



MULTIWELL RETROSPECTIVE TESTING

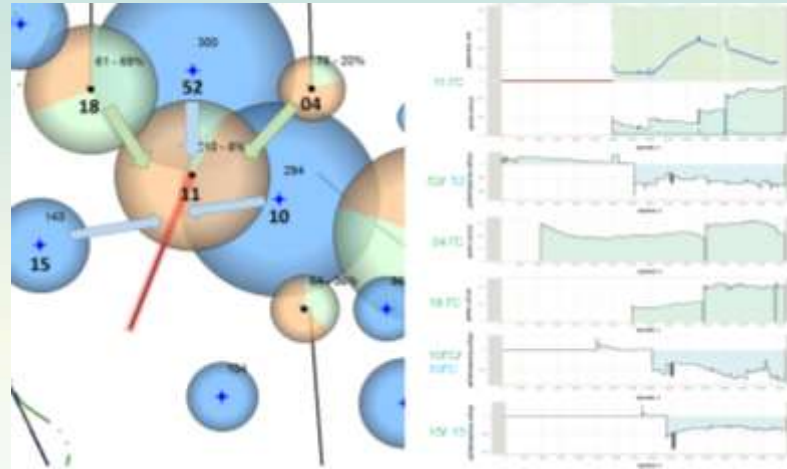
MRT

**NATURALLY DEPLETING
RESERVOIR (NDR)**

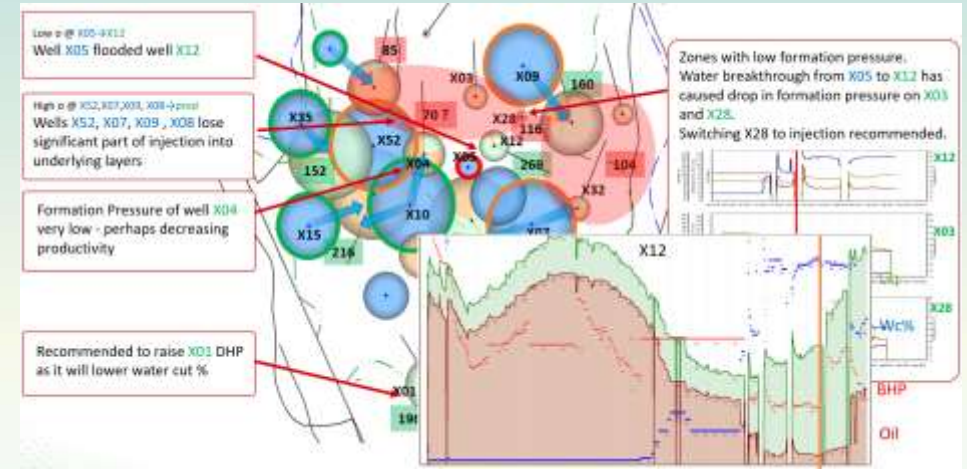
MULTIWELL RETROSPECTIVE TESTING (MRT)



