Objective
Define where the Bakken/Three Forks system may be economic in the current oil price environment.

Method
Analyze past well performance across the region and estimate well economics for various production levels.

Disclaimer
The goal of this work is not to imply individual company actions or intentions. All view expressed are strictly that of Justin J. Kringstad.

Neither the State of North Dakota, nor any agency, officer, or employee of the State of North Dakota warrants the accuracy or reliability of this product and shall not be held responsible for any losses related to its use.
Key Economic Assumptions

- $6-$8 Million Well Costs
- $59/BBL & $5.00/MCF Wellhead Pricing
- 1/6 Royalty
- Zero Flaring
- Assumed 10-20% IRR to drill (calculated after production taxes and royalties)
- No Tax Incentives Included
- Production rate is 30-day average
- All Bakken/Three Forks wells drilled in 2008+
Peak Month Minimum
400 BOPD

7,397 Wells

Peak Month Well Production, BOPD

Well Cost

<table>
<thead>
<tr>
<th>Well Cost</th>
<th>Breakeven Wellhead Price (AT IRR of 20%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 MM</td>
<td>$0 - $20</td>
</tr>
<tr>
<td>7 MM</td>
<td>$20 - $40</td>
</tr>
<tr>
<td>8 MM</td>
<td>$40 - $70</td>
</tr>
</tbody>
</table>

$59 Wellhead

After Tax IRR

- 6 MM
- 7 MM
- 8 MM

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Peak Month Minimum
500 BOPD

Peak Month Well Production, BOPD

$59 Wellhead

Breakeven Wellhead Price (AT IRR of 20%)
Peak Month Minimum 600 BOPD

Peak Month BOPD / Well Cost

After Tax IRR

Breakeven Wellhead Price (AT IRR of 20%)

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Peak Month Minimum 700 BOPD

Peak Month BOPD / Well Cost

After Tax IRR

$59 Wellhead

JJ Kringstad - North Dakota Pipeline Authority
Peak Month Minimum
800 BOPD

Peak Month BOPD / Well Cost

After Tax IRR

$59 Wellhead

<table>
<thead>
<tr>
<th>Well Cost</th>
<th>6 MM</th>
<th>7 MM</th>
<th>8 MM</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>130%</td>
<td>90%</td>
<td>70%</td>
</tr>
</tbody>
</table>

Breakeven Wellhead Price (AT IRR of 20%)

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JJ Kringstad - North Dakota Pipeline Authority
Peak Month Minimum
900 BOPD

Peak Month BOPD / Well Cost
900

After Tax IRR

Breakeven Wellhead Price (AT IRR of 20%)

$0 $5 $10 $15 $20 $25 $30 $35 $40

6 MM
7 MM
8 MM

$59 Wellhead
Peak Month Minimum 1,000 BOPD

Peak Month Well Production, BOPD

<table>
<thead>
<tr>
<th>Well Cost</th>
<th>1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 MM</td>
<td></td>
</tr>
<tr>
<td>7 MM</td>
<td></td>
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<td>8 MM</td>
<td></td>
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</tbody>
</table>

Breakeven Wellhead Price (AT IRR of 20%) $0, $5, $10, $15, $20, $25, $30, $35

$59 Wellhead

After Tax IRR

180% 200% 220%

6 MM 7 MM 8 MM

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JJ Kringstad - North Dakota Pipeline Authority
Peak Month Minimum 1,250 BOPD

Peak Month Well Production, BOPD

<table>
<thead>
<tr>
<th>Well Cost</th>
<th>Breakeven Wellhead Price (AT IRR of 20%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 MM</td>
<td>$0 - $12</td>
</tr>
<tr>
<td>7 MM</td>
<td>$12 - $16</td>
</tr>
<tr>
<td>8 MM</td>
<td>$16 - $20</td>
</tr>
</tbody>
</table>

$59 Wellhead

After Tax IRR

6 MM | 250%  
7 MM | 200%  
8 MM | 150%  

JJ Kringstad - North Dakota Pipeline Authority
Peak Month Minimum 1,500 BOPD

Peak Month Well Production, BOPD

Well Cost 1500

6 MM
7 MM
8 MM

Breakeven Wellhead Price (AT IRR of 20%)

$0 $2 $4 $6 $8 $10 $12 $14 $16 $18 $20 $22 $24 $26 $28 $30

After Tax IRR

6 MM
7 MM
8 MM

$59 Wellhead

JJ Kringstad - North Dakota Pipeline Authority
Summary of $59 Wellhead Oil

Peak Month BOPD / Well Cost

After Tax IRR

Assumed Range of Minimum Acceptable Rate of Return
Breakeven Summary

Peak Month Well Production, BOPD / Well Cost

Breakeven Wellhead Price (AT IRR of 20%)
Bakken Economics

Breakeven Analysis

Justin J Kringstad
Geological Engineer
Director
North Dakota Pipeline Authority

January 24, 2018
Objective
Define where the Bakken/Three Forks system may be economic in various price scenarios.

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Analyze past well performance across the region and estimate well economics for various production levels.

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Bakken Breakeven Analysis
Important Considerations

• Breakeven areas were determined by neighboring well performance and are expected to expand as new completion technology is applied in areas outside “the core.”

• Just because an area is considered “economic” does not mean that it is the most economic option for the industry participant(s). Competition for capital continues to exist inside and outside the region.
Bakken Breakeven Price Range (20% ATIRR)

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
## Bakken Breakeven Economics

### County/Regional Analysis

<table>
<thead>
<tr>
<th>Breakeven Range</th>
<th>Billings</th>
<th>Burke</th>
<th>Divide</th>
<th>Dunn</th>
<th>Fort Berthold</th>
<th>Golden Valley</th>
<th>McKenzie</th>
<th>Mclean</th>
<th>Mountr.</th>
<th>Stark</th>
<th>Williams</th>
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</tr>
</tbody>
</table>

**Breakeven Range Included:** $6mm, $7mm, $8mm Well Costs

**Ft. Berthold**

- Yes
- No

**Area mi²**

- Billings
- Burke
- Divide
- Dunn
- Fort Berthold
- Golden Valley
- McKenzie
- Mclean
- Mountr.
- Stark
- Williams
44% Economic Area Increase 2017 to 2018

Peak 30-Day Production Level / Wellhead Breakeven Range (20% IRR)

North Dakota Bakken Area, Square Miles

<table>
<thead>
<tr>
<th>Peak Production Level</th>
<th>400</th>
<th>500</th>
<th>600</th>
<th>700</th>
<th>800</th>
<th>900</th>
<th>1000</th>
<th>1250</th>
<th>1500</th>
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</thead>
<tbody>
<tr>
<td>2017 Range Square Miles</td>
<td>8,223</td>
<td>11,824</td>
<td>5,474</td>
<td>4,030</td>
<td>2,586</td>
<td>1,142</td>
<td>698</td>
<td>354</td>
<td>177</td>
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</tbody>
</table>

~2018YTD Range Square Miles: 11,824

~2017 Range Square Miles: 8,223

~2016 Range Square Miles: 5,474
Drilling Locations* – January 22, 2018

Bakken Breakeven Prices
$6 - $8 Million

*Due to confidential status, the target production zone for many wells is unknown.
Contact Information

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