Understanding Well Spacing Strategies in the Midland Basin

February 2020
The Enverus Well Spacing Premier solution now incorporates a Dynamic Calculator, that allows you to create a custom well spacing dataset based on your desired assumptions. This platform arms you with a comprehensive dataset needed to understand the interactions between geology, well spacing, engineering variables, and parent/child well relationships.
The GBV helps understand vertical and horizontal well spacing distances of offset wells within 2640 ft horizontally on either side of a subject well. Every subject well has a unique GBV depending on how its offset wells land when looking from the subject well’s toe towards its heel.
Outline

• Methodology Overview

• Midland Basin Spacing Trends
  – Has Productivity Peaked?

• Case Study on Improvements in 2019
  – Gun-Barrel Views and Wellbore Orientation
  – Comparing Developments and Economics

• Conclusions and Q&A
Well Spacing Methodology

Changing the paradigm of well spacing calculations

Mid-point distances

Sampling

Segment-wise analytical distances
Midpoint vs. Segment-wise

- In the graphic on the right are four wells in the Williston Basin:

- Across the whole Williston Basin, a midpoint approach would underestimate Middle Bakken formation spacing by 10%.

<table>
<thead>
<tr>
<th>Basin</th>
<th>Formation</th>
<th>Midpoint (ft)</th>
<th>DI (ft)</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Williston</td>
<td>Middle Bakken</td>
<td>866</td>
<td>954</td>
<td>10%</td>
</tr>
</tbody>
</table>

Source: Drillinginfo, DI Spacing
Midland Basin Spacing Trends

Avg. Same Zone Horizontal Distance vs. Year

Wide Range of Spacing by Formation
Operator Variance

Wolfcamp A

Wider Spacing Past 2 years

Wolfcamp B

Convergence at 5-6 wells per section
Spacing vs Frac Size vs Productivity

Wolfcamp A

Steepest degradation seen on tightly spaced high frac intensity wells

Normalized EUR (BOE/ft) vs. Same Zone Wells per Section

Wolfcamp B

Normalized EUR (BOE/ft) vs. Same Zone Wells per Section

Same Zone Wells per Section

Normalized EUR (BOE/ft)

Steepest Drop After 8 WPS

Copyright © 2020, Enverus. All rights reserved. All brand names and trademarks are the properties of their respective companies.
Parent and Child Productivity

Co-Completed wells allow for tighter spacing than child wells
Has Productivity Peaked?

Vintage Spacing and Productivity

Down-Spacing and Productivity Collide

Same spacing as 2017, higher production

Larger Frac’s activity shifted to Northern MB

Copyright © 2020, Enverus. All rights reserved. All brand names and trademarks are the properties of their respective companies.
Dueling Development Models
Case Study Introduction

Grouped Zone Spacing Vintage Comparison

Parsley steep down-spacing 2015-2018

Normalized EUR Vintage Comparison

Parsley productivity rose from 10th to 2nd in basin by operator
Development Complexity

Well Coverage

- Parsley has more “edge wells”

Well Density

- Full-section developments
“Stacked Lateral” Comparison

Parsley

Pioneer

Exxon

< 100’ Primary Hz Distance = “Stacked Lateral”
Full vs Semi Bound

Percentage of Full Bound Wells

Stacked Productivity Comparison

Stacked, Full-Bounded Wells
poor productivity

Copyright © 2020, Enverus. All rights reserved. All brand names and trademarks are the properties of their respective companies.
Parsley Acreage and Delineation

Parsley Central Midland Basin Acreage Position with Completed WC A and B
Pioneer Acreage and Delineation

Pioneer Central Midland Basin Acreage Position with Completed WC A and B
Exxon Acreage and Delineation

Exxon Central Midland Basin Acreage Position with Completed WC A and B
Map View Comparison

Parsley

Pioneer
Parsley GBV - 2017 Pad

Gun-Barrier View, Sized by Oil EUR

"Edge Well" & Semi Bounded

Parent

Stacked, full-bounded, poor results

Normalized Cum Oil over Time

"Edge Well"

Oil per ft

Date -

Copyright © 2020, Enverus. All rights reserved. All brand names and trademarks are the properties of their respective companies.
Parsley GBV - 2019 Pad

Proppant Intensity vs Time, Sized by Spacing

Gen 1
Gen 2
Gen 3
Gen 4

Gun-Barrel View

Gen 4 Example: Wider Spacing in 2019 with much Larger Frac
Pioneer GBV – 2016 Pad

Gun-Barrel View, Sized by Oil EUR

Staggered, Full Bound Laterals indicate limited interference

880’ Per Bench
440’ Staggered between A and B

EUR by Spacing Status

Cumulative Oil over Time

Copyright © 2020, Enverus. All rights reserved. All brand names and trademarks are the properties of their respective companies.
Pioneer GBV – 2019 Pad

Gun-Barrel View, Sized by Oil EUR/ft

Cum Oil over Time

Another PXD staggered full-bound example 6 wells on half section

All co-completed in 2019

+700 lb/ft frac & +25% First 6 Month Oil vs 2016

Limited interference when co-completed
Exxon GBV – 2017 Pad

Gun-Barrel View, Sized by First 6 Oil/ft

Cum Oil by Un-normalized Time

9 Wells on Half a Section

Mixed results on inference

4 “sub-bench” development helped mitigate risk

Relative small frac jobs at 1250-1500 lb/ft
## Project Economics Results

<table>
<thead>
<tr>
<th>Development</th>
<th>Wells Per Section</th>
<th>Avg Proppant Lb/ft</th>
<th>Single Well IRR</th>
<th>Single Well Oil Breakeven $/bbl</th>
<th>Project NPV $MM</th>
<th>Project EUR MMBBL Oil</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pioneer (2019)</td>
<td>12</td>
<td>2200</td>
<td>61%</td>
<td>$24</td>
<td>$93.09</td>
<td>11.28</td>
</tr>
<tr>
<td>Parsley (2019)</td>
<td>8</td>
<td>2250</td>
<td>55%</td>
<td>$27</td>
<td>$50.03</td>
<td>6.61</td>
</tr>
<tr>
<td>Pioneer (2016)</td>
<td>12</td>
<td>1500</td>
<td>41%</td>
<td>$27</td>
<td>$54.74</td>
<td>6.38</td>
</tr>
<tr>
<td>Exxon (2017)</td>
<td>18</td>
<td>1400</td>
<td>35%</td>
<td>$31</td>
<td>$73.58</td>
<td>11.22</td>
</tr>
<tr>
<td>Parsley (2017)</td>
<td>16</td>
<td>1700</td>
<td>28%</td>
<td>$34</td>
<td>$37.89</td>
<td>7.01</td>
</tr>
</tbody>
</table>

Price Assumptions:
- $45/bbl & $2/mcf net back, $7 LOE/boe,
- Type Curve Normalized to 10,000 LL,
- D&C varied on proppant intensity
Conclusions

Gun-Barrel Views and Dynamic Spacing Calculations Assist in Rigorous Benchmarking for Custom Analysis

• Development orientations are an important engineering consideration
  - “Stacked laterals” show potential for degradation

• Parsley’s transition from stacked lateral development to one with wide spacing and large fracs doubled IRR’s

• Pioneer has been extremely consistent with staggered development and steadily increased EUR/section and single well IRR
  - Co-Completions allowed for increasing frac size, mitigating child well risk

• Exxon has some of the most complex developments
  - Targeting multiple sub-benches within the WC A and B can mitigate risk
Contact us

If you’re interested in a custom well spacing demo to understand various well spacing strategies and it’s impact on productivity:

businessdevelopment@enverus.com
(512) 519-3711