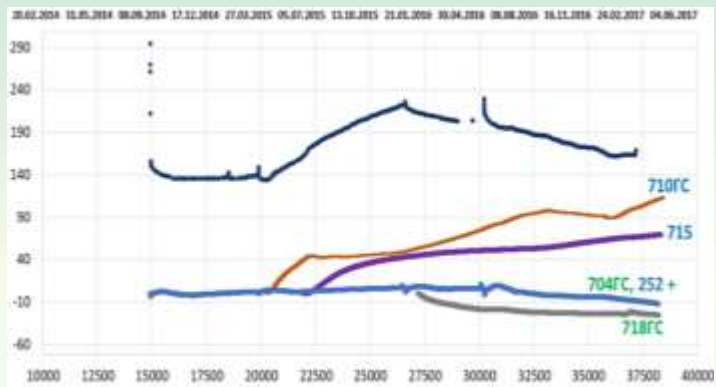
MRT Cell



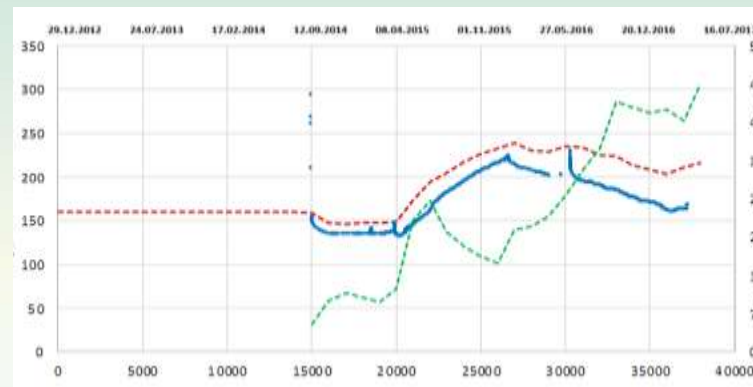
Field-wide MRT Analysis



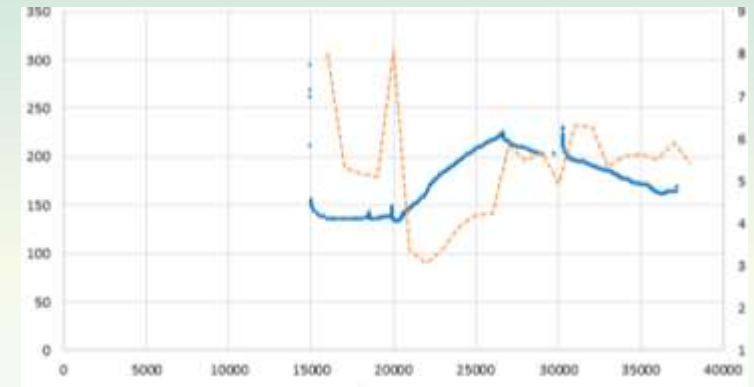
Pressure impact decomposition



Formation pressure history reconstruction

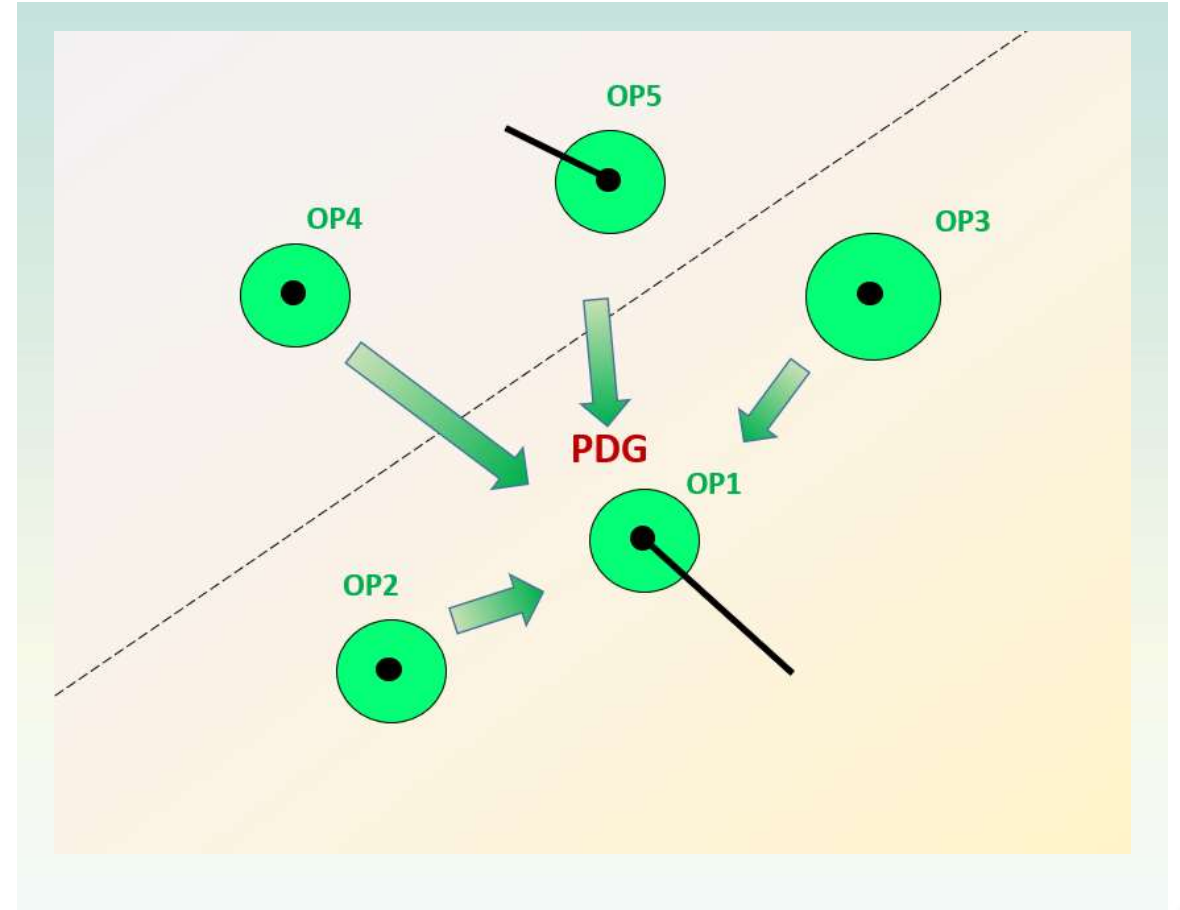


PI history reconstruction

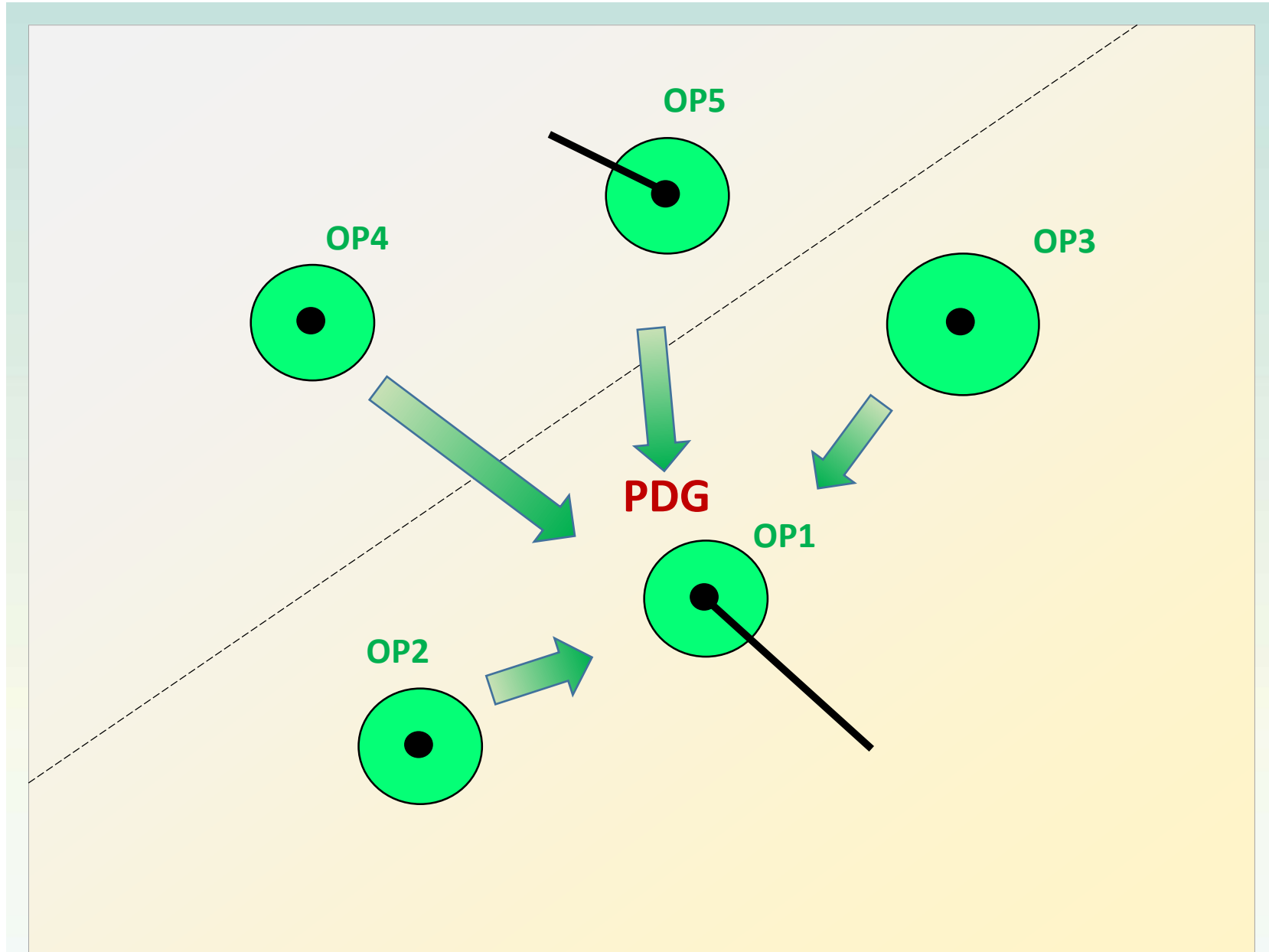


Case 1:

Verifying fault and
cross-well connectivity



FOCUS AREA AND WELL LOCATIONS



PRODUCTION AND PRESSURE HISTORY



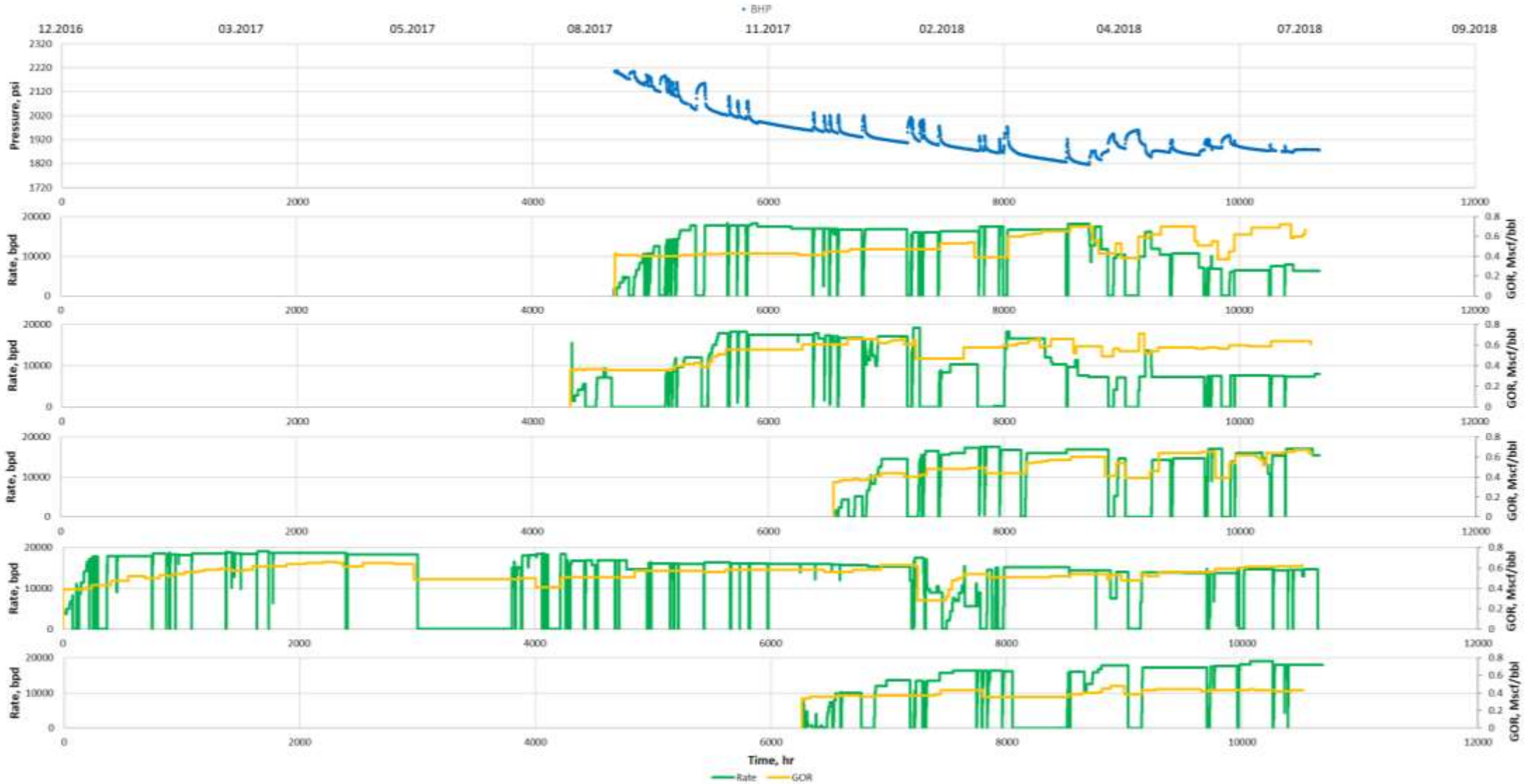
OP1

OP2

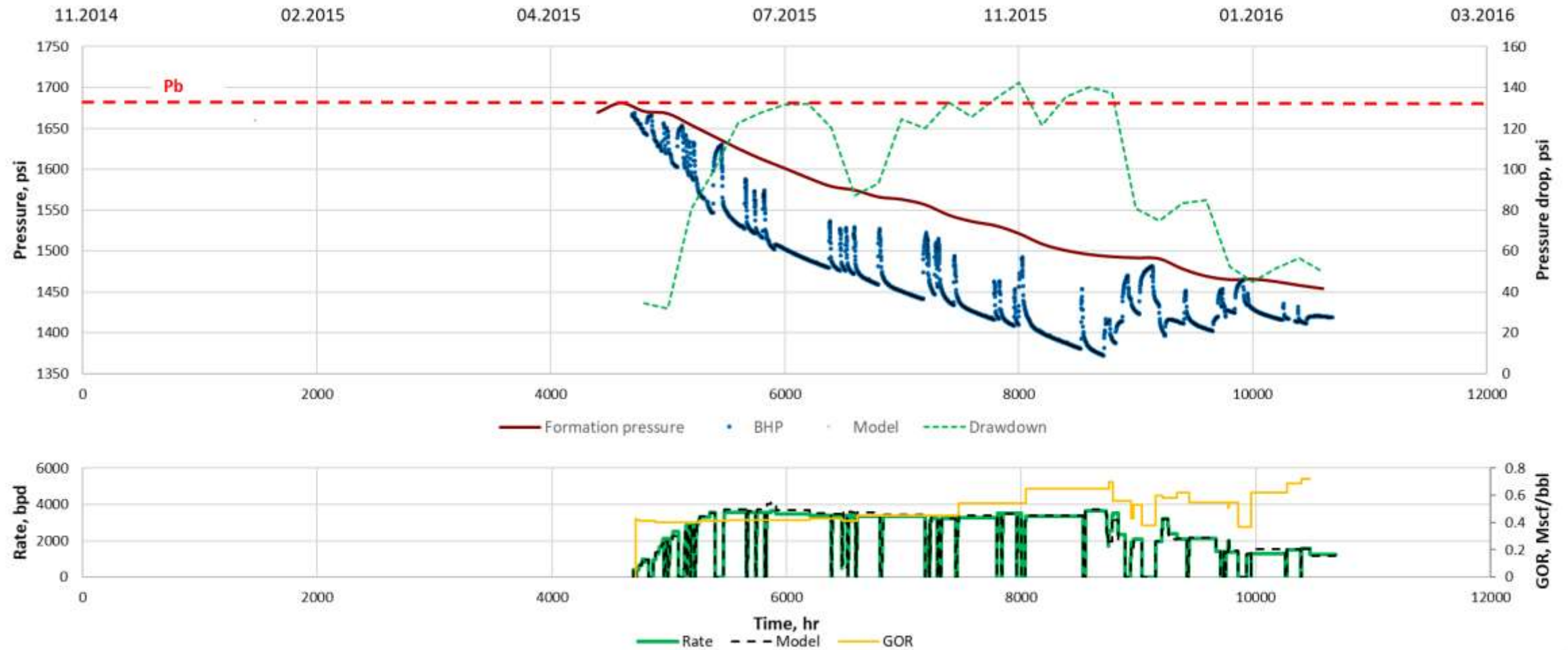
OP3

OP4

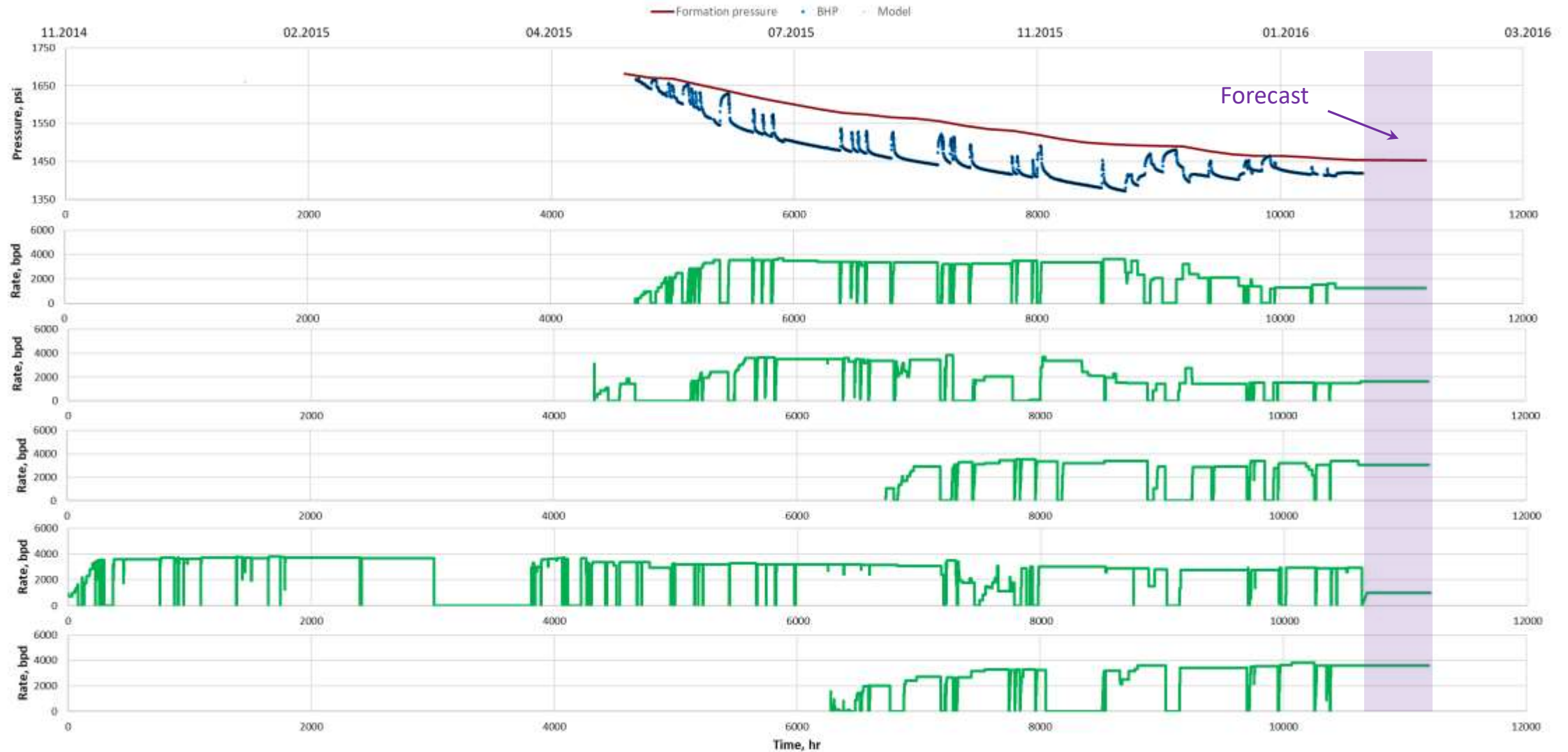
OP5



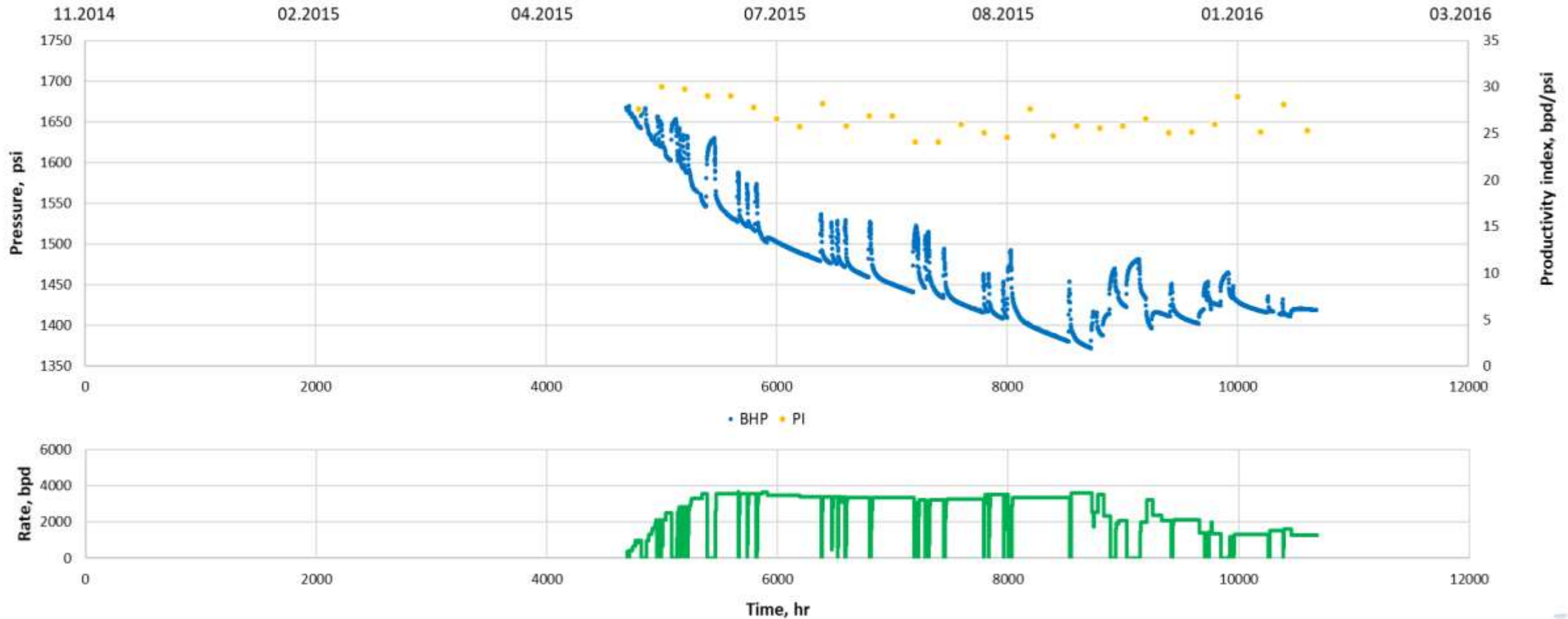
#1 – RECONSTRUCT FORMATION PRESSURE HISTORY FOR OP1



