

# PERMIAN WATER OUTLOOK



FEBRUARY 26, 2019



## **30 YEARS OF ENERGY DATA INNOVATION**

Transforming complex data into actionable, high value intelligence for responsible and profitable decisions about water resources and the water services market.

# B3 Water Study Objectives

Provide comprehensive assessment of Permian Basin water utilization to address future water management approaches.

I. Derive estimates of future:

- Water use
- Water production
- Available disposal capacity

II. Assess water management business structure:

- Range of appropriate solutions
- Identification of best practices
- Consideration of appropriate economies of scale
- Impacts of technology



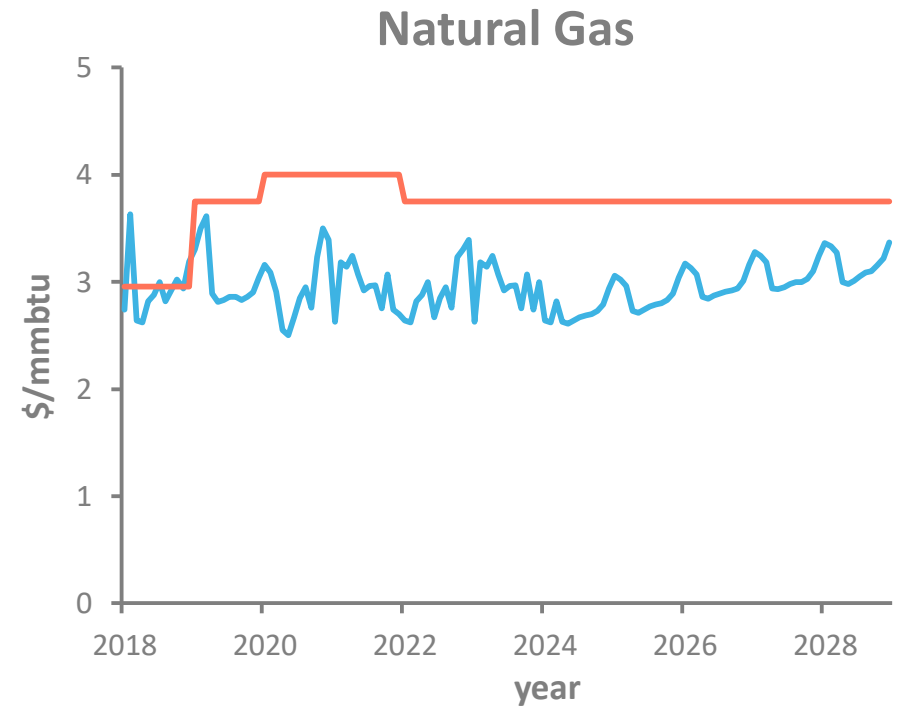
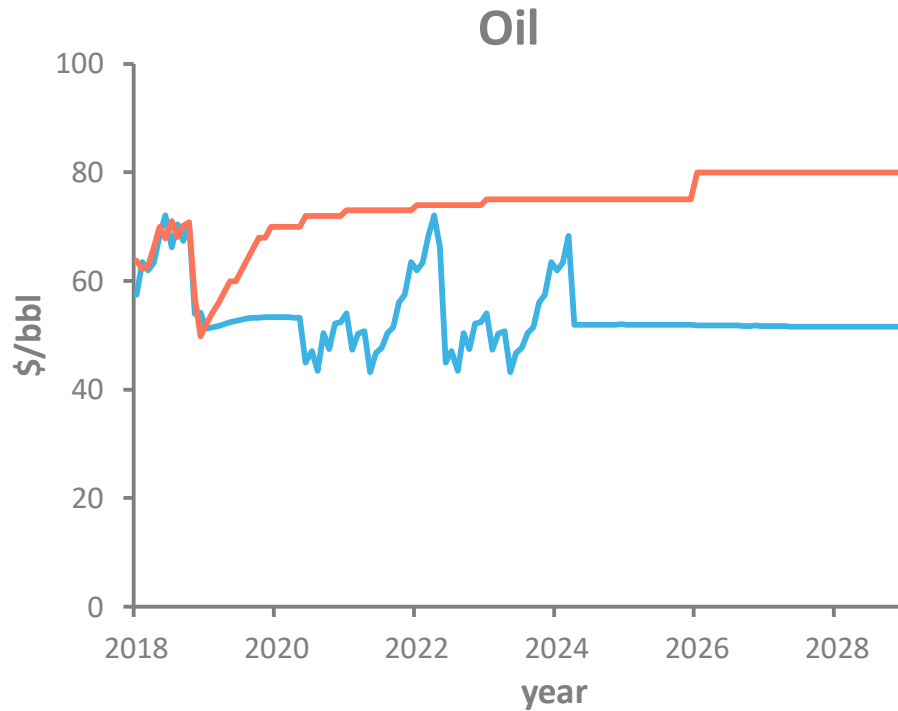
- I. Permian Basin water budget (study inputs/assumptions):
  - Oil & gas production forecast
  - Water use forecast
  - Water production forecast
- II. Current activities:
  - Water production validation
  - Pressure forecasts



