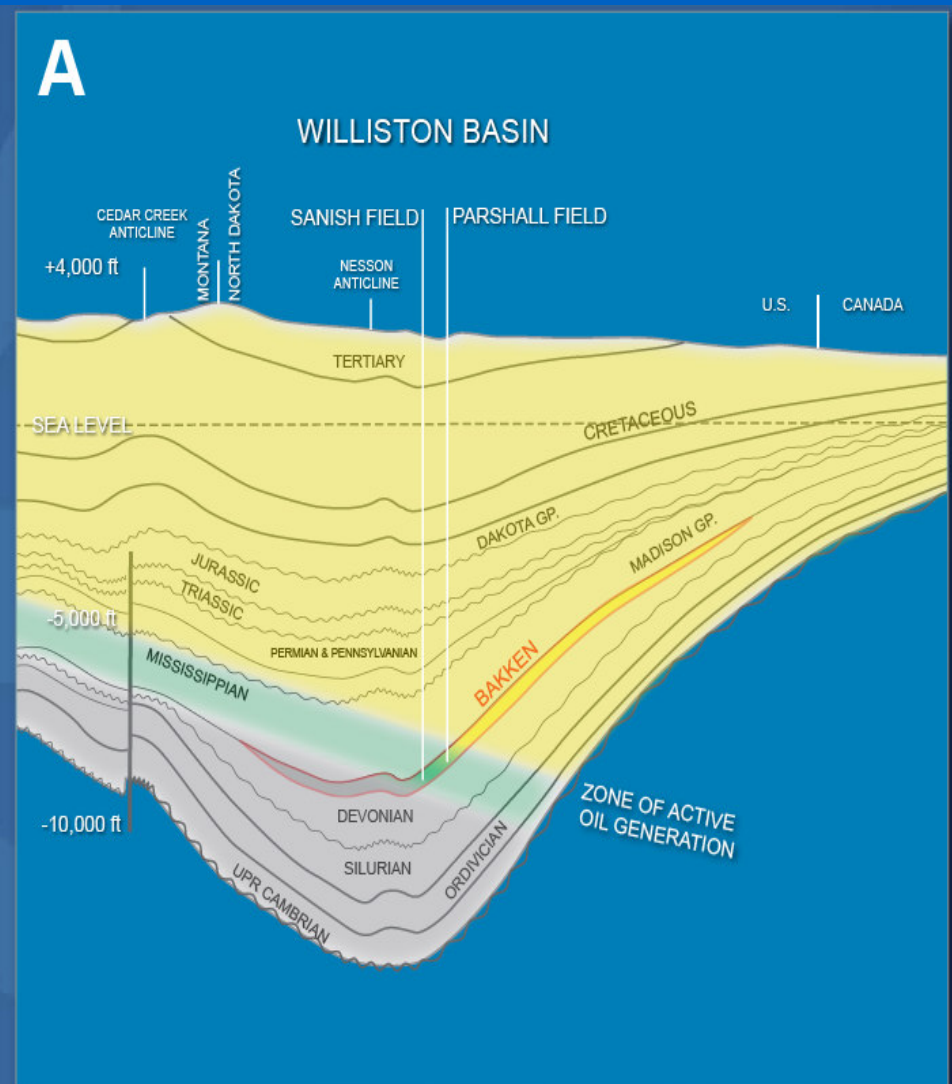
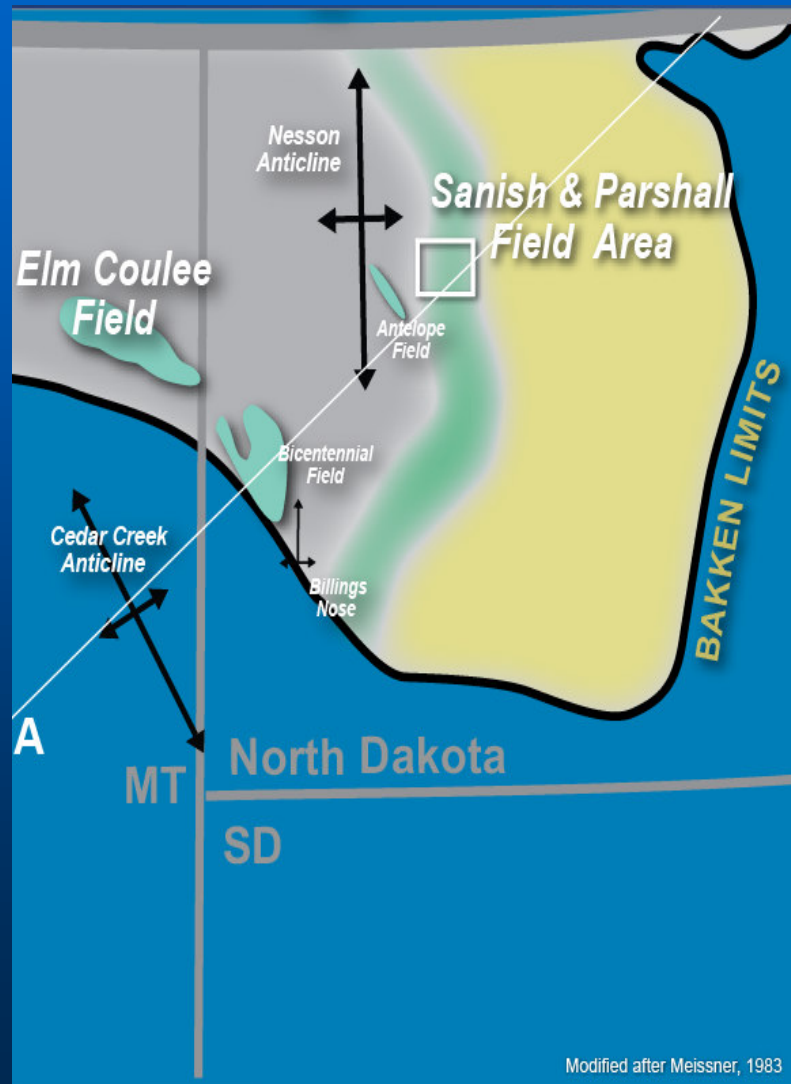


