SPE Hydraulic Fracturing Technology Conference

9–11 February 2016
THE WOODLANDS, TEXAS, USA
The Woodlands Waterway Marriott Hotel and Convention Center

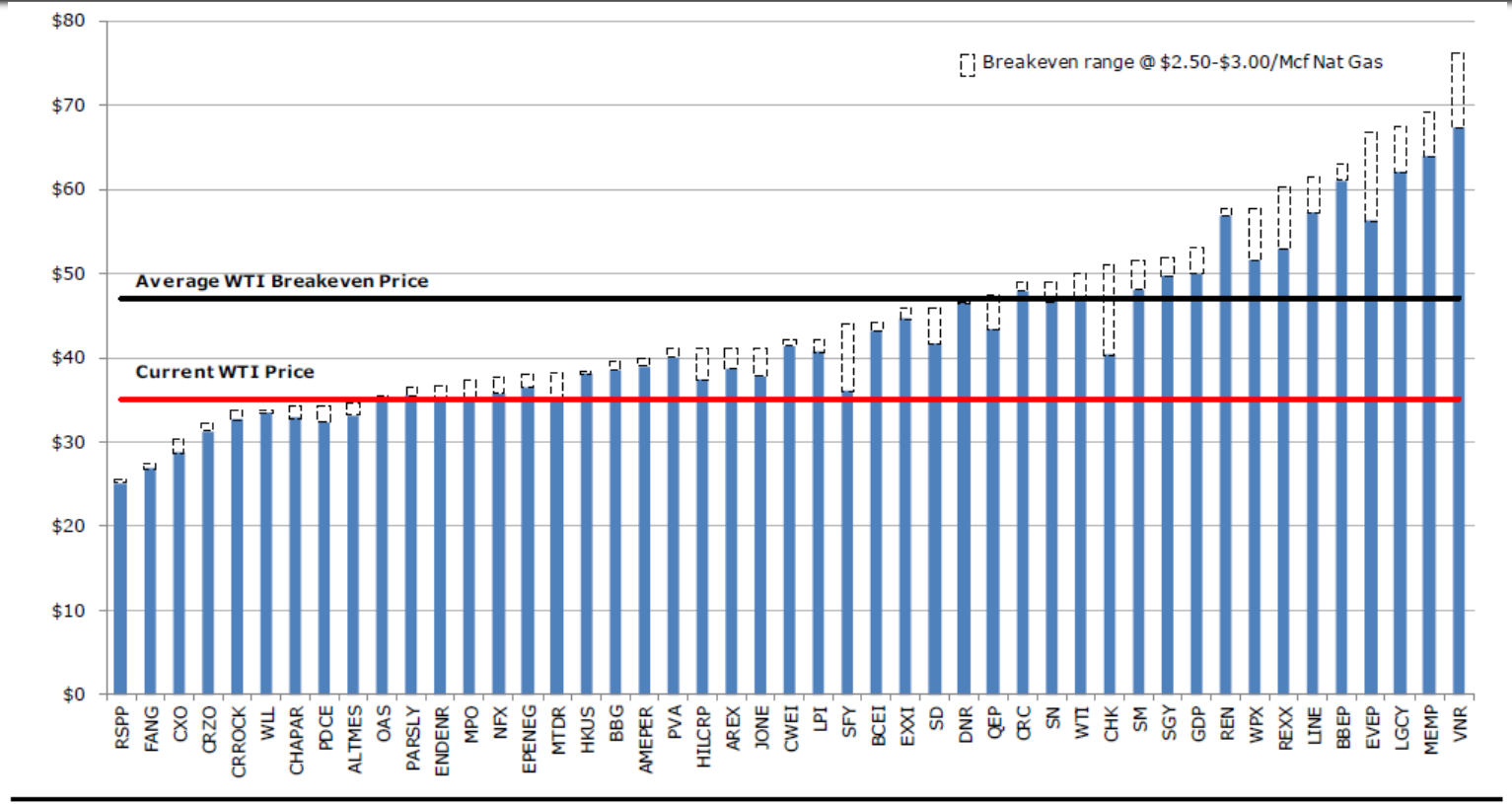
Boom, Bust, and Frac: Coping With the Downturn

“Hydraulic Fracturing to Survive in 2016”

C. Mark Pearson
Liberty Resources LLC

SPE International
Society of Petroleum Engineers

Breakeven Prices for Domestic E&P Companies



Source: Company reports, Bloomberg LP and Wells Fargo Securities LLC
Note: Analysis excludes companies where natural gas accounts for >75% of total production.

Wells Fargo Securities; 2016 E&P Breakevens; January 7, 2016

Why are we still Fracking?

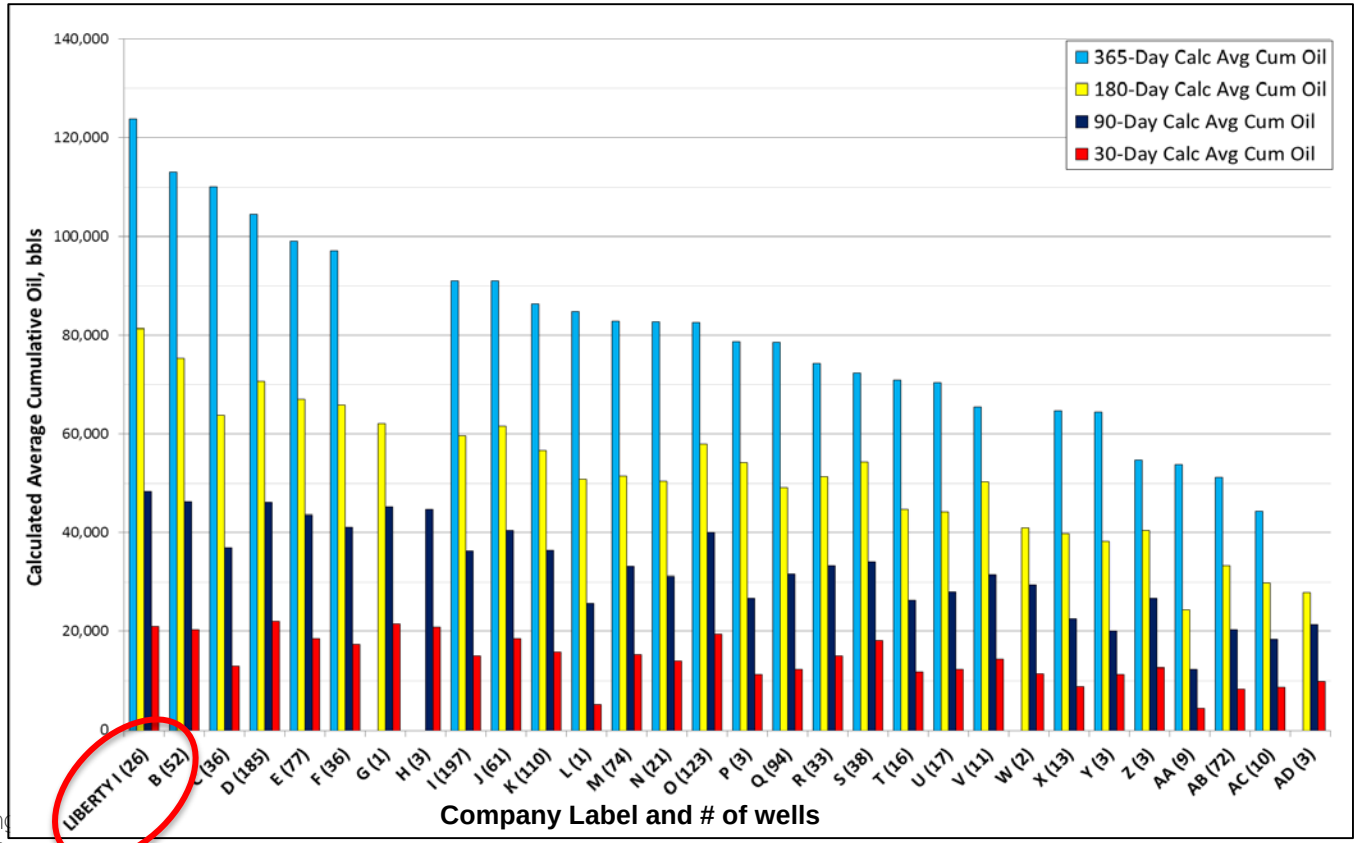
- To HBP acreage
- Support Cash Flow
- Maintain Borrowing Base

- “The Boss Told Me To”

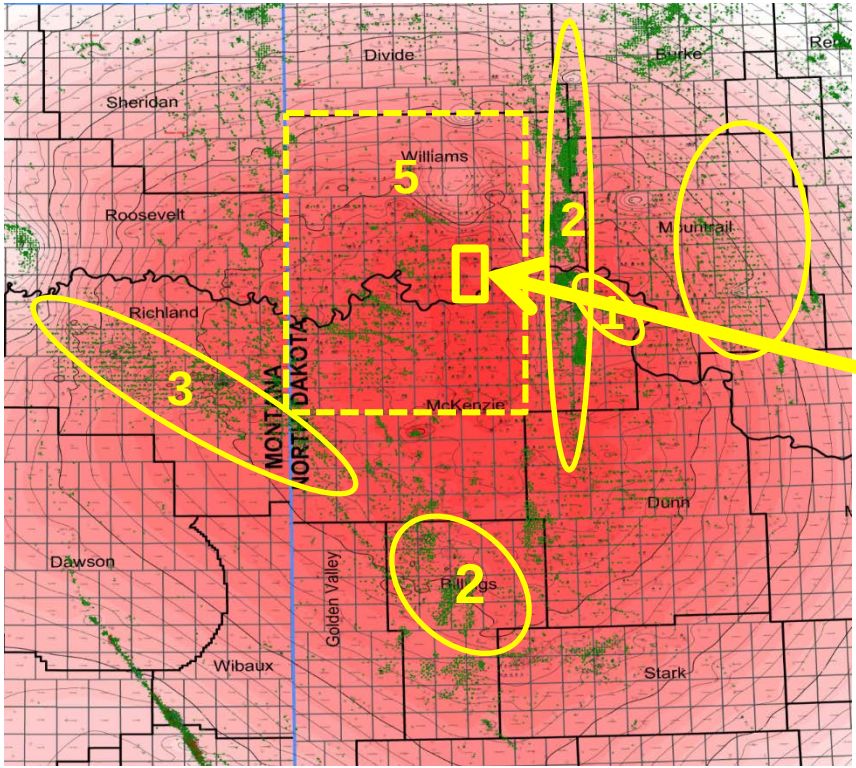
Should we be designing the Horizontal Well Completion to maximize initial rates/cash flow, maximizing reserve recovery, or minimizing completion spend?