# Oil+Gas Production Forecast



# Forward Price Curves

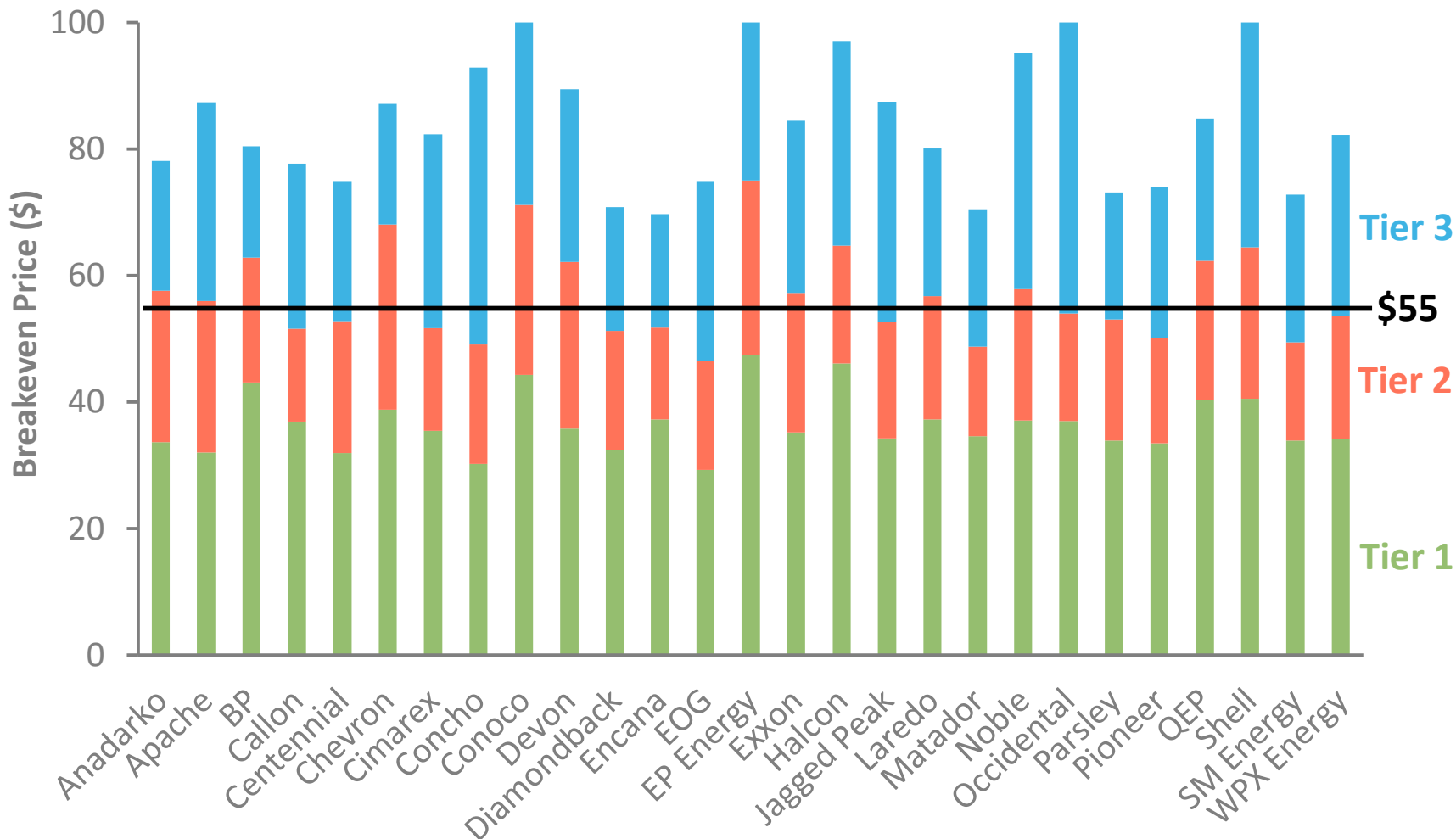


High price scenario: Drillinginfo 3Q18 forecast

Low price scenario: CME forward curve 11/17/2018



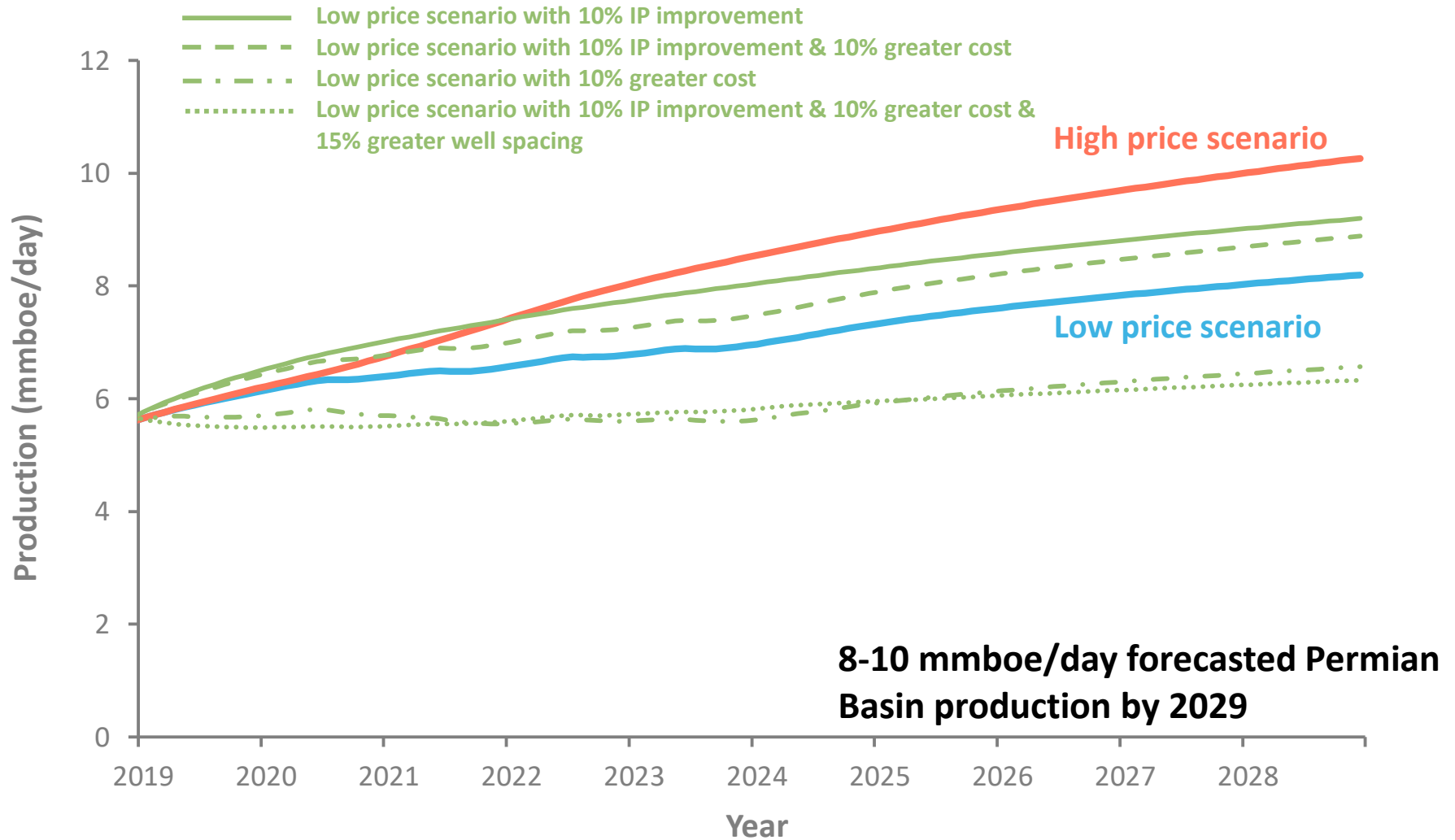
# Permian Basin Operator Breakevens



**Most major Permian Basin producers operate Tier 1 and 2 properties with half-cycle breakeven costs <\$55**



# Permian Basin Production Scenarios



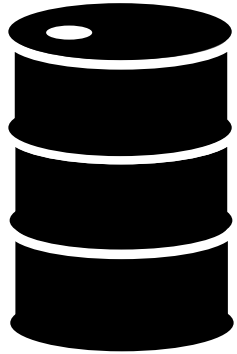




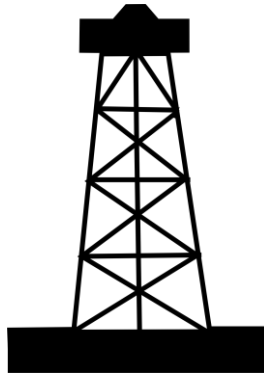
# Water Use Forecast



# Water Use Forecast Methodology



Production/  
Month  
(Forecasted)