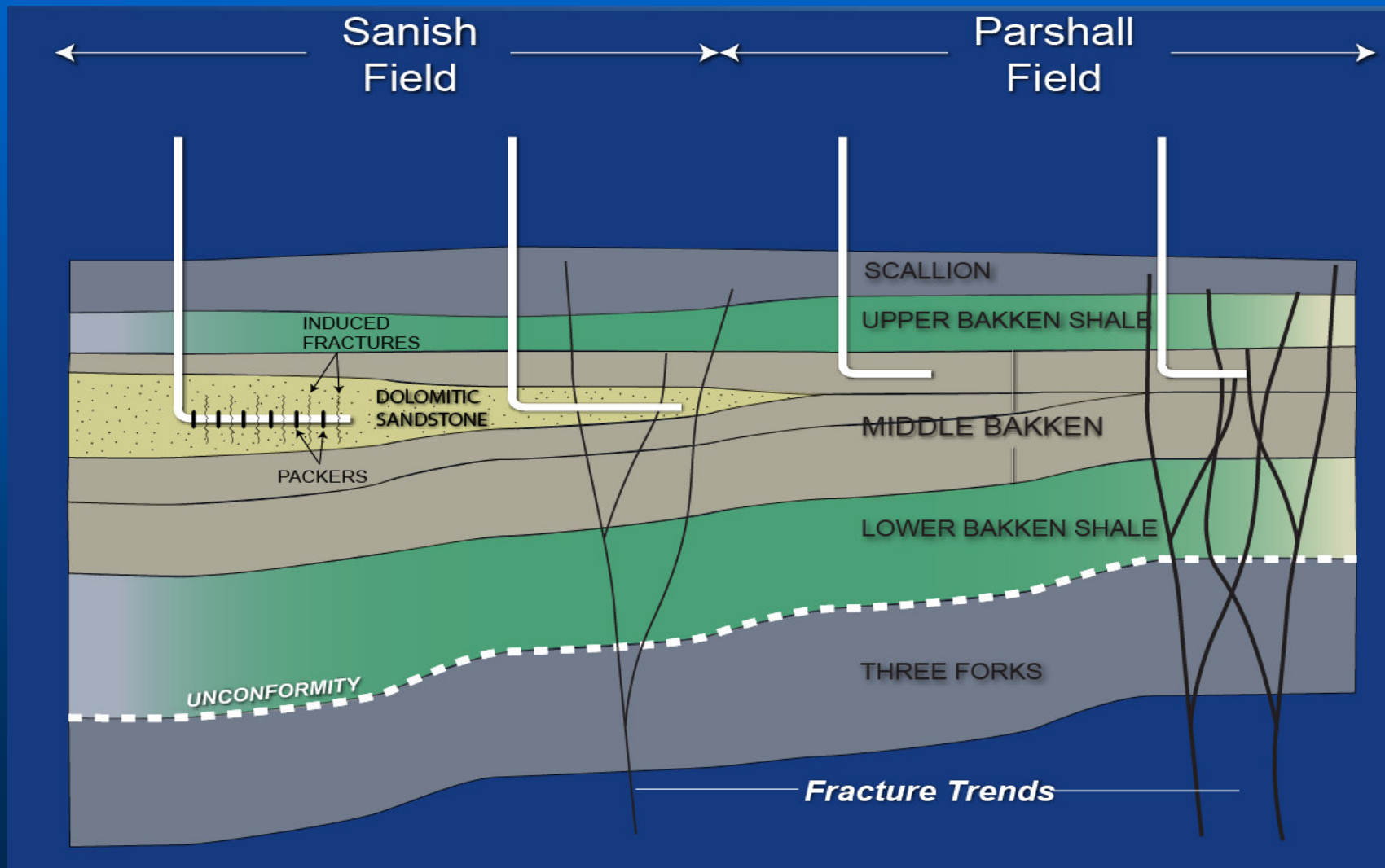
Unlocking Tight Oil: Selective Multi-stage Fracturing in the Bakken Shale

- John Paneitz & Brent Miller, Whiting Petroleum Corp.
- Sean Yakeley & Kent Evans, Baker Hughes, Inc.

Bakken Development Area

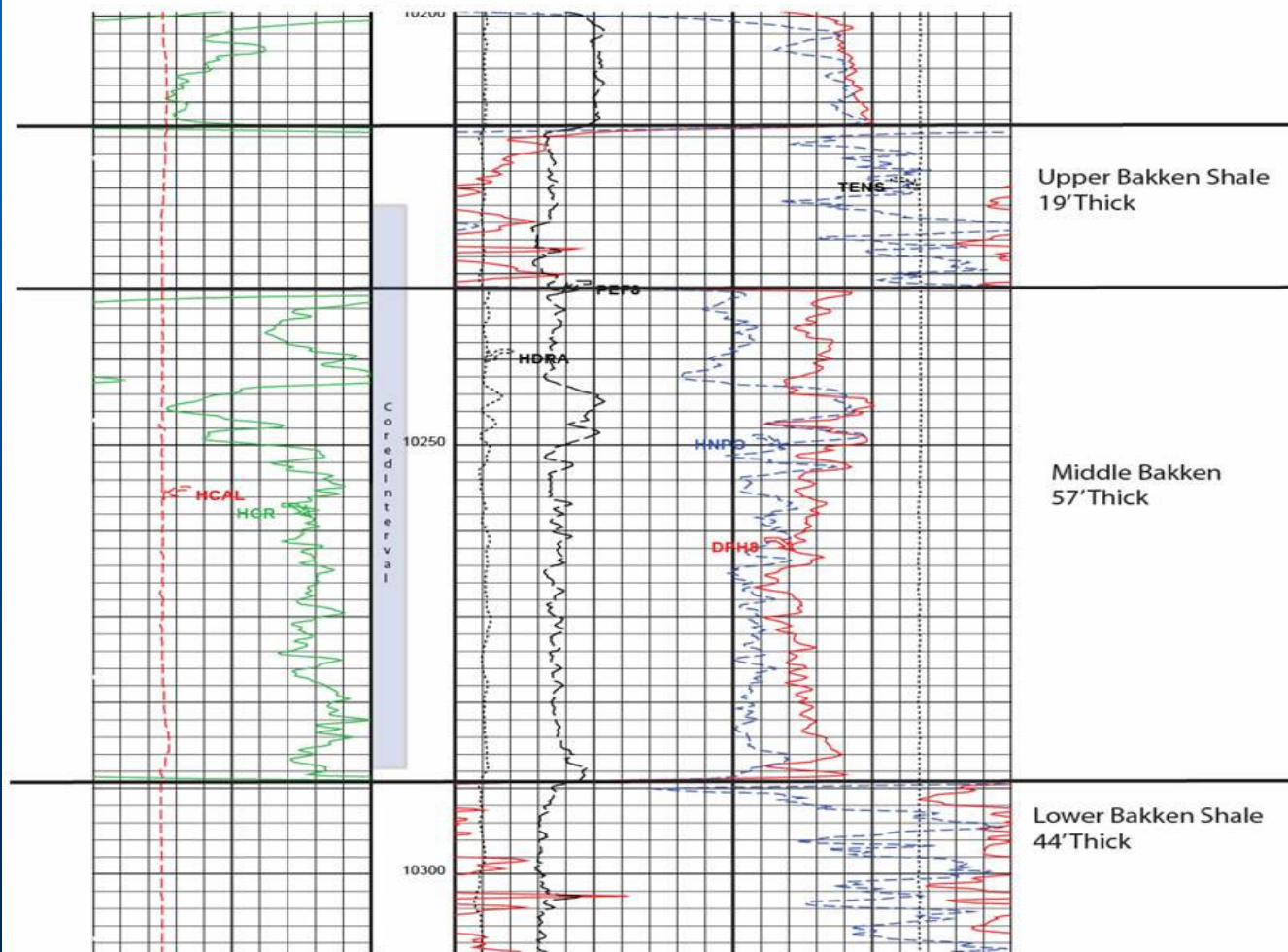


Bakken Cross-Section



Bakken Interval

Bartleson 44-1H Pilot Hole High Resolution Porosity Log
SE SE 1-T152N-R93W
Mountrail Co., North Dakota