Williston Central Basin (Twp 148-159N, R97-105W) - 1330 Bakken Wells

(completions since 1/15/2009, production through Aug 2013)

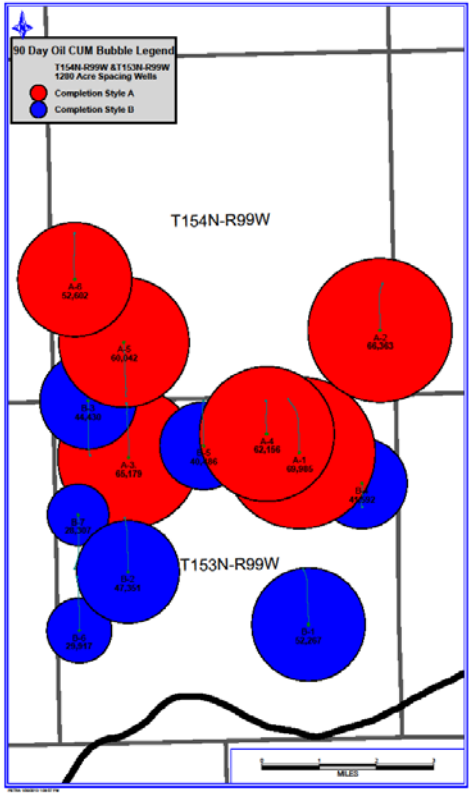


Bakken Tier 1 Case Study: South Williams County



Twp 153 & 154N;
R 99W

Bakken Tier 1 Case Study: 90-day Cum Oil Bubble Plot



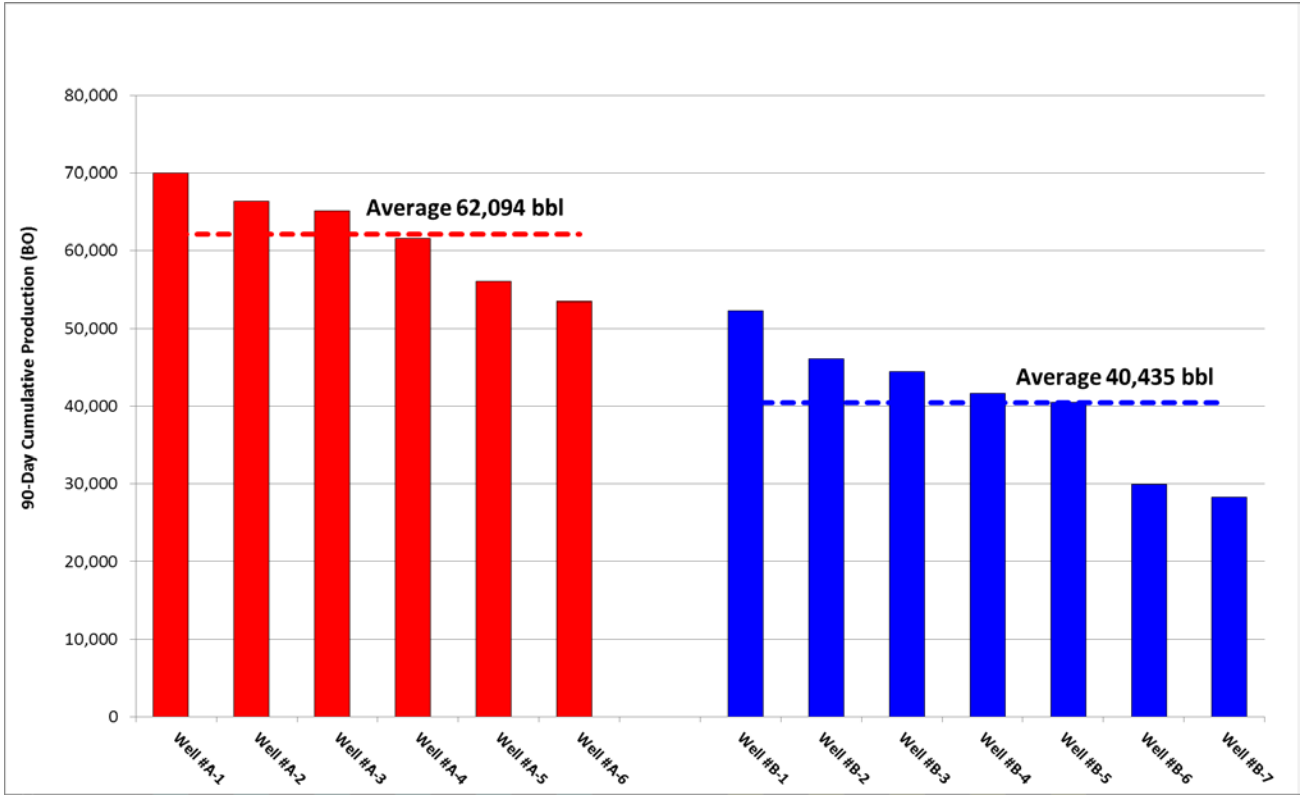
Company A Completion (the "Liberty" Slickwater Design):

- **35 Stages**
- **Plug and Perf**
- **Slickwater**
- **3.7 Million lb proppant (100% ceramic)**

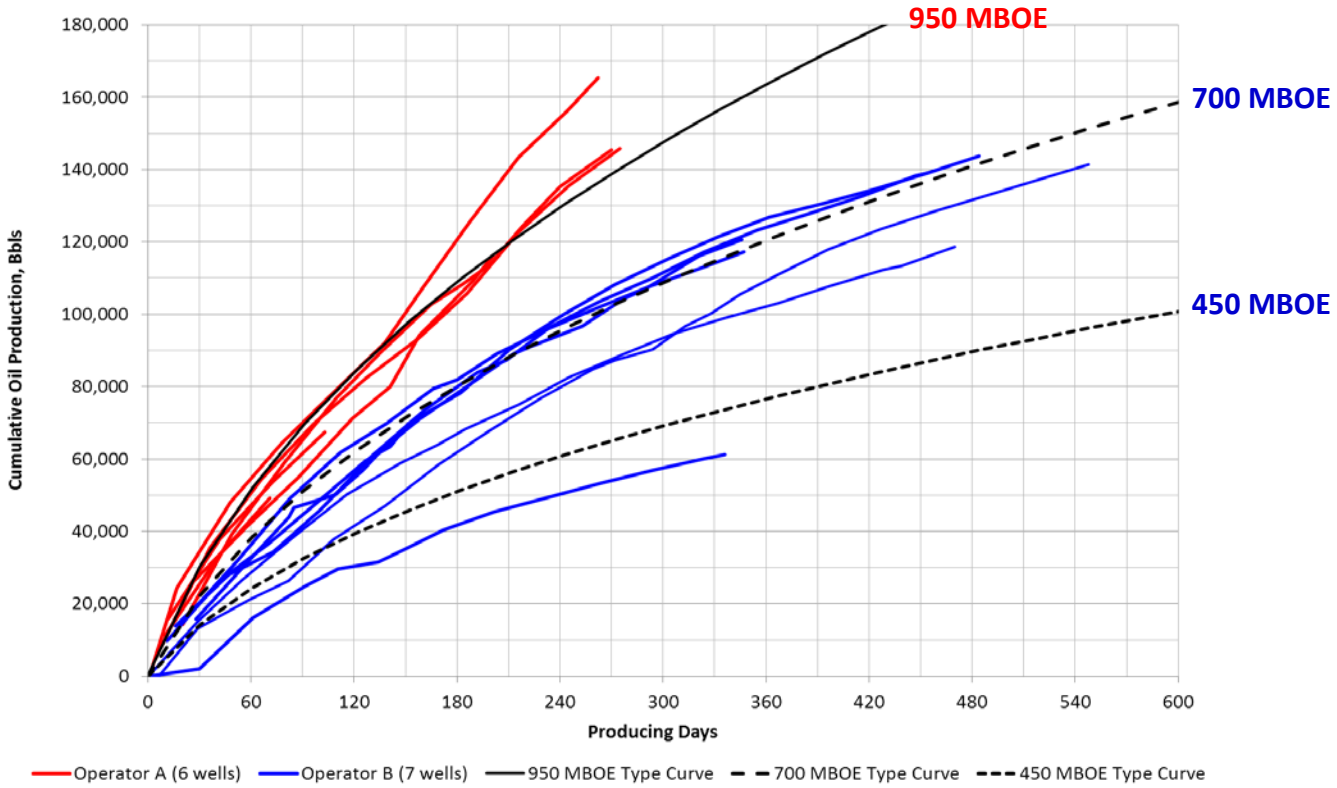
Company B Typical Completion:

- **30 Stages**
- **Plug and Perf**
- **X-Linked Gel**
- **2.6 Million lb proppant (30% ceramic; 70% sand)**

