

# Well and Scale Management in a Mature Subsea Field

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Charles Adoga

POWERING A THRIVING **FUTURE**



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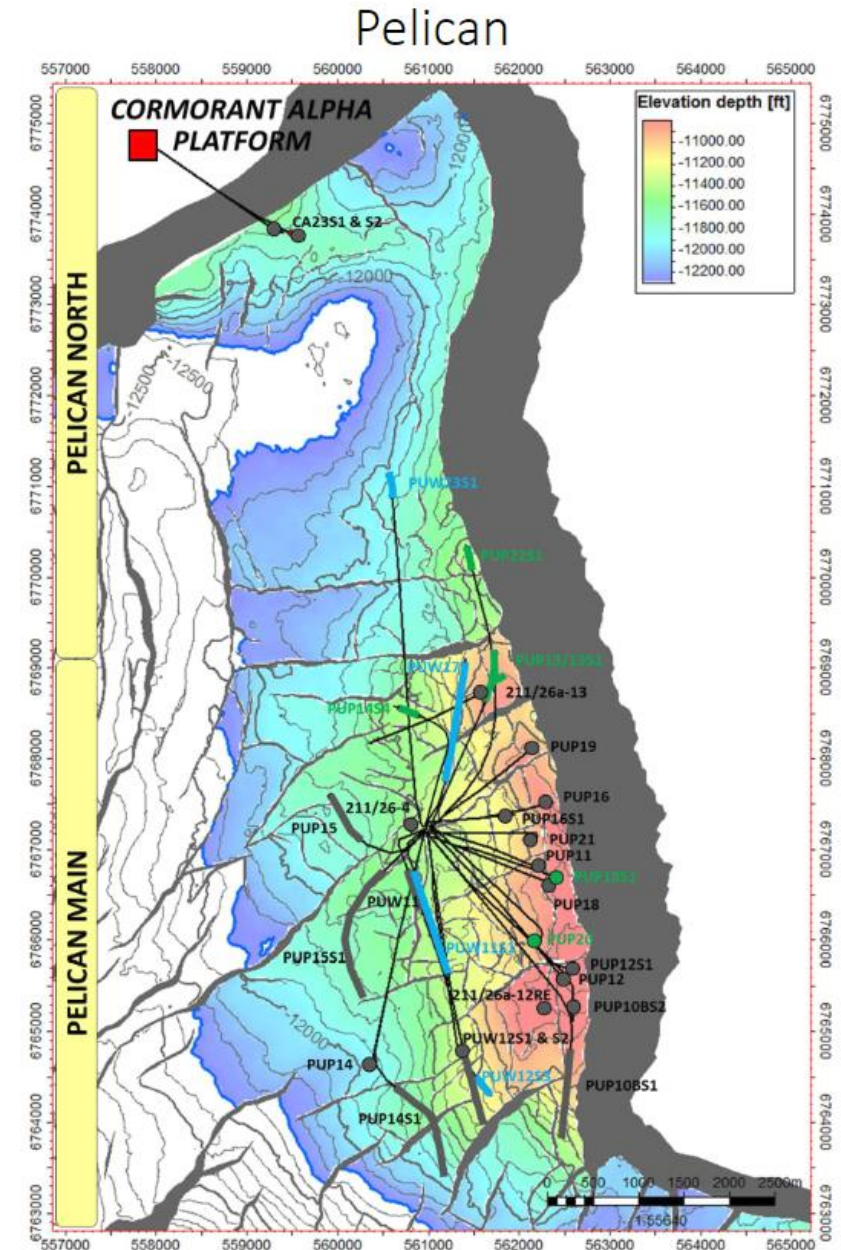
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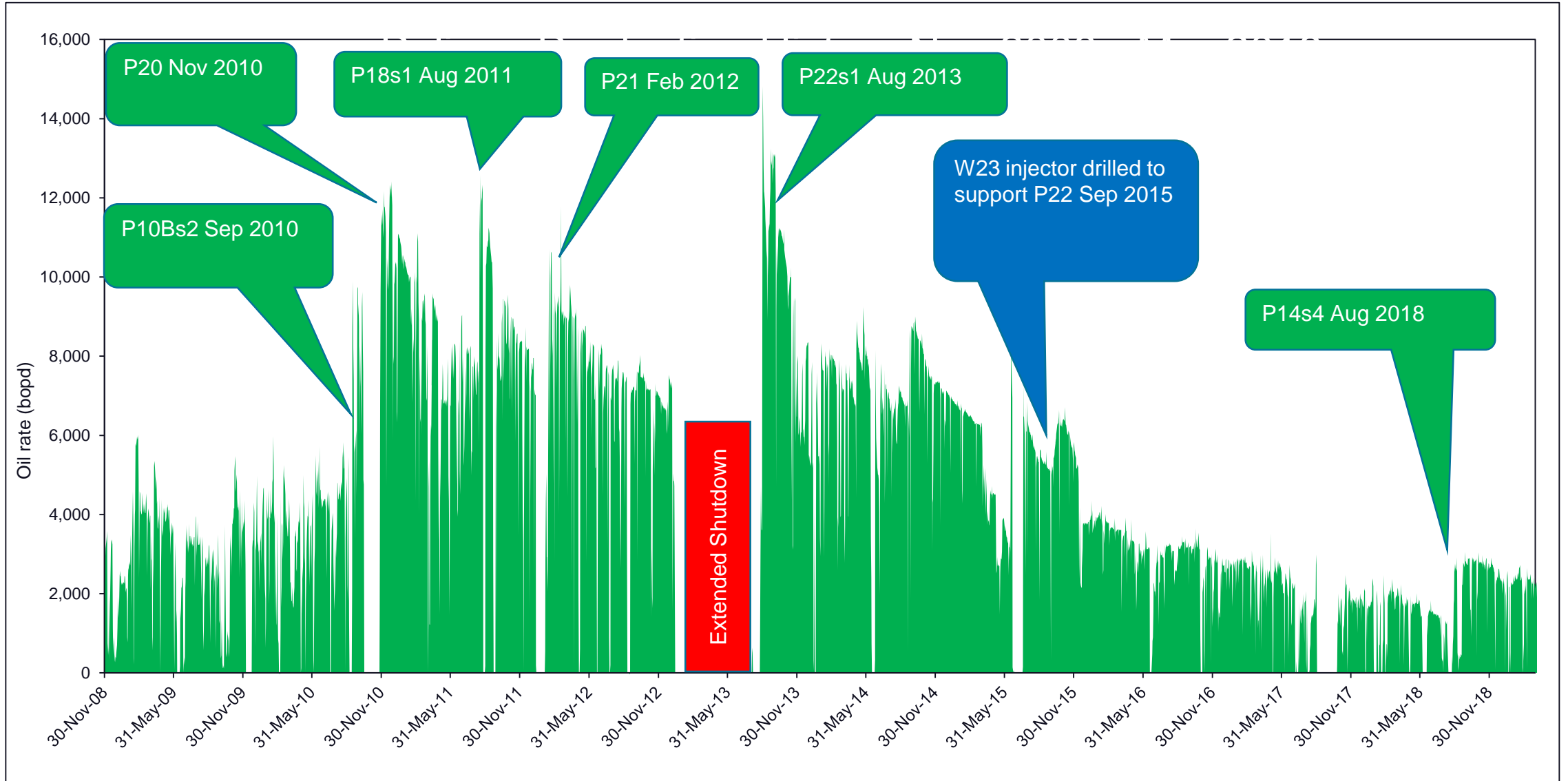
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# Pelican Background

- **Location:** East Shetland Basin, NNS
- **Discovered:** 1975
- **Field Online:** Jan 1996
  - Water Injection Jul - 1997
- **Type:** Subsea oil development tied back to the Cormorant Alpha Platform 8 Km away
  - 2 x 8" production flowlines, 1 x 8" water injection flowline
  - 1 x 6" gas lift flowline
  - 5 current gas lifted producers (includes 1 cyclic)
  - 22 wells (5 injectors and 17 producers)
  - 4 injectors
- **Reservoir:** Middle Jurassic Brent Group at 10,500 - 12,300 ft TVDSS, **OWC not penetrated**
- **Cumulative production:** 78 MMstb
- **STOIIP:** 590 MMstb
  - STOIIP in low permeability rock
  - High permeability channel intervals – premature watercut
- **Oil Properties:**
  - API 34.8
  - Bubble Point 2340 psi
  - GOR 567 scf/stb

