formation for produced water disposal, the Survey is actively mapping landslides throughout the state. Survey publications support the regulatory programs of the Industrial Commission, as well as other state and federal agencies, and assist mineral companies, geotechnical consulting firms, city and county governments, landowners, and citizens of the state.
DEPARTMENT OF MINERAL RESOURCES STAFFING

<table>
<thead>
<tr>
<th>Years of Service</th>
<th>0-3</th>
<th>4-6</th>
<th>7-10</th>
<th>11-15</th>
<th>16-20</th>
<th>21-25</th>
<th>26-30</th>
<th>30+</th>
</tr>
</thead>
<tbody>
<tr>
<td>FTE</td>
<td>22</td>
<td>23</td>
<td>19</td>
<td>8</td>
<td>7</td>
<td>3</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>%</td>
<td>23%</td>
<td>25%</td>
<td>20%</td>
<td>9%</td>
<td>7%</td>
<td>3%</td>
<td>2%</td>
<td>11%</td>
</tr>
</tbody>
</table>
2017 Legislation

• HB 1151
  – Not required to report contained spills <10 barrels
  – Too soon to evaluate trend
  – 2018 versus 2017
    • Reported spills down 25%
    • Reported released volume down 20%
    • Percent of wells with a spill down 19%
    • Percent of spills contained down 7%

• HB 1257
  – Reduced unitization requirement from 60% to 55%
  – 2 new units and 1 unit expansion biennium to date
  – 1 unit approved and currently seeking ratification
  – 1 unit hearing pending
2017 Legislation

- HB 1336
  - Environmental Health and Safety Self Audits
  - 2 audits involving NDIC regulations biennium to date
    - One is complete for NDIC regulations but extension requested for DEQ regulations
    - One audit in progress

- SB 2134
  - Determine Ordinary High Water Mark of Missouri River from northern boundary of Fort Berthold Indian Reservation to Trenton
  - Study was completed and OHWM order approved 9/27/18
  - Oral arguments 1/4/19 Sorum etal vs North Dakota etal
    - Expect appeal to Supreme Court in 2019 with a decision in 2020
  - Spent less than ½ of appropriation ($387,450)
    - Trust Lands is requesting funding to provide accurate acreage allocations for property transfer
2017 Legislation

- **SB 2156**
  - High Level Radioactive Waste Storage or Disposal
  - Interim study completed
  - SB 2037 heard 1/4/19

- **SB 2333**
  - Reclamation requirements for land disturbed by oil and gas activity
  - No identifiable impact
  - Bill codified existing administrative rule into statute
AGENCY OVERVIEW
2017 LEGISLATION REVIEW
ACTIVITY & 2019 SESSION ISSUES
OIL & GAS DIVISION
GEOLOGICAL SURVEY DIVISION
<table>
<thead>
<tr>
<th>Wells</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Active</strong></td>
</tr>
<tr>
<td>Conventional</td>
</tr>
<tr>
<td>Bakken/Three Forks</td>
</tr>
<tr>
<td><strong>Inactive</strong></td>
</tr>
<tr>
<td>&gt;$50 for 90 days Jan 2018</td>
</tr>
<tr>
<td><strong>Waiting on Completion</strong></td>
</tr>
<tr>
<td>+$55 for 90 days Feb 2018</td>
</tr>
<tr>
<td><strong>Permitted</strong></td>
</tr>
<tr>
<td>+$60 for 90 days April 2018</td>
</tr>
<tr>
<td><strong>Increase Density</strong></td>
</tr>
<tr>
<td>Approved as of 12/21/18</td>
</tr>
<tr>
<td><strong>Total</strong></td>
</tr>
<tr>
<td><strong>Estimated Final</strong></td>
</tr>
<tr>
<td>$60-80/BO &amp; 60-70 rigs</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
Orders Signed--Cases Heard
The Oil and Gas Division continues to work on issuing the backlog of pending applications and is now seeing signs of increasing hearing activity.

Well Construction
The Oil and Gas Division has well construction rules to protect underground drinking water. Without this program 5-10% of new North Dakota wells could be leaking.
Mechanical Integrity Tests

The Oil and Gas Division witnesses nearly all mechanical integrity tests. Without this program 6-11% of North Dakota injection and temporary abandoned wells could be leaking.

Sales Meter Tests

The Oil and Gas Division regulates oil and gas meter accuracy and royalty owner information. Recent decline in meter witness percentage reflects 2016 staff reduction due to mandatory budget allotments.
Solving the Flaring Challenge
Assumes Current Technology – Enhanced Oil Recovery Not Included

Graph showing the planned and actual plant capacities, as well as forecasted data for NDPA Case 1 and 2. The graph also includes historical sold and flared data, with specific targets for Case 1 indicated.

Jan-05 to Nov-45 timeline with data points for each month.
Gas Processing Plants

2.14 BCFD in 2017 > 3.36 BCFD in 2020
One of the biggest unknowns associated with produced gas injection into saline aquifers, such as Broom Creek, is the regulatory framework for gas injection into non-hydrocarbon-bearing formations. Additional regulatory clarity regarding pore space ownership and potential landowner reimbursements for pore space use is needed, as this could impact the economics of the operation as well as the permitting process.