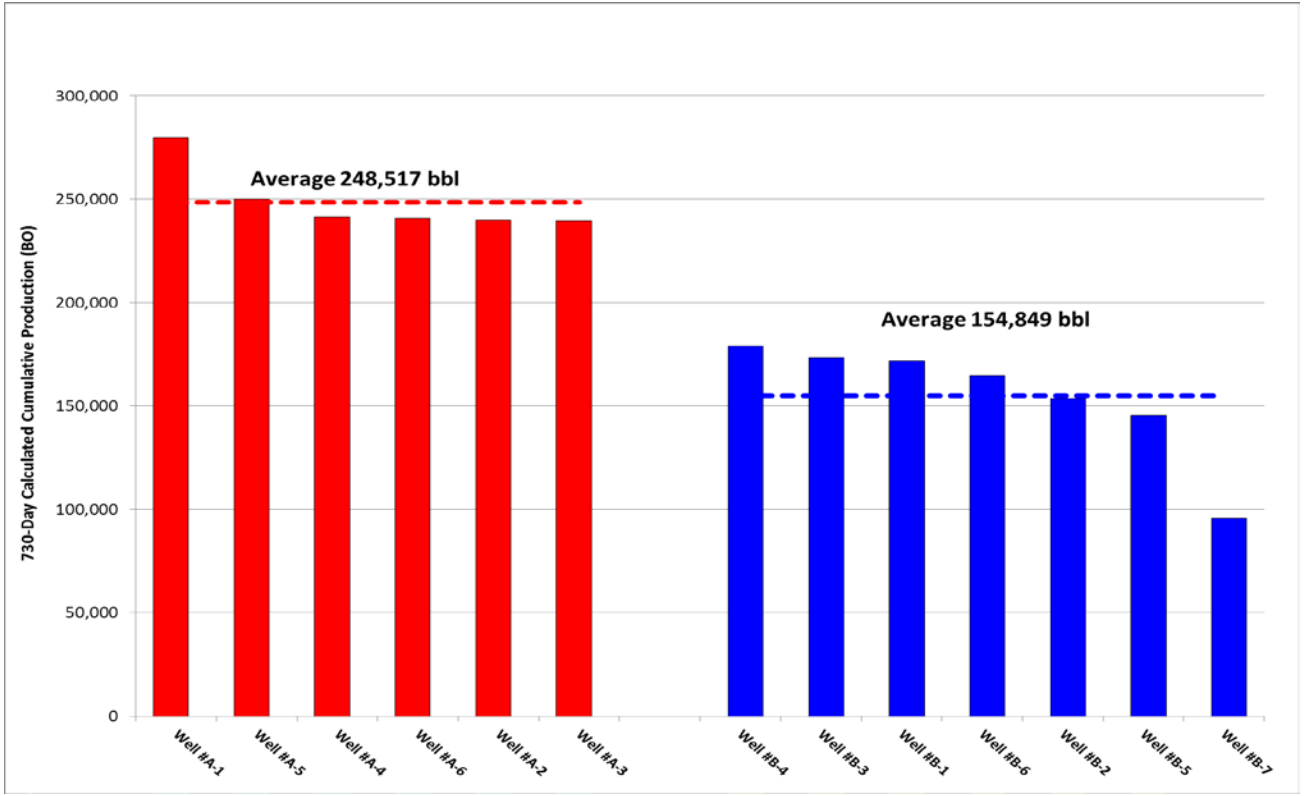
Bakken Tier 1 Case Study: 90-day Cum Oil



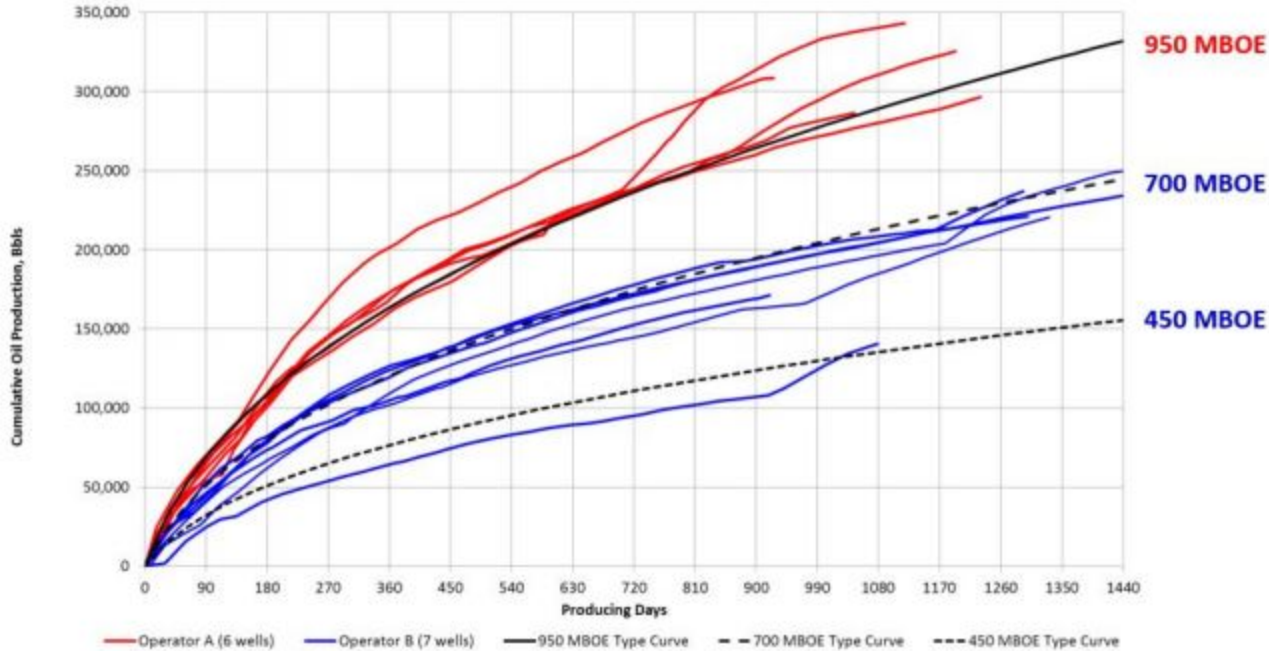
Bakken Tier 1 Case Study: November 2012 Update



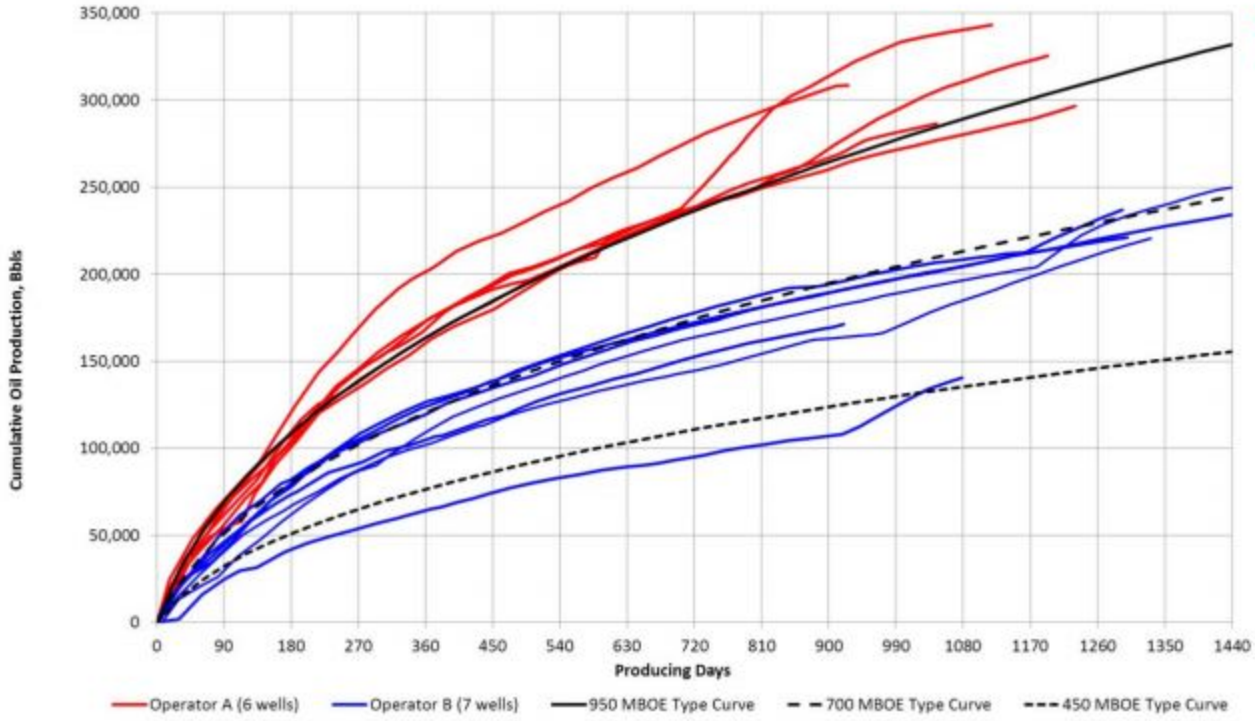
Bakken Tier 1 Case Study: Two-Year Cum Oil Update