Wells  
Drilled/  
Month

X



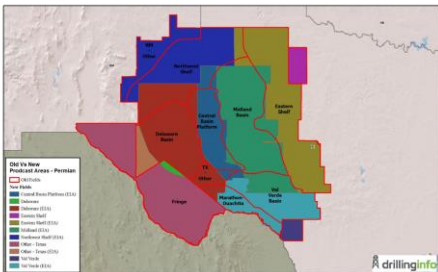
Average  
Water  
Use/Well

=



Water  
Use/Year

PERMIAN



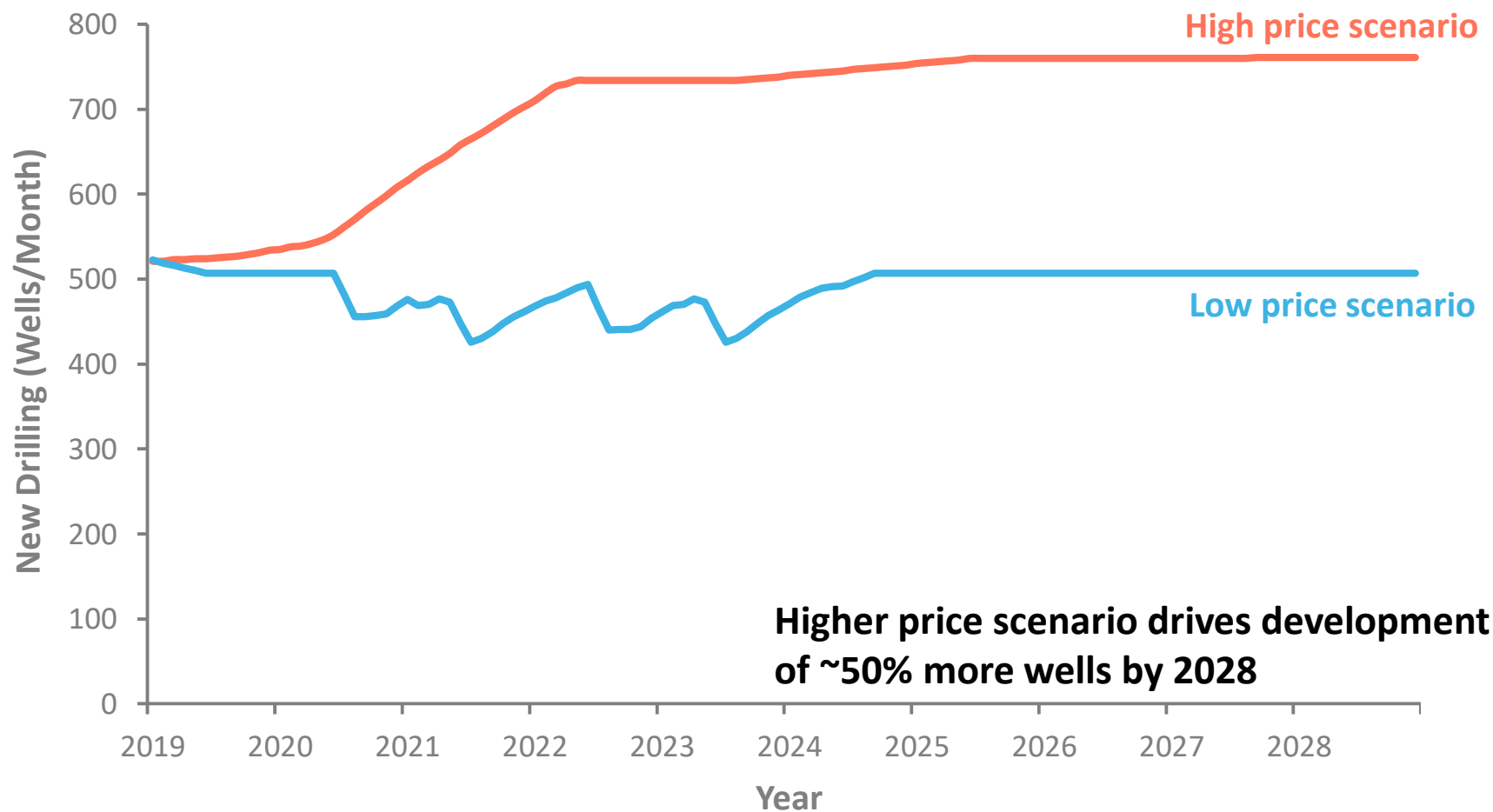
10  
Subareas

37 Different  
Sub-Subareas  
(e.g., Bone Springs,  
Spraberry, Wolfcamp)

3 Tiers Based  
on DI Estimates of  
Breakeven Price

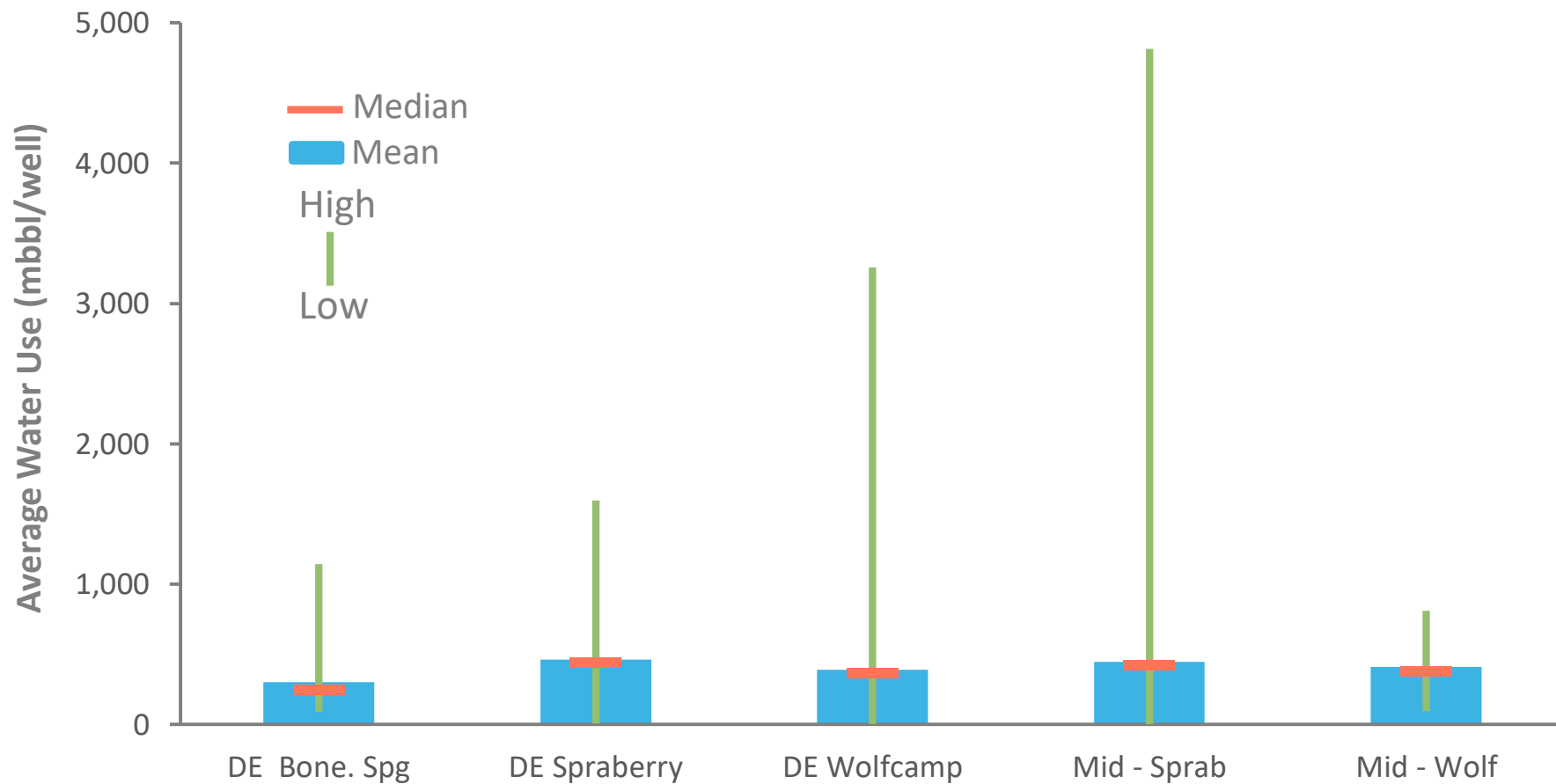