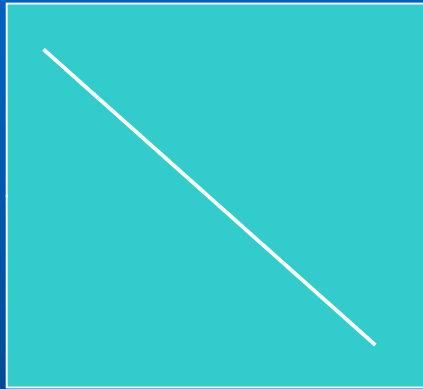


Design Goals of Bakken Completion Strategy

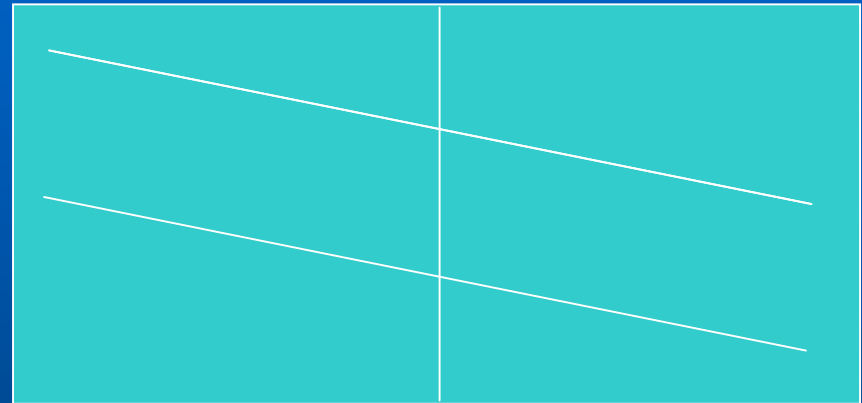
- **Mechanical Fracture Diversion**
 - Sand slugs, frac balls largely ineffective
- **Maximize Reservoir Exposure**
 - Intersect natural fractures
- **Simple and Cost Effective**
 - Time savings = \$ savings

Well Configuration?