Bakken Tier 1 Case Study: Nov. 2015 Update



Bakken Tier 1 Case Study: Nov. 2015 Update

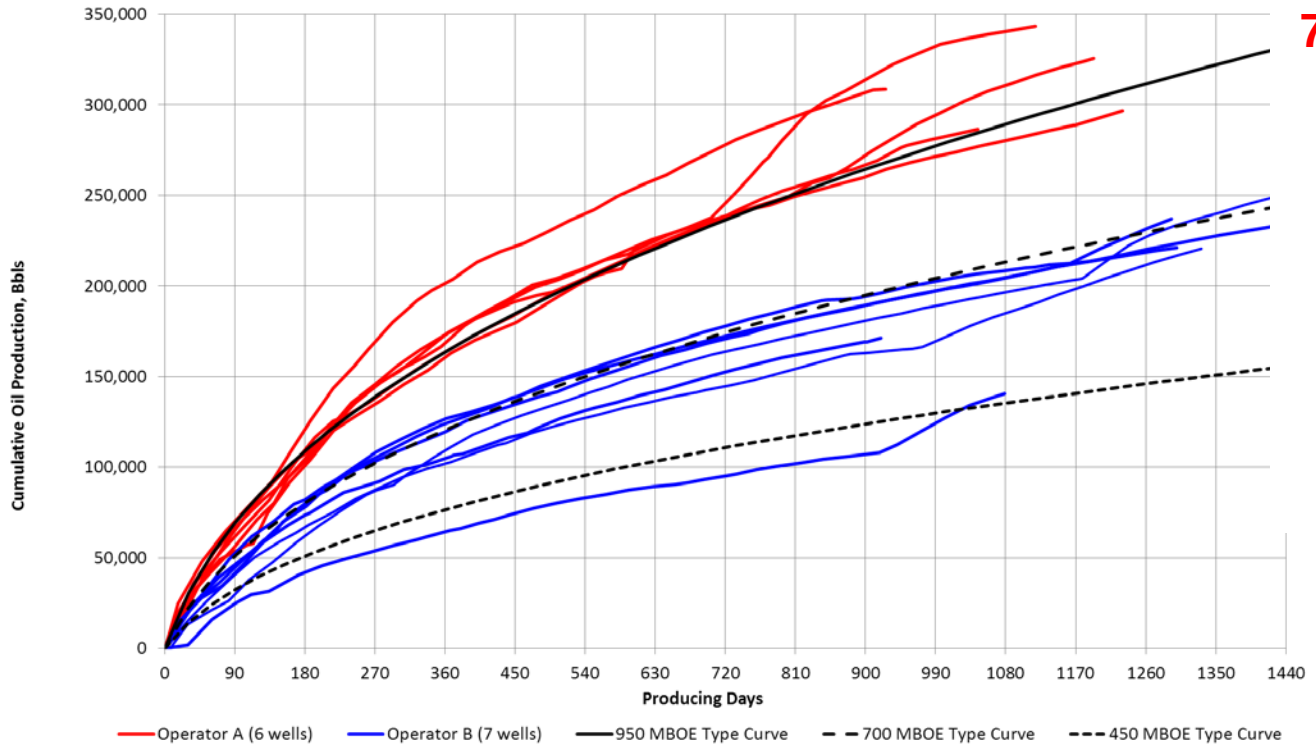


10 MM$ D&C
91% IRR

9 MM$ D&C
56% IRR

$95 WTI

Bakken Tier 1 Case Study: Nov. 2015 Update

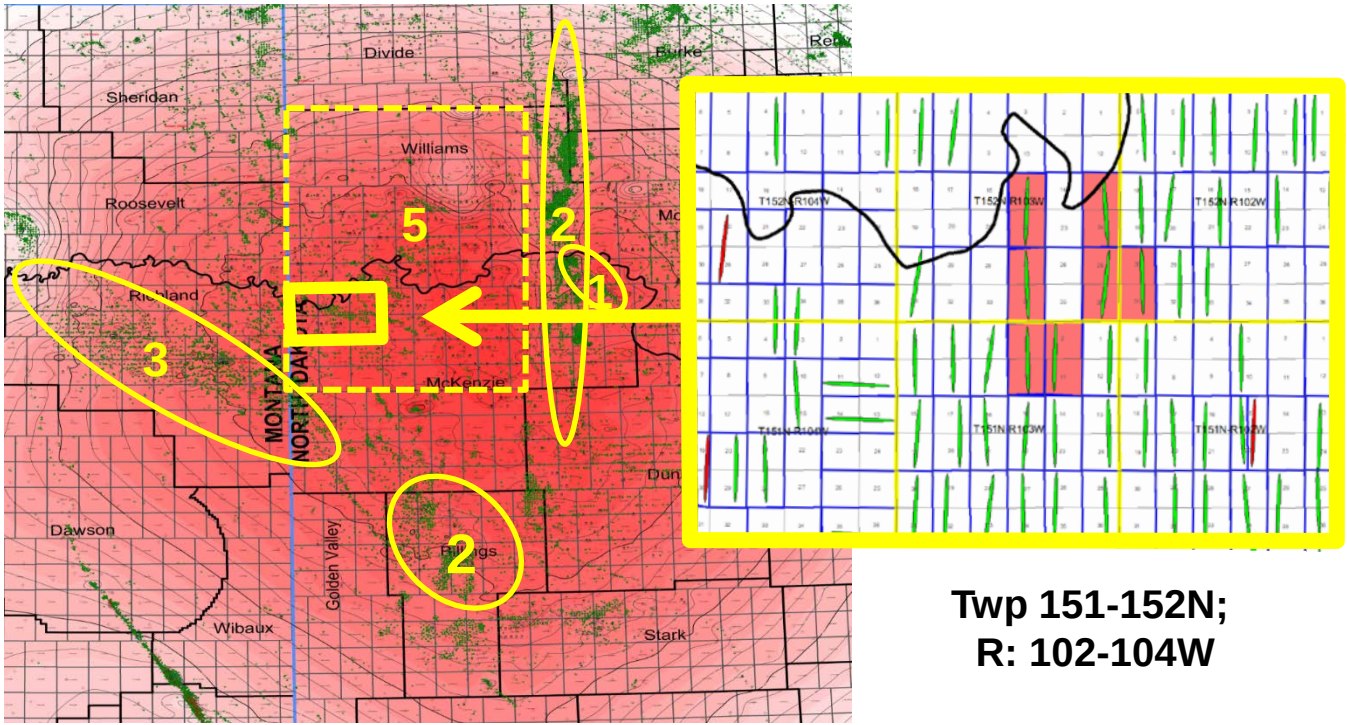


7.5 MM$ D&C
7% IRR

7 MM$ D&C
1% IRR

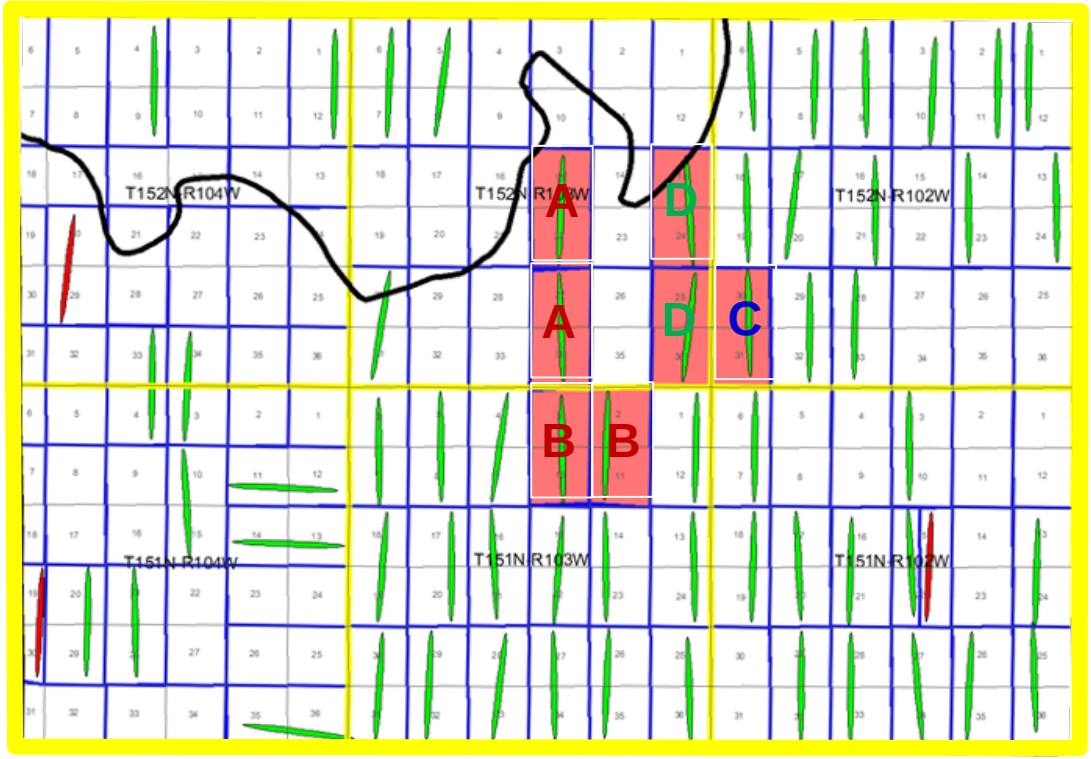
$40 WTI

Bakken Tier 2 Case Study: NW McKenzie County

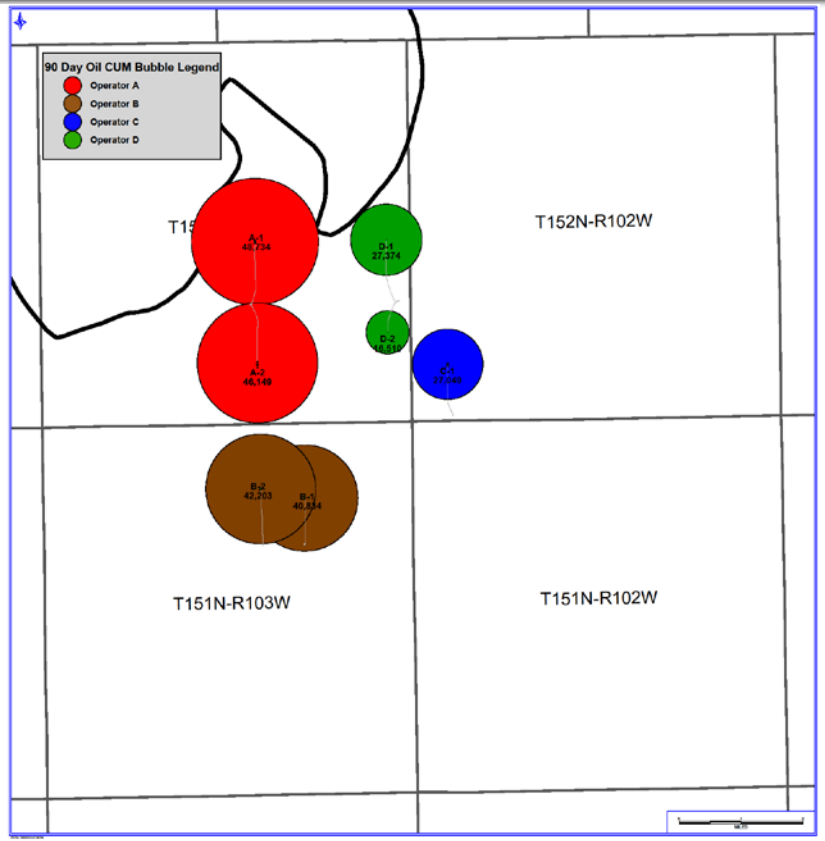


Twp 151-152N;
R: 102-104W