# Permian Basin Drilling Scenarios



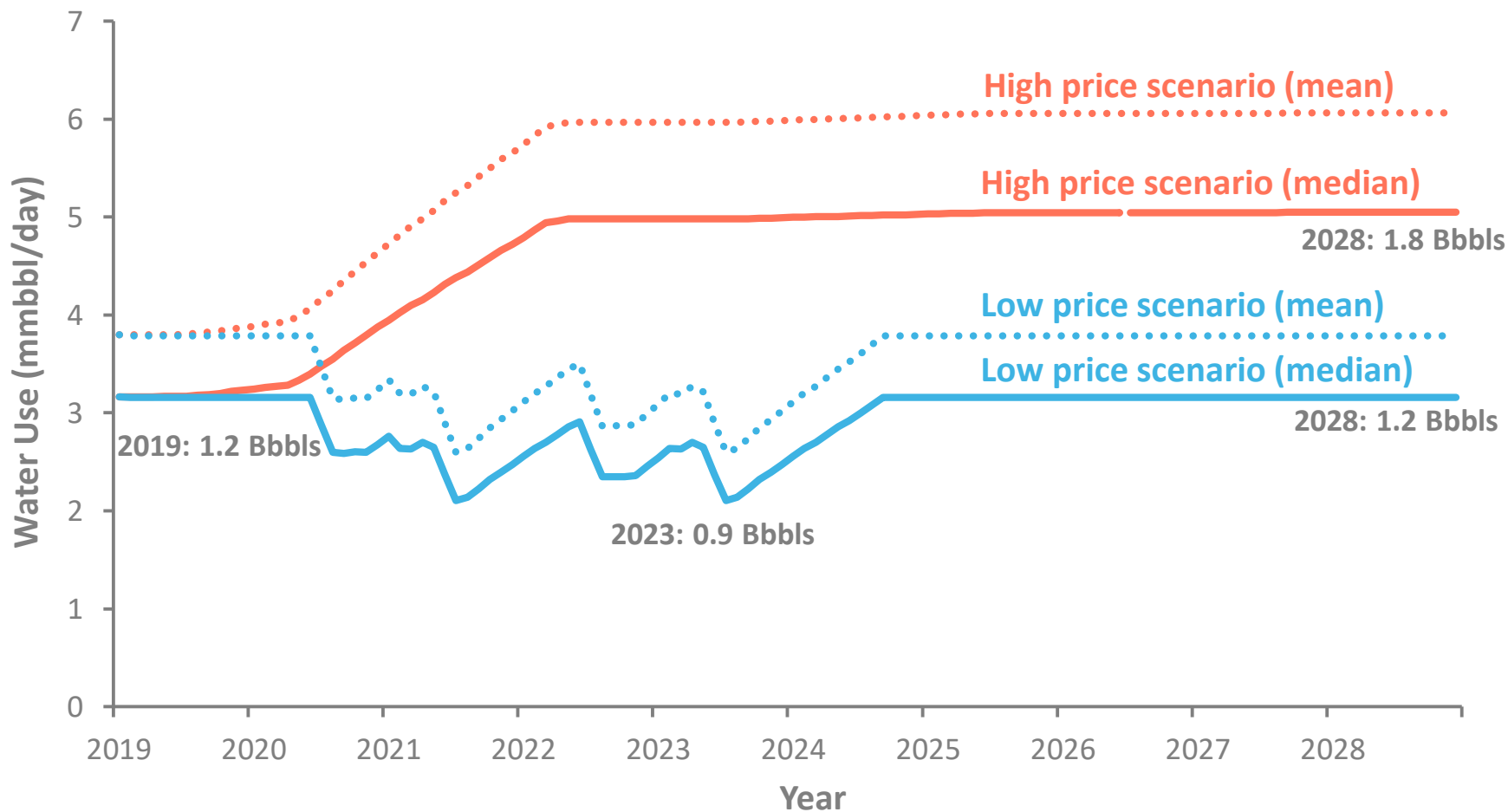


# Water Use (2017)





# Permian Basin Forecasted Water Use

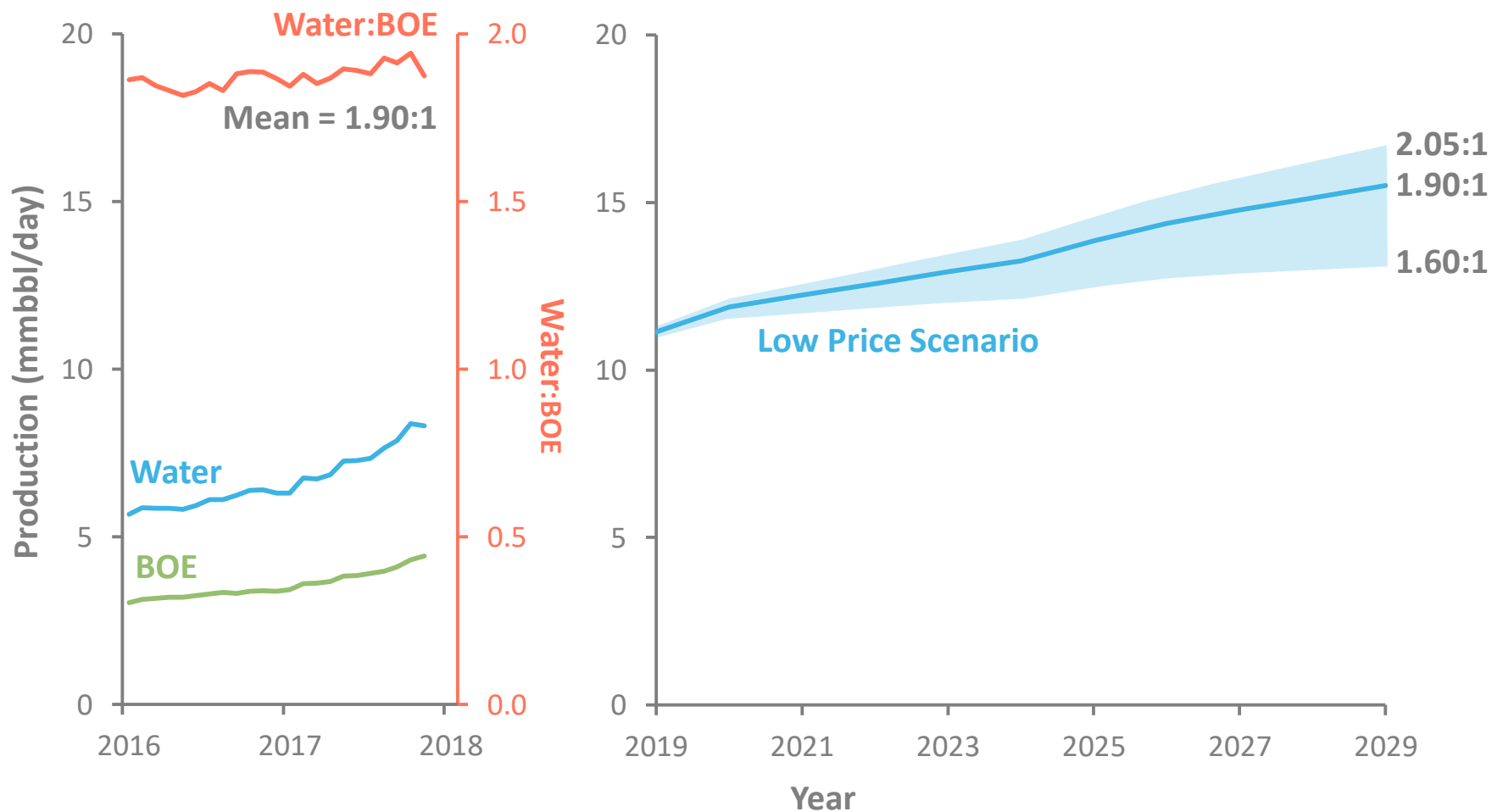




# Water Production Forecast



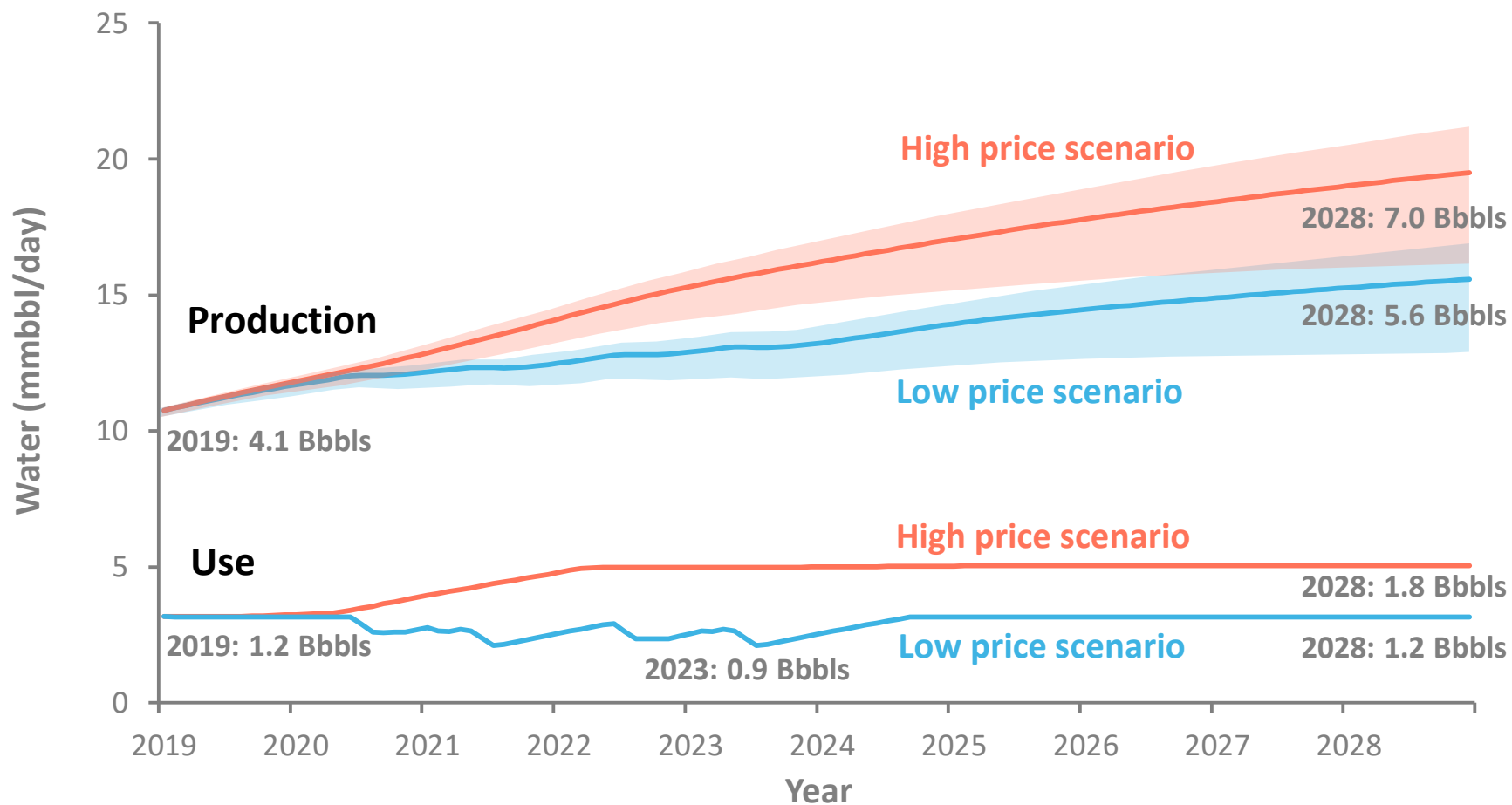
# Permian Basin Forecasted Water Production



Source: B3