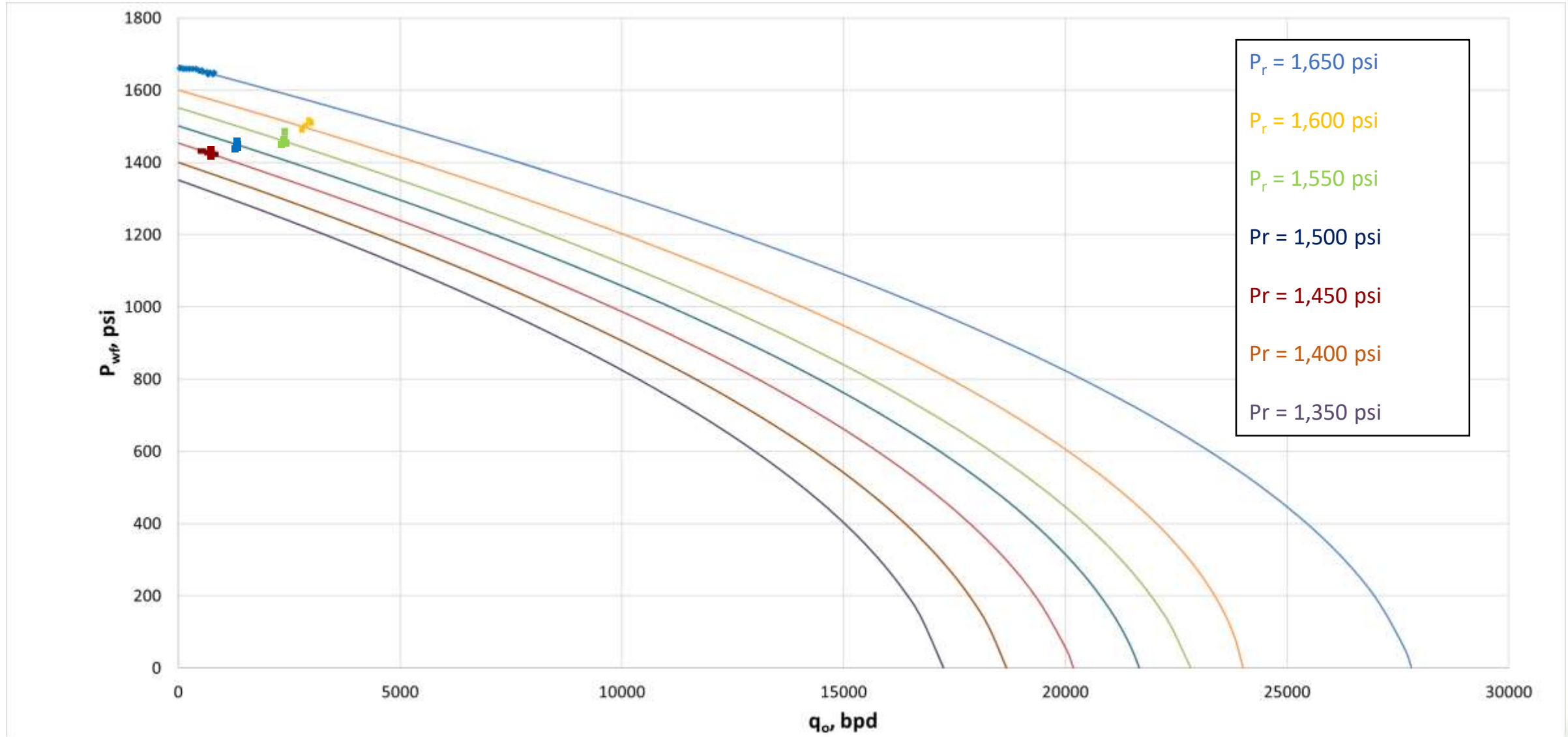
#2 – PREDICT FORMATION PRESSURE BASED ON THE CURRENT RATE FOR OP1



#3 – RECONSTRUCT PRODUCTIVITY INDEX HISTORY FOR OP1

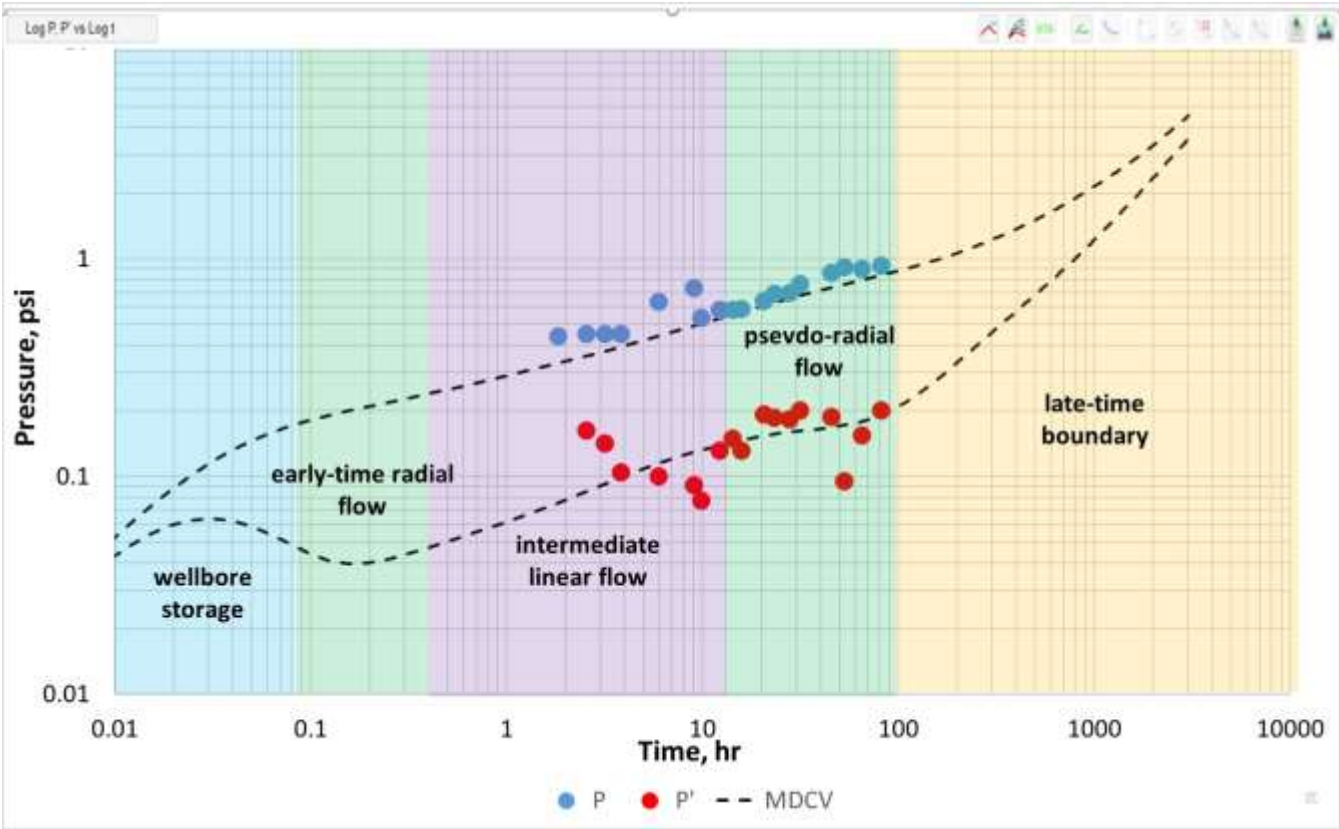


#4 – ASSESS FORMATION PRESSURE IMPACT ON IPR FOR OP1



#5 – ESTIMATE SKIN-FACTOR, TRANSMISSIBILITY AND DRAINAGE AREA OF OP1

well OP1