640 acres

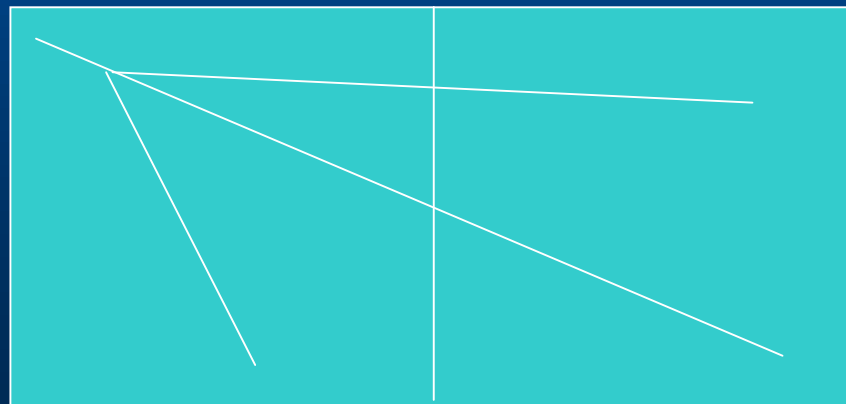


1280 acres

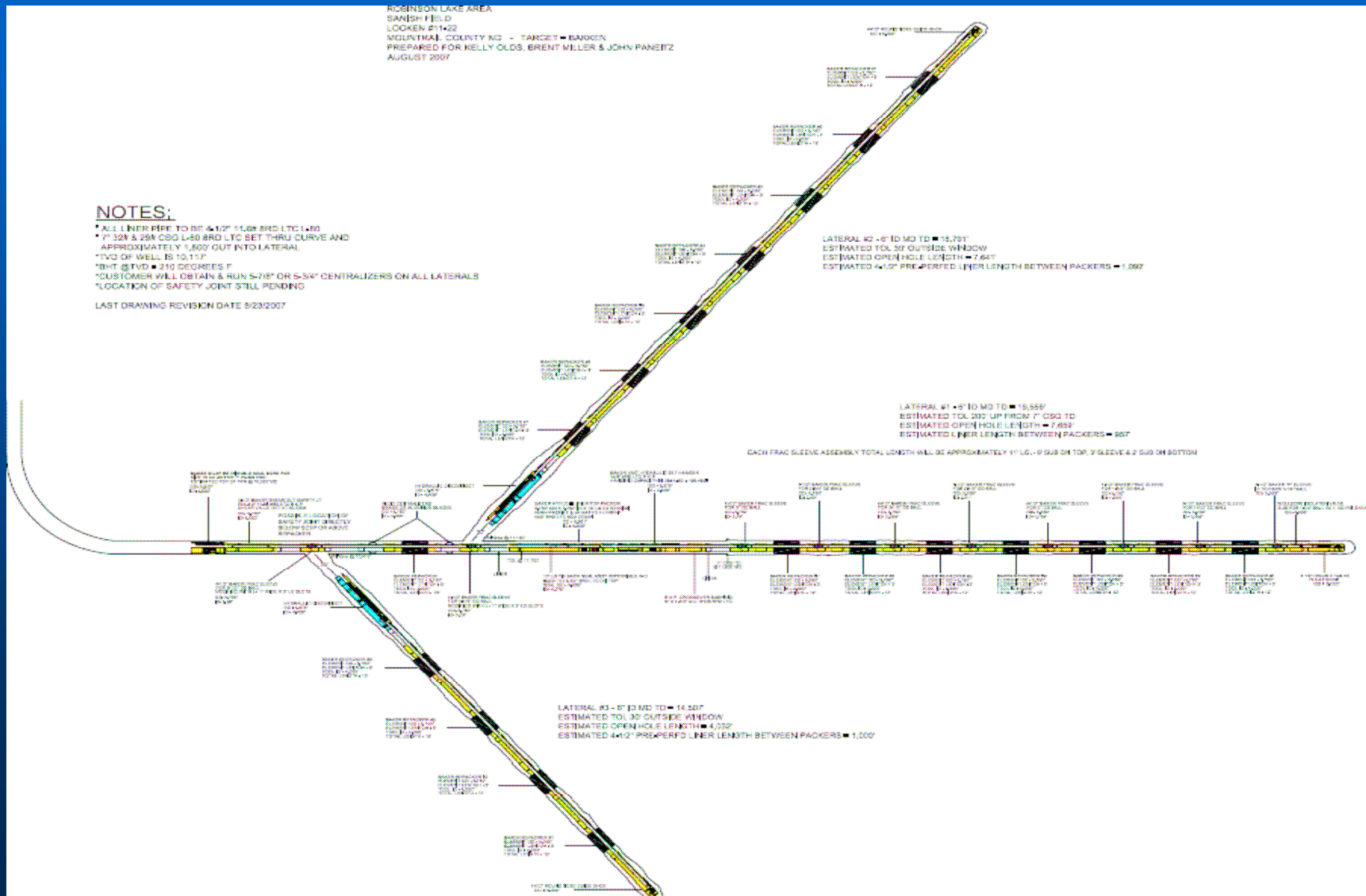


Or

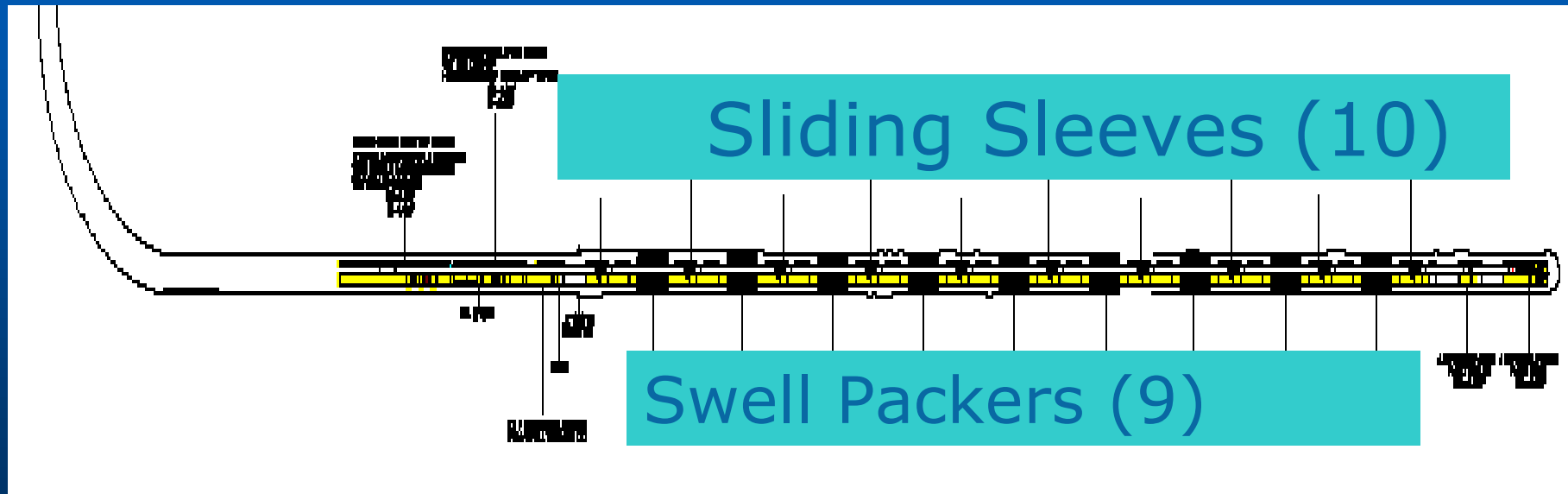
Or



Original Tri-lateral Design

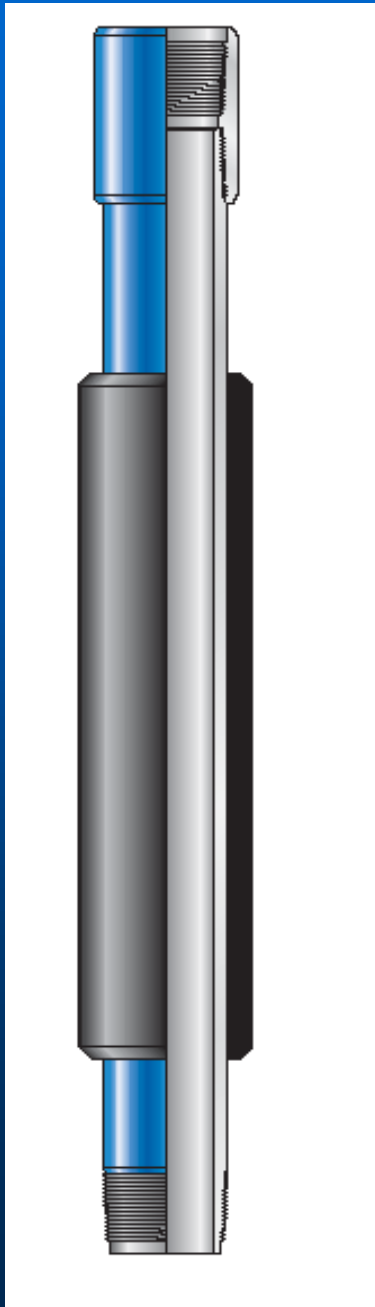


Single-leg Horizontal



Components of System

- Oil Swelling open-hole packers
 - 3'x5.75" tools in 6.00" hole
- Sliding Sleeves (ball actuated)
 - Slotted frac ports
 - Spaced 900' apart
- Double Float-shoe and Float collar
 - For wellbore isolation
 - Could use P-sleeve
- Liner hanger/packer



Oil-Swelling, Open-hole Packer

3'x 5.75" element

Swell Packer Predictor

REPackTM Swell Predictor

Job Details

Customer	
Well Name	
Geomarket Location	
Date	

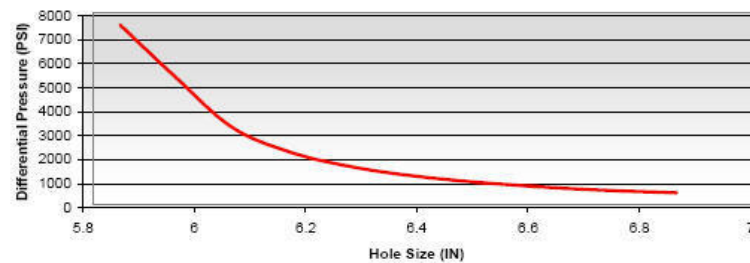
Well Data Input

	Value	Units
Well MD		mts
Well TVD		mts
Run-in Drift		in
Max Deviation		Degrees
Max Dog-Leg Severity		Deg/100ft
Setting Depth		mts
Setting Depth Deviation		Degrees
Setting Depth Hole Size	6	in
Open Hole / Cased	Open	
Wellbore Fluid		
Specific Gravity		API
Salinity		%
Viscosity		cP
Run-in Time to Setting Depth		Hrs
BHT (Setting Conditions)	220	F
BHT (Flowing Conditions)		F
BHP (Static)		psi
BHP (Flowing)		psi
Additional Comments (Mineral Presence, Wellbore Stability, Gauged Hole, etc,...)		