The regulatory framework regarding produced gas injection into oil-bearing formations is better defined, and it circumvents the need for regulatory clarity with respect to pore space ownership. The economics may also be even more favorable with this approach as a result of the additional revenue derived from any incremental oil recovery on-site. If the Bakken or Three Forks Formation was the target, the injection of produced gas back into the producing horizon would eliminate the need for royalty payments to the mineral owner and payment of extraction taxes to the state. The key challenge with gas injection into a fractured, unconventional oil target is conformance or controlling the movement of gas within the productive zone.

Gas injection into conventional oil fields for EOR is advantageous in that many of the fields have already undergone secondary recovery and, thus, are unitized. Also, many fields in the state (unitized or not) may benefit from tertiary oil recovery which has likely been constrained by a shortage of gas for use in EOR operations. Preadecence for the concept of hydrocarbon gas injection into conventional fields has already been established through projects located in the Red Wing Creek, Dolphin, and Stonewall oil fields. A basic economic benefit summary of the EOR operation in the Red Wing Creek oil field suggested that even at a much smaller scale of gas injection, an additional $29.5 million worth of incremental oil was recovered from the field.

Ultimately, the various options for produced gas capture will need to be evaluated on a case-by-case basis to determine which scenarios are the most cost-effective and least complicated from a technical, regulatory, and legal standpoint. There are many factors that impact the viability of any alternative gas use option, and site-specific conditions vary widely across the Bakken. Potential options for future work to better define the various scenarios to achieve the desired gas capture requirements are discussed as follows.
Figure 8: Map view of the simulation model showing the injection well locations and depth of the Broom Creek Formation top. North is toward the top of the image.

Figure 12: Gas and water production rates following 3 years of gas injection (a) and gas recovery factors (b) for a cyclic gas injection and recovery scenario.

<table>
<thead>
<tr>
<th>Cycle</th>
<th>MCFD Inj (MMscf/d)</th>
<th>Days/Yr</th>
<th>Years</th>
<th>MCF Inj (MMscf)</th>
<th>RF</th>
<th>MCF Prod (MMscf)</th>
<th>Investment ($M)</th>
<th>$/MCF</th>
<th>Oper Cost ($M)</th>
<th>Total Cost ($M)</th>
<th>$/MCF</th>
</tr>
</thead>
<tbody>
<tr>
<td>cycle 1</td>
<td>10,000</td>
<td>365</td>
<td>4</td>
<td>7,300,000</td>
<td>50%</td>
<td>3,650,000</td>
<td>15,700,000</td>
<td>$2.15</td>
<td>7,000,000</td>
<td>22,700,000</td>
<td>$6.22</td>
</tr>
<tr>
<td>cycle 2</td>
<td>10,000</td>
<td>365</td>
<td>4</td>
<td>7,300,000</td>
<td>57%</td>
<td>4,161,000</td>
<td>15,700,000</td>
<td>$2.15</td>
<td>7,000,000</td>
<td>22,700,000</td>
<td>$1.68</td>
</tr>
<tr>
<td>cycle 3</td>
<td>10,000</td>
<td>365</td>
<td>4</td>
<td>7,300,000</td>
<td>63%</td>
<td>4,599,000</td>
<td>15,700,000</td>
<td>$2.15</td>
<td>7,000,000</td>
<td>22,700,000</td>
<td>$1.52</td>
</tr>
</tbody>
</table>

Investment: $15,700,000
$/MCF: $2.15
Oper Cost: $7,000,000
$/MCF: $6.22
Total Cost: $22,700,000
$/MCF: $2.96
Project Tundra questions

- Economics for carbon capture at each plant
- Economics for pipelines and oil fields
- Specific technology evaluations for each plant, pipeline, and oil field
Abandoned Well Plugging and Site Restoration

• Current fund balance $21 million
  – Legacy sites
    • $3.331 million reclamation 2017-2019 biennium
    • $100,000 anticipated 2019-2021 biennium
Abandoned Well Plugging and Site Restoration

• Current fund balance $21 million

  – Brine Ponds
    • $980,000 research 2017-2019 biennium
    • $200,000 pilot project 2019-2021 biennium
Abandoned Well Plugging and Site Restoration

• Current fund balance $21 million

  – Compaction
    • $368,000 research 2017-2019 biennium
    • $100,000 2019-2021 biennium
Abandoned Well Plugging and Site Restoration

- Current fund balance $21 million
  - Plugging and Reclamation
    - 438 Total North Dakota wells plugged and reclaimed 2017-2019 biennium $32.3 million
    - 5 wells plugged and reclaimed by AWPSRF fund $369,000
    - Anticipate the same for 2019-2021 biennium

- 2018 bankruptcy case
  - $2 million in bonds
  - 590 wells
    - 384 active, 116 abandoned, 51 inactive, 25 temp abandoned, 14 undrilled locations
    - $23 million liabilities
    - $39 million assets
G1 to G3 Re-Frac
G1-G2-G3 to G4 Re-Frac
RBDMS UPGRADE “NORTHSTAR” PROJECT
(2018-2021)

**Current RBDMS System**
System uses Access 2003 which MS support ended in 2013 as well as Access 2010 which MS support will end in 2020.

