

12-13,000'
Red lift (few ESP)



CURTIS WHITSON PVT COURSE
POWDER RIVER BASIN FRONTIER DATA

June 9 & 10, 2016
Houston, TX

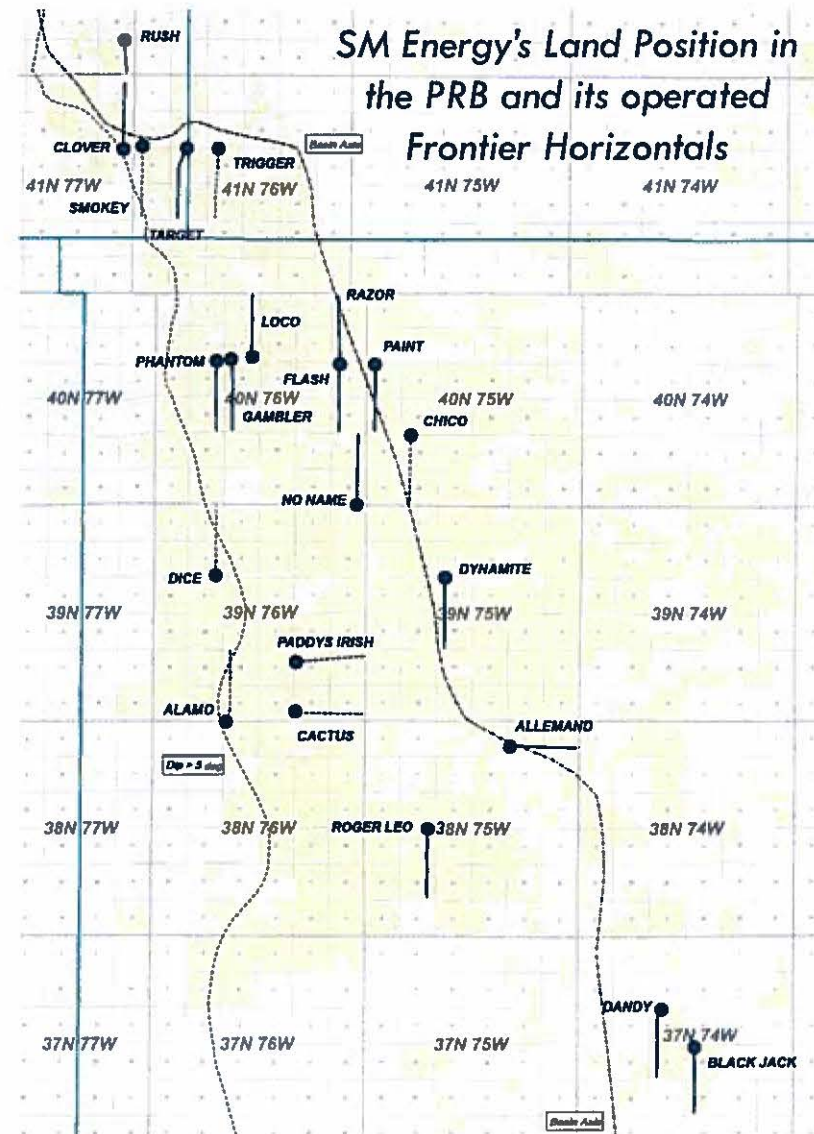
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FUNDAMENTAL QUESTIONS

- How do we better predict the GOR behavior of a Frontier Horizontal well?
- What is the Peak GOR going to be for a Frontier Horizontal Well?
- What is the optimal flow back progression and artificial lift system to maximize oil and gas reserves?

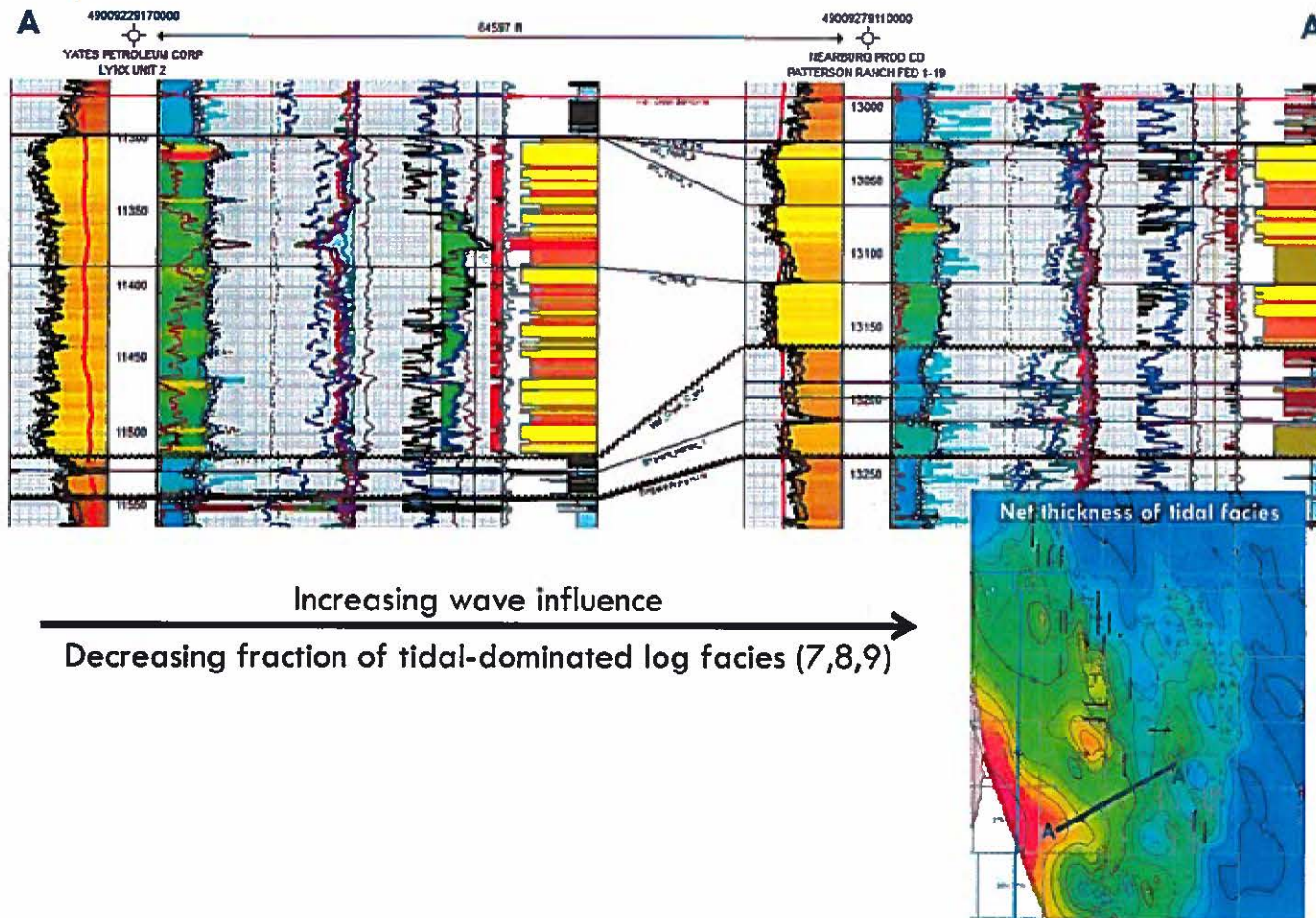
FRONTIER REVIEW

- Geologic Overview
- Type Curve Areas
- Pressure, GOR, WC Maps
- Reservoir Volumetrics
- Production Data for Wells with PVT
- Wells of Interest
- Rate Transient Analysis Work



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FRONTIER RESERVOIR CHARACTERISTICS



Reservoir mapping based on ~600 vertical wells with QC'd, edited, and normalized digital log data sets

Mapping cutoffs:

- $V_{sh} \leq 0.35$
- $\Phi_{IE} \geq 0.03$

Horizontal Resource defined by:

- Porosity 3-10%
- Water saturation 30-60%
- Permeability .005-5 mD

OOIP: 2-12 MMBO/section

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FRONTIER TYPE CURVE AREAS

Type Curve Area Definitions

Tier 1 Areas: >2.5 phi-h LF(8&9)