# Production and Use Comparison





# Summary of Findings to Date

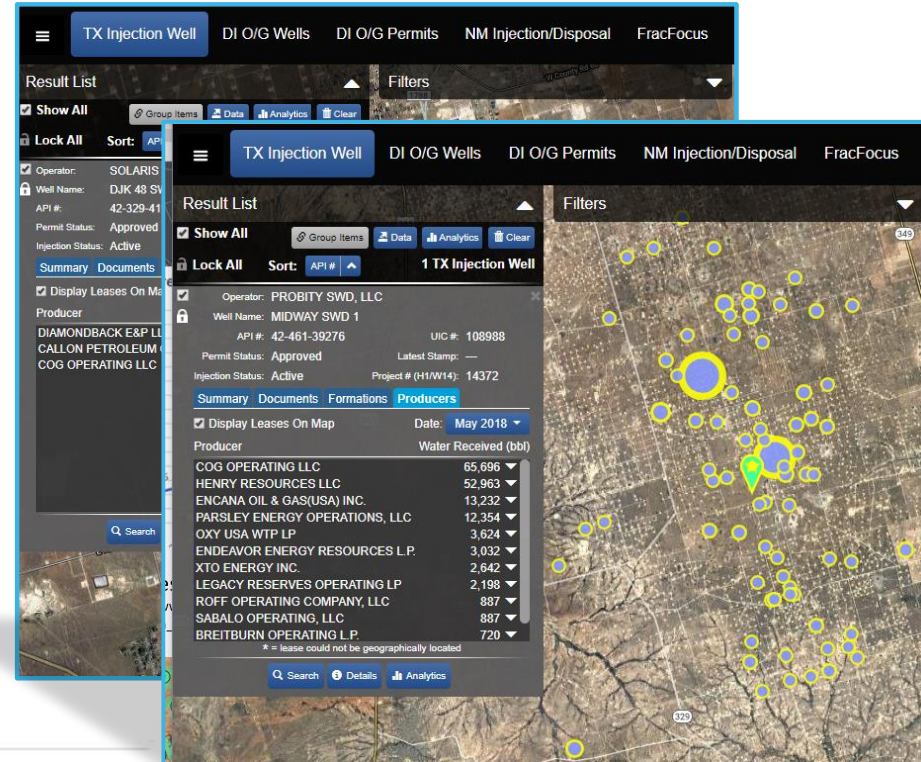
- Production economics in the Permian Basin are generally sub-\$55 half-cycle breakeven in many Tier 1 and Tier 2 areas.
- Given the likelihood that prices fluctuate between \$55 and \$75 for the foreseeable future, water demand for hydraulic fracking will be between 0.9 and 1.8 Bbbls per year.
- Dependent on number and location of new wells, produced water volume is expected to exceed maximum water demand by 3x-5x for the given production scenarios.
- Over the next decade, 35-60 B bbl of water in excess of water use for hydraulic fracturing will need to be managed. Reuse is, at best, a partial solution.