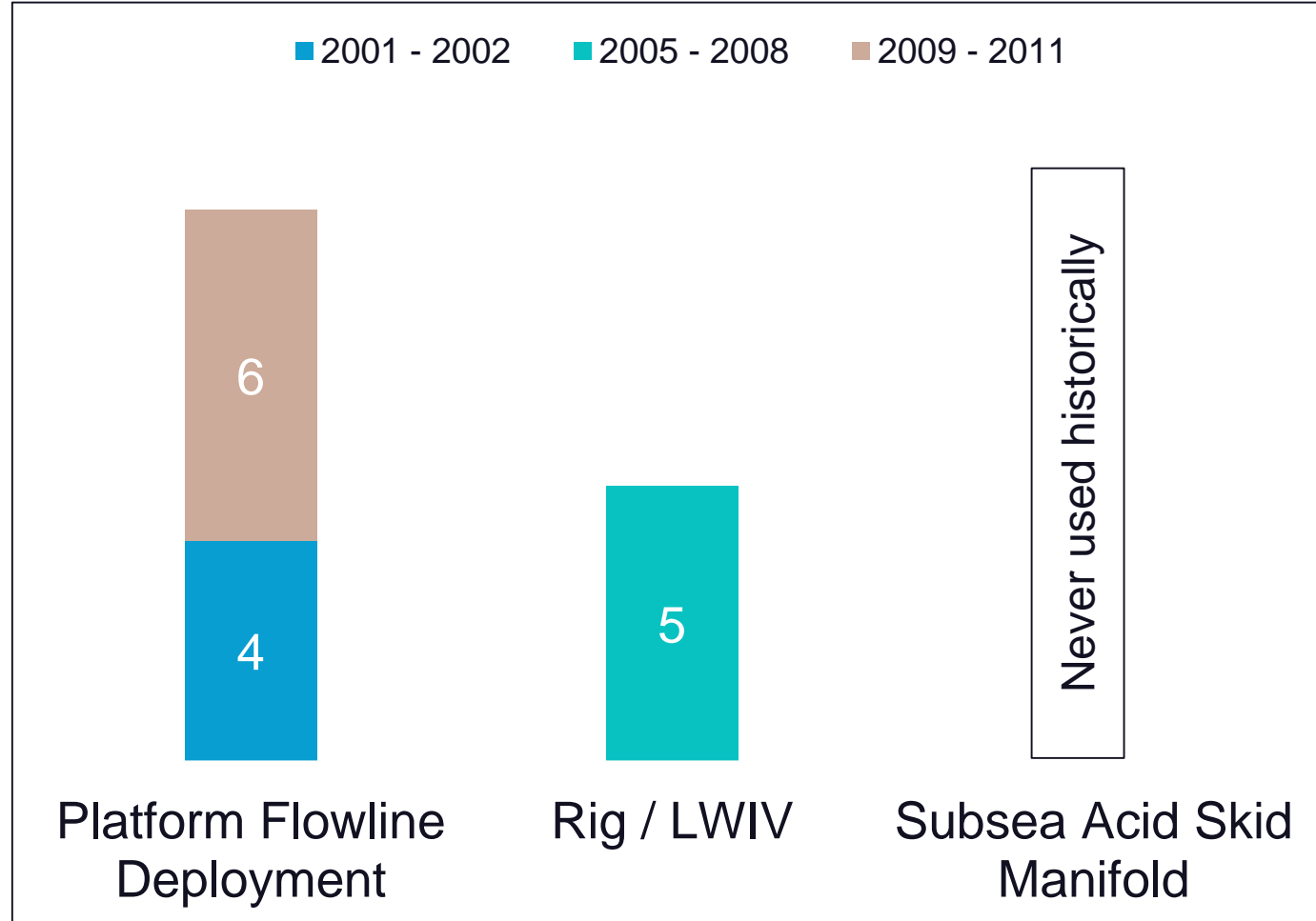


# Production History (TAQA operatorship)



# Scale Management History

## Deployment Technique



Deployment option depends on:

- Economics
  - Cheapest – Platform flowline
  - Most expensive – Rig / LWIV
- Risk of diversion
  - Platform flowline – risk of debris impairment
- Other planned well activities

# Scale Management History

## Timelines

Pre 2011

- Active infill well drilling & interventions
- **Scale prevention via inhibition & treatment (dissolver + squeeze)**
- Good water injection uptime

2011-2017

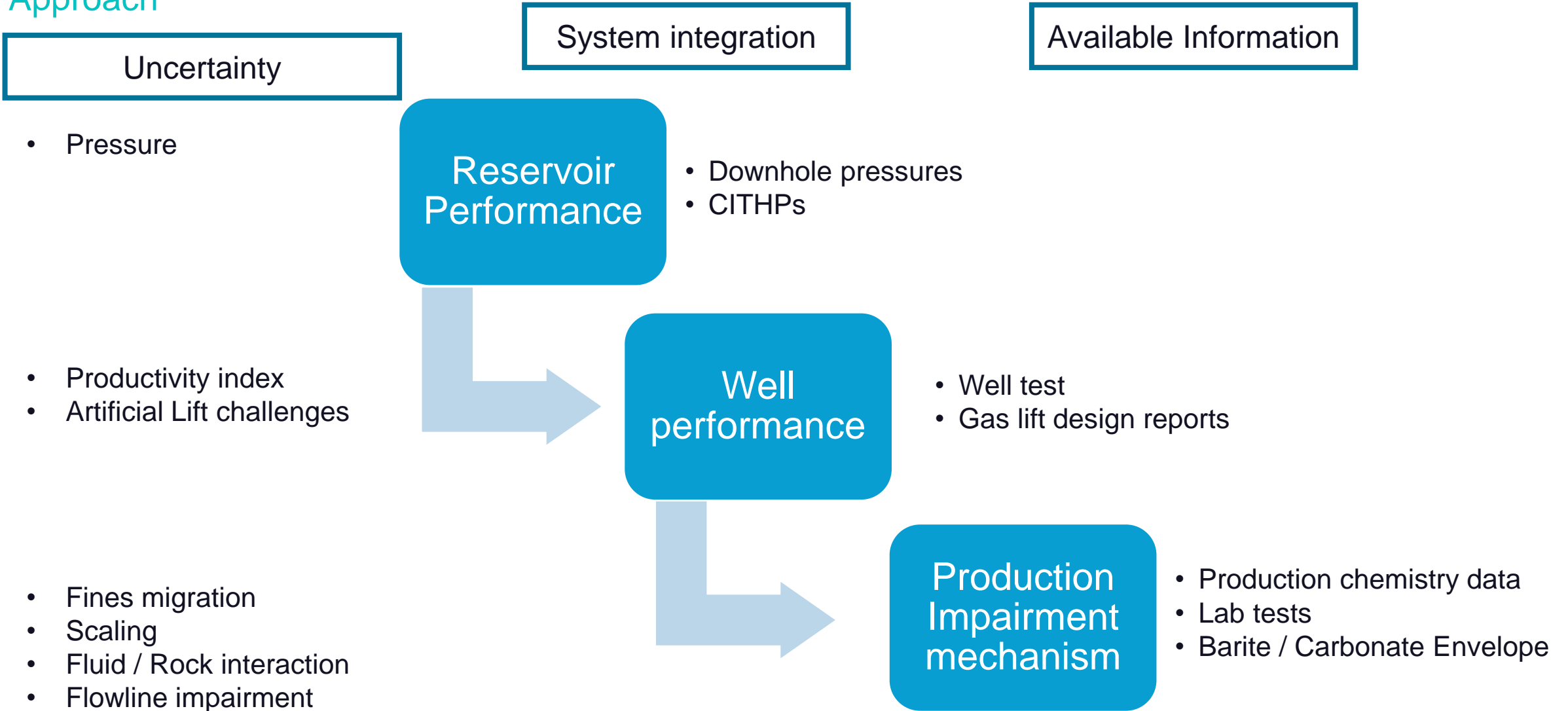
- **P10bs2 scale inhibition squeeze in 2011**
- Poor water injection uptime
- **P22s1 coreflood test – 50% return permeability impairment**