Tier 2 Areas: <2.5 phi-h LF(8&9) and >0.5 So-phi-h LF(7+8+9)

Tier 3 Area: High GOR, Gas at reservoir Conditions

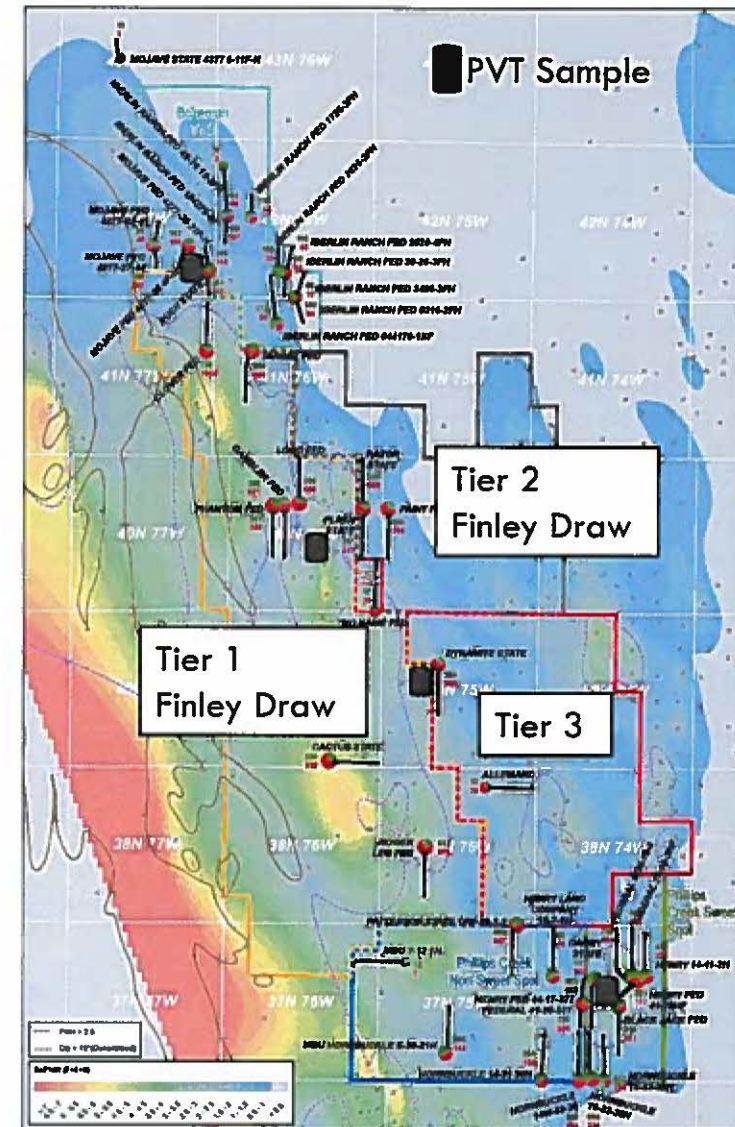
PVT Data Summary

Rush - Modern recombined sample, Black oil Pb = 3290 psi Tests CCE, DL viscosity, Single stage separator Test

Dynamite - Modern recombined sample, Wet gas DP= 5800 psi Tests CCE, CVD, Separator tests

USA 22-1-1980's sub-surface sample, Volatile oil Pb = 4250 PSI Tests CCE and viscosity

Ackerman State 41-16 - 1980's recombined Sample Volatile oil Pb = 3840 PSI CVD, 3 Separator tests

