North Dakota Law Review
Energy Law Symposium

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April 11, 2019
Williston Basin Deposition

- Fort Union Group
- Fox Hills Fm.
- Cretaceous Shales
- Inyan Kara Fm.
- Jurassic
- Spearfish Fm.
- Portland
- Tyler Fm.
- BAKKEN & THREE FORKS FMS.
- RED RIVER Fm.
- Devonian undifferentiated
- Interlakes Fm.
- MADISON & BIG SNOWY GROUPS
- Glacial deposits

[Diagram showing geological layers and deposition patterns]
North Dakota Stratigraphic Column

Bakken Formation
~360 Million Years Old
Paleozoic Era
Mississippian/Devonian Period
~110' thick

Three Forks/Sanish
~370 Million Years Old
Paleozoic Era
Devonian Period
~240' thick
North Dakota Drilling Activity – 63 Rigs (April 9, 2019)
North Dakota Drilling Activity

Drilling Rigs & Spuds

Spuds Per Rig Per Month

Spuds - Drilling Rigs - Spuds per Rig per Month

Sep-11 Jan-12 May-12 Sep-12 Jan-13 May-13 Sep-13 Jan-14 May-14 Sep-14 Jan-15 May-15 Sep-15 Jan-16 May-16 Sep-16 Jan-17 May-17 Sep-17 Jan-18 May-18 Sep-18 Jan-19

0 50 100 150 200 250 300
0.2 0.7 1.2 1.7 2.2

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Bakken Breakeven Price Range (20% IRR)

Bakken Breakeven Prices
$6 - $8 Million
Completed Wells Cost

- $58-$73
- $49-$61
- $43-$52
- $39-$48
- $36-$43
- $34-$40
- $32-$38
- $28-$33
- $26-$30

Background Map: Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

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Bakken-Three Forks Drilling Inventory Study

www.northdakotapipelines.com
Cumulative Remaining Wells – Peak Month Minimum BOPD

Production Zone

<table>
<thead>
<tr>
<th>30-Day Initial Production (BOPD)</th>
<th>Remaining Wells Low Case Cumulative</th>
<th>Remaining Wells High Case Cumulative</th>
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<tbody>
<tr>
<td>100+</td>
<td>37,077</td>
<td>106,455</td>
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<tr>
<td>200+</td>
<td>34,440</td>
<td>98,266</td>
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<td>300+</td>
<td>29,822</td>
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<td>1250+</td>
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<tr>
<td>1500+</td>
<td>2,292</td>
<td>7,178</td>
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</table>
Years Remaining* / Minimum Wellhead Oil Price

*Assumes 1,200 Completions Per Year and $7MM Well Costs (20% After Tax IRR)
Estimated Williston Basin Oil Transportation
Estimated ND Rail Export Volumes
Crude Oil Prices – April 2, 2019

Pricing Data: Bloomberg & CME (LLS-Argus)
Statewide Oil Performance

~12% Improvement Over 2017

Cumulative Oil Production, BBL

Production Month

IP Year
- 2018
- 2017
- 2016
- 2015
- 2014
- 2013
- 2012
- 2011
- 2010
- 2009
Statewide Initial Oil Production Rates – 24hr

Avg. 24Hr Initial Production (IP), Oil - BOPD

Statewide Initial Production Rate: 24hr
4,000+ BOPD 24hr Initial Production Rates
4,000+ BOPD 24hr Initial Production Rates
North Dakota Oil Production Forecast

Assumes Current Technology – Enhanced Oil Recovery Not Included
North Dakota Oil Production Forecast

Assumes Current Technology – Enhanced Oil Recovery Not Included

[Graph showing oil production forecast with key data points and trends]
Williston Basin Oil Production & Export Capacity, BOPD
Assumes Current Technology – Enhanced Oil Recovery Not Included

Production forecast is for visual demonstration purposes only and should not be considered accurate for any near or long term planning.
Natural Gas Update