Bakken Tier 2 Case Study: NW McKenzie County

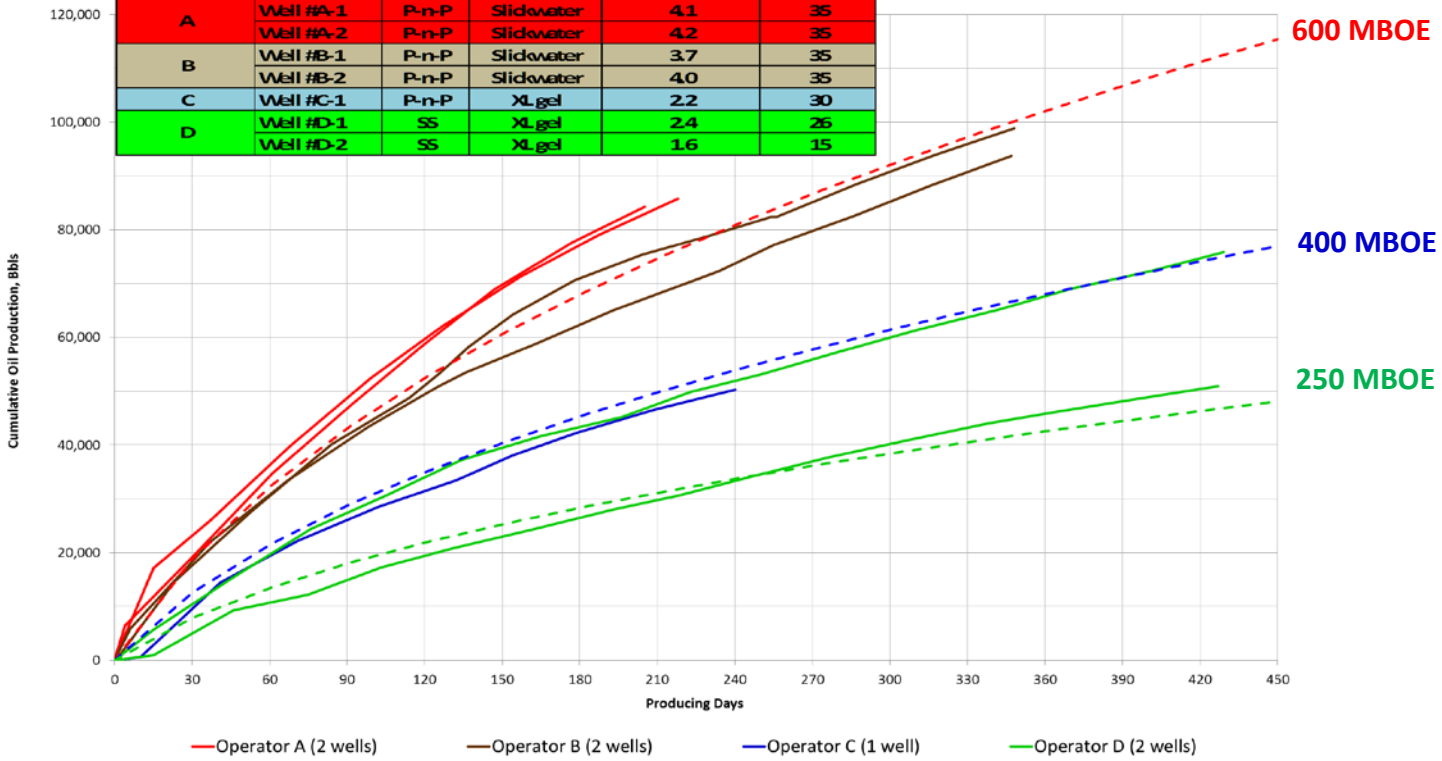


Bakken Tier 2 Case Study: 90-day Cum Oil Bubble Plot



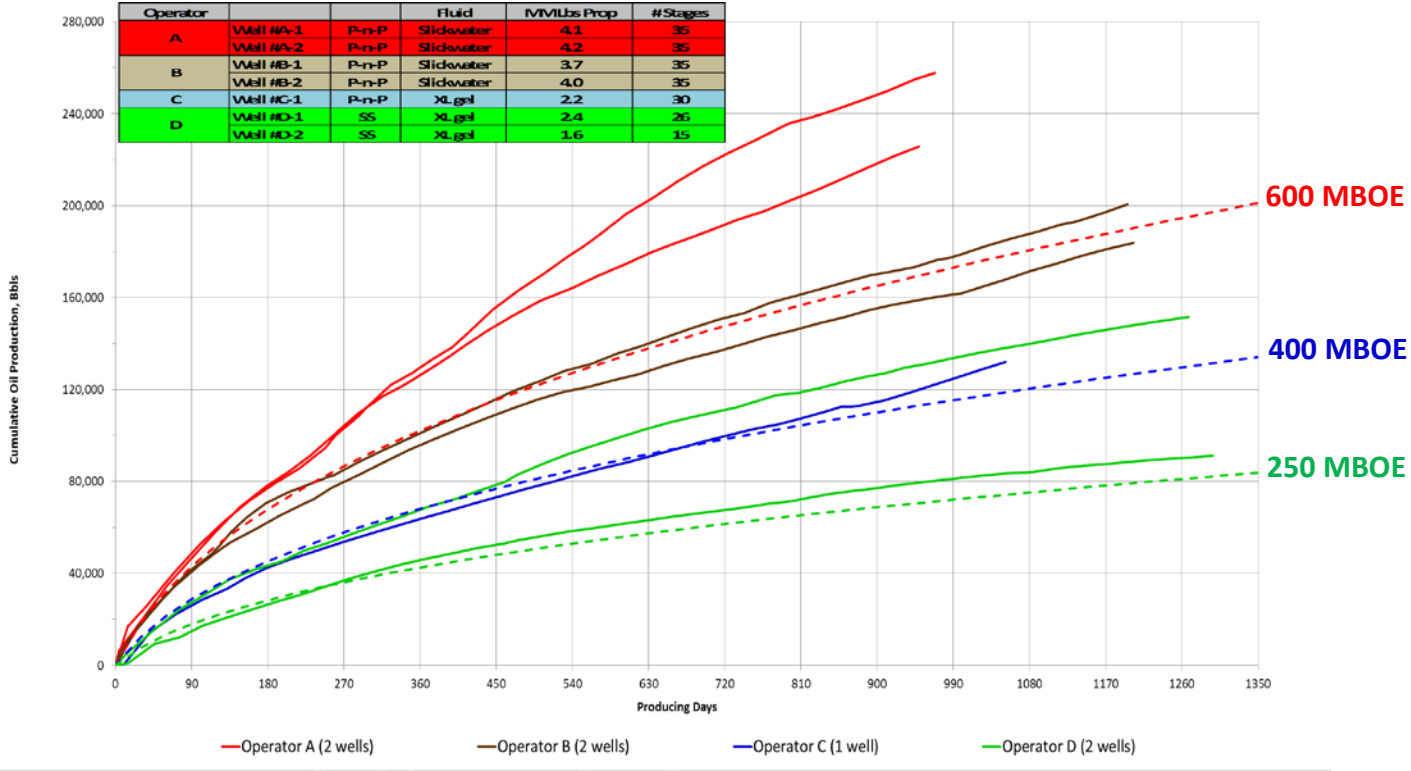
Bakken Tier 2 Case Study: April 2013 Update

Operator			Fluid	MMLbs Prop	#Stages
A	Well #A-1	P-n-P	Slickwater	4.1	35
	Well #A-2	P-n-P	Slickwater	4.2	35
B	Well #B-1	P-n-P	Slickwater	3.7	35
	Well #B-2	P-n-P	Slickwater	4.0	35
C	Well #C-1	P-n-P	XL gel	2.2	30
D	Well #D-1	SS	XL gel	2.4	26
	Well #D-2	SS	XL gel	1.6	15