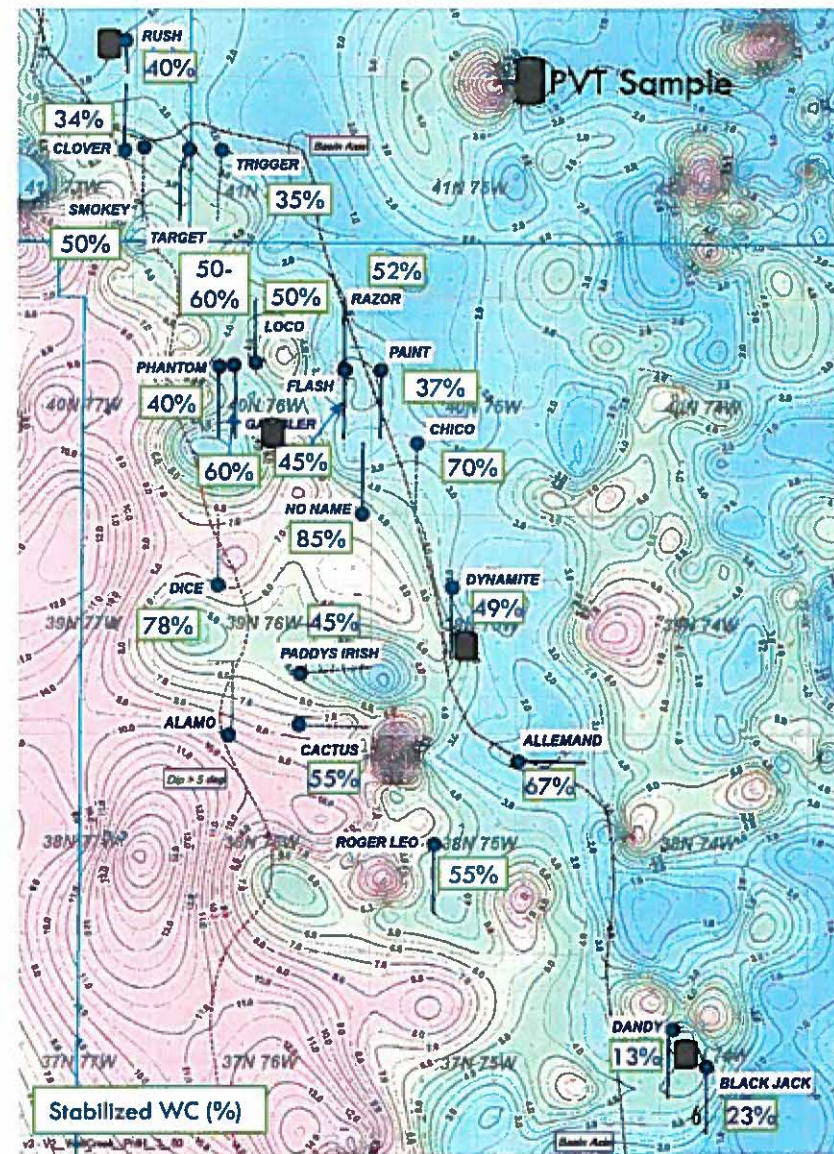


So-Phi-H map of log facies 7+8+9

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PHI*H MAP WATER CUT

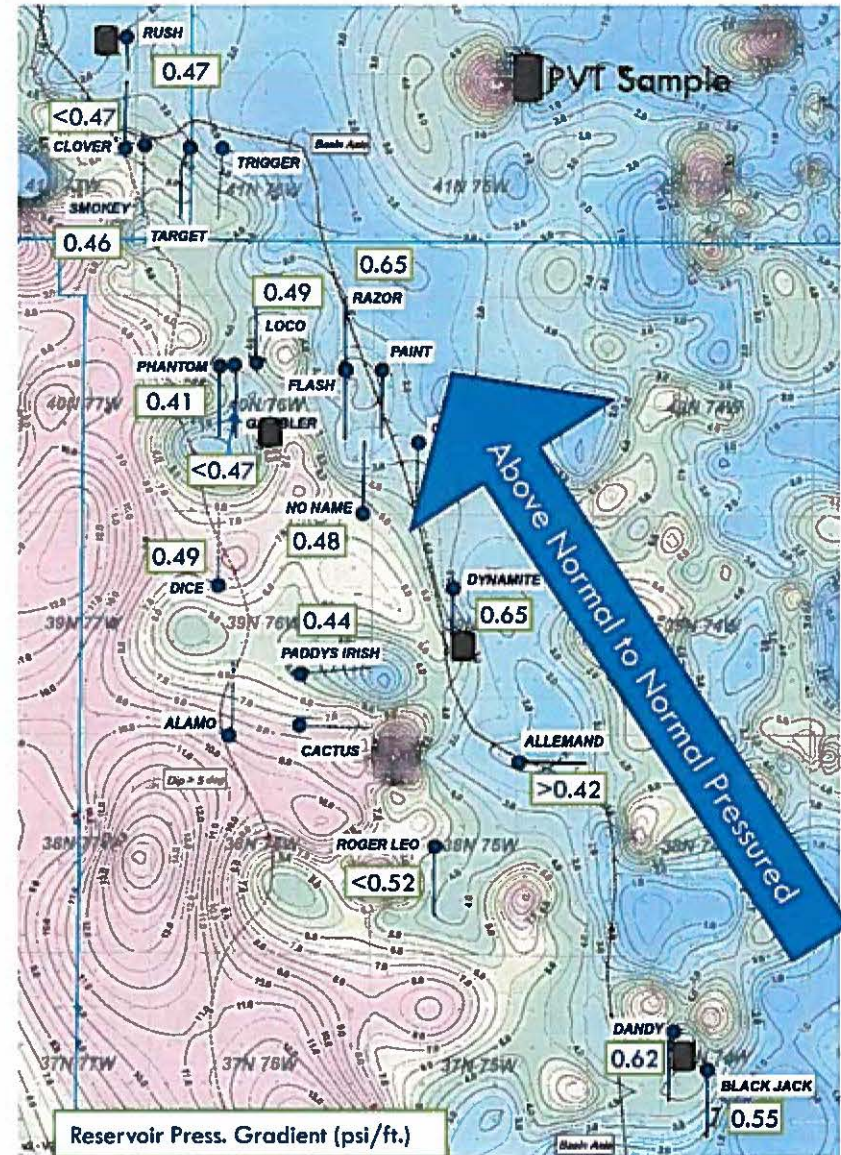
- No Name and Allemand are poor performers and have Water Cut's around 70%
- Best performers Clover, Rush, and Paint are around 30% WC



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PHI*H MAP PRESSURE

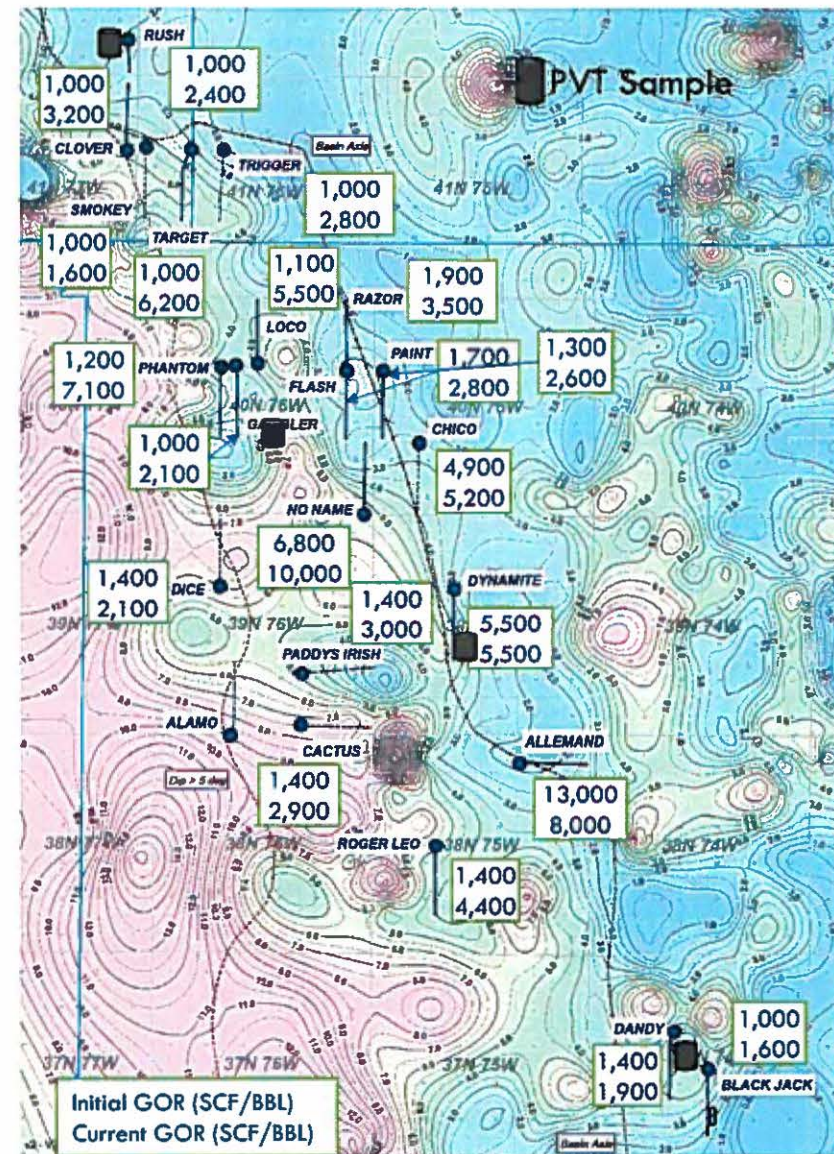
- Limited Pressure data points
- Wells to the left/west of the basin axis seem to be lower pressure



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PHI*H MAP GAS-OIL RATIO

- Wells from the Loco to the Rush have initial GOR's around 1,000 SCF/BBL
- Flash, Razor and Paint all near the basin axis and have initial GOR's around 1,500 SCF/BBL and not climbing significantly
- Phantom, Paddys, Cactus initial GOR's around 1,500 SCF/BBL and climbing quickly
- No Name, Dynamite, Chico and Allemand have very high initial GOR's