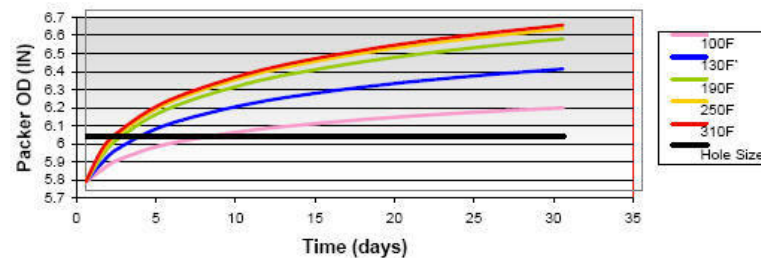
Packer Description

	Value	Units
Mandrel Size	4.5	in
Element OD	5.75	in
Element Length	3	ft
Packer Style	Mandrel Wrapped	
Activation Fluid	Oil	

Differential Pressure vs. Hole Size



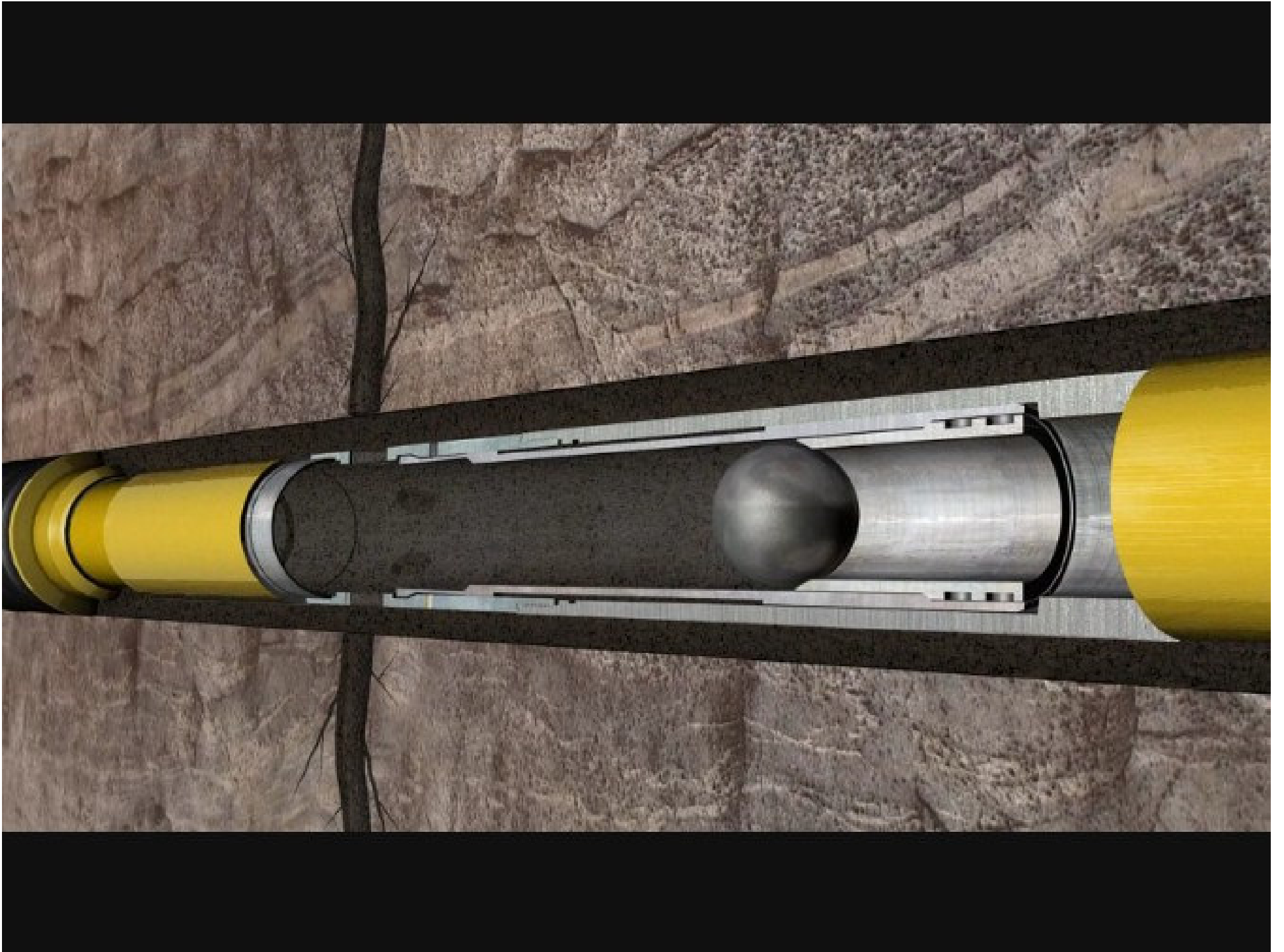
Swell Rate vs. Time (Per BHT)



Output Calculations

% Swell	22.9%
Pressure Differential	4072 PSI
Time to Swell (Est.)	2.3 days

Baker Oil Tools Representative





2nd Stage

1.50"



3rd Stage

1.75"



4th Stage

2.00"