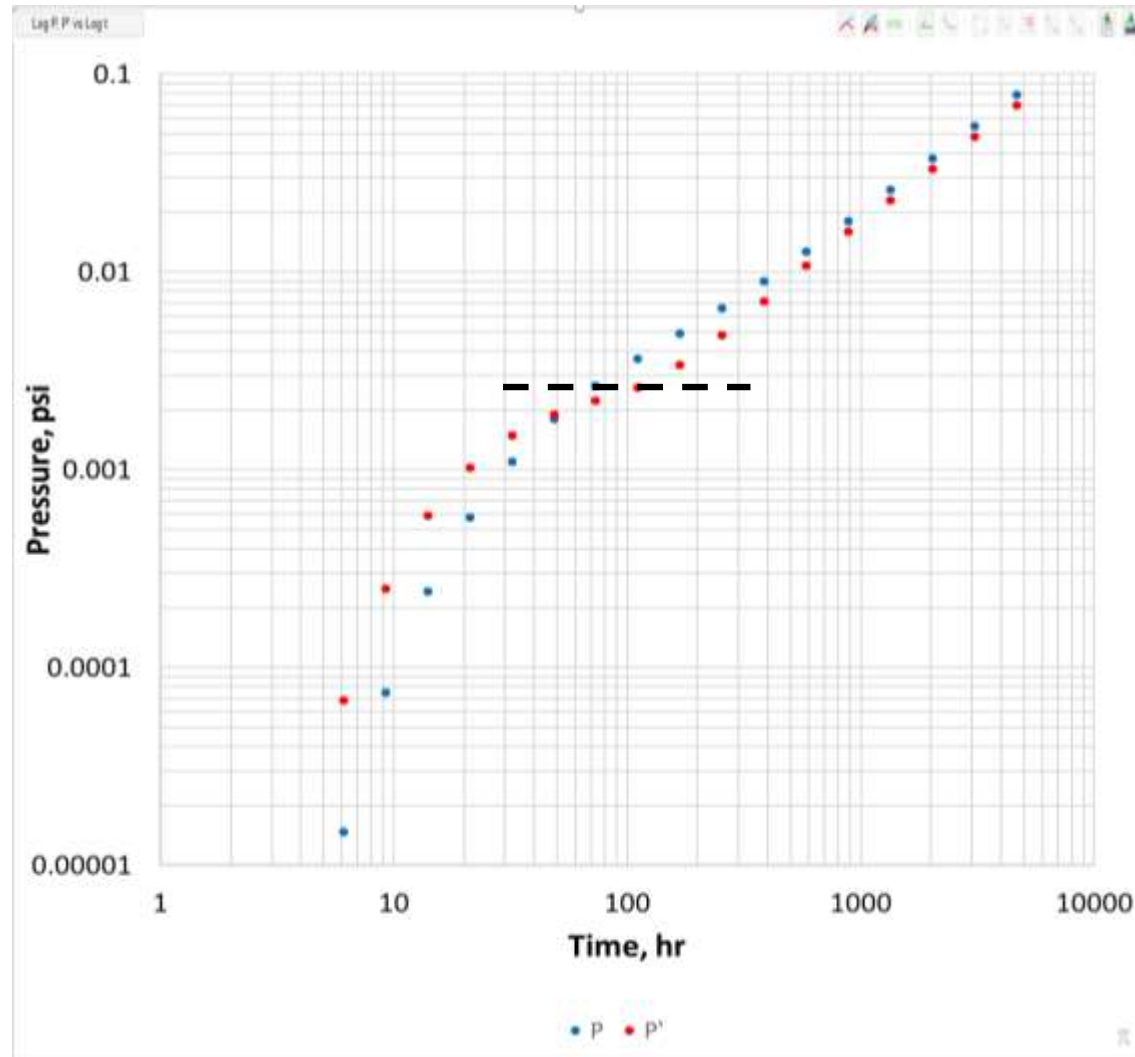


Property]	MDCV Value	OH Value
Net thickness, ft		100
Transmissibility, (mD*ft/cPs)	88,000	87,500
Total Skin	-4.86	
Mechanical Skin	+1	
Permeability, K _{oil} (mD)	230	
Permeability, K _a (mD)	756	753
Horizontal length, ft	520	540
PI, bpd/psi	25	
Formation pressure @ 28.02.2018, (psi)	1453	
Drainage area, ft ²	59,510,516	