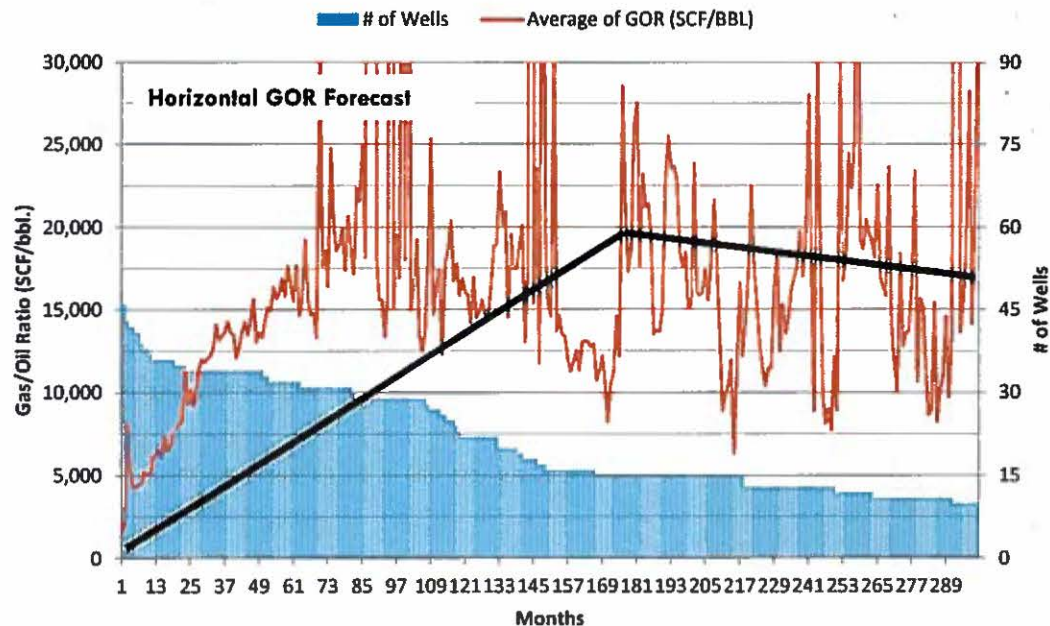


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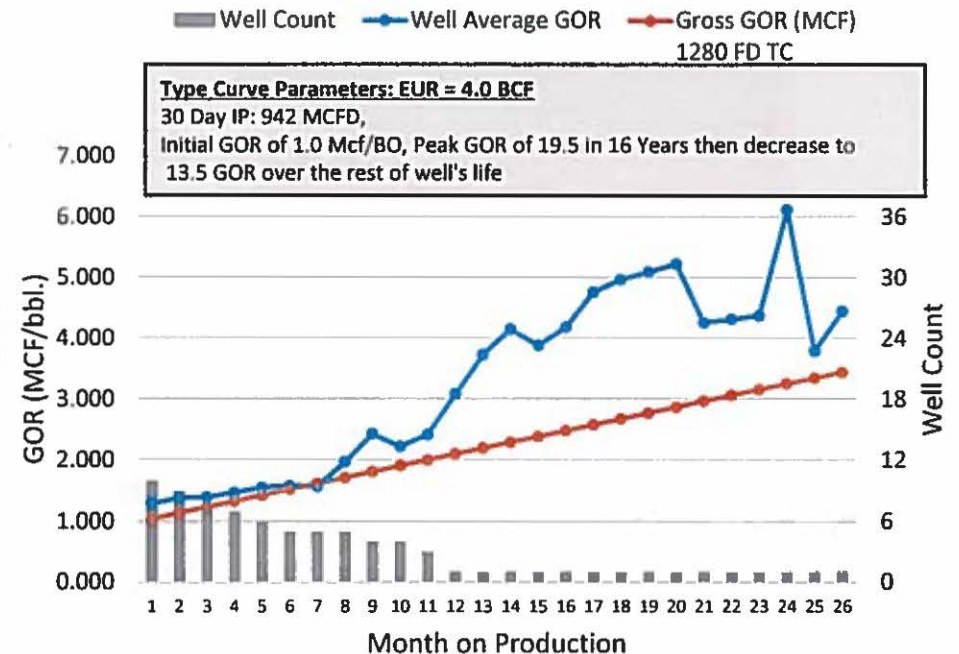
FINLEY DRAW GOR FORECAST

APPLIES TO TIER 1 AND TIER 2 TYPE CURVES

SM Energy's Frontier Finley Draw Area GOR Profile



1280 Frontier Finley Draw Gas Type Curve Comparison to Average Actual Production



- Initial GOR honors initial GOR of horizontals
- Peak GOR based on vertical wells
- Time to reach Peak GOR increased to protect overbooking of gas reserves due to PVT analysis

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FRONTIER TIER 1 VOLUMETRIC ANALYSIS

Inputs

Area: 427 Acres

Net Pay: 96 ft.

Porosity: 5.0%

Oil Saturation: 53%

Initial Reservoir Conditions

OOIP: 4.8 MMBO

OGIP: 6.8 BCF

$P_i = 6,000$ psi

$P_b = 3,943$ psi

$R_{vi} = 1,429$ scf/STB

$B_{oi} = 1.739$ bbl/STB

Type Curve Reserves: 1,171 MBOE

Gas (Liberated): 3.04 BCF

Gas (Flat GOR): 0.77 BCF

Oil: 537 MBO

56% Recovery

11% Recovery

Production

Remaining

Abandonment Conditions

Excess Gas Prod Potential: 0.4 BCF

Free GIP: 1.0 BCF

Solution GIP: 1.6 BCF

Remaining GIP: 2.6 BCF

Remaining OIP: 4.2 MMBO

$P_{i(ab)} = 1000$ psi

$R_{s(ab)} = 376$ scf/STB

$B_{o(ab)} = 1.27$ bbl/STB

$E_g = 55.39$ scf/rcf

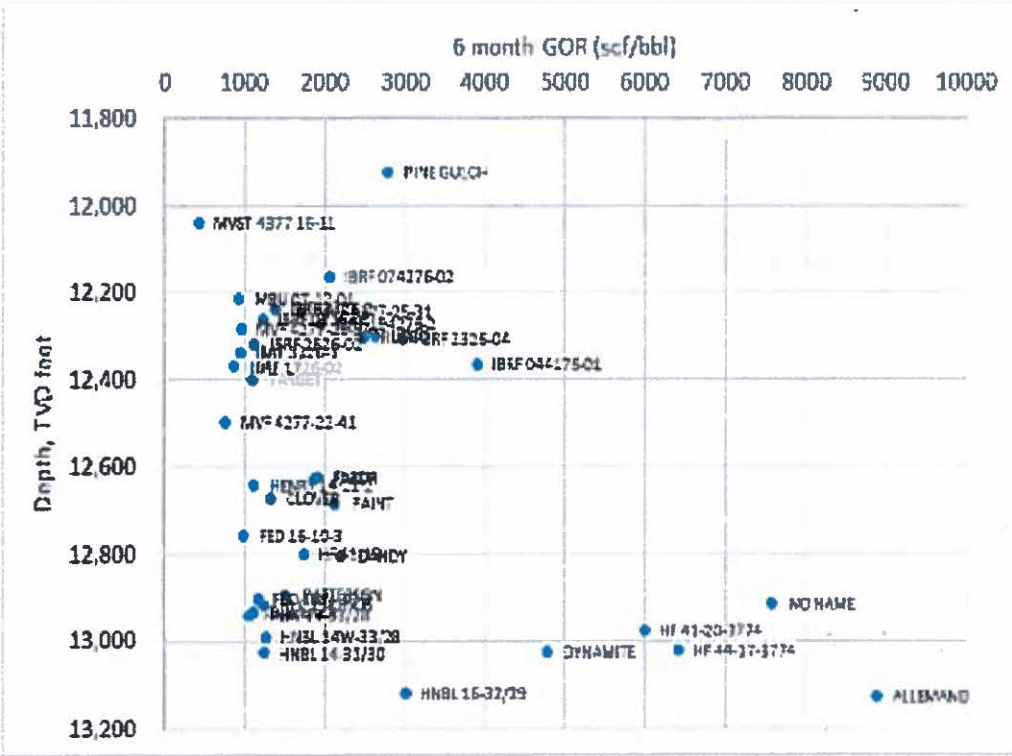
Volumetric calculations based on PVT data suggest an additional 6% (0.4 BCF) of gas recovery potential exists (in excess of type curve).

11/2/2015

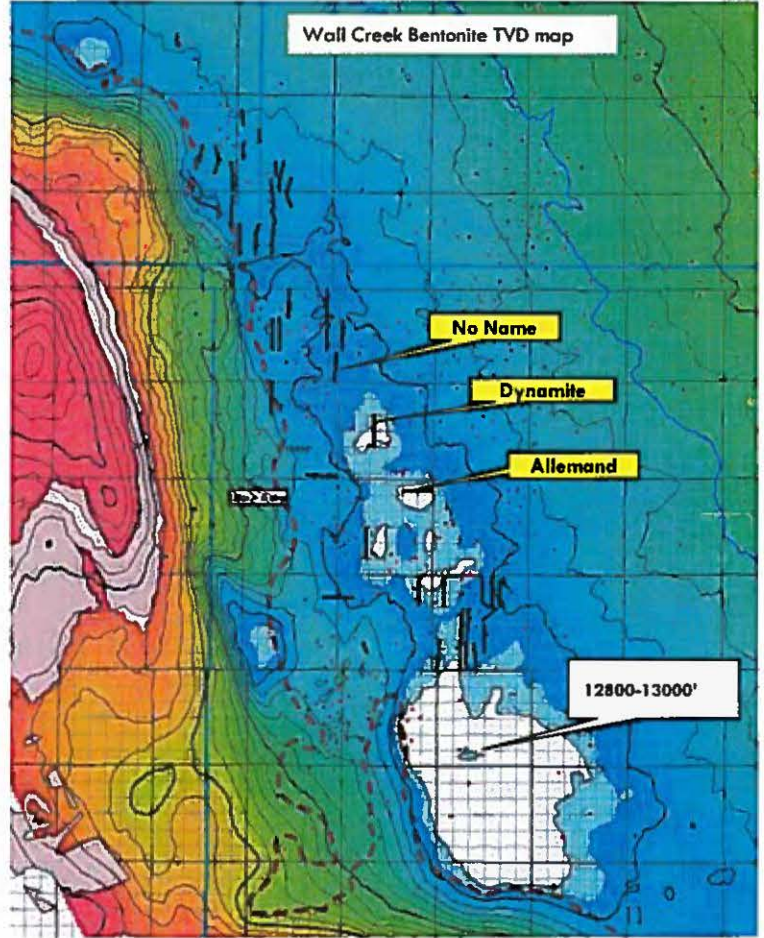
10

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CAN WE PREDICT PHASE IN RESERVOIR?