Typical Bakken Frac Design

“Hybrid” Frac design

1.8 Million lbs proppant

600,000 lbs 100 mesh

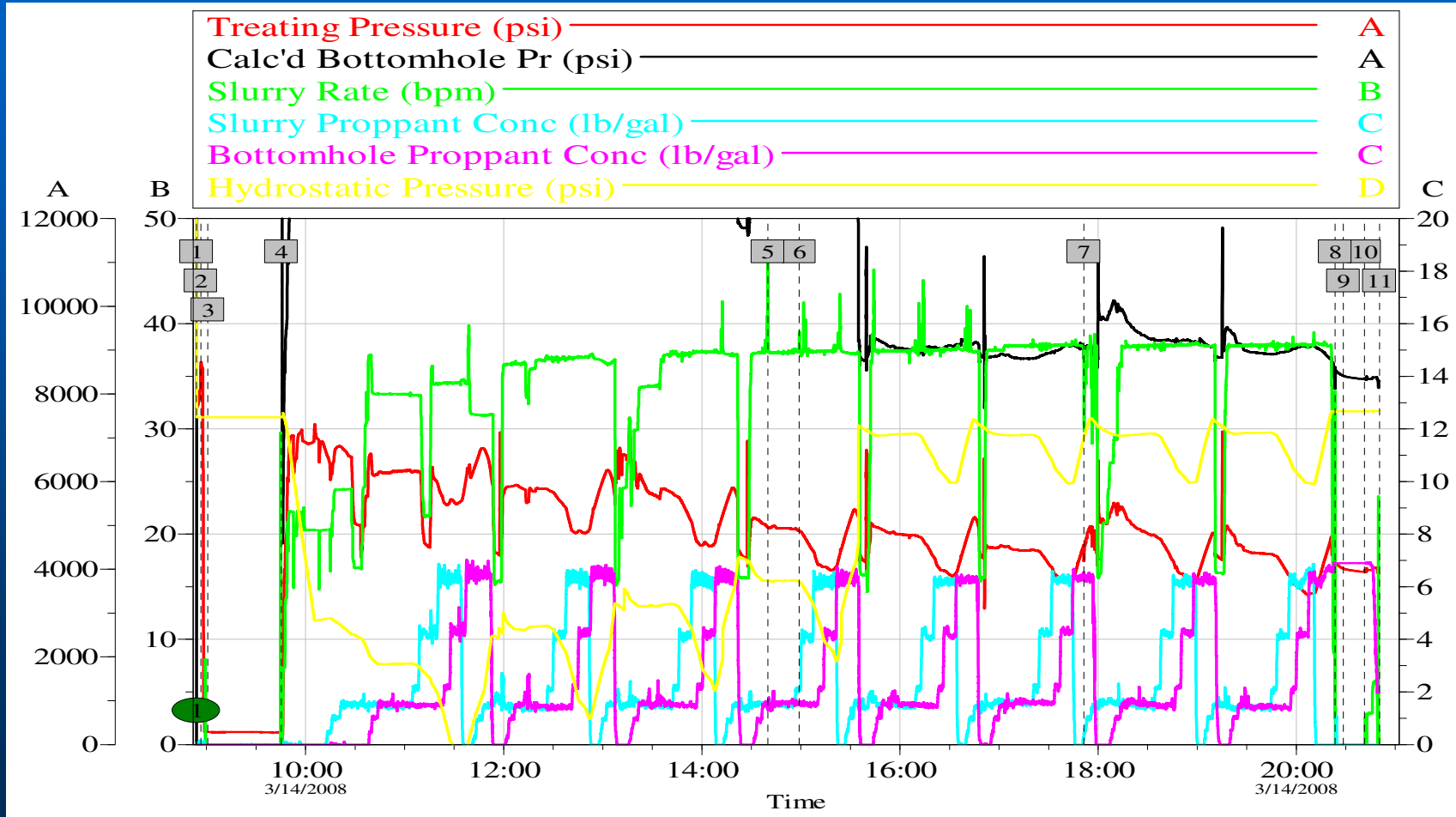
1,200,000 lbs 20/40 sand

18,000 barrels fluid

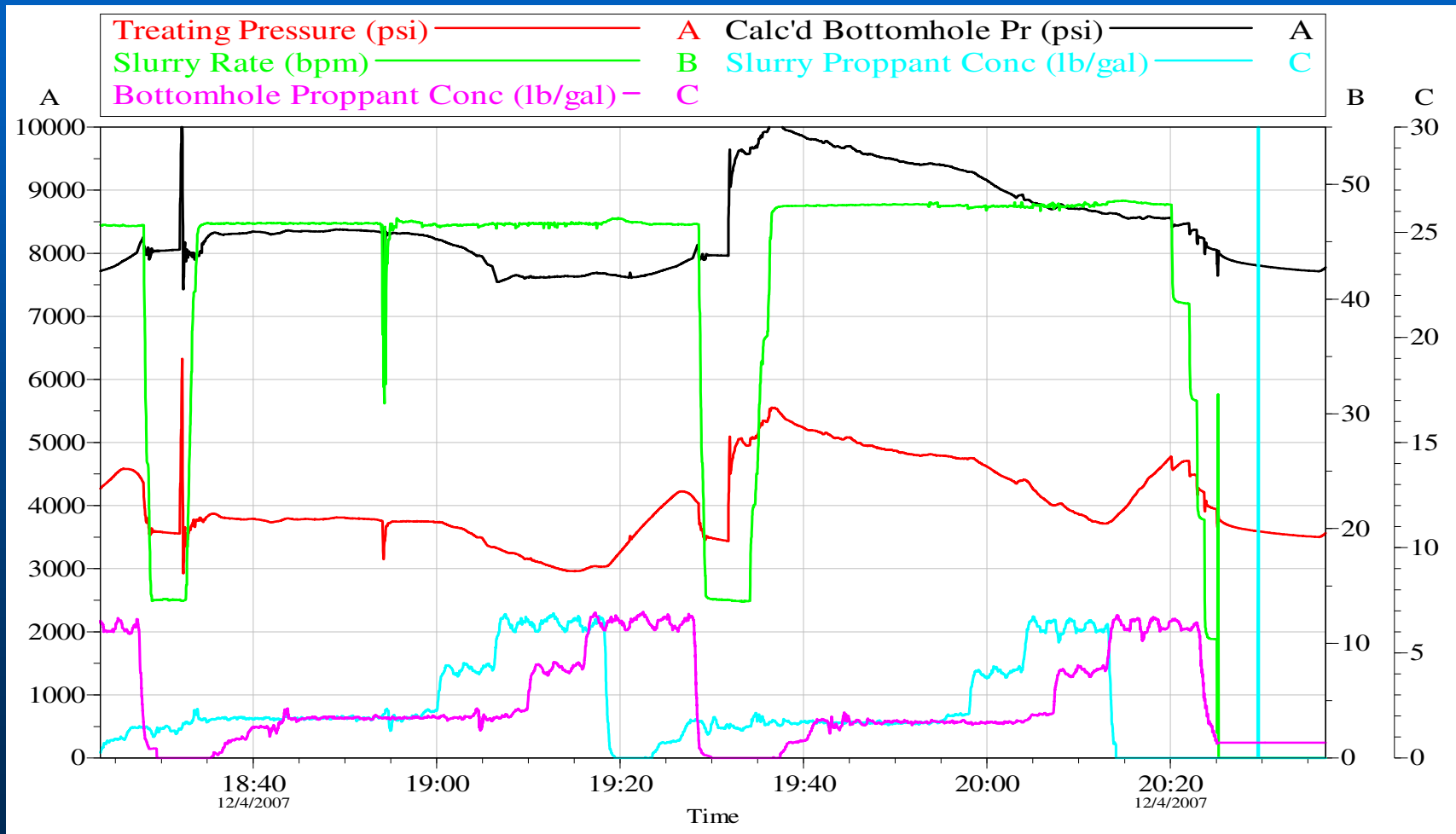
30-40 BPM

Continuous 10-12 hrs. pumping

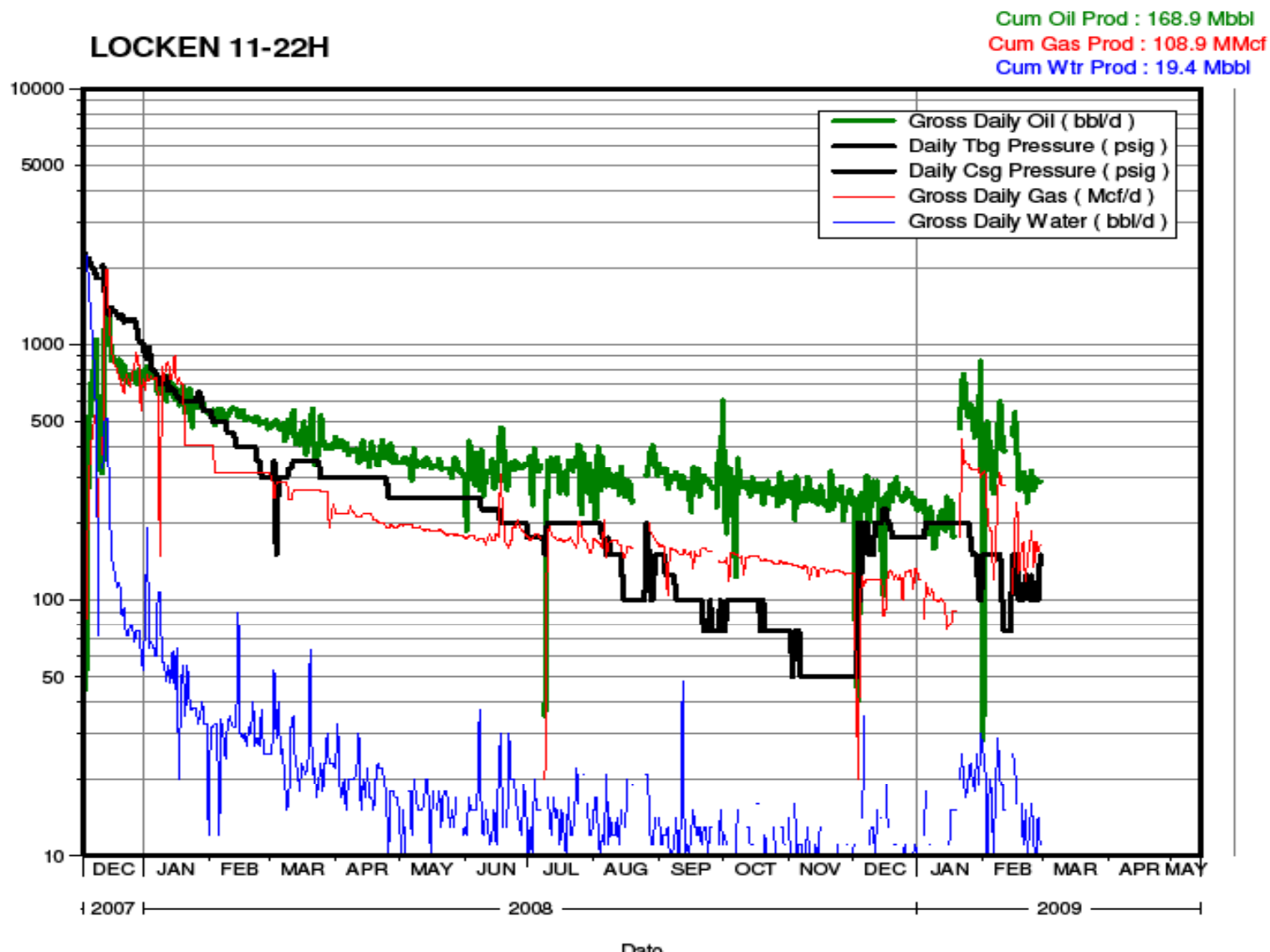
8 stage frac



Two Frac stages with varying treating Pressures



Typical Bakken Producer



30- and 60-day Average Production Rates for Whiting Operated Sanish Field Wells in 2008 and 2009



Well Name	WI	NRI	Comp. Date	IP (BOE/d) 24-hr. Test	Average 1st 30 Days (BOE/d)	Average 1st 60 Days (BOE/d)
1) Fladeland 12-18H (Infill)	99%	81%	02/18/09	1,765	N/A	N/A
2) Niemitalo 11-35H	71%	58%	02/04/09	3,547	N/A	N/A
3) Braaflat 21-11TFH	97%	79%	12/31/08	1,005	N/A	N/A
4) McNamara 42-26H (Infill)	90%	73%	12/06/08	2,170	737 ⁽¹⁾	715 ⁽¹⁾
5) Bartleson 11-19H	93%	76%	11/18/08	1,325	494 ⁽¹⁾	357 ⁽¹⁾
6) Smith 11-20H	99%	80%	11/05/08	3,405	1,097 ⁽¹⁾	877 ⁽¹⁾
7) Kinnoin 11-14H	52%	42%	10/29/08	3,646	1,476	1,237
8) Richardson Federal 11-9H	85%	69%	10/22/08	4,570 ⁽²⁾	1,274	1,195
9) Roggenbuck 11-25H	78%	64%	10/13/08	1,950	730	553