#6 – RECONSTRUCT THE HISTORY OF CROSS-WELL INTERFERENCE

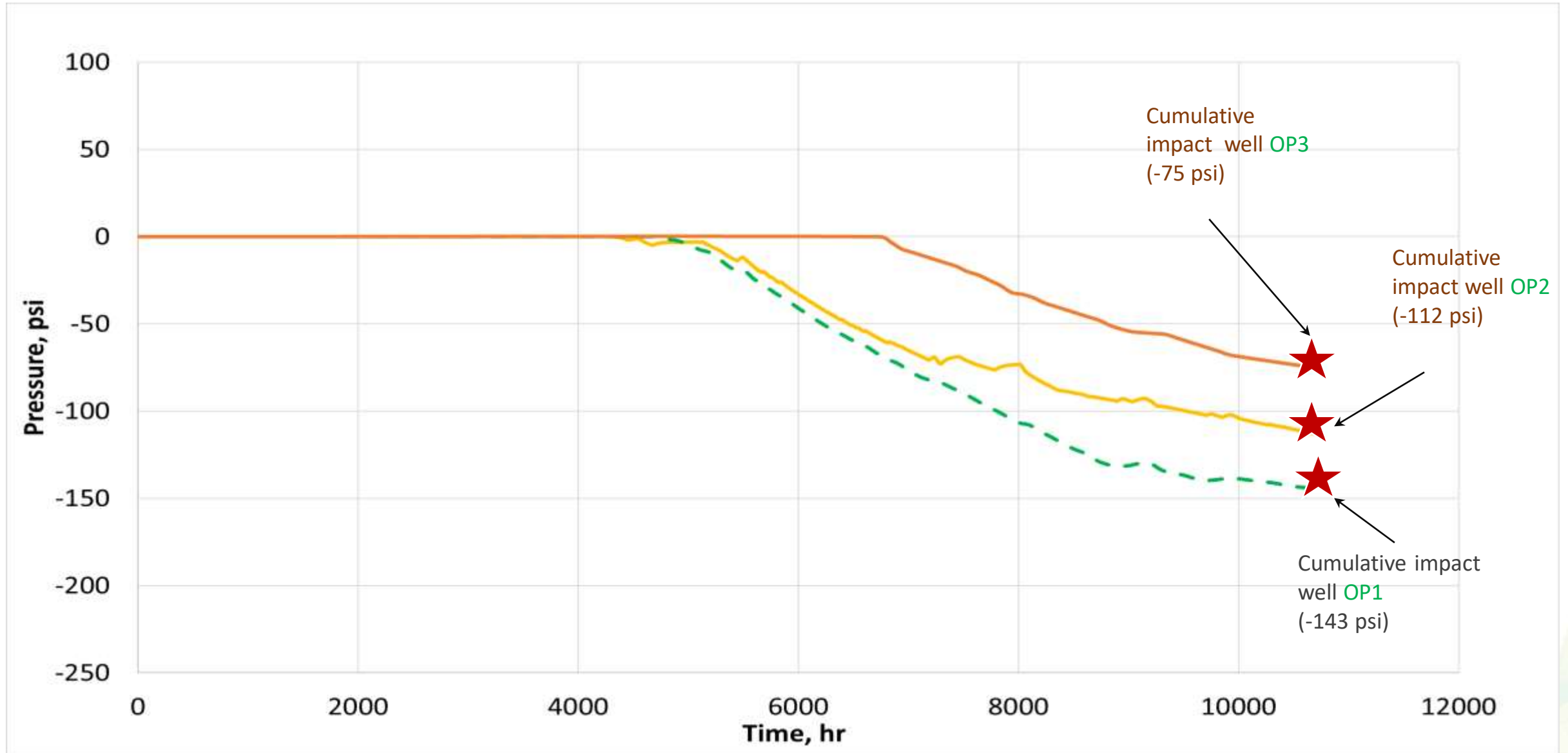


OP-2 → OP-1

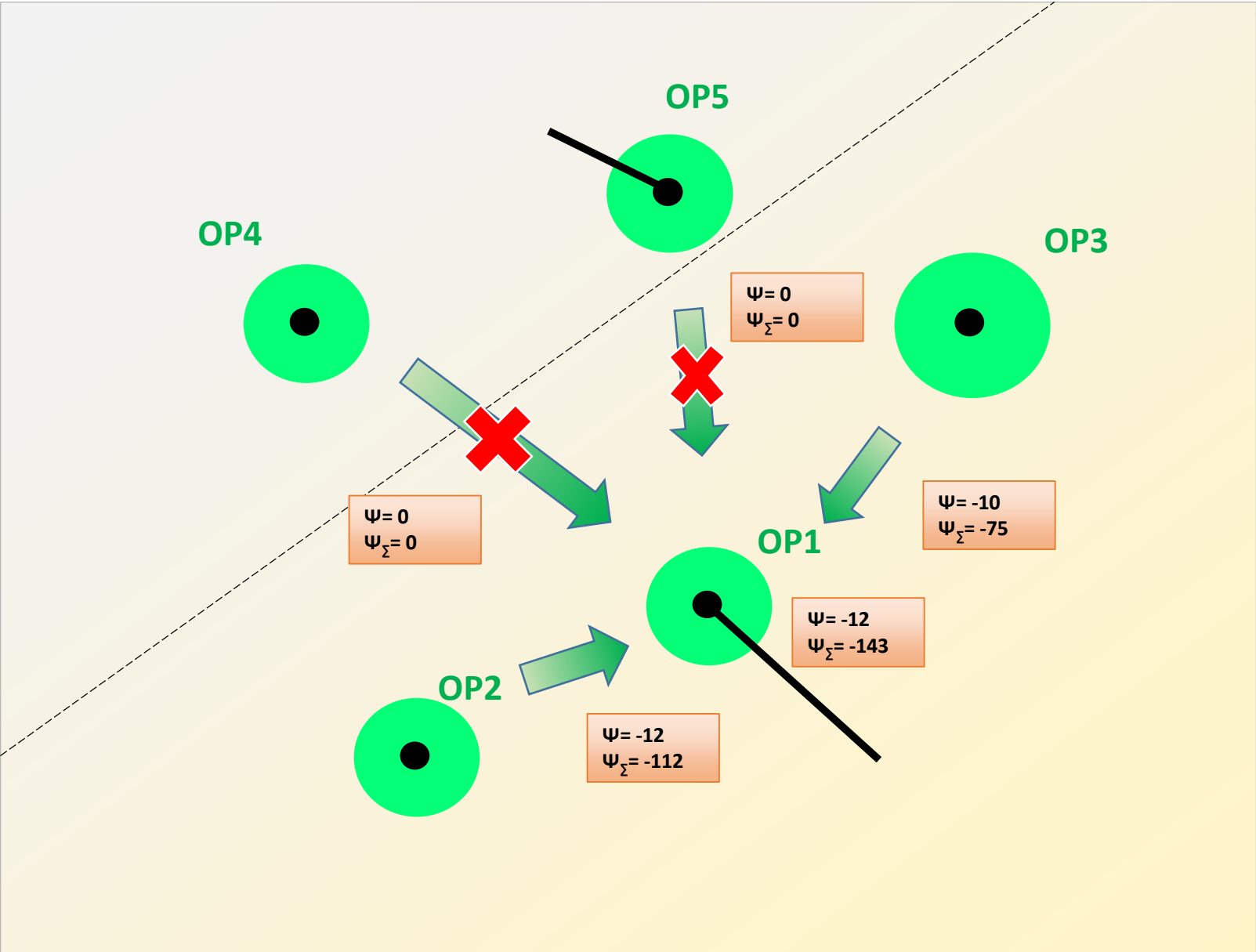


Parameter	Abbreviation	Unit	MRT Value
Transmissibility oil	σ	md·ft/cp	86,380

#7 – RECONSTRUCT THE HISTORY OF CROSS-WELL INTERFERENCE WITH OP1

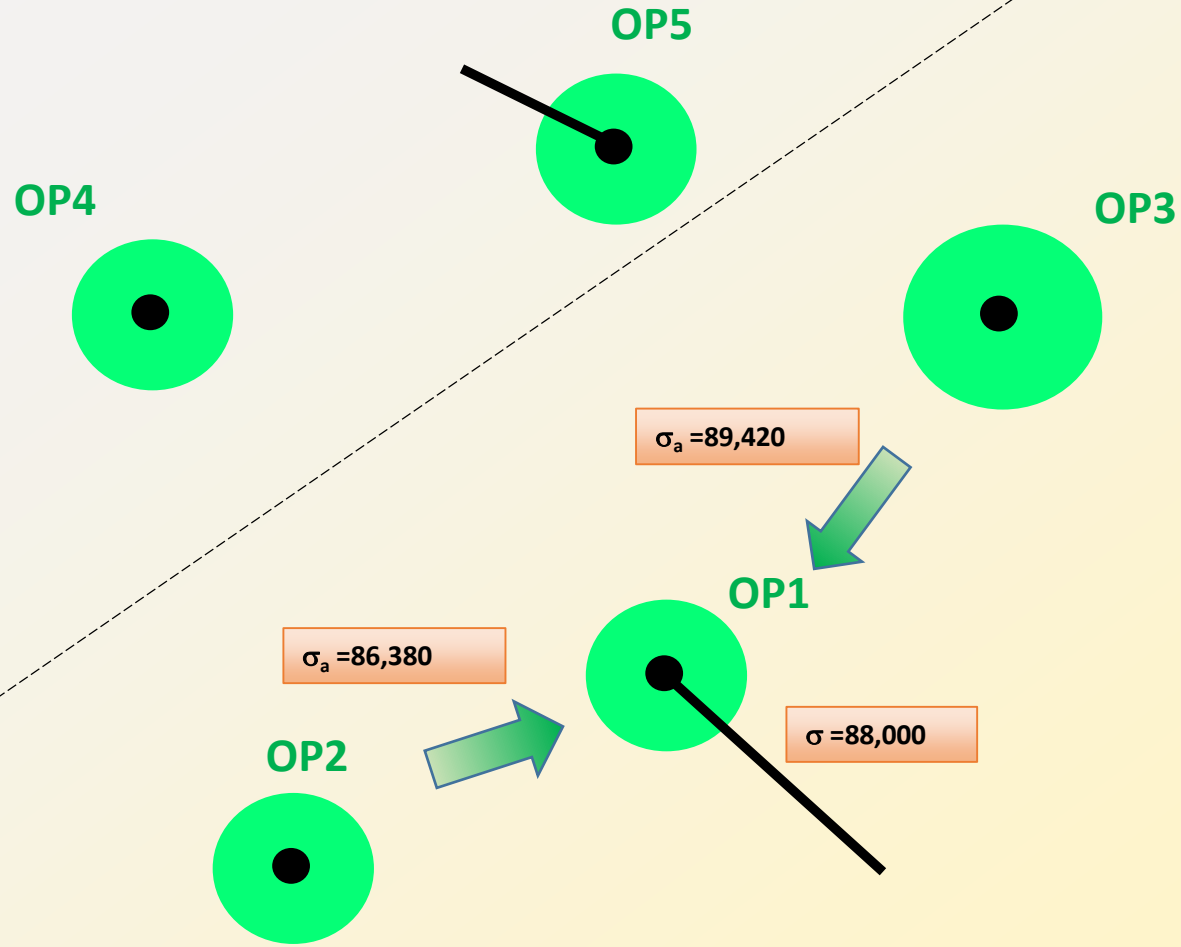


#6 – RECONSTRUCT THE HISTORY OF CROSS-WELL INTERFERENCE WITH OP1



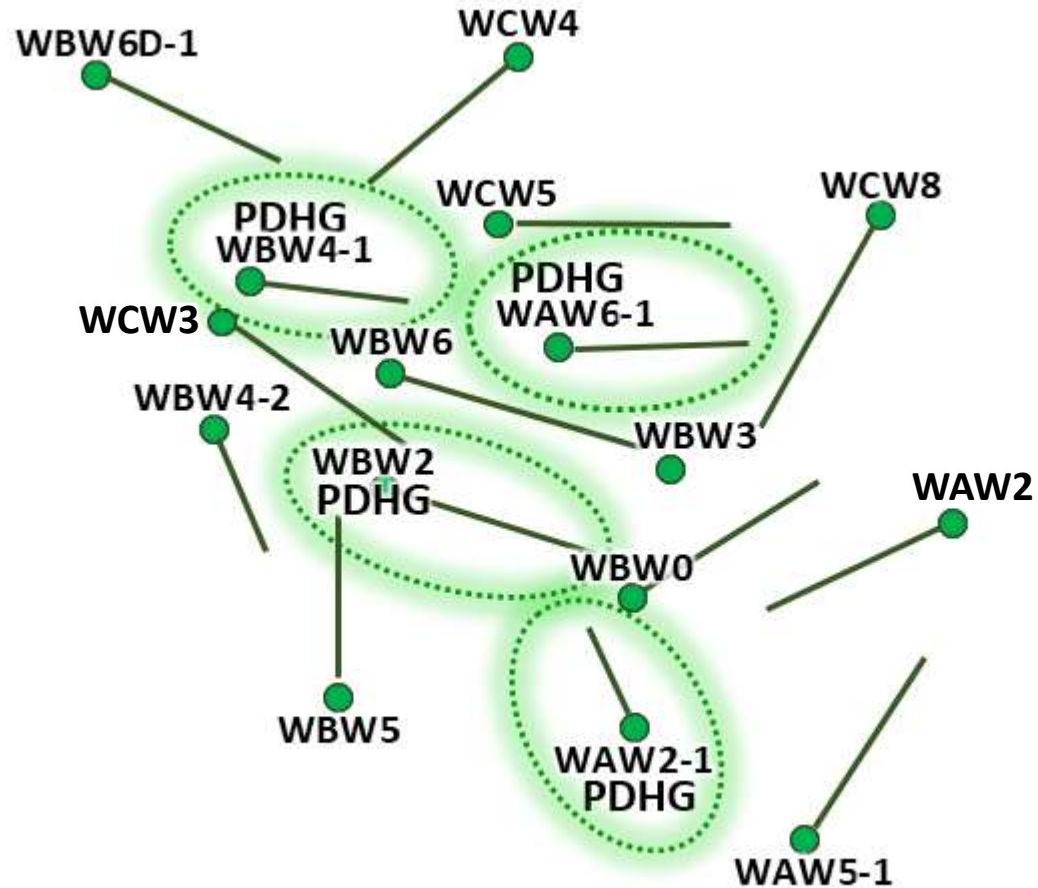
ψ	psi/mnth	Current impact
ψ_Σ	psi	Cumulative impact

#7 – ESTIMATE CROSS-WELL TRANSMISSIBILITY FROM OFFSET WELLS -> OP1



σ	md · ft / cp	pressure tested well transmissibility
σ_a	md · ft / cp	apparent cross-well transmissibility

Apparent cross-well transmissibility **2,3** → **1** is similar to near wellbore transmissibility of which **1**



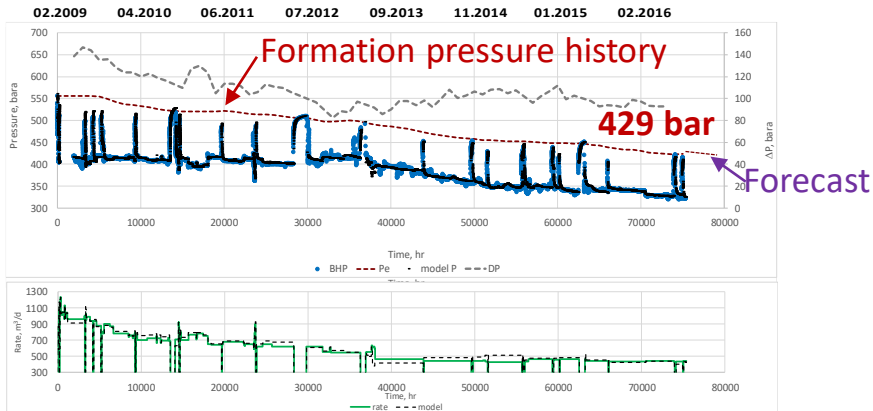
TEST GOALS

- **Reveal well interference**
- **Evaluate the necessity of infill drilling for recovery**