- GOR generally <2,500 scf/bbl. above 12,800'
- GOR abruptly increases below 12,900' TVD
- May be maturity trend produced by in-reservoir cracking of oil to gas in the deepest part of basin
- More basin modeling work to confirm



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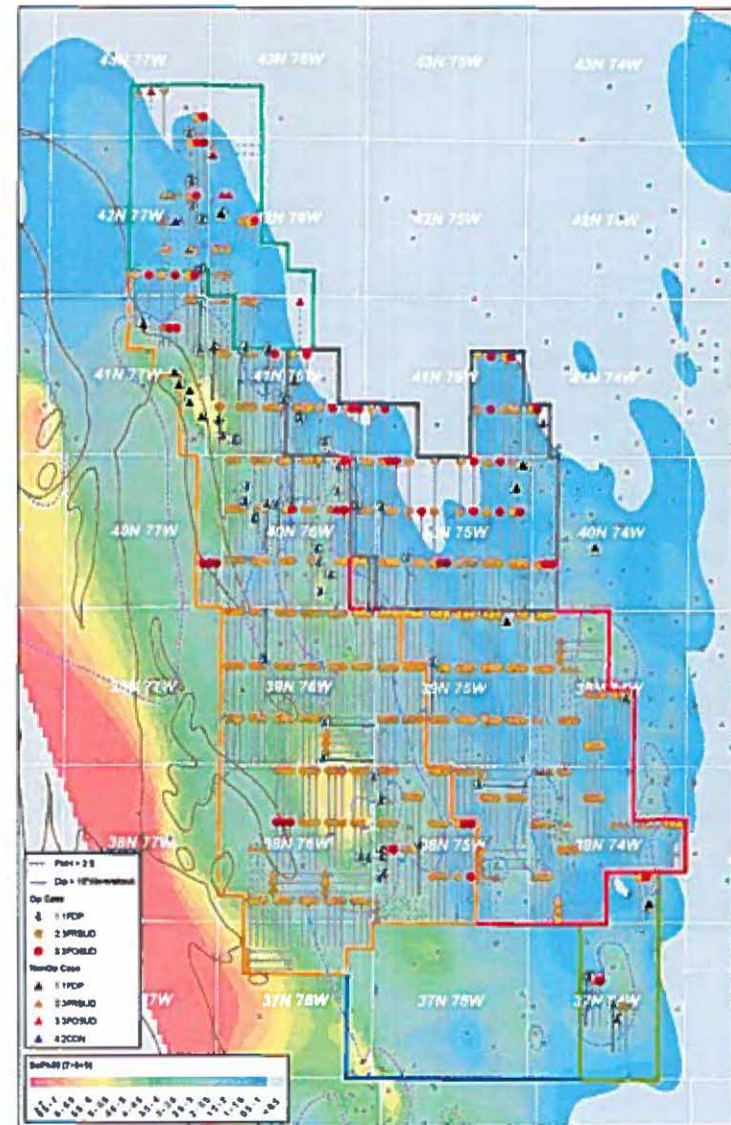
FRONTIER - VOLUMETRIC OVERVIEW

TYPE CURVE AREA	Avg. S_w	Avg. Phi	SU Avg. h (ft.)	SU Avg. OOIP (MMBO)
FD Sweet	48%	5.3%	99	13.3
PC Sweet	44%	5.1%	59	8.3
FD Non Sweet	46%	5.8%	30	4.6
African Swallow	49%	5.1%	59	7.5
Bozeman Trail	48%	5.6%	32	3.0
Average	48%	5.4%	70	9.3

Pay cut-offs $V_{sh} < 0.35$ $\Phi_{IE} > .03$; $B_o = 2.0$

	FD Sweet	PC Sweet	FD Non Sweet	African Swallow
<i>N</i> (1280 SU's)	77	3	30	39
P10 (OOIP)	19.66	10.08	6.99	10.51
P50 (OOIP)	12.97	8.29	4.34	7.20
MEAN (OOIP)	13.61	8.35	4.62	7.48
P90 (OOIP)	8.55	6.82	2.69	4.94
Avg. RF using Area TC's	13.0%	19.3%	18.7%	7.8%

All recovery factor calculations include vertical production in spacing unit



So-Phi-H map of log facies 7+8+9

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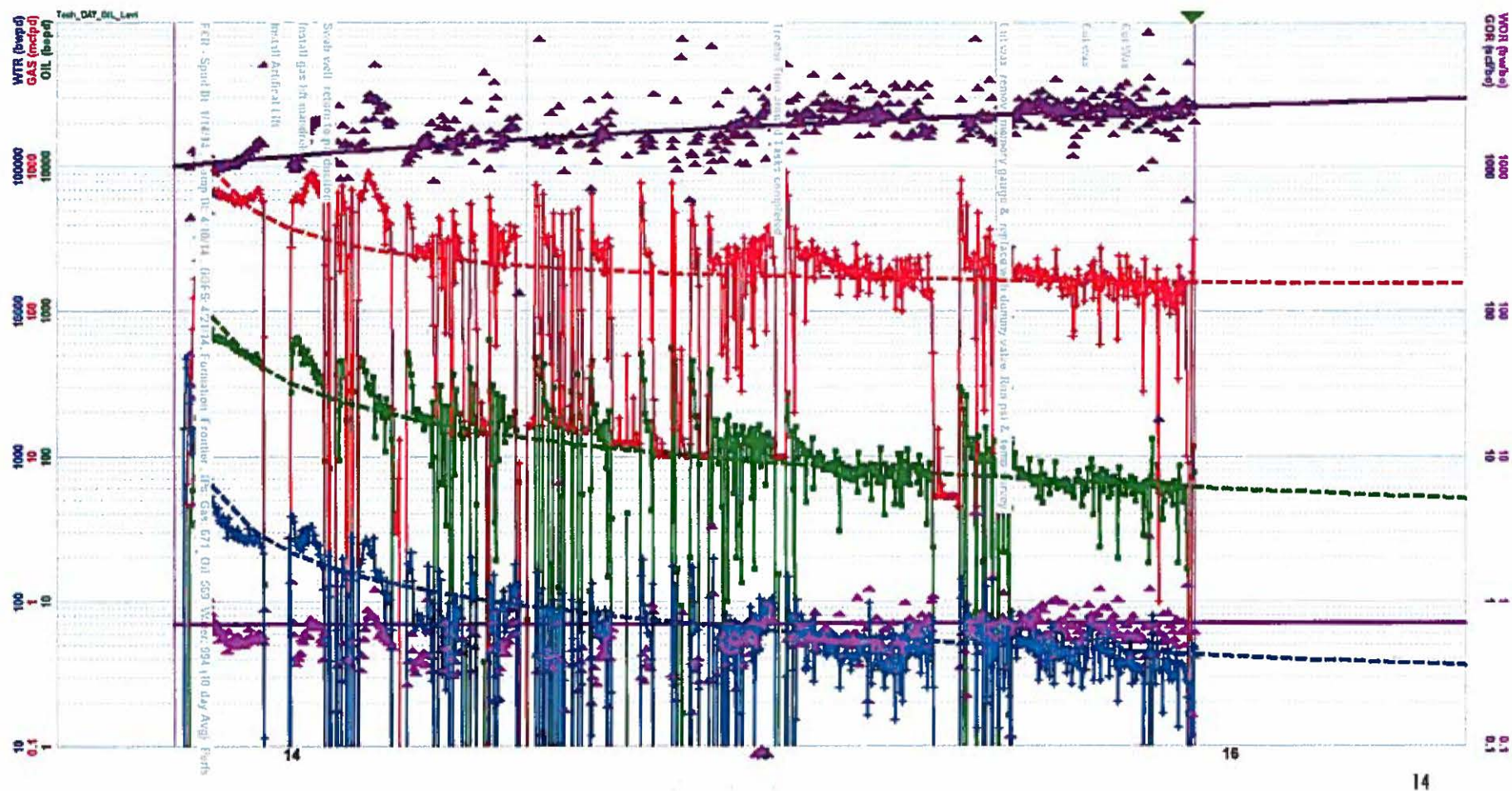