2017-date

- Rejuvenation of scale management & change of production storage to direct export
- Laboratory Tests (P22s1 repeat, P12 expanded coreflood tests)
- **Scale remediation via scale dissolver treatment**

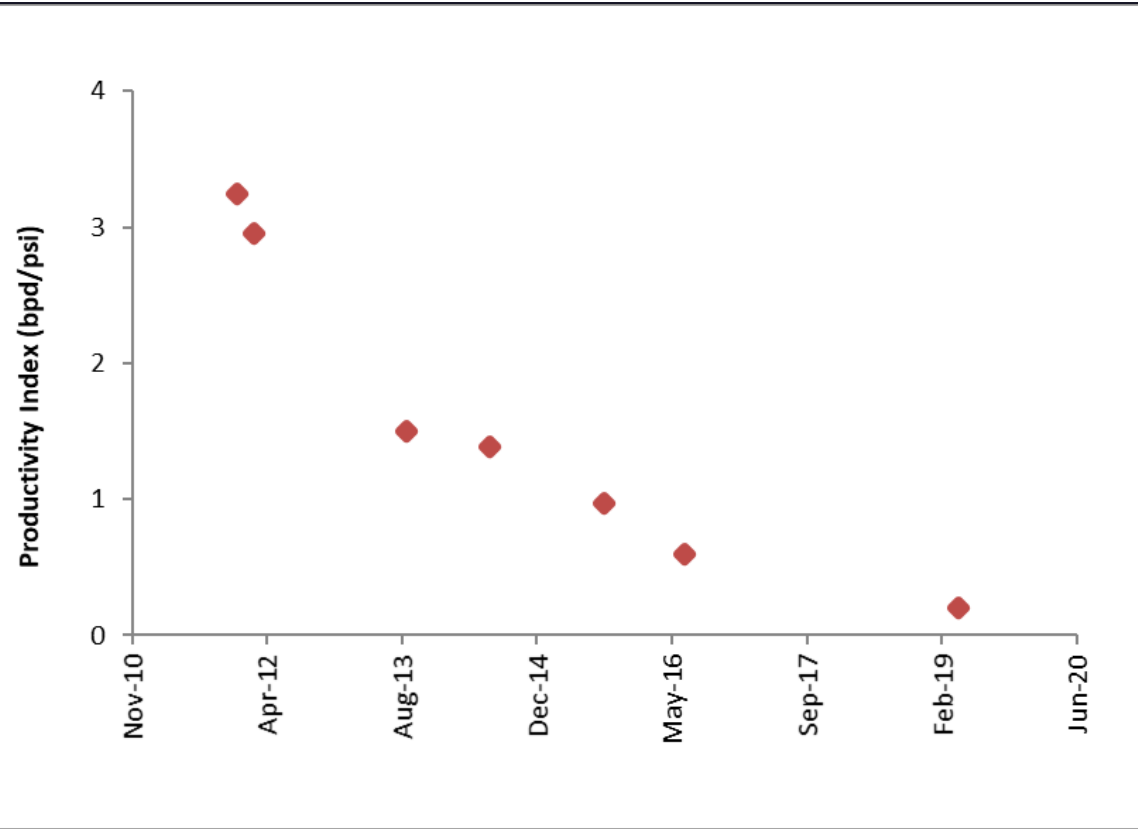
# Rejuvenation of Scale Management

## Approach



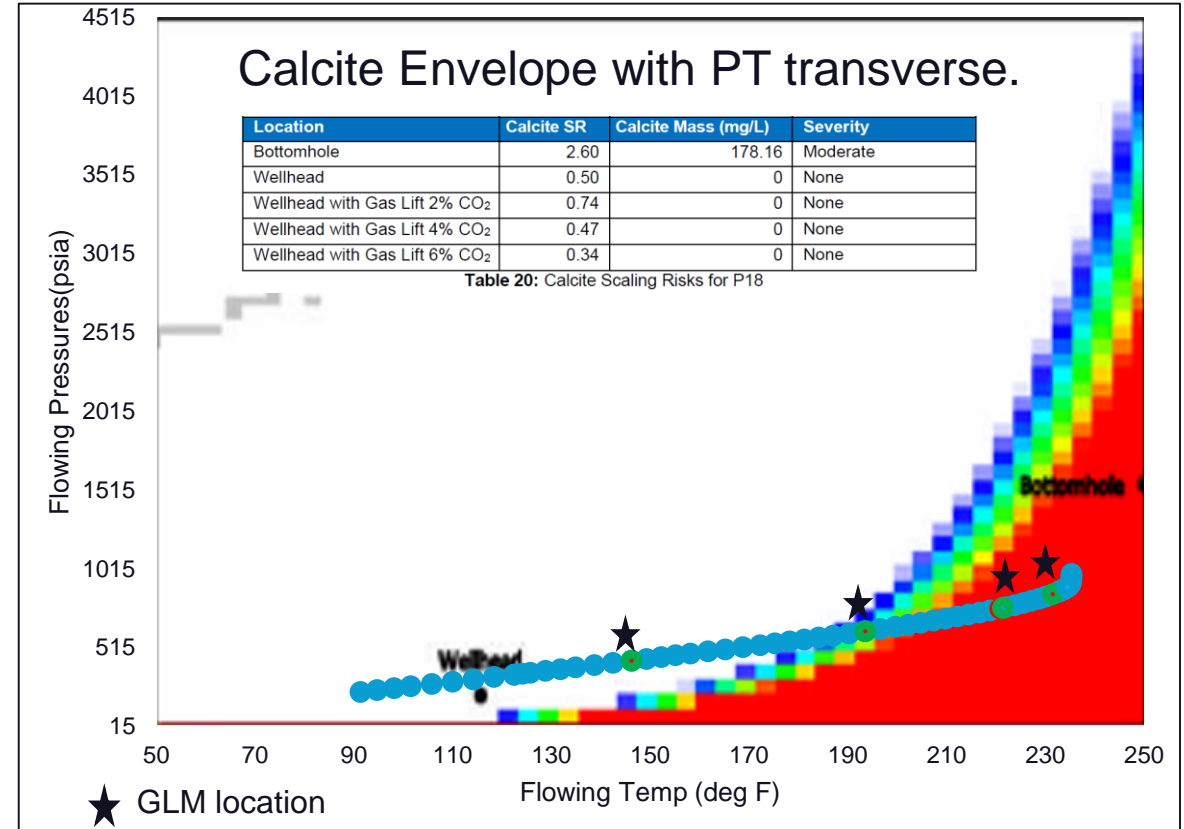
# Rejuvenation of Scale Management

## Impact of Historical Scale Management



- Over 90% of initial productivity of well impaired
- Sub-optimal gas lift performance
- Poor well performance contributed 20-30% reduction in recoverable reserves