Bakken Tier 2 Case Study: Nov. 2015 Update

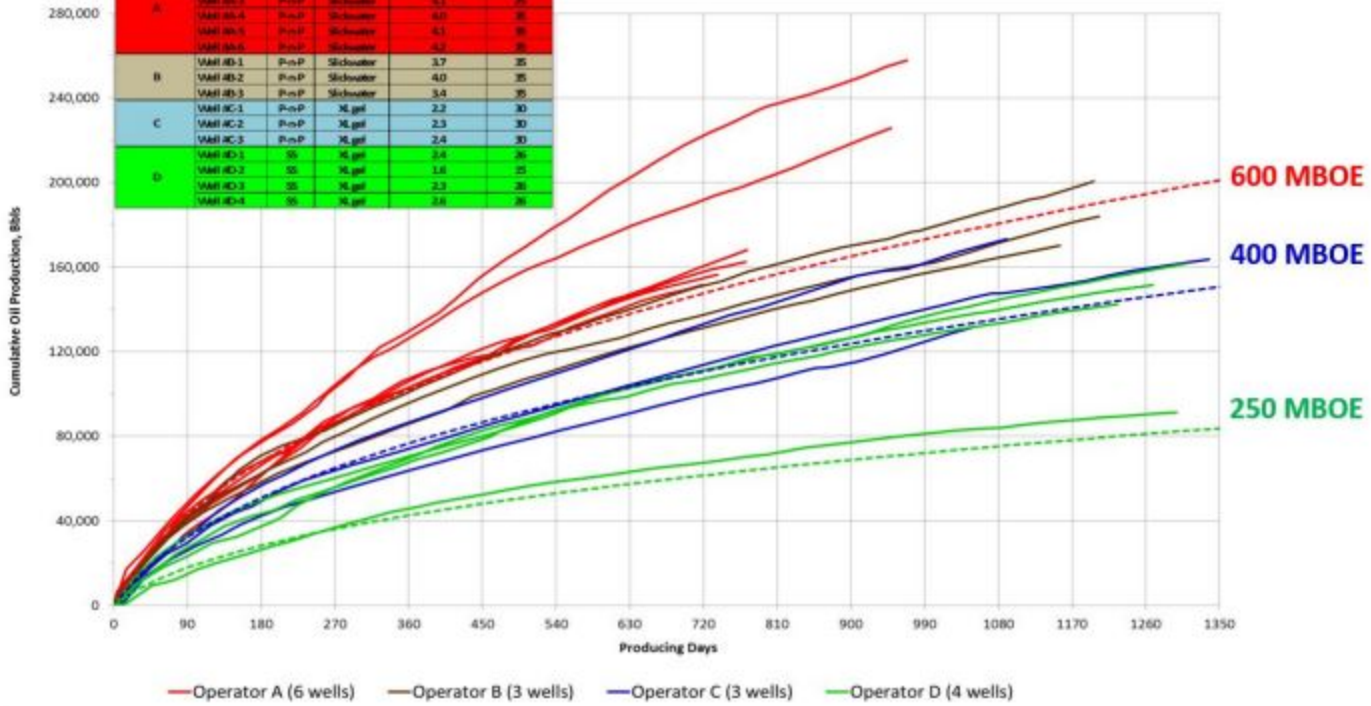
Operator			Fluid	MMLbs Prop	# Stages
A	Well #A-1	P-n-P	Slickwater	4.1	35
	Well #A-2	P-n-P	Slickwater	4.2	35
B	Well #B-1	P-n-P	Slickwater	3.7	35
	Well #B-2	P-n-P	Slickwater	4.0	35
C	Well #C-1	P-n-P	XL gel	2.2	30
D	Well #D-1	SS	XL gel	2.4	26
	Well #D-2	SS	XL gel	1.6	15



Bakken Tier 2 Case Study: Nov. 2015 Update

with added wells (SE of T152N-R103W & NE of T151N-R103W)

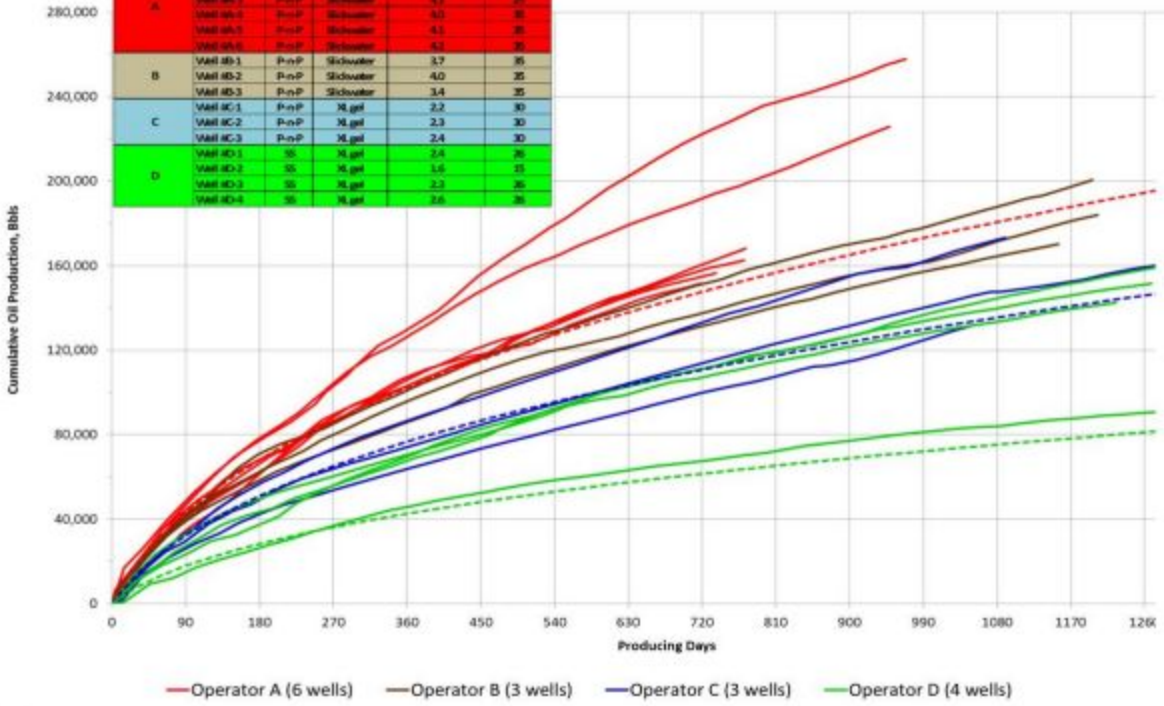
Operator			Fluid	MMlbs Prop	#Stages
A	Well #A-1	P-n-P	Slickwater	6.1	35
	Well #A-2	P-n-P	Slickwater	6.2	35
	Well #A-3	P-n-P	Slickwater	6.1	35
	Well #A-4	P-n-P	Slickwater	6.0	35
	Well #A-5	P-n-P	Slickwater	6.1	35
	Well #A-6	P-n-P	Slickwater	6.2	35
B	Well #B-1	P-n-P	Slickwater	3.7	35
	Well #B-2	P-n-P	Slickwater	4.0	35
	Well #B-3	P-n-P	Slickwater	3.4	35
C	Well #C-1	P-n-P	XL gel	2.2	30
	Well #C-2	P-n-P	XL gel	2.3	30
	Well #C-3	P-n-P	XL gel	2.4	30
D	Well #D-1	SS	XL gel	2.4	26
	Well #D-2	SS	XL gel	1.6	15
	Well #D-3	SS	XL gel	2.3	26
	Well #D-4	SS	XL gel	2.6	26



Bakken Tier 2 Case Study: Nov. 2015 Update

with added wells (SE of T152N-R103W & NE of T151N-R103W)

Operator			Fluid	MMlbs Prop	# Stages
A	Well 4A-1	P+P	Slickwater	4.1	35
	Well 4A-2	P+P	Slickwater	4.2	35
	Well 4A-3	P+P	Slickwater	4.3	35
	Well 4A-4	P+P	Slickwater	4.0	35
	Well 4A-5	P+P	Slickwater	4.1	35
	Well 4A-6	P+P	Slickwater	4.2	35
B	Well 4B-1	P+P	Slickwater	3.7	35
	Well 4B-2	P+P	Slickwater	4.0	35
	Well 4B-3	P+P	Slickwater	3.4	35
C	Well 4C-1	P+P	XLgel	2.2	30
	Well 4C-2	P+P	XLgel	2.3	30
	Well 4C-3	P+P	XLgel	2.4	30
D	Well 4D-1	SS	XLgel	2.4	26
	Well 4D-2	SS	XLgel	1.6	15
	Well 4D-3	SS	XLgel	2.3	26
	Well 4D-4	SS	XLgel	2.6	26



$95 WTI

10 MM$ D&C
30% IRR

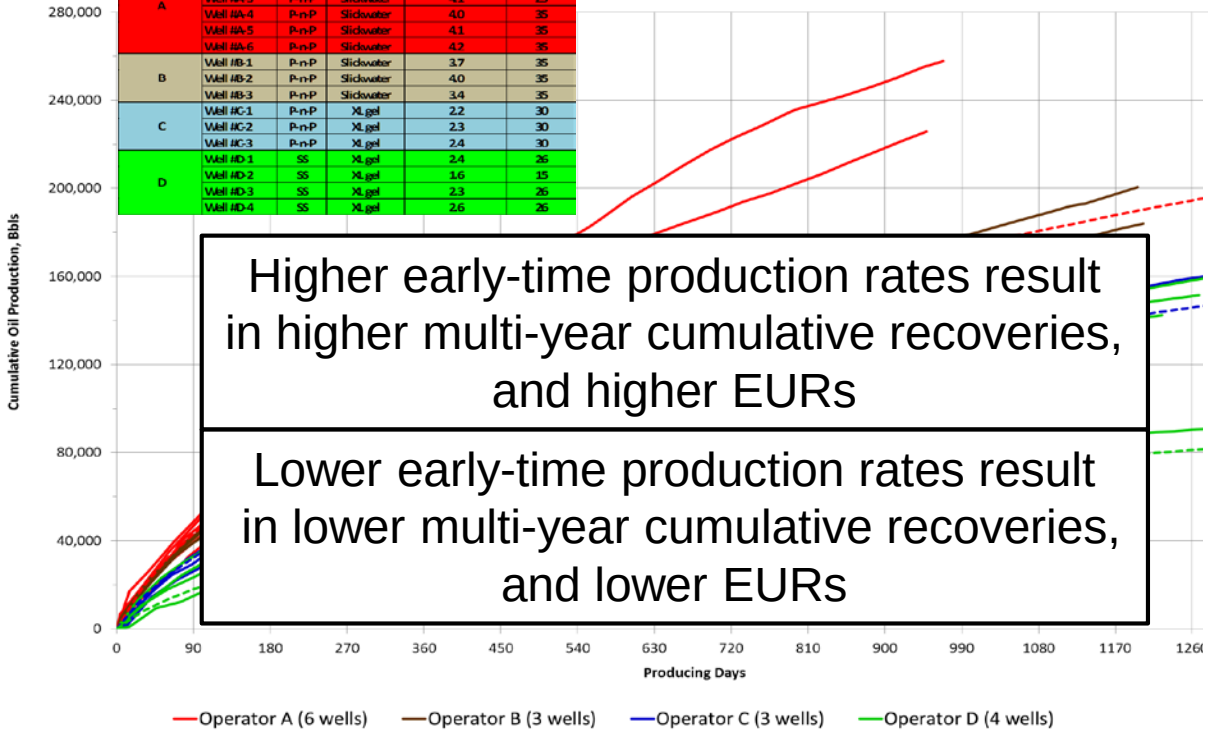
9 MM$ D&C
13% IRR

8 MM$ D&C
3% IRR

Bakken Tier 2 Case Study: Nov. 2015 Update

with added wells (SE of T152N-R103W & NE of T151N-R103W)