WELLS WITH PVT DATA |

13

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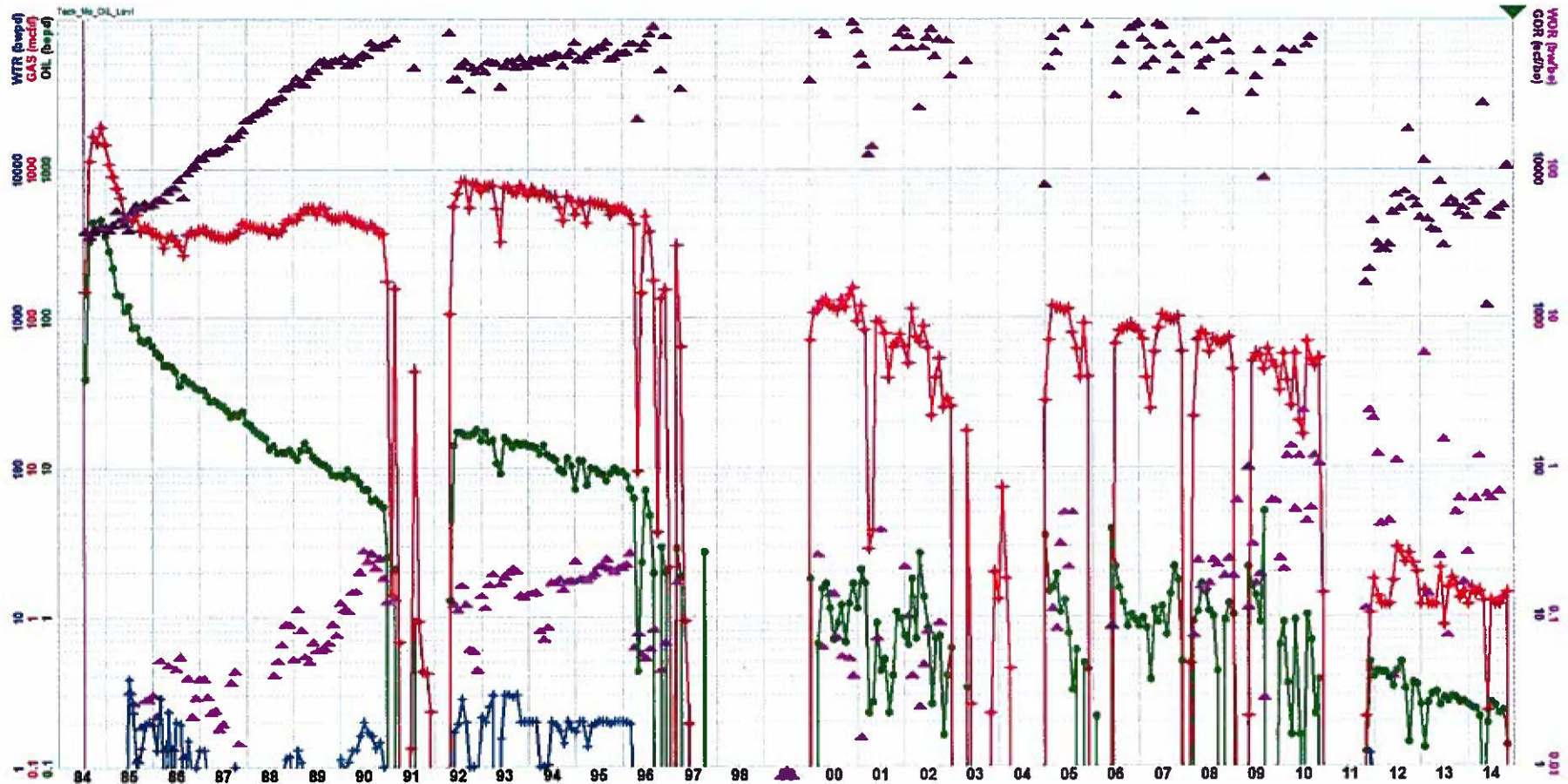
RUSH STATE 4277-36-01FH



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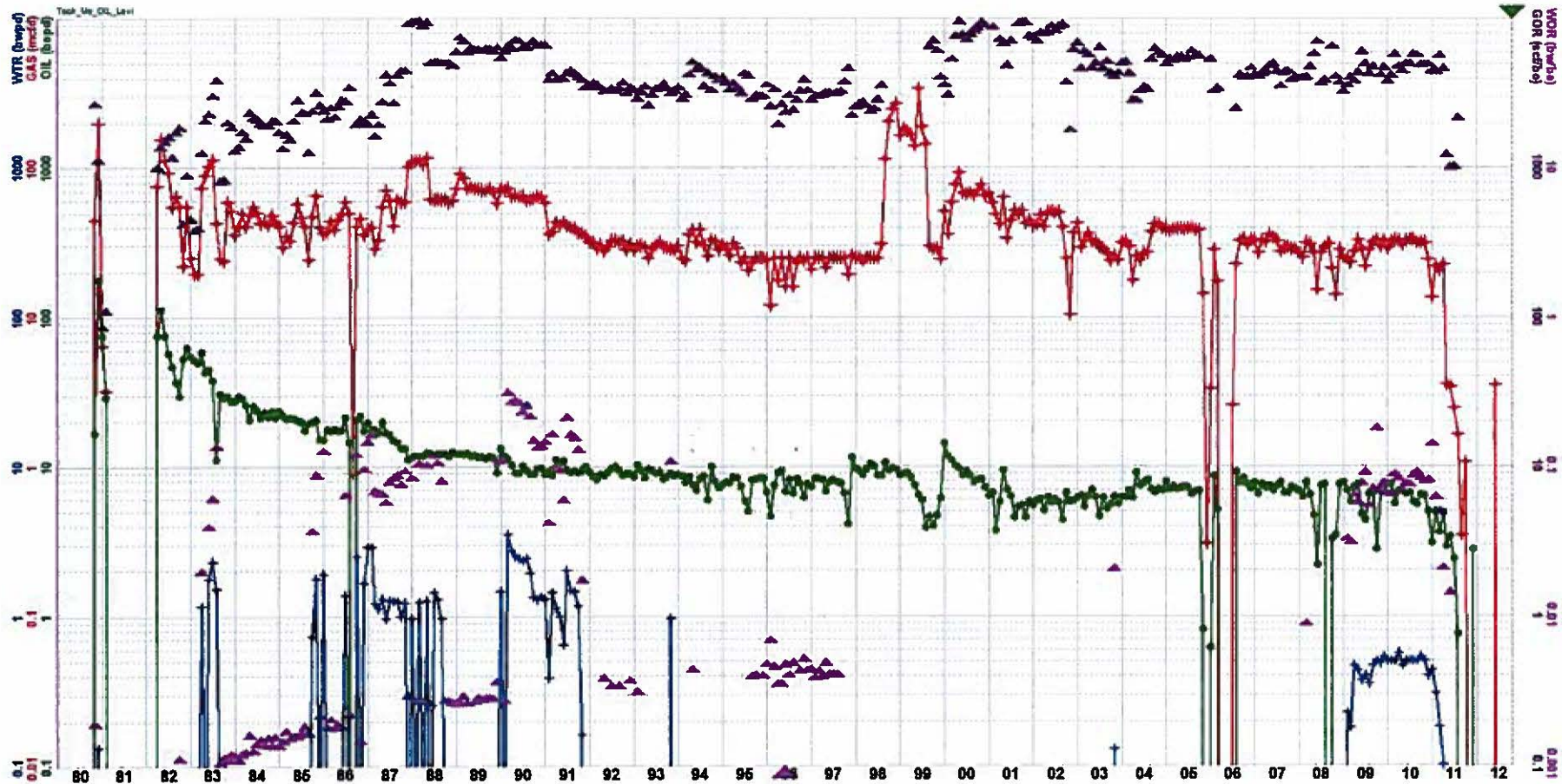
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USA FED 22-01