## Data Interpretation & Integration

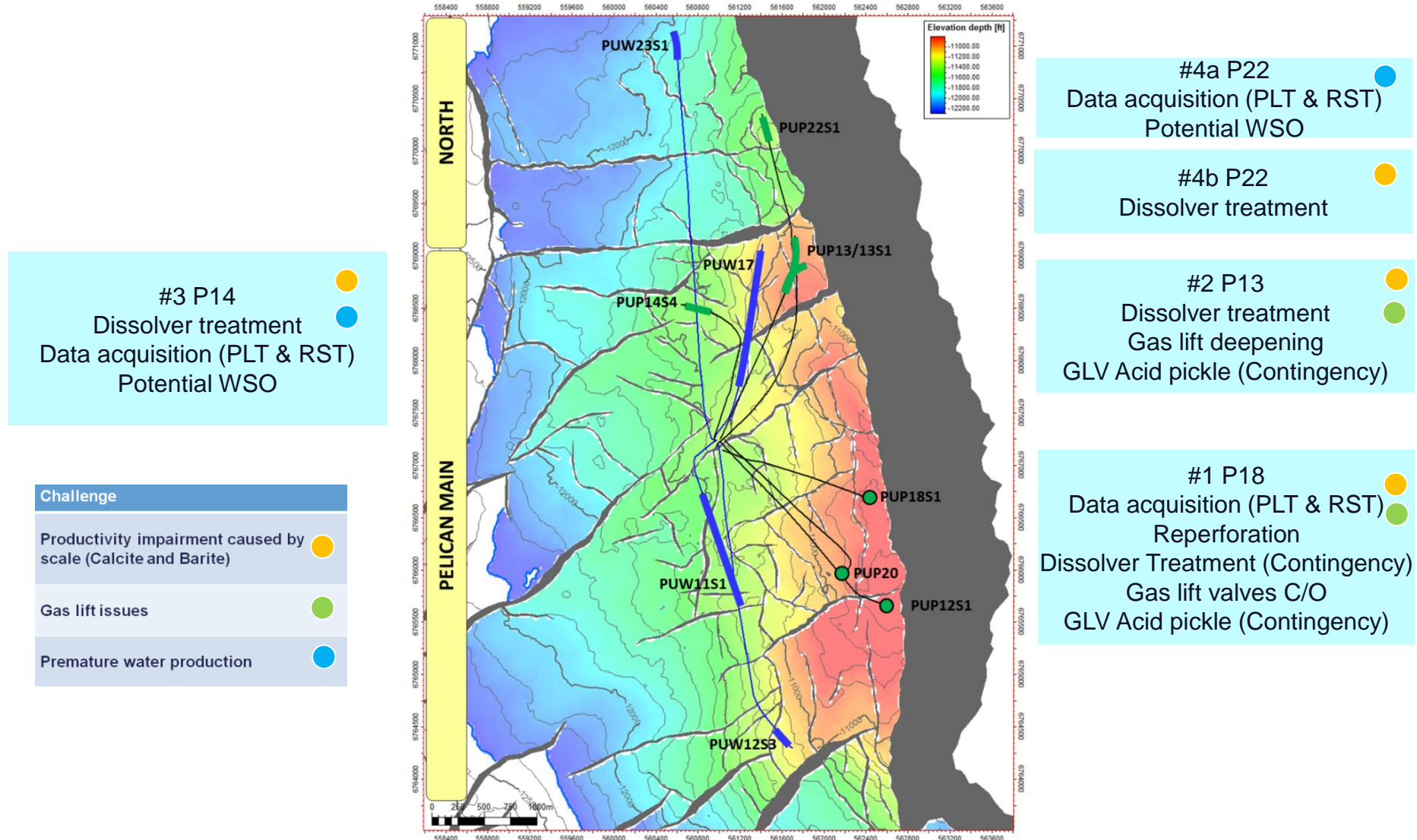


Integration of well performance and scale model output predicted **severe scaling**, although by standard analysis, moderate scaling severity was suggested



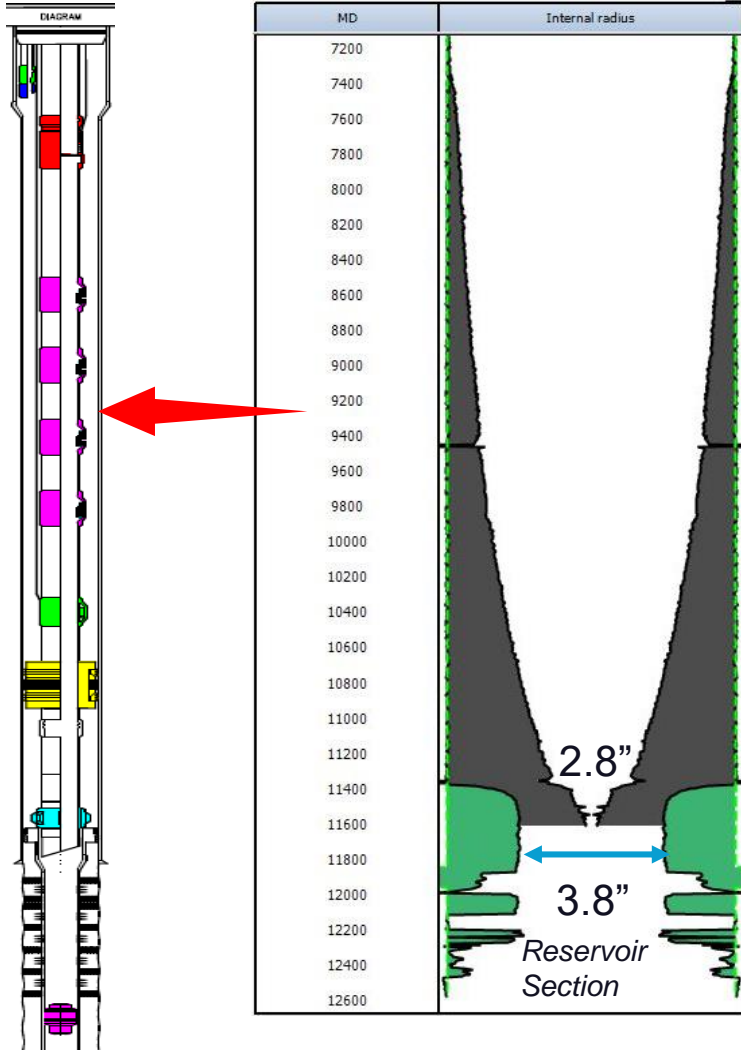
# Programme of Work on MSS1 Rig

## Initial Scopes



# P18 Intervention Summary

## Well Access, Caliper Log, Milling & Dissolver Treatments

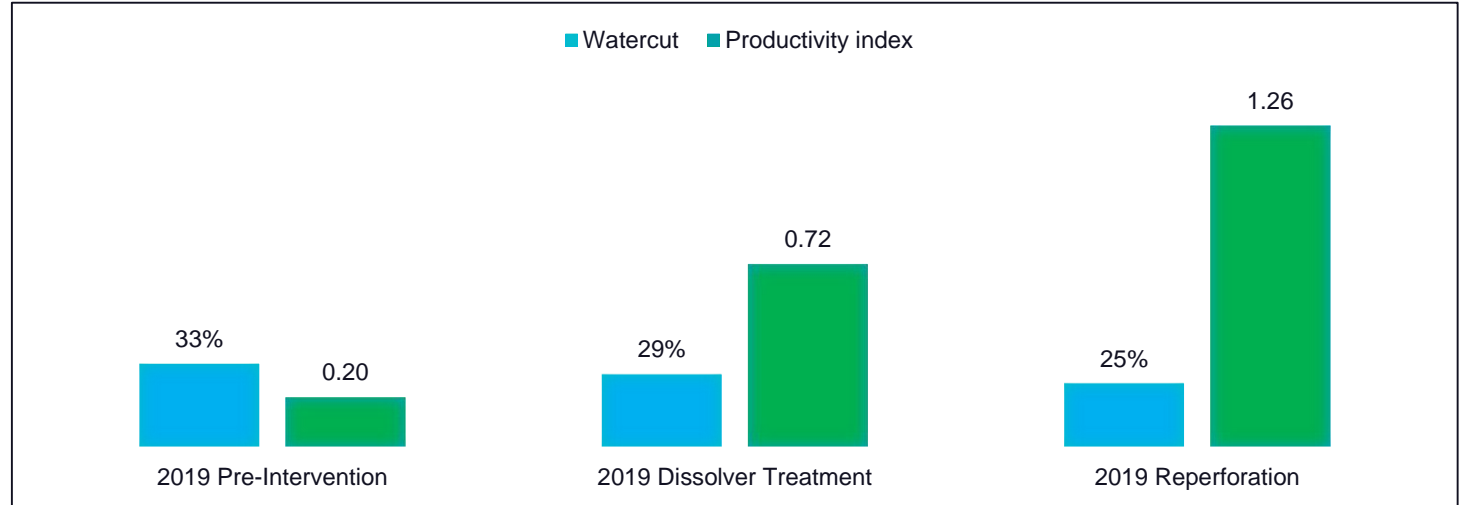
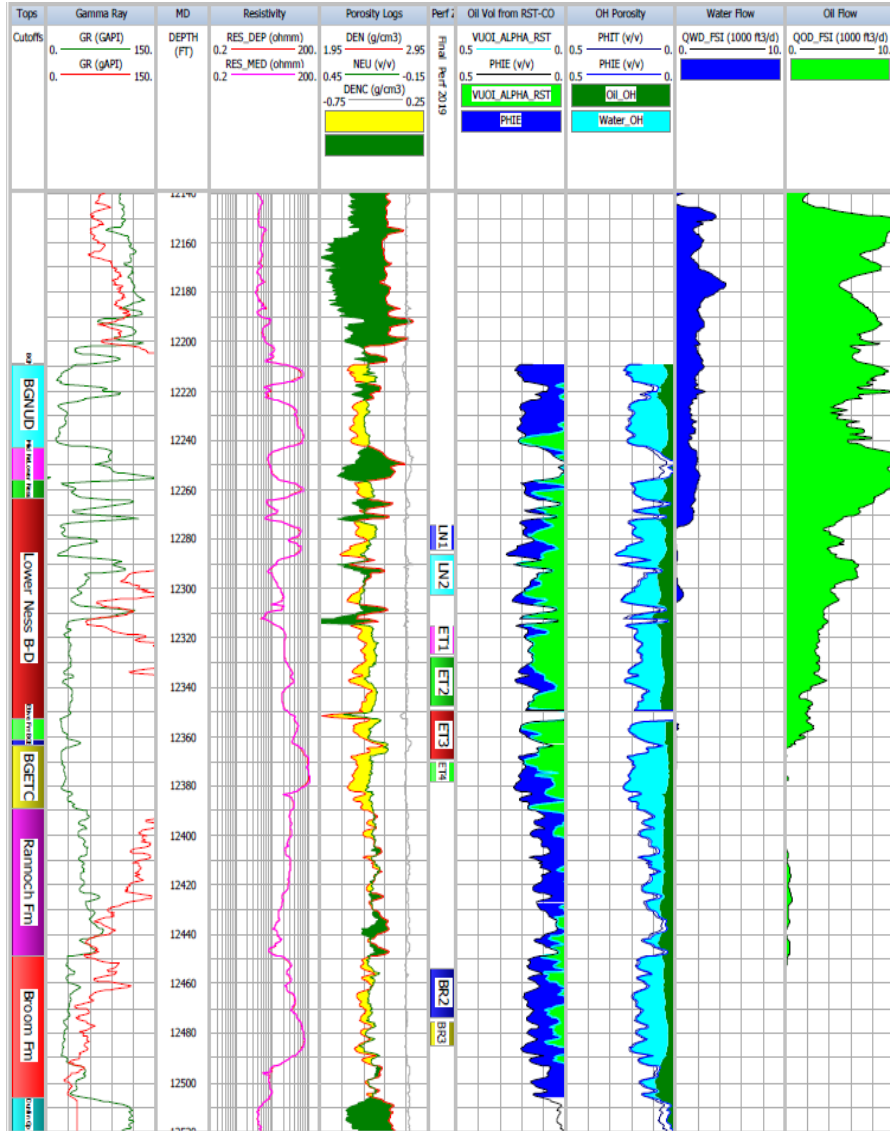