Operator			Fluid	MMLbs Prop	# Stages
A	Well #A-1	P-n-P	Slickwater	4.1	35
	Well #A-2	P-n-P	Slickwater	4.2	35
	Well #A-3	P-n-P	Slickwater	4.1	25
	Well #A-4	P-n-P	Slickwater	4.0	35
	Well #A-5	P-n-P	Slickwater	4.1	35
	Well #A-6	P-n-P	Slickwater	4.2	35
B	Well #B-1	P-n-P	Slickwater	3.7	35
	Well #B-2	P-n-P	Slickwater	4.0	35
	Well #B-3	P-n-P	Slickwater	3.4	35
C	Well #C-1	P-n-P	XL gel	2.2	30
	Well #C-2	P-n-P	XL gel	2.3	30
	Well #C-3	P-n-P	XL gel	2.4	30
D	Well #D-1	SS	XL gel	2.4	26
	Well #D-2	SS	XL gel	1.6	15
	Well #D-3	SS	XL gel	2.3	26
	Well #D-4	SS	XL gel	2.6	26



Higher early-time production rates result in higher multi-year cumulative recoveries, and higher EURs

Lower early-time production rates result in lower multi-year cumulative recoveries, and lower EURs

$50 WTI

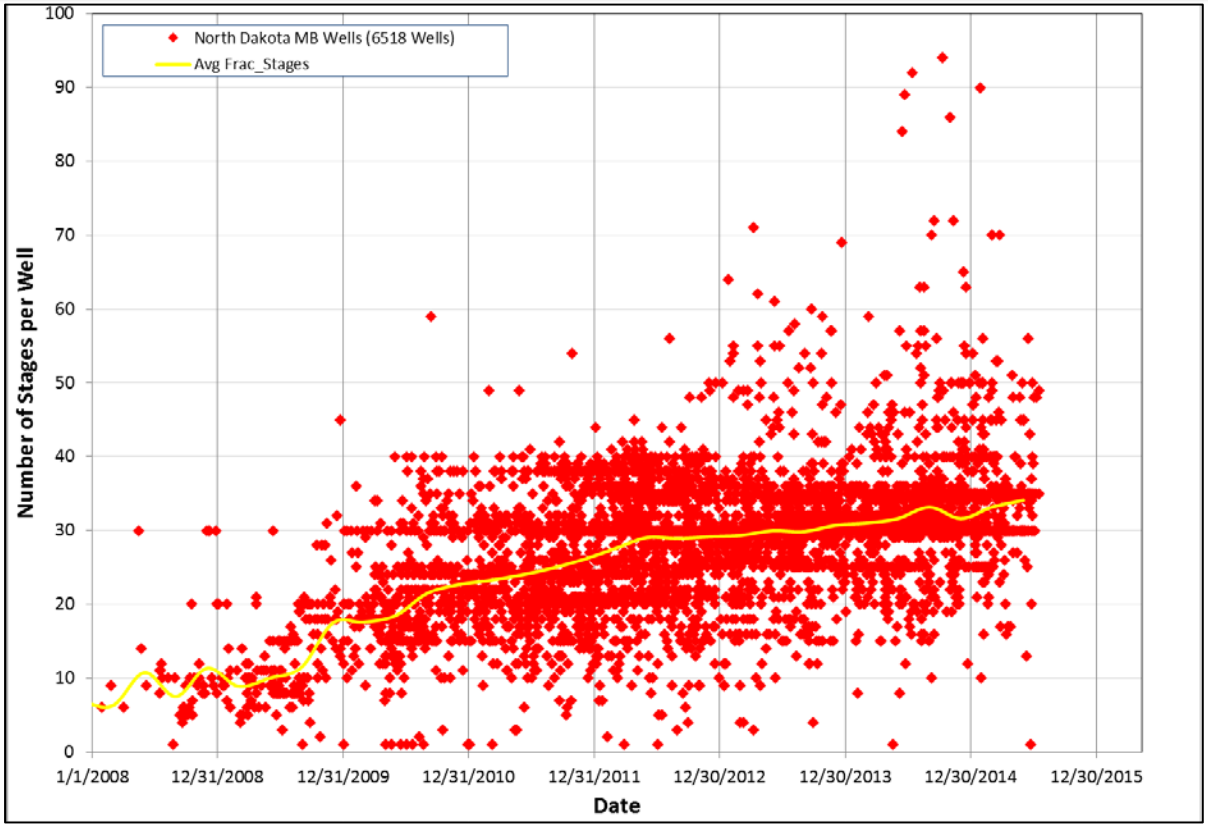
7.5 MM$ D&C
4% IRR

7 MM$ D&C
-4% IRR

6.5 MM$ D&C
-13% IRR

Bakken Historical Completions

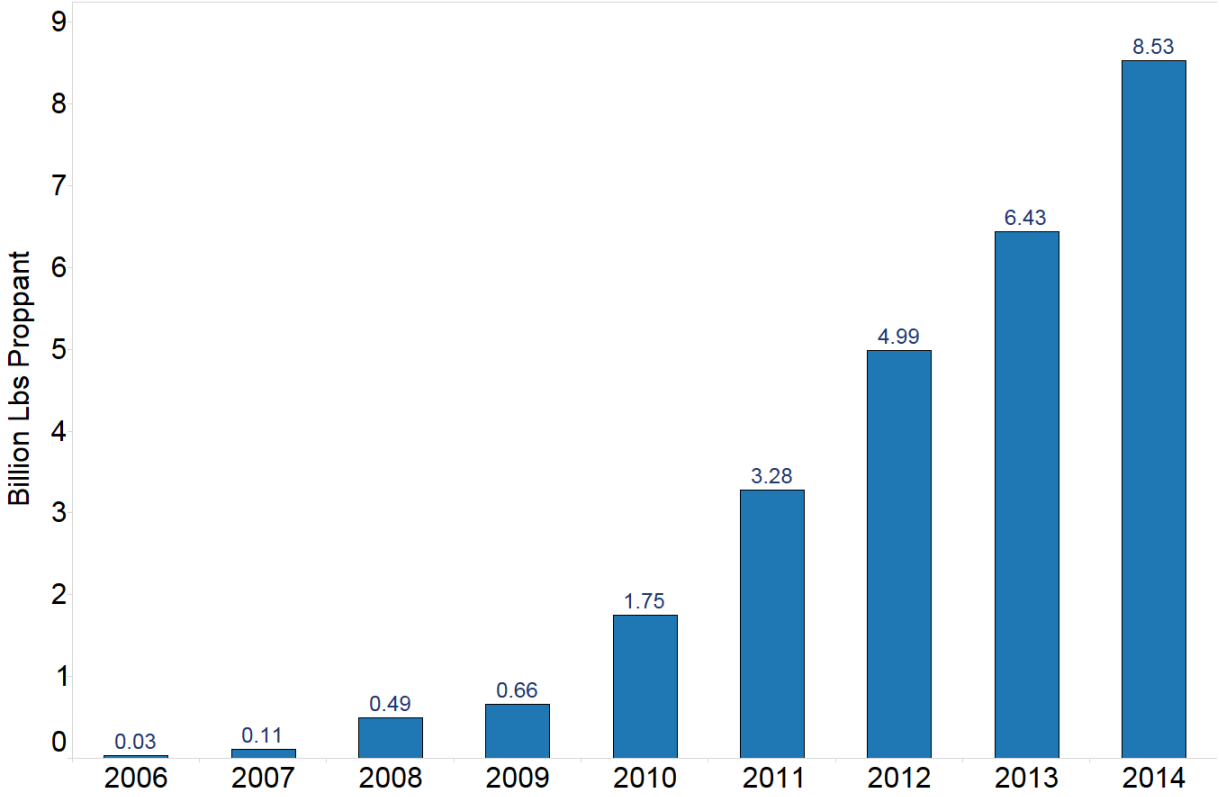
Number of Frac Stages/Well



Stage Count / Interval Length

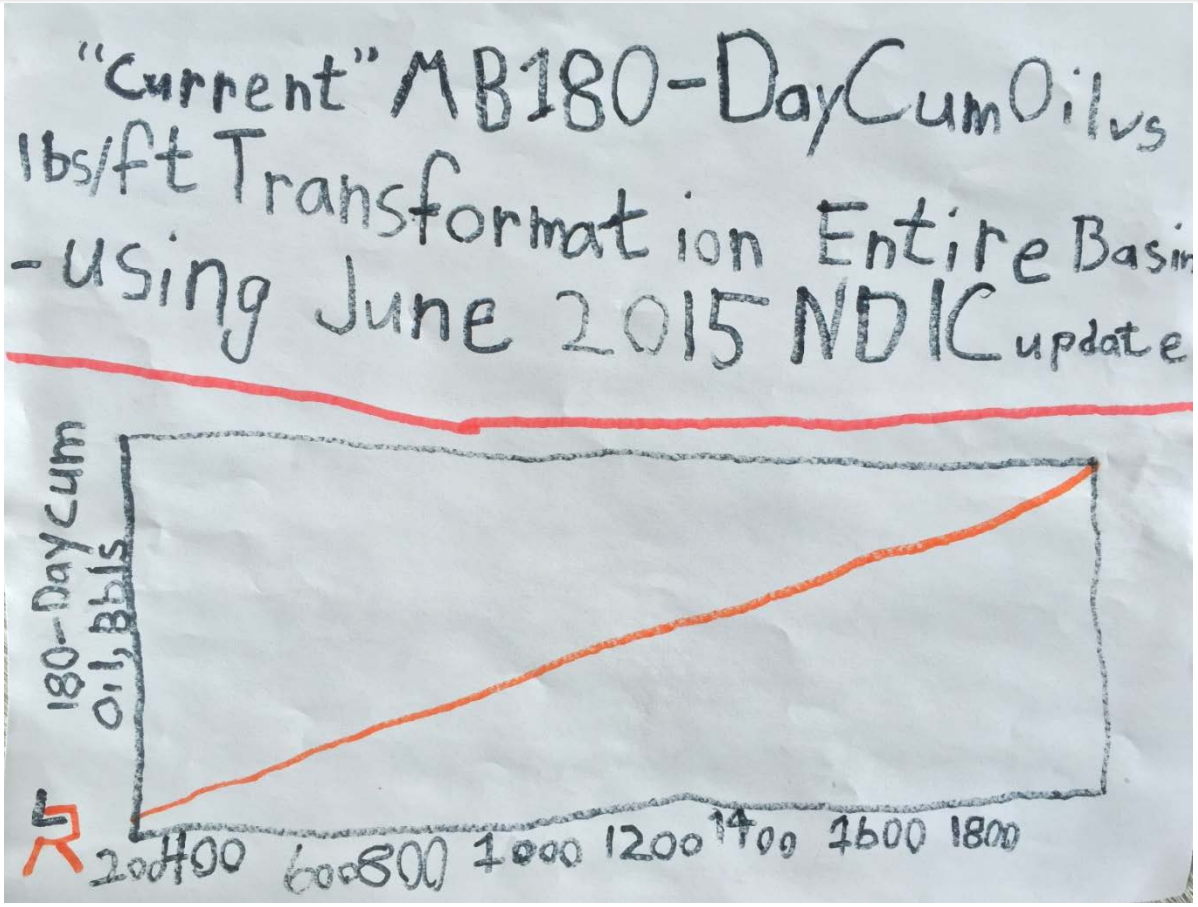
- More Stages → More Production / Recovery
  - Change the Pumping Contract from “per stage” to “per increment of pumping time”
  - Reduce the # of stages, but pump larger volumes to maintain designed proppant lb/ft or volume bbl/ft
  - Re-design with fewer stages but having more perforation clusters – go from a “stage design” to a “cluster design”.

ND Proppant Usage (Billion Pounds/Year)

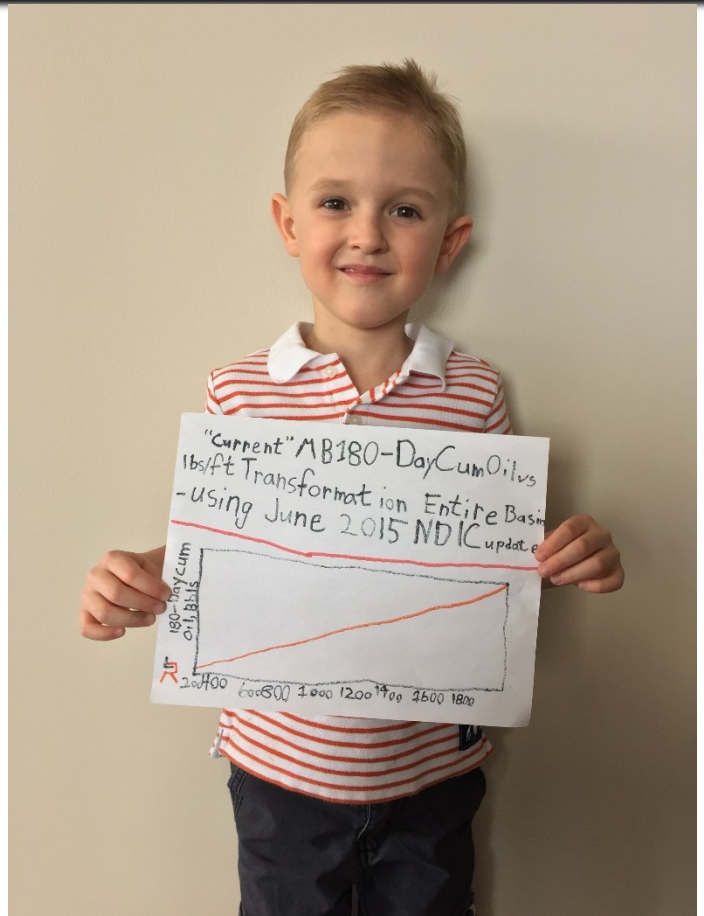