North Dakota Implementation of RBDMS
RBDMS UPGRADE “NORTHSTAR” PROJECT
(2018-2021)

Future RBDMS System – “NorthSTAR”

North Dakota’s Statewide Tracking and Reporting System “NorthSTAR” will capitalize on work completed by the State of California and the Groundwater Protection Council, who are the original developers of the program. Upgraded system will allow for cloud based data storage, interactive electronic regulatory filing options, and will integrate with a user friendly public interface (“WellFinder” app) in the future. A portion of costs are being shared by North Dakota Department of Mineral Resources and Groundwater Protection Council. Work is currently in the 1st of four phases to build out the program.
AGENCY OVERVIEW
2017 LEGISLATION REVIEW
ACTIVITY & 2019 SESSION ISSUES
OIL & GAS DIVISION
GEOLOGICAL SURVEY DIVISION
Upper Left: Expansion of the Wilson M. Laird Core and Sample Library was completed in 2015. Right: Slightly more than 50,000 cuttings boxes are stored in the south aisle of the core library. Lower left: A total of 12,750 feet of core has been cut that has not yet been submitted to the core library, 6,000 feet of that should come into the core library before the end of this biennium.
PUBLIC FOSSIL DIG PROGRAM

Public Fossil Dig Slots
Geological Survey

Left: Some of the participants at the 2018 Medora dig. Right: A 60 million year old crocodile scute uncovered at the 2018 Medora dig.
Left: A landslide and broken oil pipeline coincide in Billings County. Right: A landslide to the south of ND Highway 200A west of Washburn. The slope has since been cut back to stabilize it. Whenever possible, the Survey maps areas ahead of development so that infrastructure can be diverted around areas of unstable slopes.
LANDSLIDE MAPPING PROJECT
2017 - 2019 Biennium Geological Survey

319 Publications
104 Presentations
ENGINEERING & ENVIRONMENTAL REVIEW PROGRAM

Left: Bridge replacement over the Heart River west of Dickinson in 2013 (Vern Whitten Photography). Right: The Tatanka Wind Farm in Dickey County.
RARE EARTH SAMPLING PROJECT
(2015-2021)

In 2015, we received $100,000 in one-time funding to initiate a study of rare earth element concentrations in ND lignites and collected and had analyzed 342 samples. Since that time, we have collected an additional 855 samples and submitted 413 more for analysis. Twelve of our North Dakota lignite samples, coming from four different localities in western North Dakota, exceed 653 ppm, the highest concentration previously reported from a coal in North America. Our highest coal sample contains 1,026 ppm of rare earth elements, almost four times the threshold for coal set by the U.S. Department of Energy.

Our studies have garnered national attention, but we have yet to find consistently high rare earth concentrations over a large area. We would like to collect an additional 400 samples from specific areas in western North Dakota with the intent of generating an exploration model.

Sample collection (travel) = $20,000
350 samples @ $400/sample = $140,000
Total project cost = $160,000

The rare earth element concentrations of 106 of the 755 Geological Survey samples exceed the U.S. Department of Energy threshold of 300 parts per million.
Left: One of the Geological Survey study sites along the Little Missouri River in Slope County. Upper right: The locations of the Geological Survey rare earth sample sites. Lower right: Prior to the Geological Survey study, the highest rare earth concentration reported from a North Dakota lignite was 165 parts per million.
During the 2009-2011 biennium, we received $30,000 in one-time funding to investigate the potential for sand resources in North Dakota to be used as proppant for oil and gas wells. We collected 125 samples and submitted the top ten samples to an independent testing lab. Those ND sand samples were of lesser quality than the silica sands that the industry was using from the upper-Midwest.

However, in 2018 the U.S. oil and gas industry began utilizing local sand resources with lower, but acceptable, quality standards. In response to those changes, we collected an additional 90 samples from bedrock sandstones in the west and wind-blown surficial sand deposits in the east and central portions of the state. We wish to collect an additional 100 samples and have the top 40 samples laboratory tested to determine if the best samples meet the new industry standards for proppant.

Sample collection (travel) = $ 10,000
40 samples @ $2,500 = $100,000
Total project cost = $110,000
PROPPANT SAND PROJECT
(2018-2021)

Left: A sandstone sample being collected from a study site in McKenzie County. Upper right: Sand and sandstone samples have been collected for this project from across North Dakota. Center: A few examples of the 215 photographs of North Dakota sand under a microscope that we have taken. Sample (a) is a windblown deposit from Burleigh County, (b) is an Ottawa white proppant sand from Illinois and (c) is a bedrock sandstone from Slope County.