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ACKERMAN STATE 41-16



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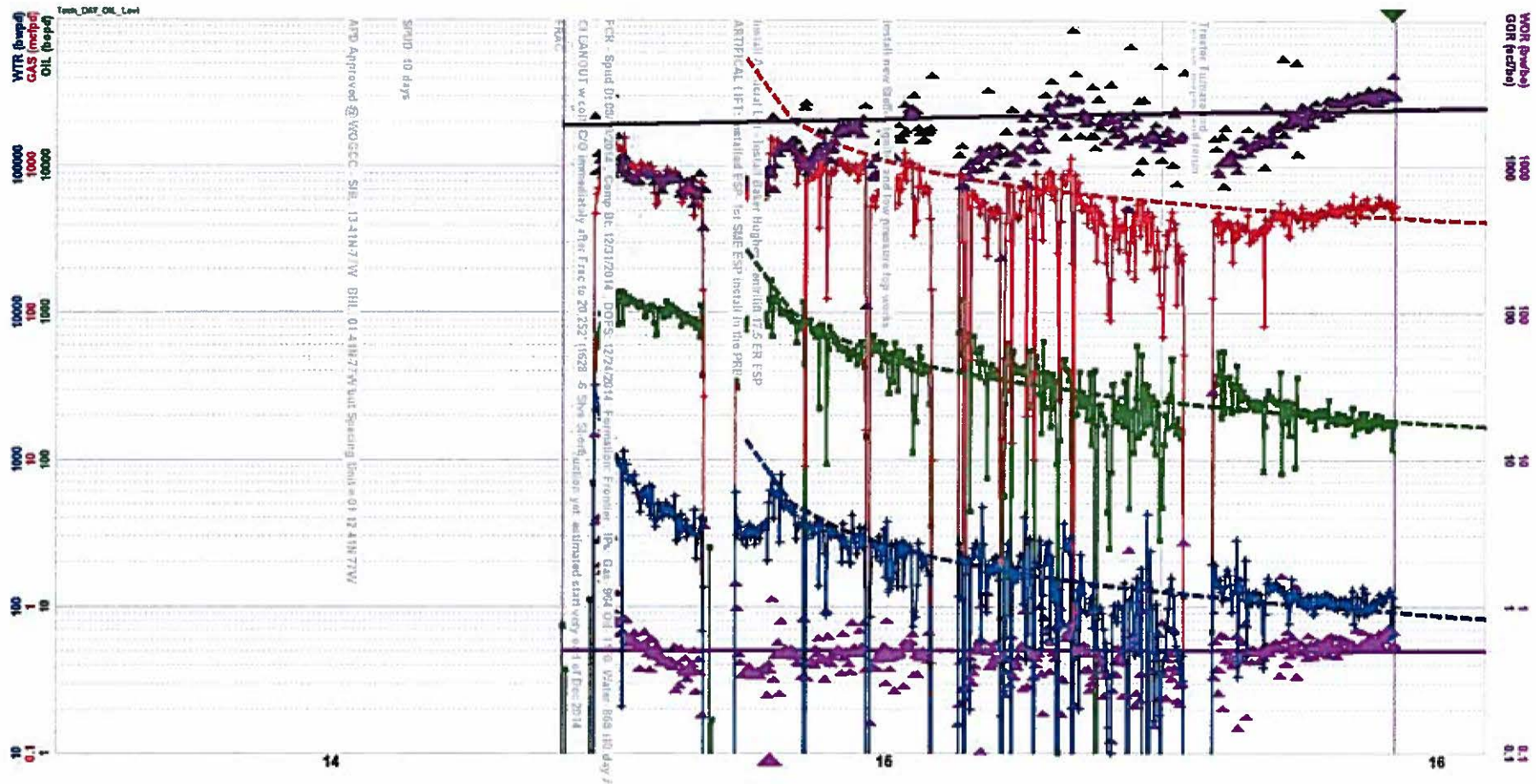


WELLS OF INTEREST |

18

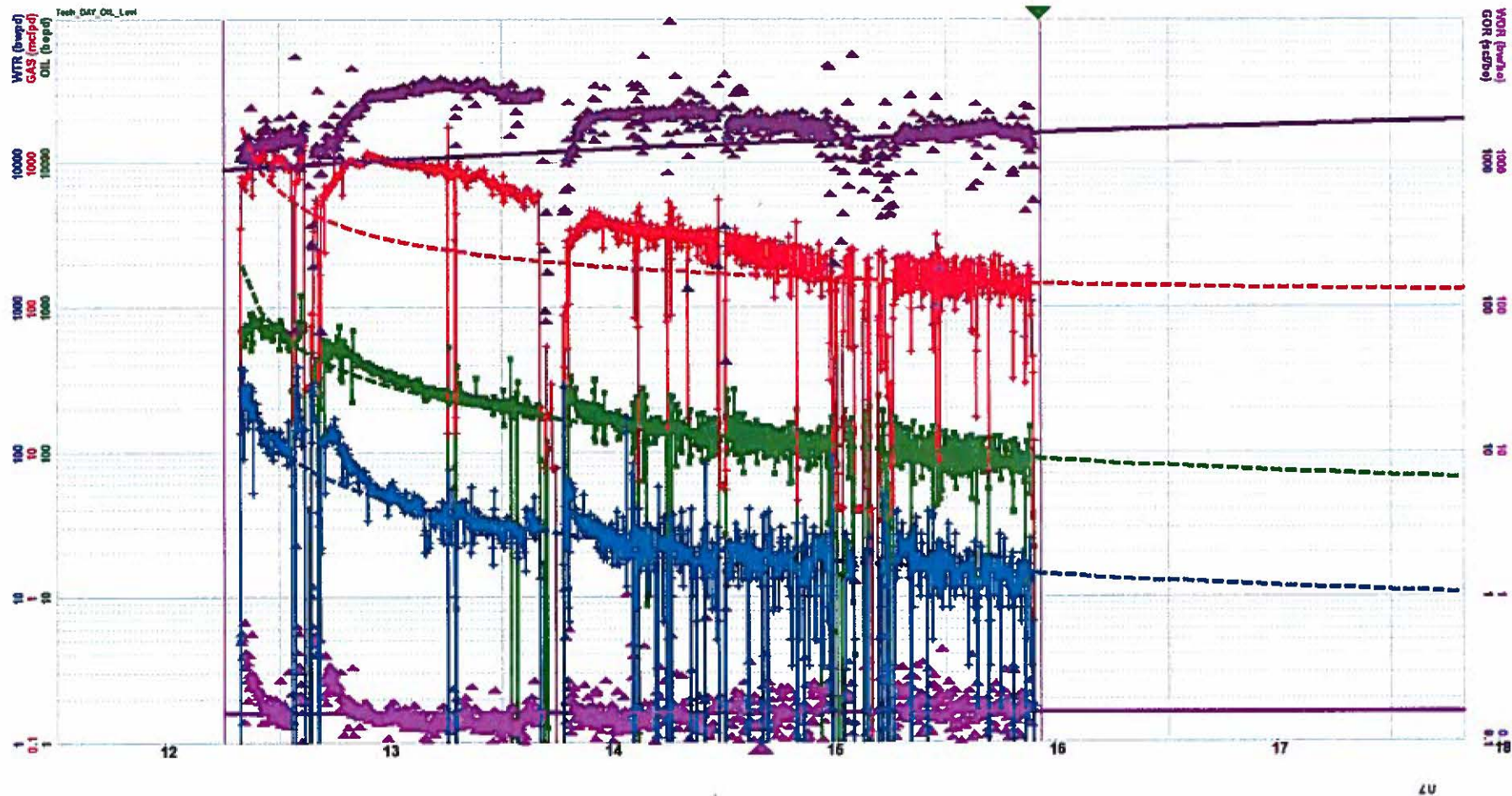
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CLOVER FED 4177-12-01-01FH (NEXT TO RUSH WELL)