### Scale deposition

- Drift hung up at 9,240 ft. Target depth of 12,626ft
- Calliper log revealed the extent scaling
- 3<sup>rd</sup> and 4<sup>th</sup> GLM covered completely with scale
- Pervasive scale present across perforation
- CT mobilised and carried out:
  - 6 milling runs (~3,300ft scale milled)
  - 3 Cal-Acid dissolver treatments (306 bbls) and
  - target depth below the perms reached

# P18s1 Intervention Summary

## Re-perforation & Result

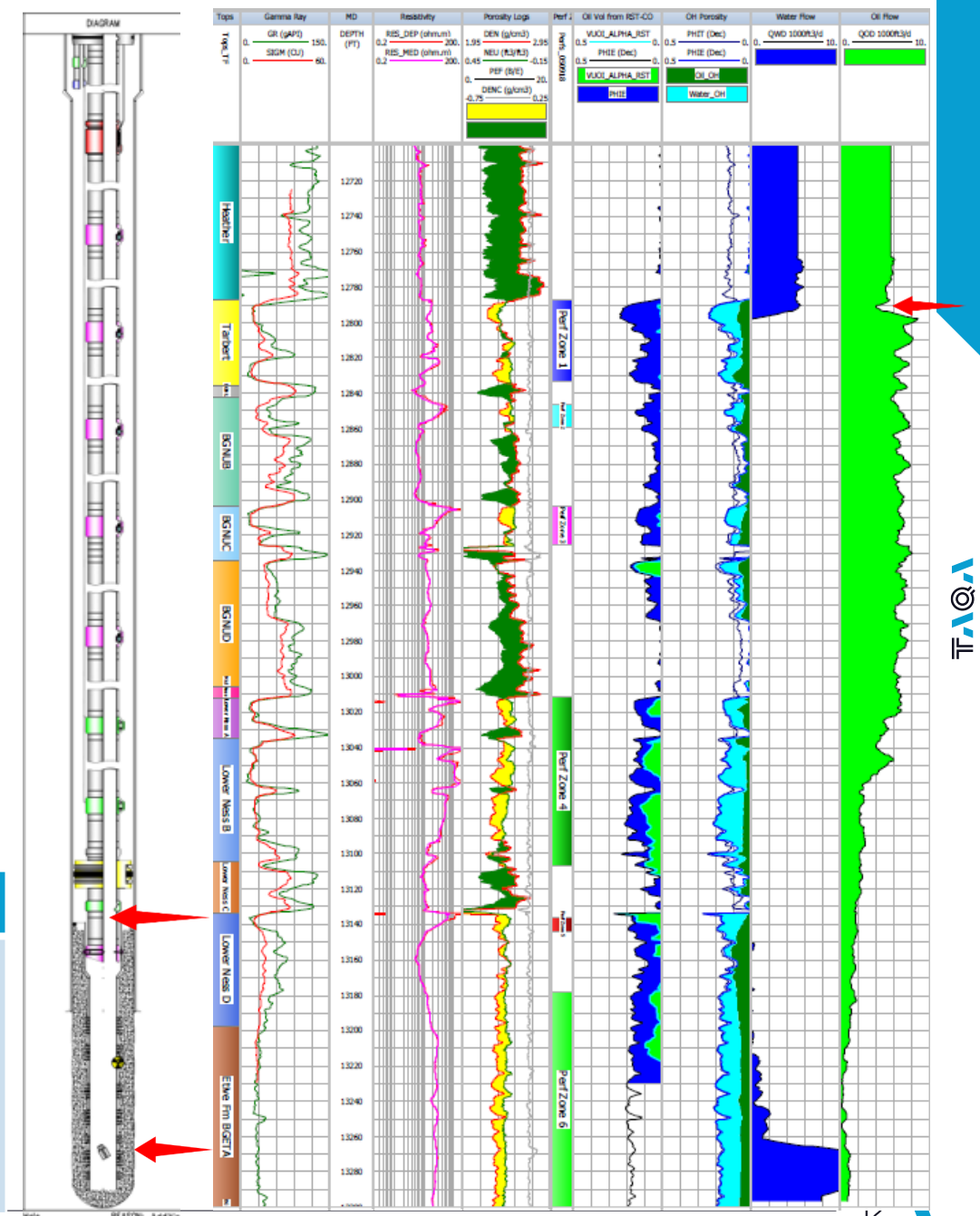


- Dissolver Treatment effective in improving well productivity
- Dissolver Treatment enhanced Vertical Lift Performance
  - reinstated gas lift orifice valve operability confirmed with FGS
- Selective reperforation from saturation log prevented adding perf in watered zones
  - Planned 3-3/8" gun changed to 2-7/8" to prevent gun getting stuck post perforation
- GLV change out was cancelled due to perceived challenges to carry out change out

# P14s4 Intervention Summary

- P14s4 came online in August 2018 with initial watercut reaching 70%.
- Scale encountered ~600ft above top perforation
- Reservoir access established via dissolver treatments c/w wire brush.
- Fish left in well after establishing reservoir access, but access for data acquisition not affected by fish.
- Data acquisition completed
  - Saturation logs revealed swept intervals
  - Production logs showed oil production being suppressed by jets of water
  - Flowing Gradient Surveys across GLMs confirmed optimal performance