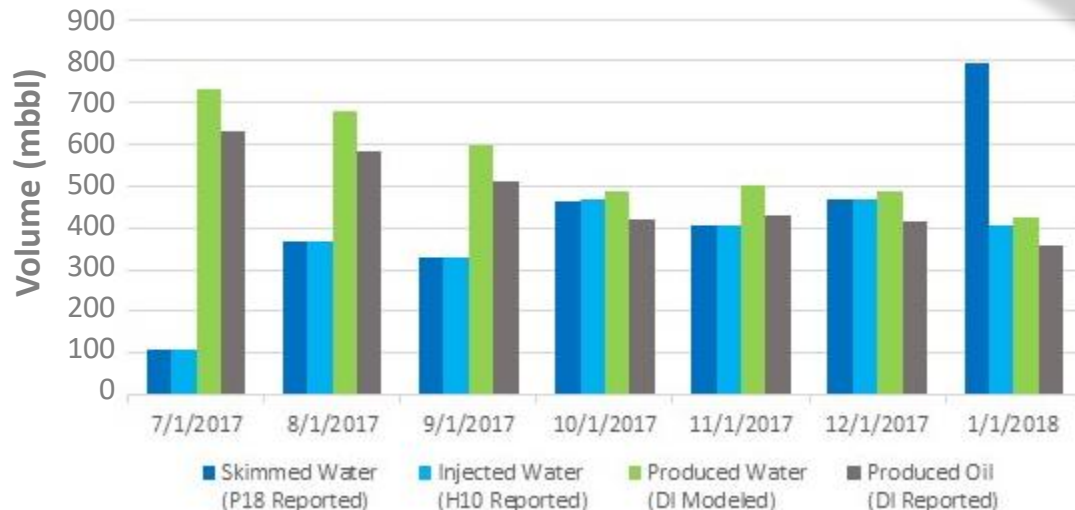
# Current activities

# B Water Production Validation

- P-18 (Skim Oil/Condensate Report) provides water, oil, and condensate amounts received at commercial disposal facilities from producing properties.
- Data collected in platform being used to derive monthly lease-level water production and WOR.



Solaris DJK 48 SWD 1

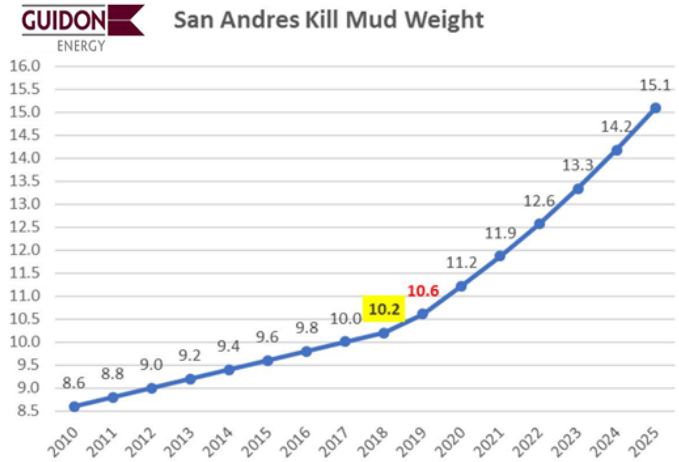






# Permian Basin Pressure

- Empirical/anecdotal evidence suggests increasing pressure and seismic activity due to subsurface produced water disposal.
- Pressures increases are expected to be both local (generally transitory) and distributed (more persistent), influenced by the rate of fluid injection, the cumulative volume of fluid injection, and associated rock properties.
- Basin-wide description/prediction of spatial and temporal pressure is currently hindered by lack of aggregation/analysis of available geologic and injection data.



“The San Andres Problem” (Guidon)

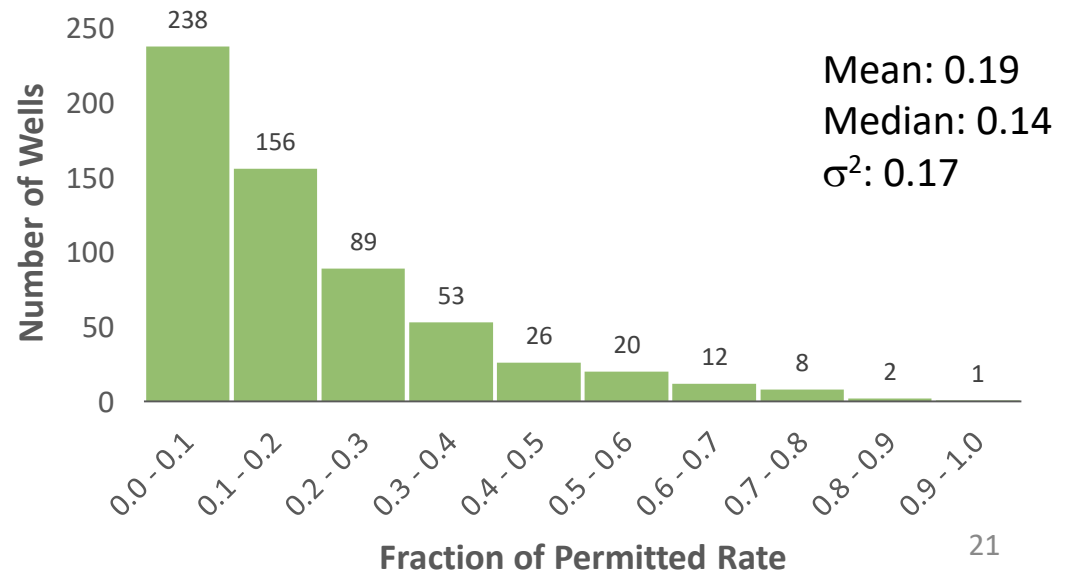
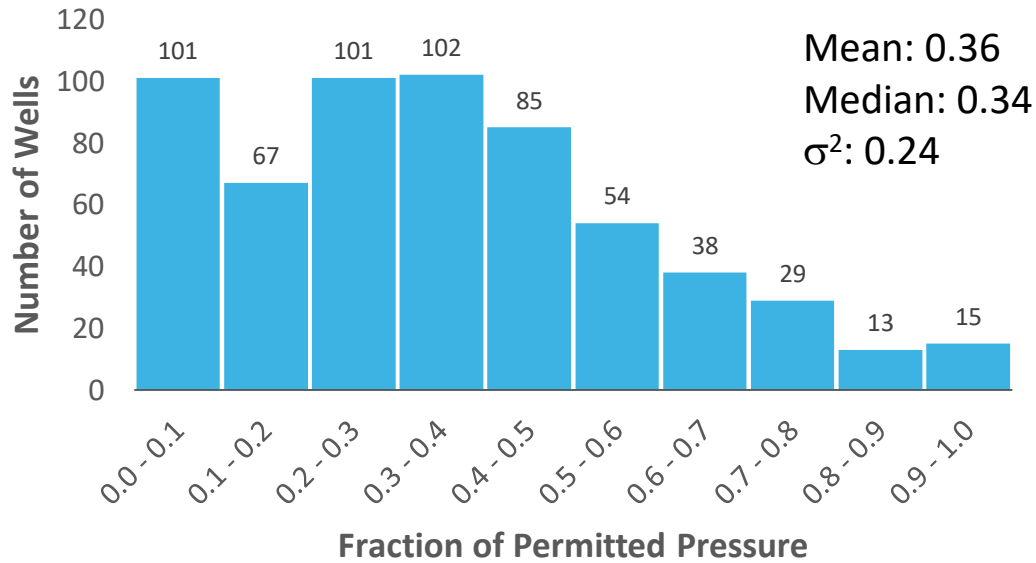
Online Source: [http://www.aade.org/app/download/7247547316/Th+SanAndresProblem\\_Permian+AADE\\_5-10-18.pdf](http://www.aade.org/app/download/7247547316/Th+SanAndresProblem_Permian+AADE_5-10-18.pdf)