SPE Hydraulic Fracturing Technology Conference

Frac Design per the IR Analysts? ……

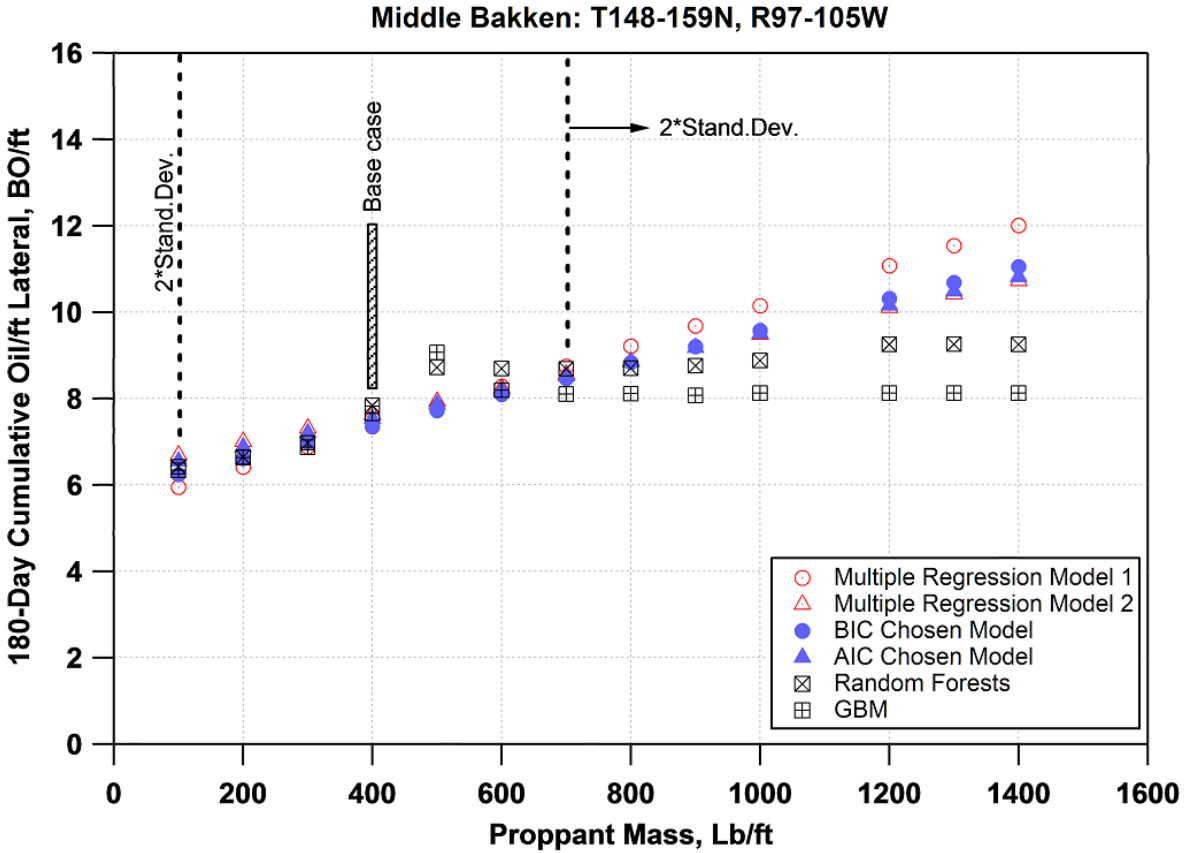


William “FracPup” Pearson



Be Careful Using Linear Correlations

SPE 179171 – E. Lolon et al; to be presented on Thursday Morning !!



Summary

- The Horizontal Well Completion is Critical to Long-Term Recovery
- The fracs you design today will define the well's recovery over the next 30 – 40 years
- Beware of making cuts in the completion spend thinking it is just affecting initial production rates and early-time cumulative production
- Use the slowdown in industry activity to do a better job engineering the completion and not just using a geometric design.
- Work on "GeoEngineering" your completion

Liberty Resources' "Fracking to Survive in 2016"

- Frac wells as needed to HBP acreage or maintain financial covenants
- Changed design to reduce costs:
  - Larger job sizes rather than more frac stages
  - Pumping higher proppant concentrations to cut fluid volumes ~10%
  - Changing from premium proppants to sand
  - Reducing the chemical additive packages to what has been proven to be needed
- Changed design to improve performance:
  - More proppant volume per lateral foot
  - More perforation clusters having less individual perforations
  - Use of diversion material during the stages
- GeoEngineering the completion

Acknowledgements

Co-workers at Liberty Resources and Liberty Oilfield Services


LIBERTY
RESOURCES
THANK YOU