Well	Initial Scope	Executed Scope
P14	<ul style="list-style-type: none"> <li>• Dissolver treatment</li> <li>• Data acquisition (PLT &amp; RST)</li> <li>• Potential WSO</li> </ul>	<ul style="list-style-type: none"> <li>• Wireline runs &amp; dissolver treatments to gain access to perfs</li> <li>• Slickline fishing</li> <li>• Dissolver treatment</li> <li>• Data acquisition</li> </ul>





# Programme of Work on MSS1 Rig

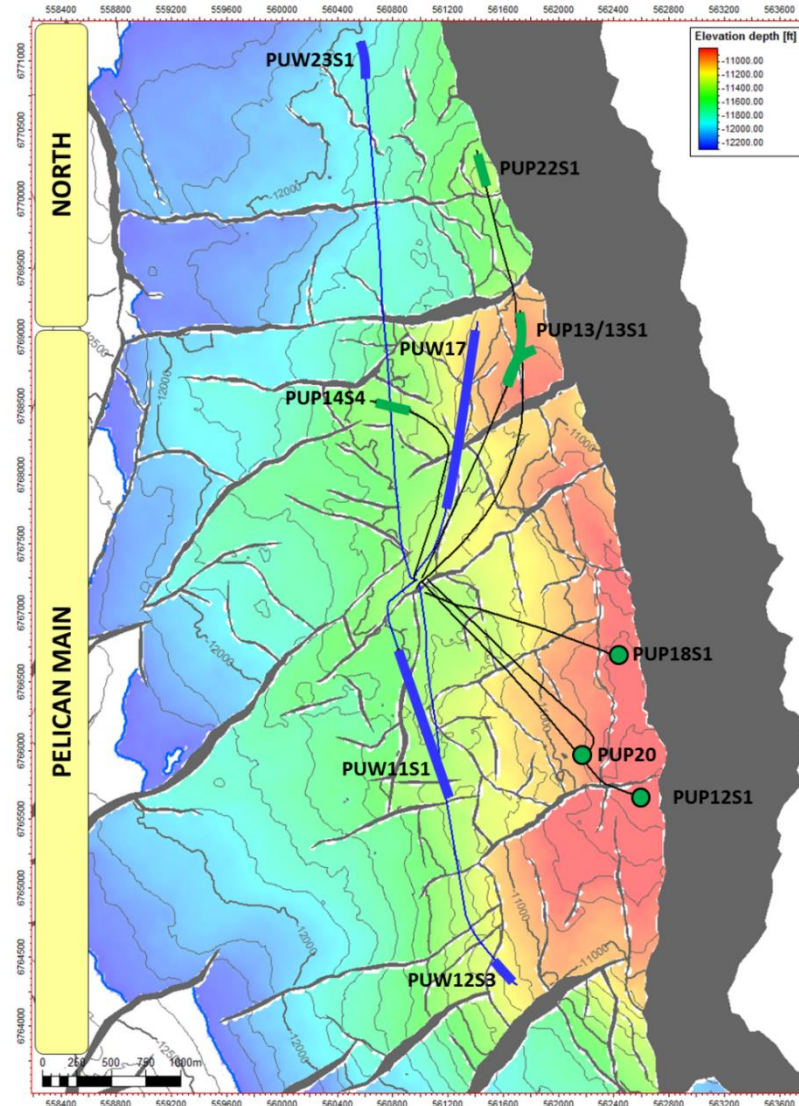
## Completed scopes

#3 P14  
Dissolver treatment  
Data acquisition (PLT & RST)

Challenge	
Productivity impairment caused by scale (Calcite and Barite)	●
Gas lift issues	●
Premature water production	●

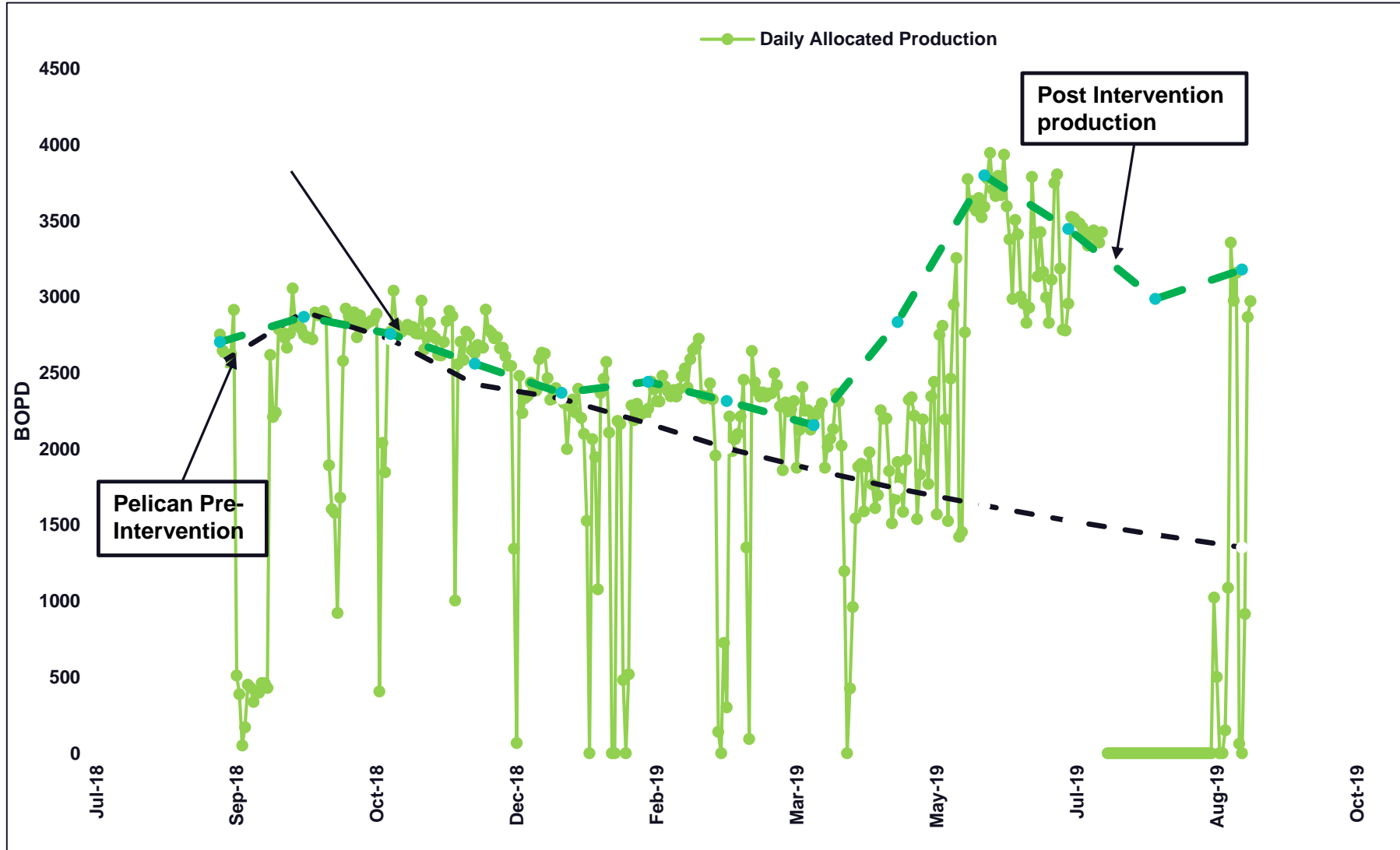
#2 P13  
Dissolver treatment

#1 P18  
Data acquisition (PLT & RST)  
Reperforation  
Dissolver Treatment (Contingency)



# Programme of Work on MSS1 Rig

## Production Incremental



**Intervention  
Incremental  
1870 bopd**

# Conclusions

## Integration & Communication

- Intervention team comprised production engineer, intervention and completion engineers and management
- Daily meetings with management for:
  - Intervention progress
  - Daily campaign economic return updates
  - Scopes balancing

## Scale

- Scale modelling was helpful in predicting wells with scaling presence
- Dissolver treatments helped in removal of scale but need mechanical agitation / mill to remove significant quantities

## Data Acquisition

- Acquired saturation log was critical in optimising the reperforation to avoid swept zones
- Acquired production log was useful in identifying zone for future water shut-off