10) Lacey 11-10H	73%	59%	09/29/08	1,811	953	781
11) Pennington 11-3H	66%	54%	09/20/08	1,473	715	585
12) Nesheim 1-24H	67%	54%	09/10/08	2,169	1,072	912
13) Brehm 44-5H	99%	81%	09/04/08	1,298	678	529
14) Kannianen 11-4H	95%	77%	08/09/08	2,226	956 ⁽³⁾	1,018
15) Smith 11-7H	69%	56%	07/31/08	2,421	725 ⁽³⁾	758
16) Littlefield 11-29H	93%	75%	07/27/08	2,069	673 ⁽³⁾	642
17) Stenseth Trust 11-5H	73%	59%	07/06/08	3,044	905 ⁽³⁾	718
18) Lacey 11-1H	86%	70%	07/01/08	2,330	978	792
19) Behr 11-34H	54%	44%	06/20/08	3,245	1,373	970
20) Abbott 11-18H	99%	80%	06/16/08	1,959	1,010	890
21) Locken 14-28H	78%	63%	05/31/08	1,719	930	755
22) Braaflat 11-11H	97%	78%	05/23/08	2,997	1,506	1,268
23) Maynard Uran Trust 11-24H	84%	68%	04/23/08	2,132	1,041	869
24) Peterson 11-34H	91%	75%	03/19/08	1,088	551	437
25) Liffbrig 11-27H	81%	67%	01/24/08	2,538	1,120	923
Averages	83%	67%		2,316	954	808

⁽¹⁾ Daily crude oil volumes were affected by winter weather in North Dakota, which caused delays in trucking operations.

⁽²⁾ The Richardson Federal 11-9H recorded the highest initial rate for any Bakken well drilled to date, according to the NDIC.