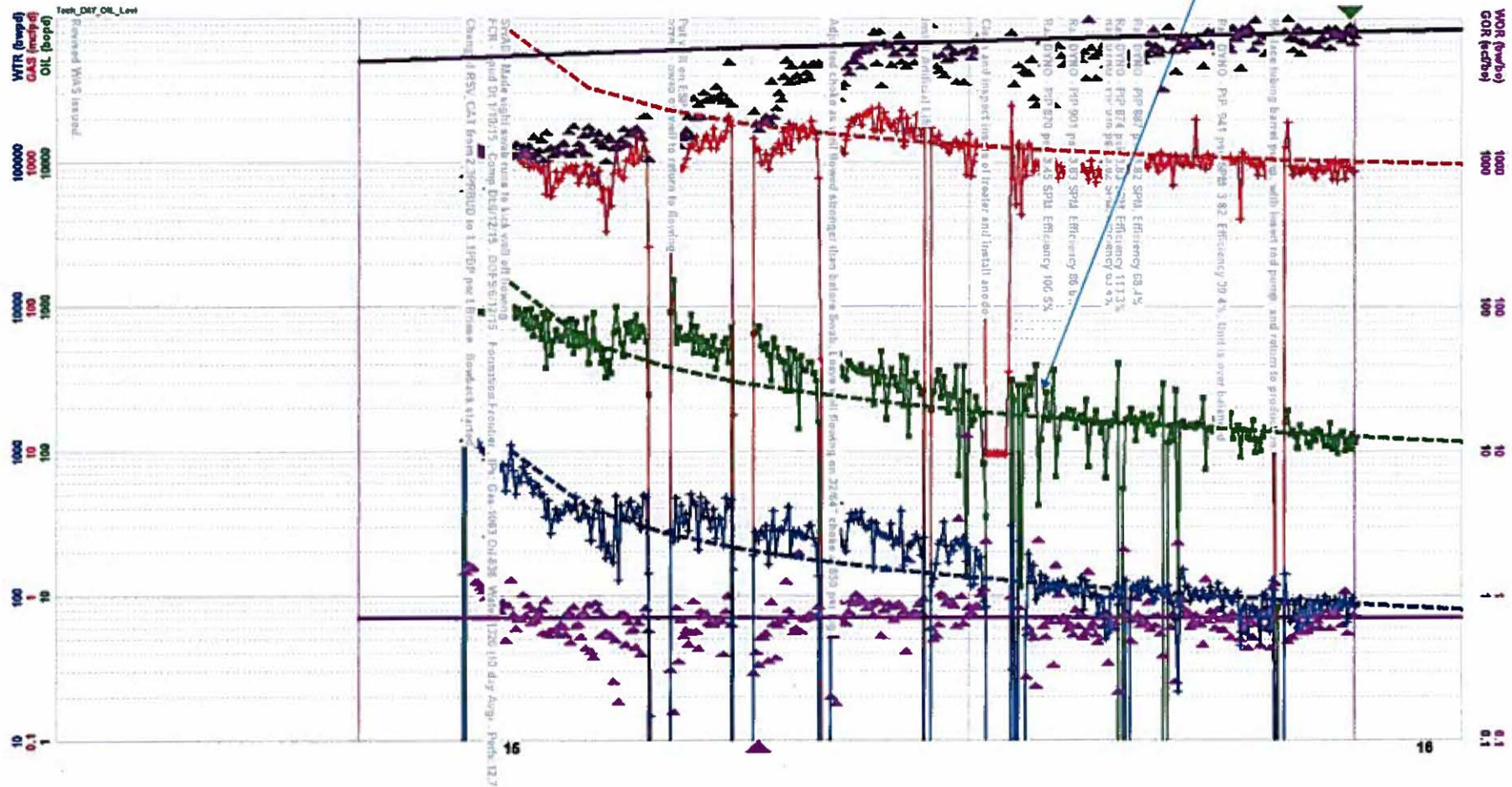
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DANDY STATE 3774-16-2-01FH (DECREASING GOR)



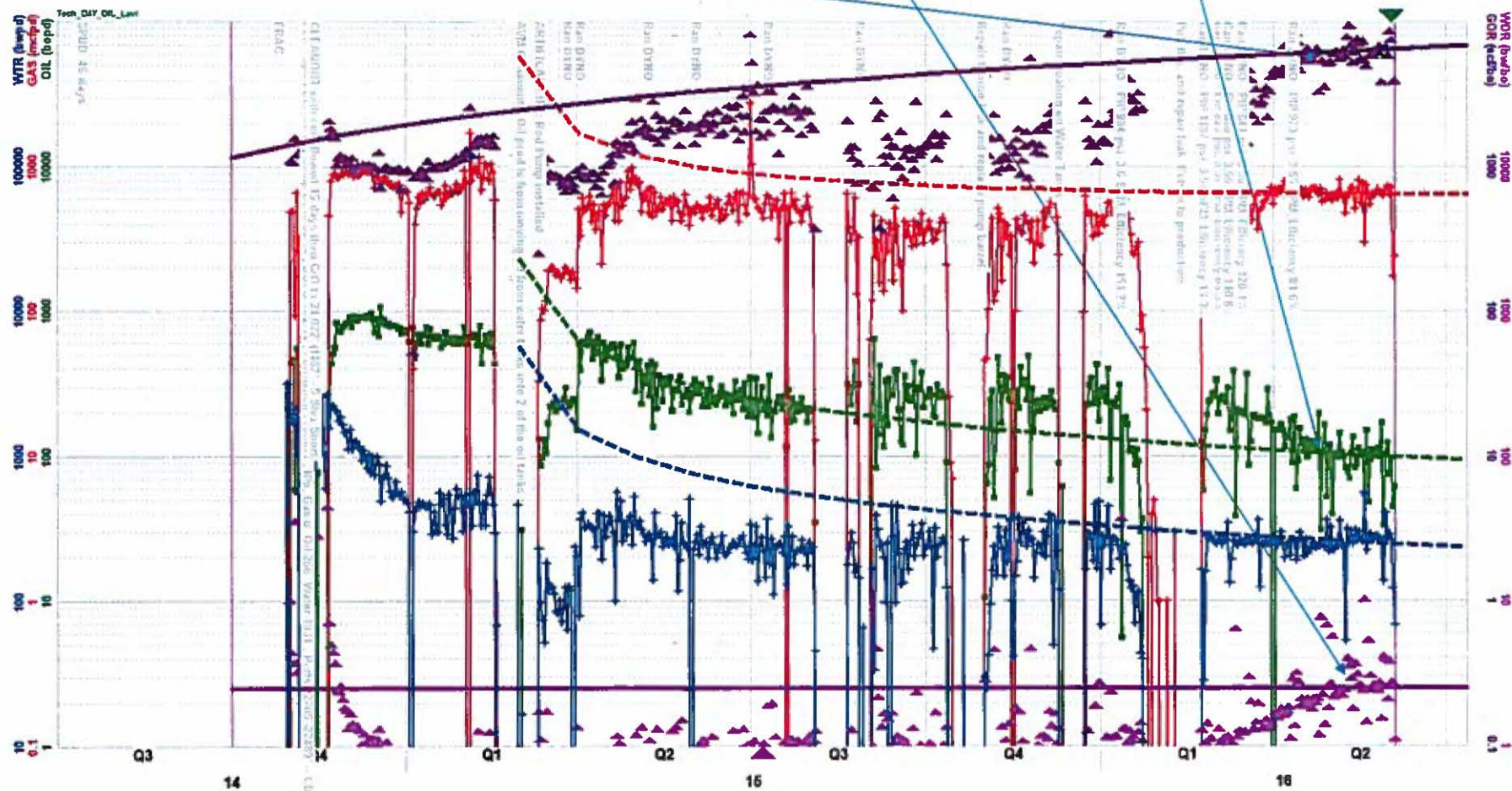
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PHANTOM FED 4076-17-20-01FH (OIL PROD DECREASE)



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TARGET FED 4176-17-20-01FH (GOR AND WOR INCREASE OIL DECREASE)



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