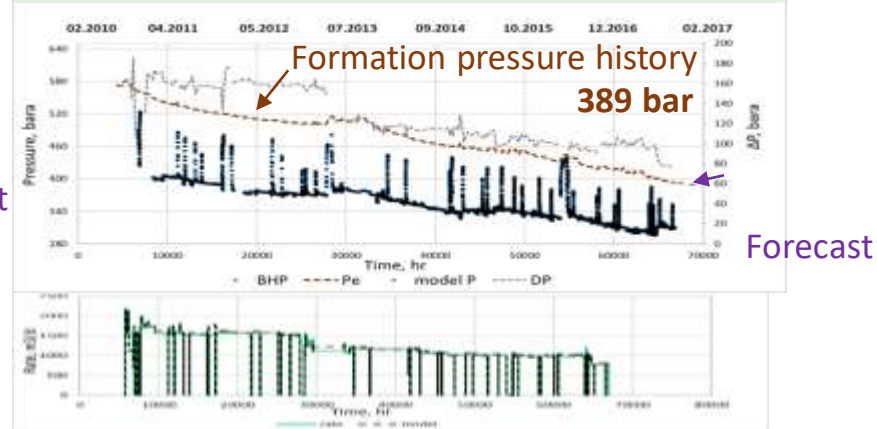
RESULTS vs. OBJECTIVES. FORMATION PRESSURE



well WAW2

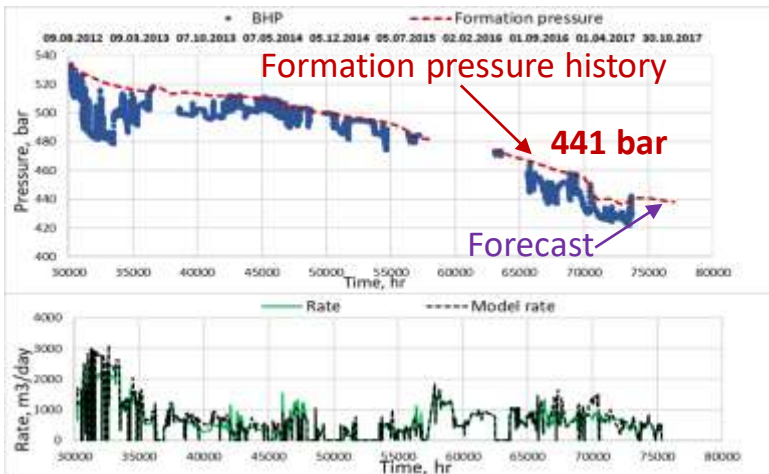


well WAW6-1

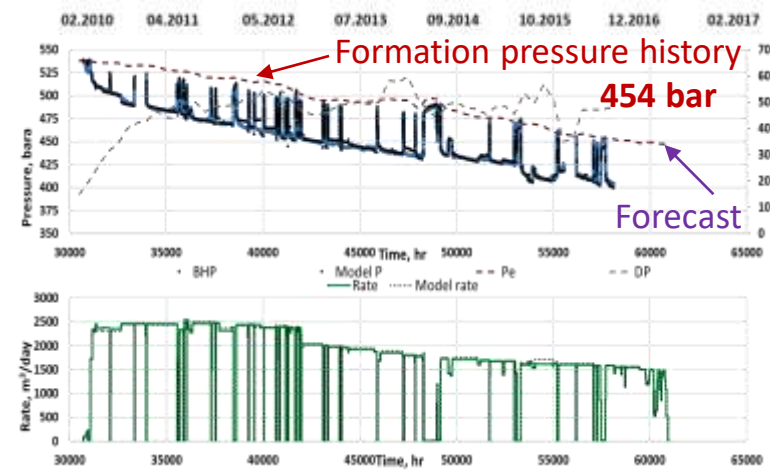


Formation pressure at the area of all pressure-tested wells decreased during the production from 2009 to 2017

well WBW2

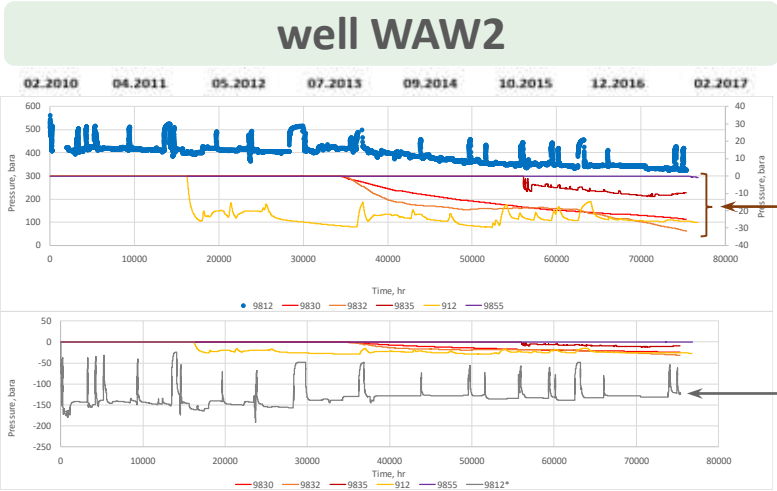


well WBW4-1



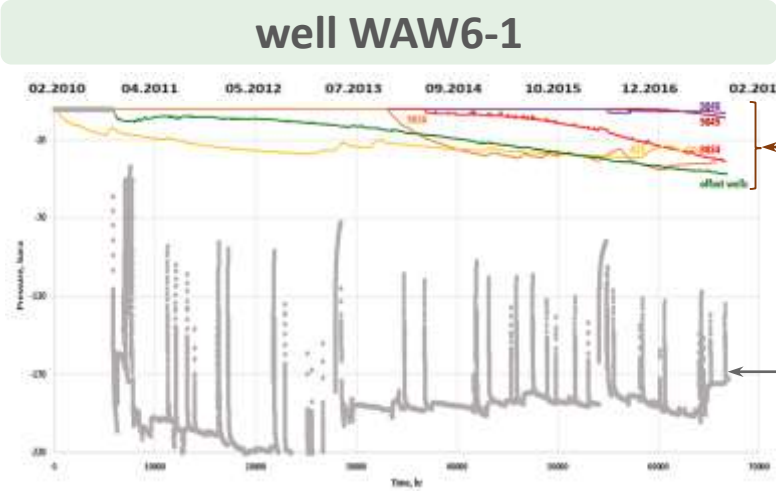
Further decline is predicted for NFA scenario.

RESULTS vs. OBJECTIVES. CROSS-WELL INTERFERENCE HISTORY PLOT



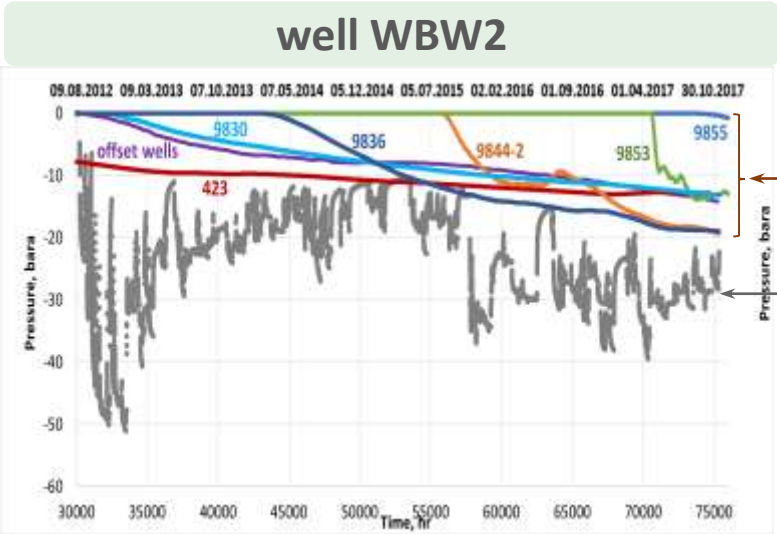
Other wells cumulative impact (-93.8 bar)

Pressure tested well impact (-39.6 bar)



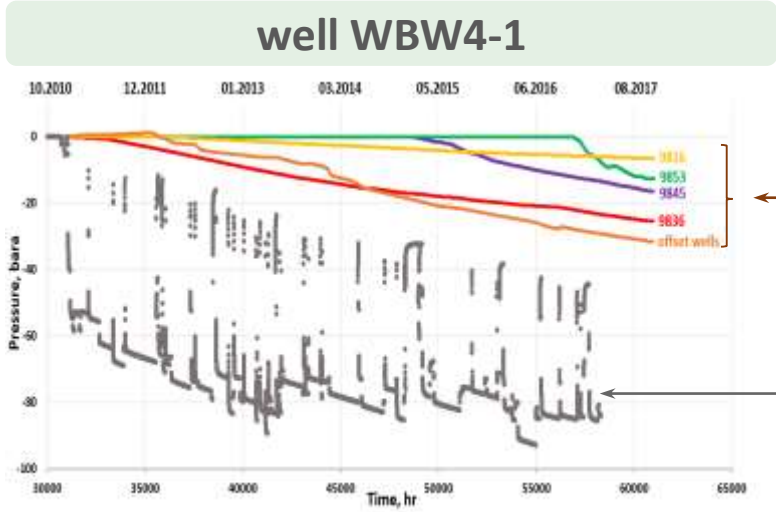
Other wells cumulative impact (-145 bar)