- Production
  - Technology
  - Markets

- Gathering
  - Capacity
  - Connections

- Processing
  - Capacity
  - Location

- Transmission
  - Dry Gas
  - Natural Gas Liquids
Natural Gas Update

Production
- Technology
- Markets

Gathering
- Capacity
- Connections

Processing
- Capacity
- Location

Transmission
- Dry Gas
- Natural Gas Liquids
NDPA North Dakota Gas Production Forecast

 Assumes Current Technology – Enhanced Oil Recovery Not Included

- ND Gas Case 1 - MMCFD
- ND Gas Case 2 - MMCFD
Natural Gas Update

Production
- Technology
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Solving the Flaring Challenge

**Simple Terms**

- **Blue** – Lack of pipelines
- **Orange** – Challenges on existing infrastructure

**GREEN** – % of gas captured and sold
- Blue – % flared from zero sales wells
- Orange – % flared from wells with at least one mcf sold.

Statewide

- **81%**
- **5%**
- **14%**

Dec. 2018 Data – Non-Confidential Wells
Statewide Gas Performance

~12% Improvement Over 2017
Statewide Initial Gas Production Rate: 24hr

Avg. 24Hr Initial Production (IP) Gas - MCFD

- 2014
- 2015
- 2016
- 2017
- 2018
- 2019

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Bakken and Three Forks Gas Performance

Graph showing the average MCFD (Million Cubic Feet Per Day) for different years (2013-2018) in production months for Dunn, McKenzie, Mountrail, and Williams counties.
Natural Gas Update

Production
- Technology
- Markets

Gathering
- Capacity
- Connections

Processing
- Capacity
- Location

Transmission
- Dry Gas
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Solving the Flaring Challenge

 Assumes Current Technology – Enhanced Oil Recovery Not Included
Solving the Flaring Challenge
Assumes Current Technology – Enhanced Oil Recovery Not Included

- Planned Plant Capacity
- Existing Plant Capacity
- NDPA Case 1 Forecast
- NDPA Case 2 Forecast
- Historical Sold, MMCFD
- Historical Flared, MMCFD
- Targets Case 1 (Sold)
- Targets Case 1 (Flared)
Natural Gas Update

Production
- Technology
- Markets

Gathering
- Capacity
- Connections

Processing
- Capacity
- Location

Transmission
- Dry Gas
- Natural Gas Liquids
Major Gas Pipeline and Processing Infrastructure

Upcoming or Recent Plant Expansion

No

Yes
Northern Border Pipeline

- 42” Pipeline
- Carries Canadian (Port of Morgan) and Domestic Gas
- Receives Gas From ND Plants, WBI Transmission Interconnections, and WY Pipelines (Bison & Grasslands)
- Midcontinent Deliveries
Simplified Example NB Calculations

Conclusion: **IF** no other gas export options open and all other deliveries on other pipelines stay static, ND gas production could increase 0.96-1.26 BCFD (from Jan-19) before Northern Border is 100% Bakken production. **BTU management becomes increasingly important for Bakken residue gas.**
Regional NGL Infrastructure
North Dakota Captured* NGL’s

*Non-flared NGL's & Assumes 10 GPM
NGL Pipeline Takeaway Options

- Northern Border (ND Prod.)
- Aux Sable Prairie Rose
- Alliance Tioga Lateral
- ONEOK Elk Creek
- ONEOK Bakken NGL
- Vantage
- Elk Creek Expansion (Proposed)
- Case 1: All Captured NGLs
- Case 2: All Captured NGLs
ONEOK Elk Creek NGL Pipeline

**Project Highlights**
- 900 Miles - 20” Pipeline
- $1.4 Billion
- 240,000 BPD Capacity
- Expandable to 400,000 BPD
- End of 2019 Proposed Completion
- Y-Grade Transportation
North Dakota Pipeline Construction

- New Miles
- Year End Miles

Sources: NDIC & PHMSA

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