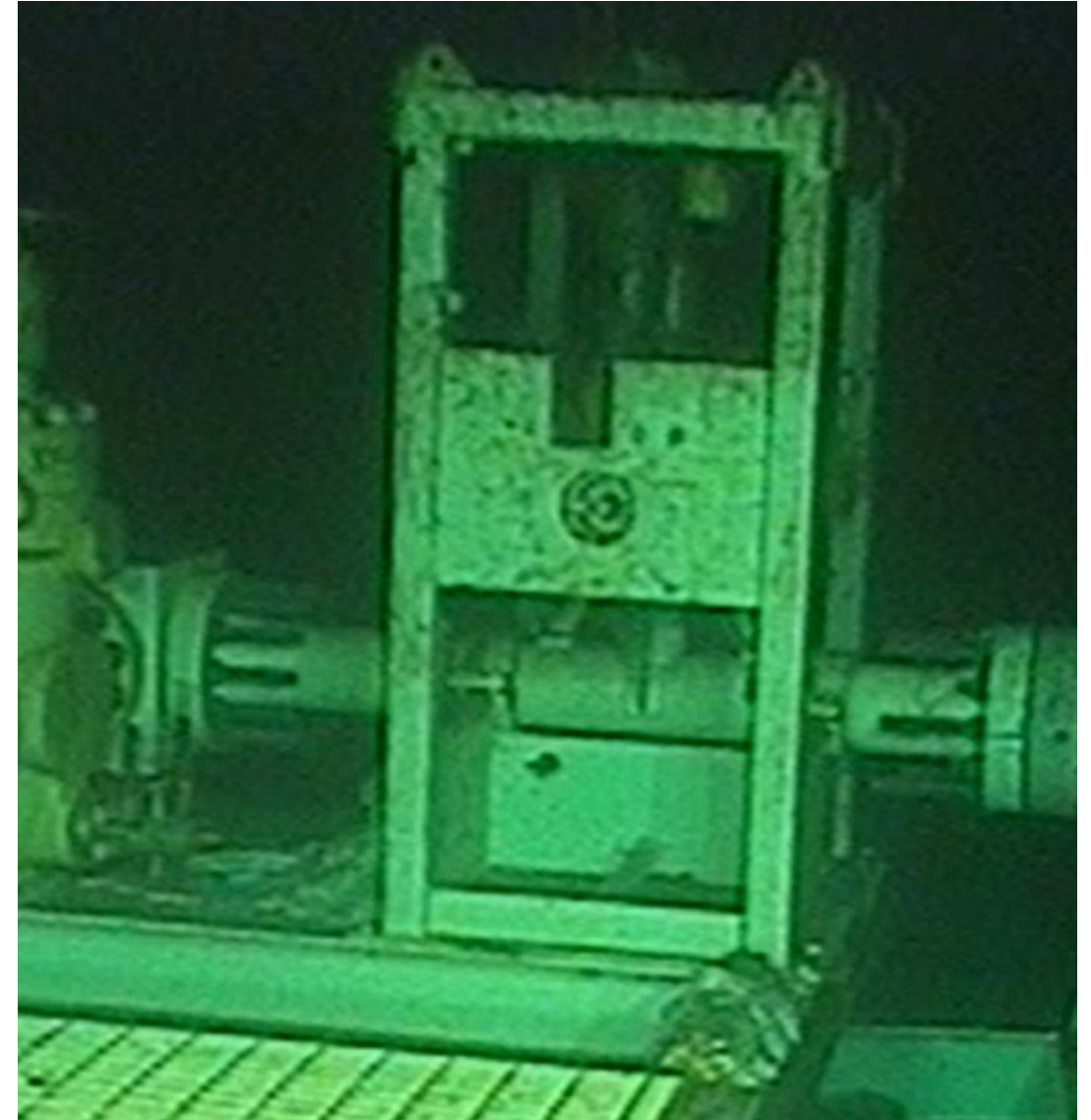
## Operational contingencies/learnings

- Coil tubing contingency – acidizing and tractor milling alone may not sufficient to remove extensive scale from wells
- Flexibility in perforating guns configuration should be considered

# Scale Management

## Next Steps

- **Continue Well performance monitoring**
  - Welltests and
  - Production chemistry data acquisition
  - Data analyses and integration
- **Approval to carry out dissolver treatments in 2021**
  - Subsea intervention in 2020 to confirm functionality and operability of the subsea scale squeeze skids - completed
  - Execute approved dissolver treatment scopes in 3 wells in 2021
- **Plan P&A activities with robust contingencies for scale in tubing**



ROV footage of Pelican Subsea stim skid

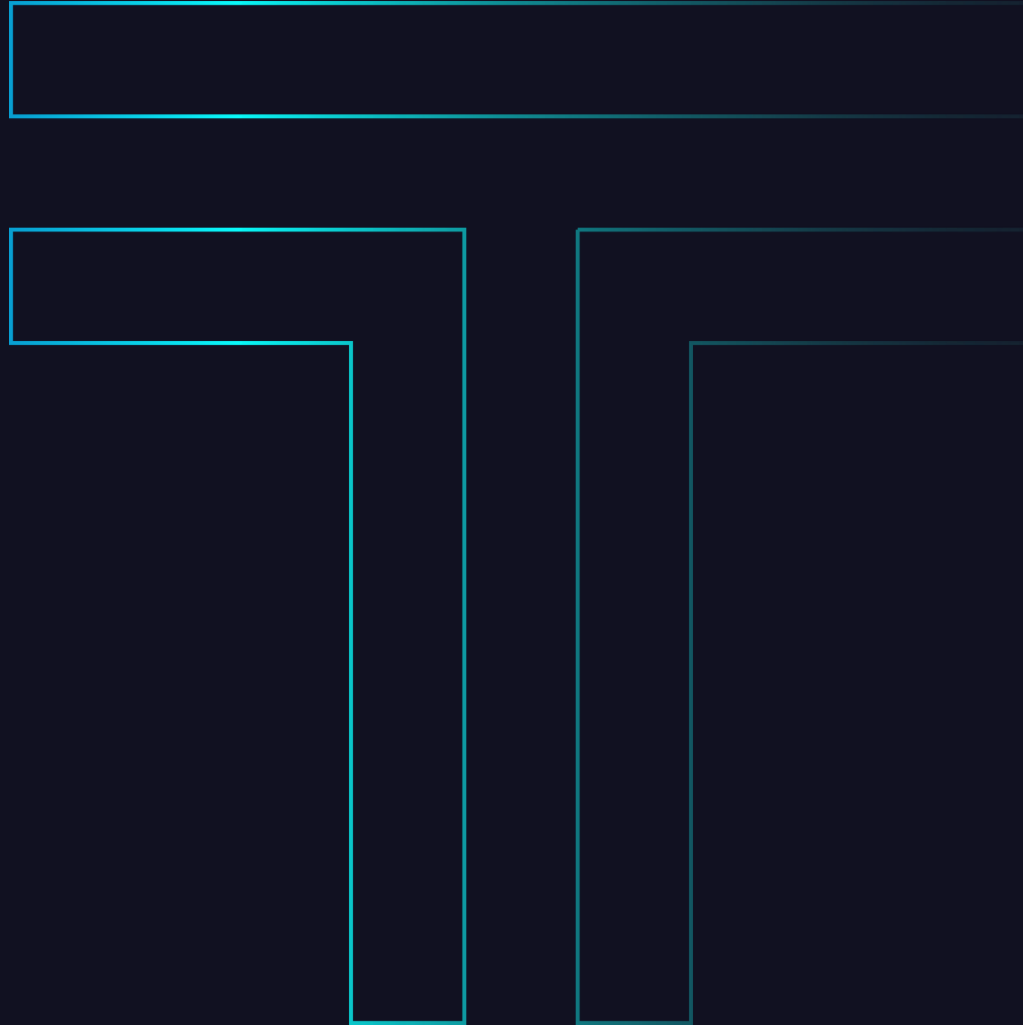


# Acknowledgement

Many thanks to TAQA for giving the permission and support to present this material.

Also thanks to Jane Tomkinson and the Cormorant Alpha Subsurface & Wells Teams for their great support during the planning and execution of the 2019 Pelican Intervention on the MSS1 Rig.

Finally, thanks to the Devex organising committee for the opportunity to present today.