# Pressure/Rate Limits

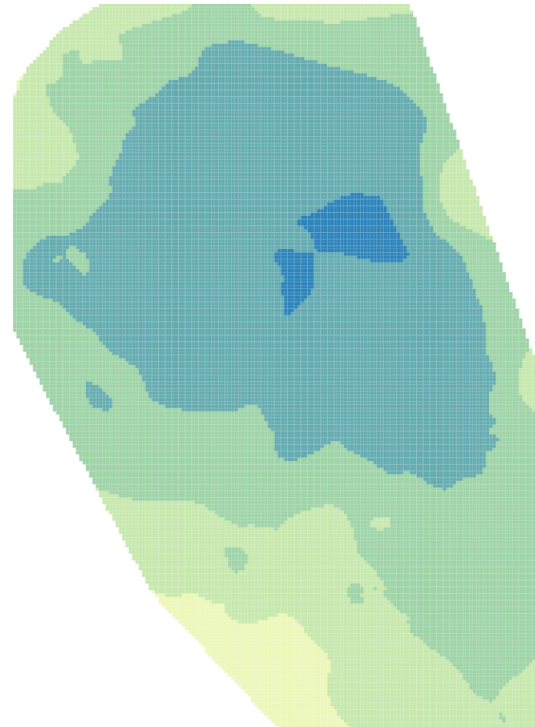
## Permian Basin (Texas)





# Pressure Modeling for Capacity Estimation

- B3 is using industry standard groundwater flow simulation software to generate pressure forecasts at Basin and subarea scales.
- Models to account for static/dynamic formation and fluid properties and be calibrated to historical fluid injection/pressure response.
- Results intended to be used to address the nexus of localized, near-wellbore pressure perturbations due to active injection and larger-scale, background pressure changes attributed to cumulative disposal.



Phi-H Upper DMG

## Inputs:

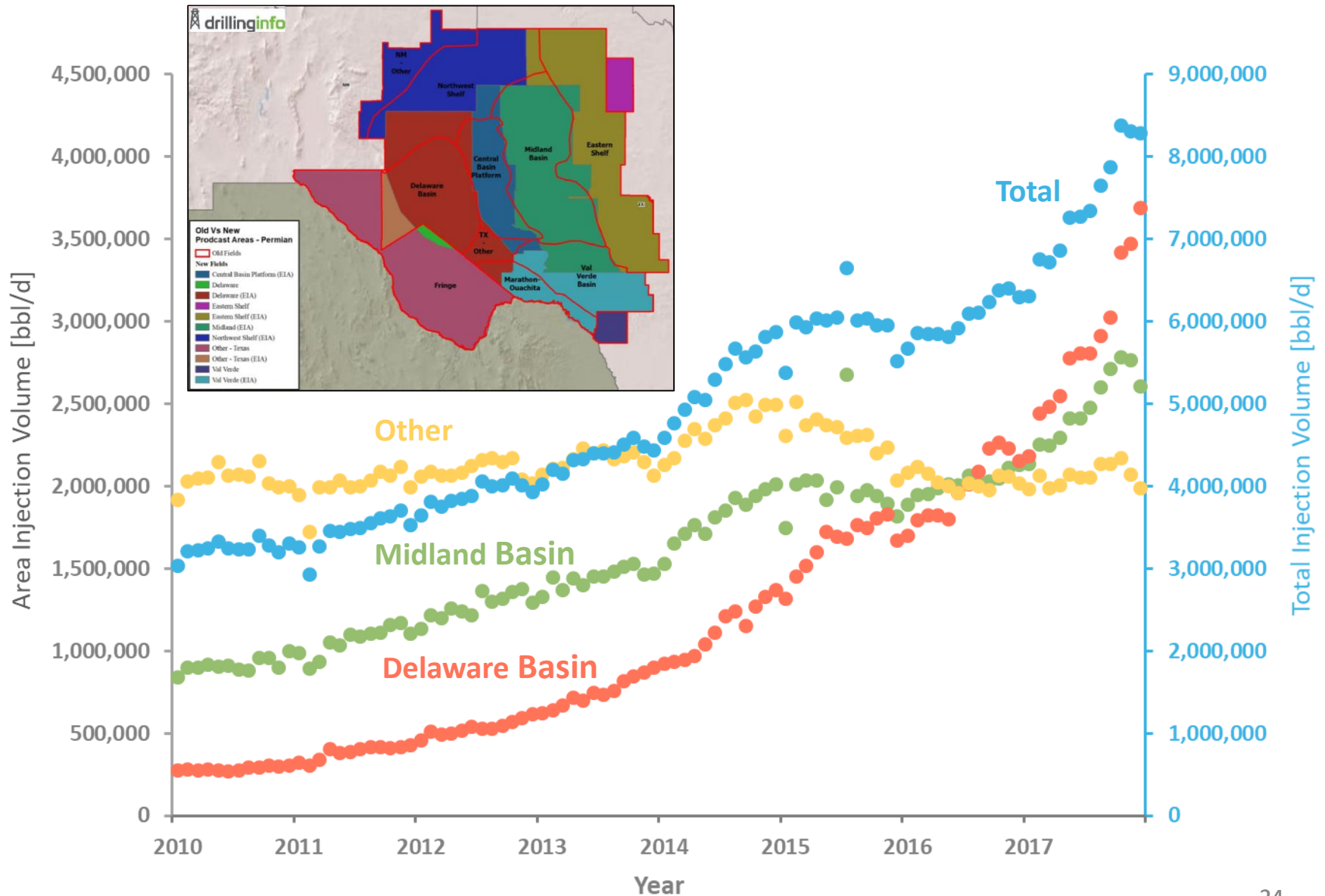
- Basin structure
- Basin stratigraphy
- Basin rock and fluid properties
- Injection rates/cumulative volumes
- Downhole pressure
- Well properties/distribution



# Appendices



# Absolute Water Disposal (2010-2017)







# Relative Water Disposal (2010-2017)