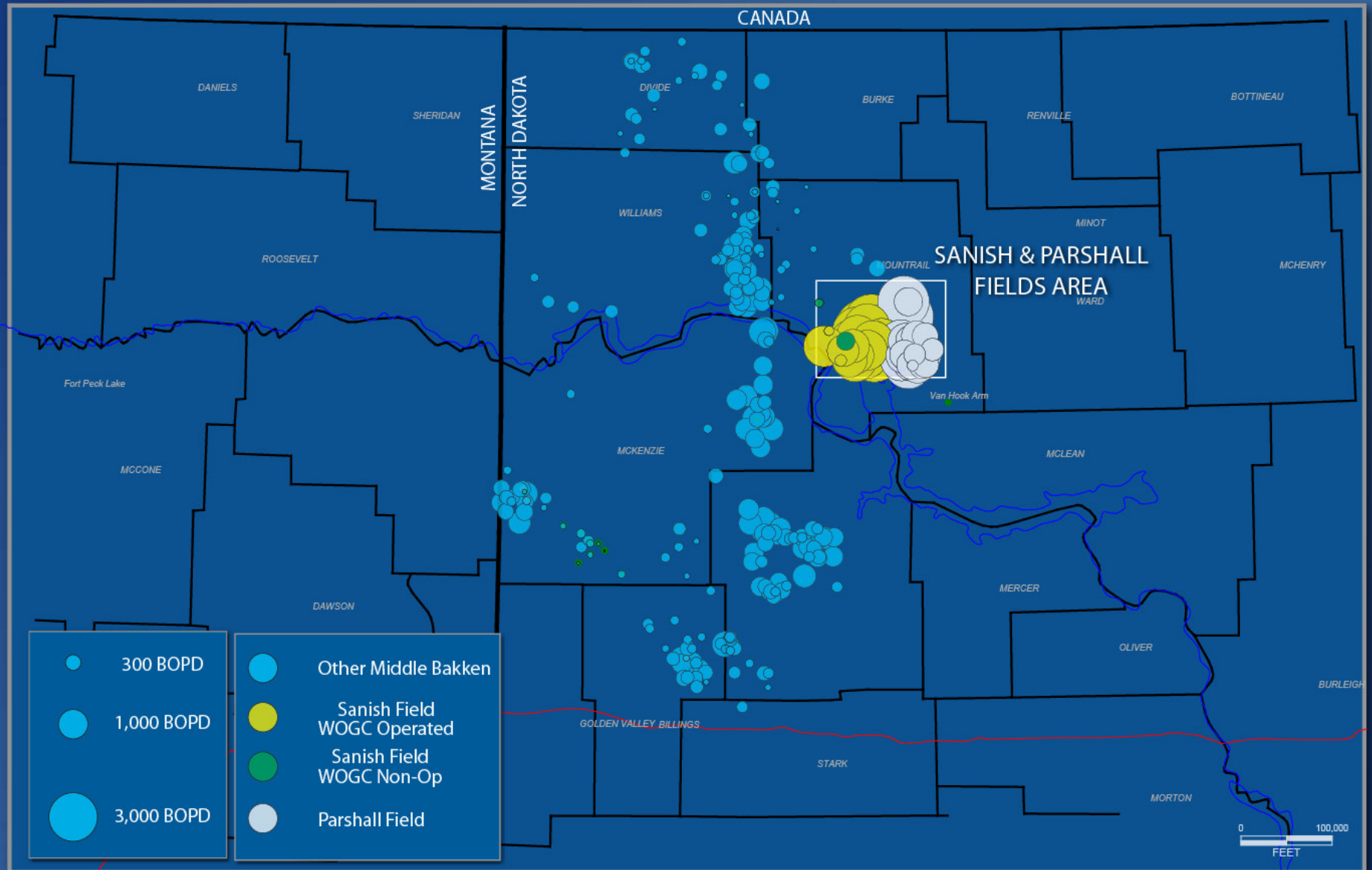
⁽³⁾ The first 30-day average production rate was restricted due to maintenance on the Enbridge crude oil line.

Reported Initial Oil Rate

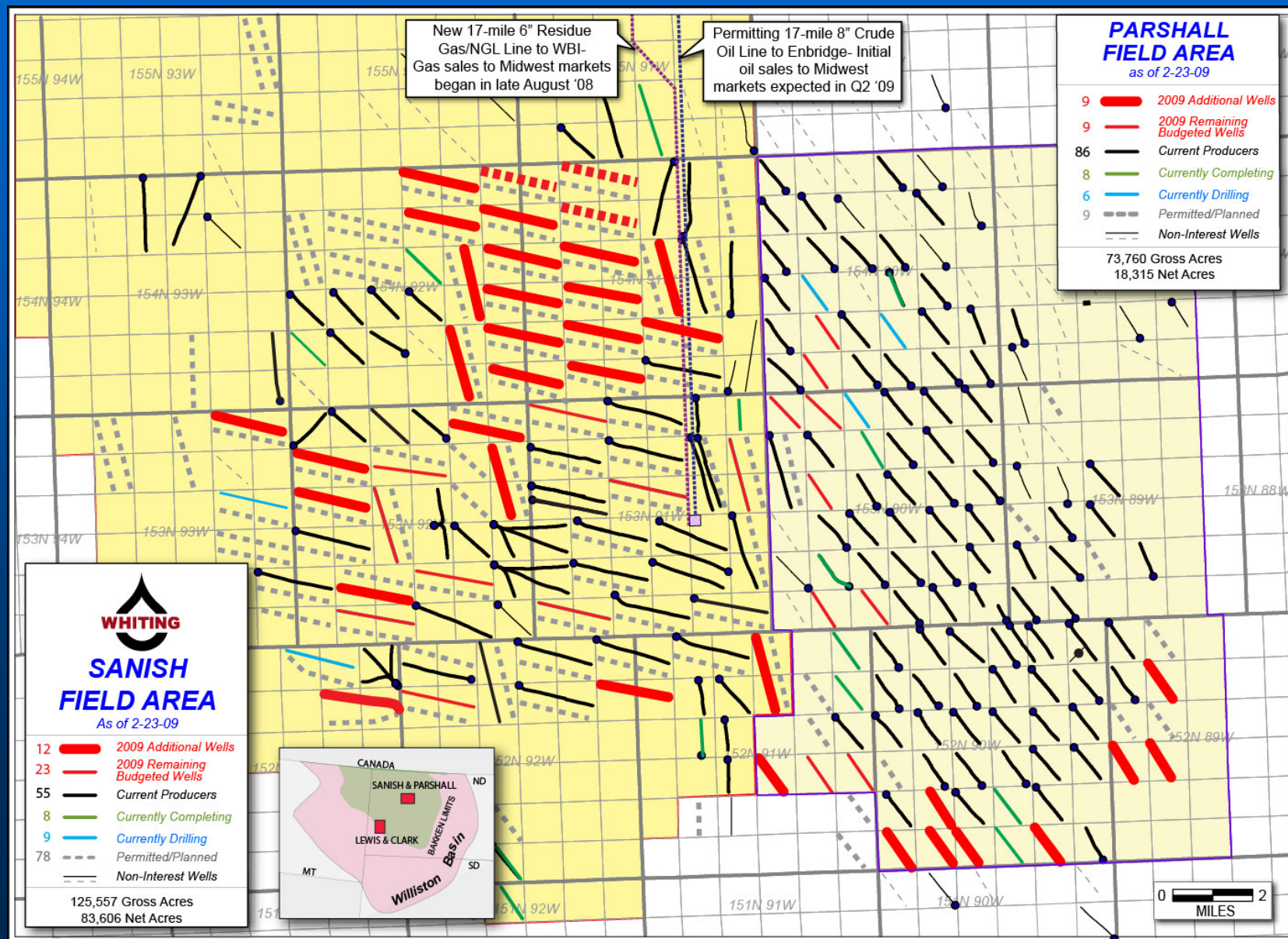
North Dakota Middle Bakken Horizontal Wells since 2000

North Dakota Industrial Commission

October, 2008



Sanish & Parshall Fields



Conclusions:
(or)
Benefits of Swell/Sleeve Design

- Positive frac diversion
- Rapid completion
- Rig-less completion
- Low mechanical risk

Contact Information:

John M. Paneitz

Sr. Operations Engineer

Whiting Petroleum Corp

1700 Broadway

Denver, CO 80290

(303) 390-4921

JohnP@whiting.com