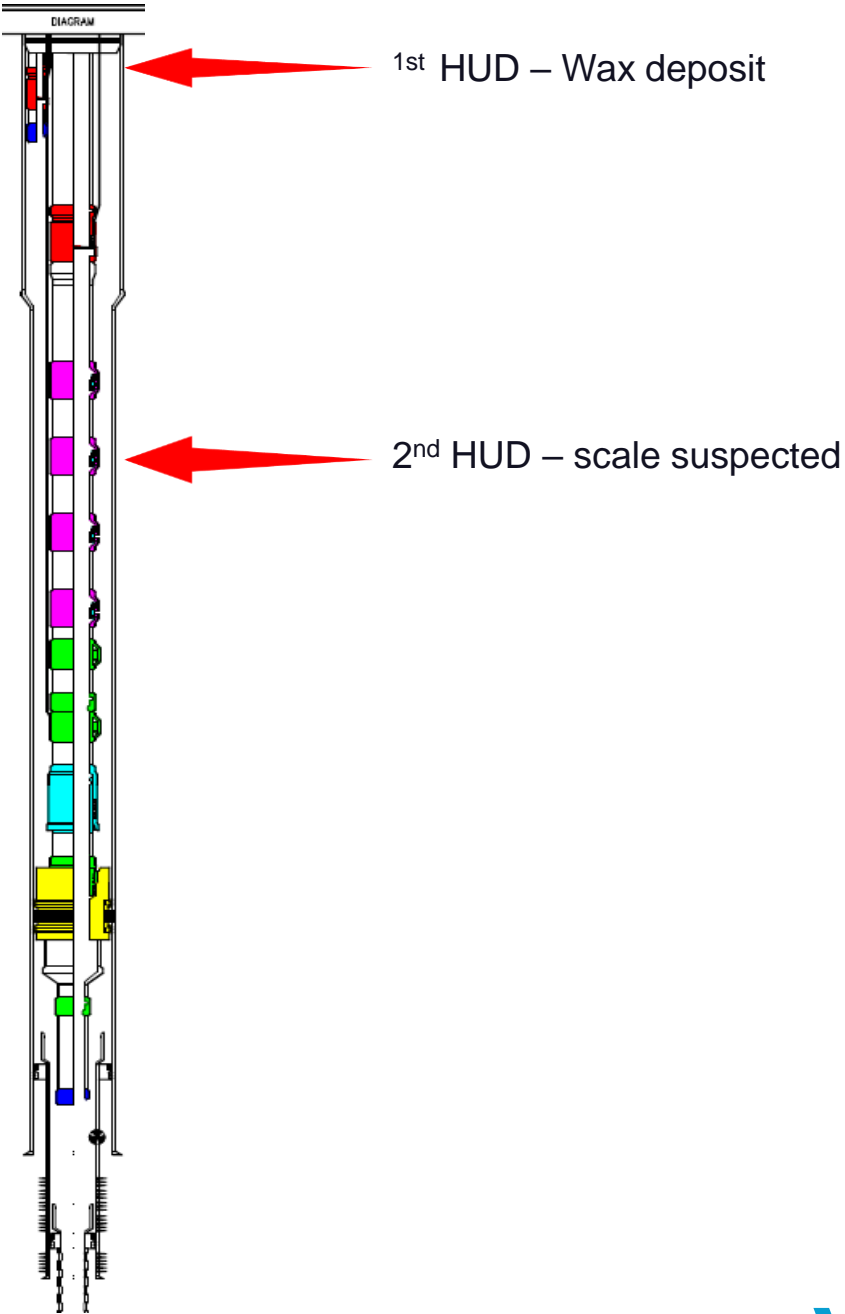


**THANK YOU**

# P13 Intervention Summary

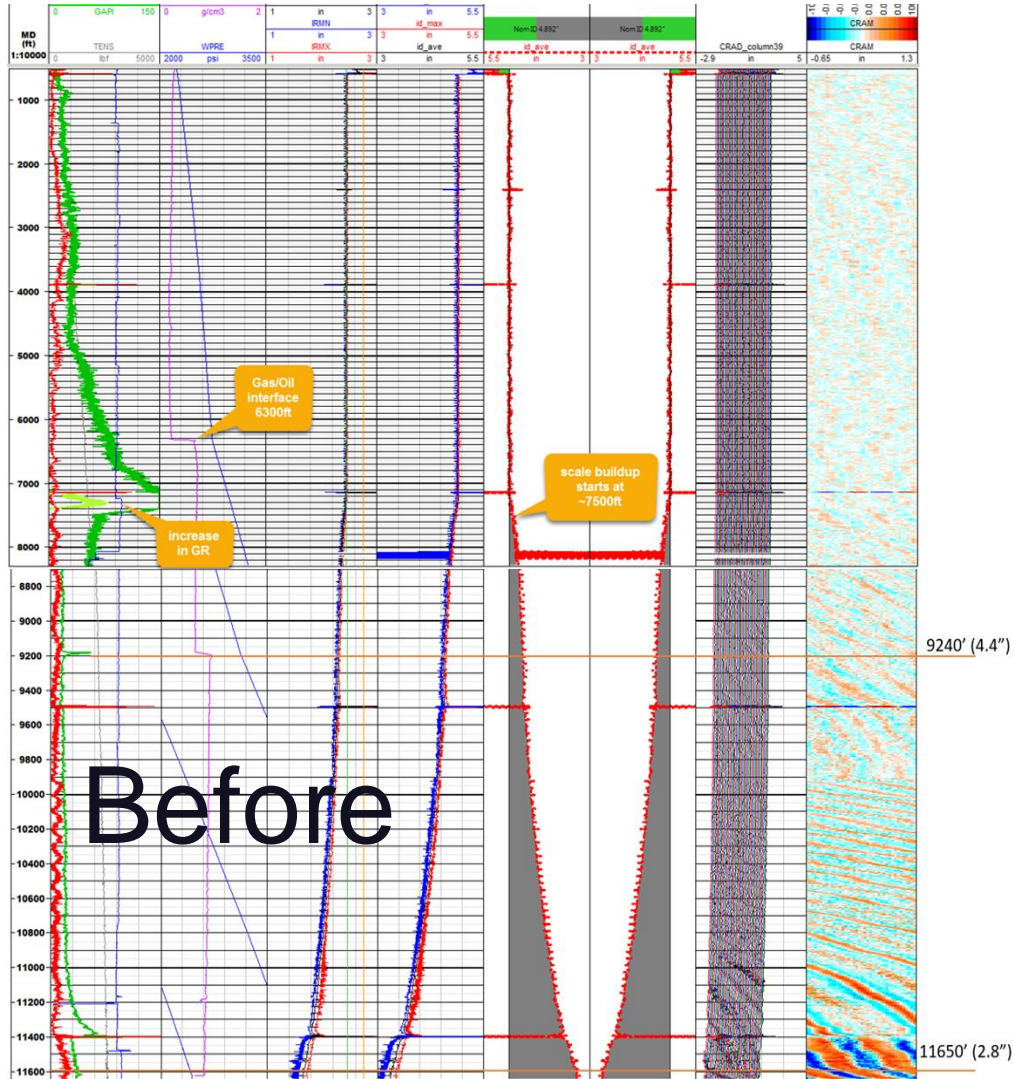
- Well had not been entered since its completion in 1996 apart from a scale dissolver treatment pumped from the Corm Alpha in 2009.
- Initial drift hung up 15ft below tubing hanger. Wax deposit found.
- Tubing eventually cleaned to TRSSSV with combination of wire brush and Base Oil soaks (200bbls).
- Shock sheared FIT whilst trouble shooting TRSSSV issue. Found fish at 6300ft and recovered.
- Ran 3" deep drift and held up at 6,900ft. Suspected scale.
- Pumped dissolver treatments (683bbls) and GLVs changeout cancelled

Well	Initial Scope	Executed Scope
P13	<ul style="list-style-type: none"> <li>Dissolver treatments</li> <li>Gas lift deepening</li> <li>GLV Acid pickle (Contingency)</li> </ul>	<ul style="list-style-type: none"> <li>Wax removal</li> <li>Re instatement of TRSSSV</li> <li>Fish recovery</li> <li>Dissolvers treatments</li> </ul>



# P18s1 Intervention Summary

## Milling & Dissolver Treatment



## Reservoir Section