Pressure tested well impact (-178 bar)



Other wells cumulative impact (-93.1 bar)

Pressure tested well impact (-28.3 bar)

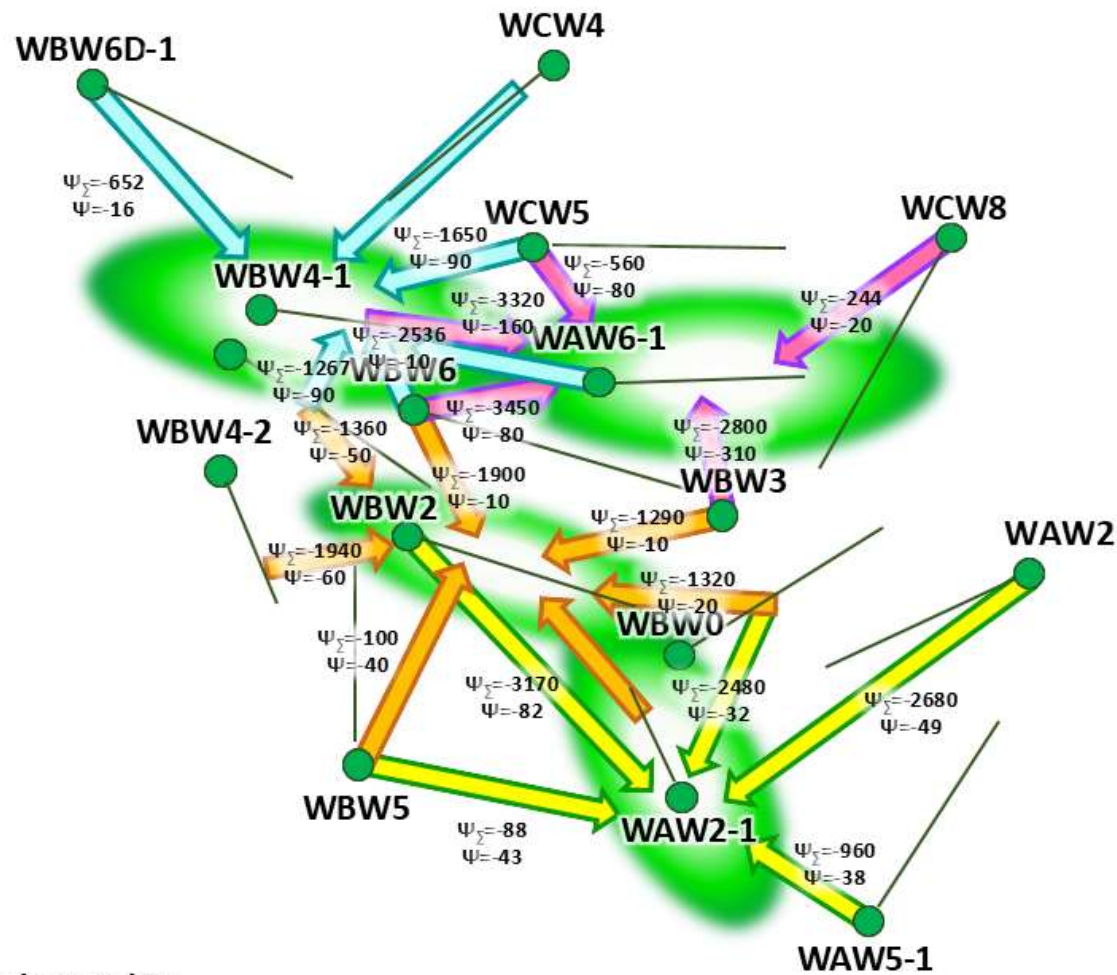


Other wells cumulative impact (-93 bar)

Pressure tested well impact (-84 bar)

All wells are interfering. Moderate cross-well interference has detected

RESULTS vs. OBJECTIVES. CROSS-WELL INTERFERENCE SCHEME



Ψ_{Σ} – Cumulative impact, kPa
 Ψ – Current impact, kPa / last month



Wells with pressure impact corresponding to prediction can be converted to injection with less risk of water breakthrough.

It can be wells **WBWD-1** and **WBW0**.

KEY RESULTS

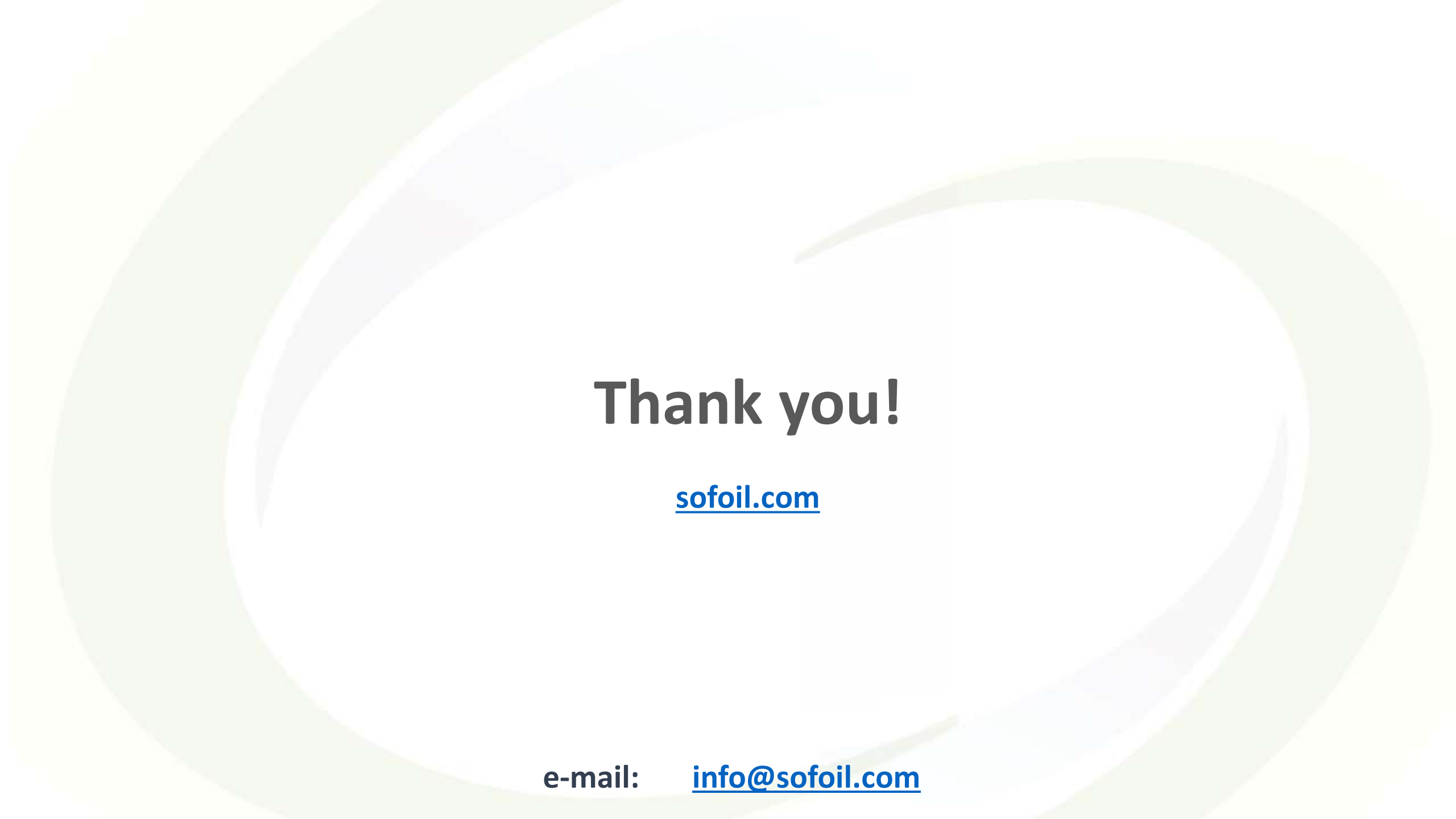


- Formation pressure at the area of all pressure-tested wells decreased during the production from 2009 to 2017 because of the influence of production wells;
- The MRT study is showing a fair connection between wells in the tested areas; no infill drilling requires for better recovery
- Apparent cross-well transmissibility is in the same order of magnitude as pressure tested transmissibility. It can be a sign of relatively similar connected formation thickness between the wells;
- MRT-based transmissibility can be used to calibrate the 3D model permeability around the wells and reservoir transmissibility in between the wells
- South area has poorer transmissibility. It leads to restricted productivity and restricted well interference there.
- Gross impact from offset wells results in pressure decline (from 10 bar to 35 bar cumulative pressure decrease);
- Total skin of wells is a large negative value due to horizontal wellbore, but productivity index of all pressure-tested wells decreased during the production from 2009 to 2017. It can be due to formation damage or dissolved gas liberation near the wellbore because of BHP drop.

Well	PI _{initial} , m ³ /(day·bar)	PI _{current} , m ³ /(day·bar)
WAW2	6.1	4.4
WAW6-1	11.7	7.5
WBW2	55	39.8
WBW4-1	49.7	24.8

RECOMMENDATIONS:

- **Consider implementing of pressure maintenance system.**



Thank you!

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