

Produced Water Society

September 20, 2017 - Midland, Texas

Permian Basin Produced Water Trends

Bill Zartler, CEO Solaris Midstream

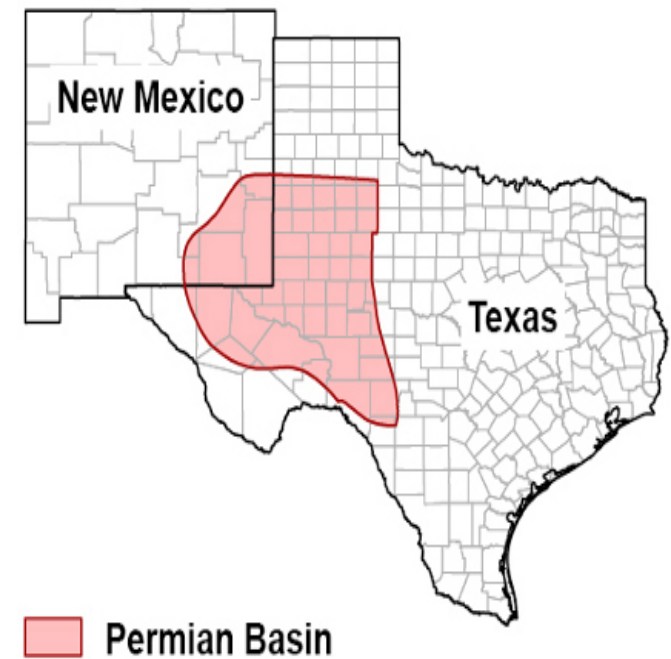
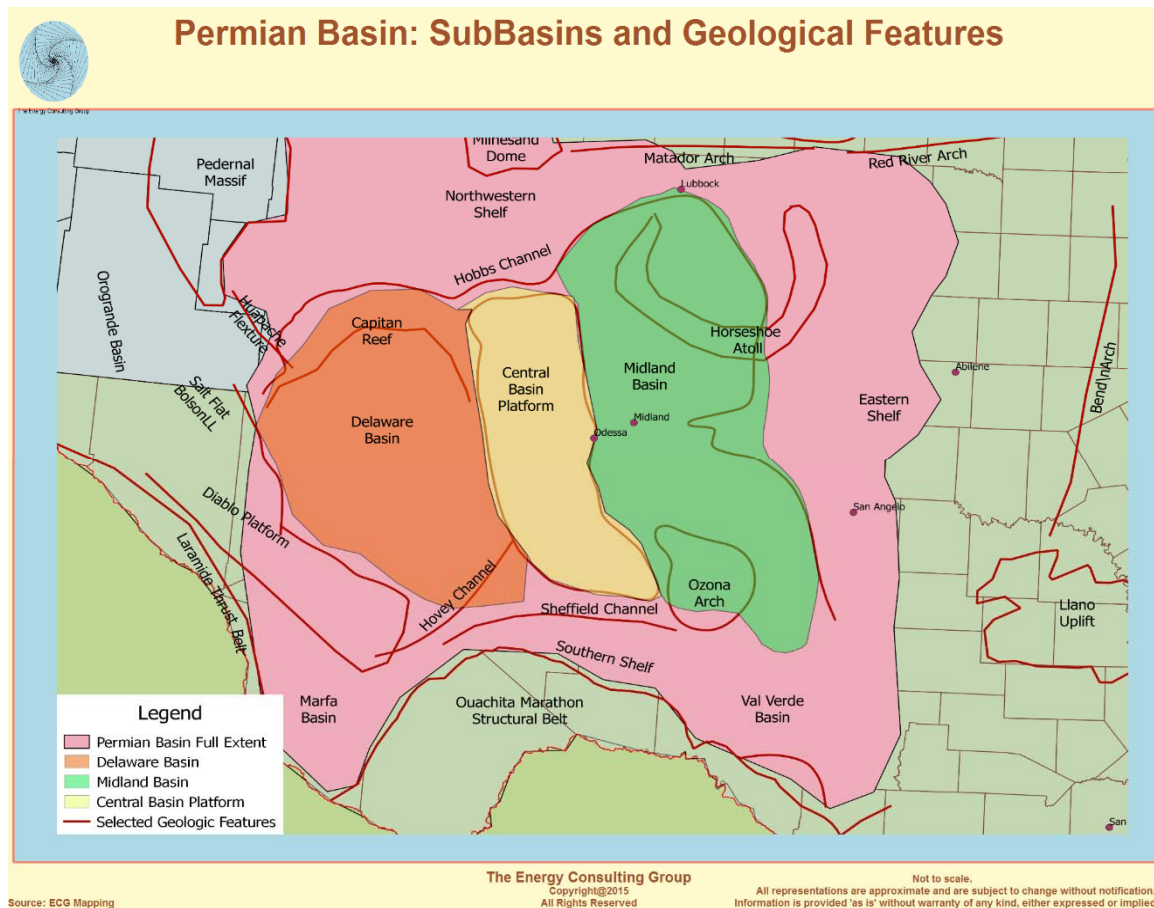


Solaris has seen 3 consistent trends in water sourcing, transfer, and disposal in the Permian Basin

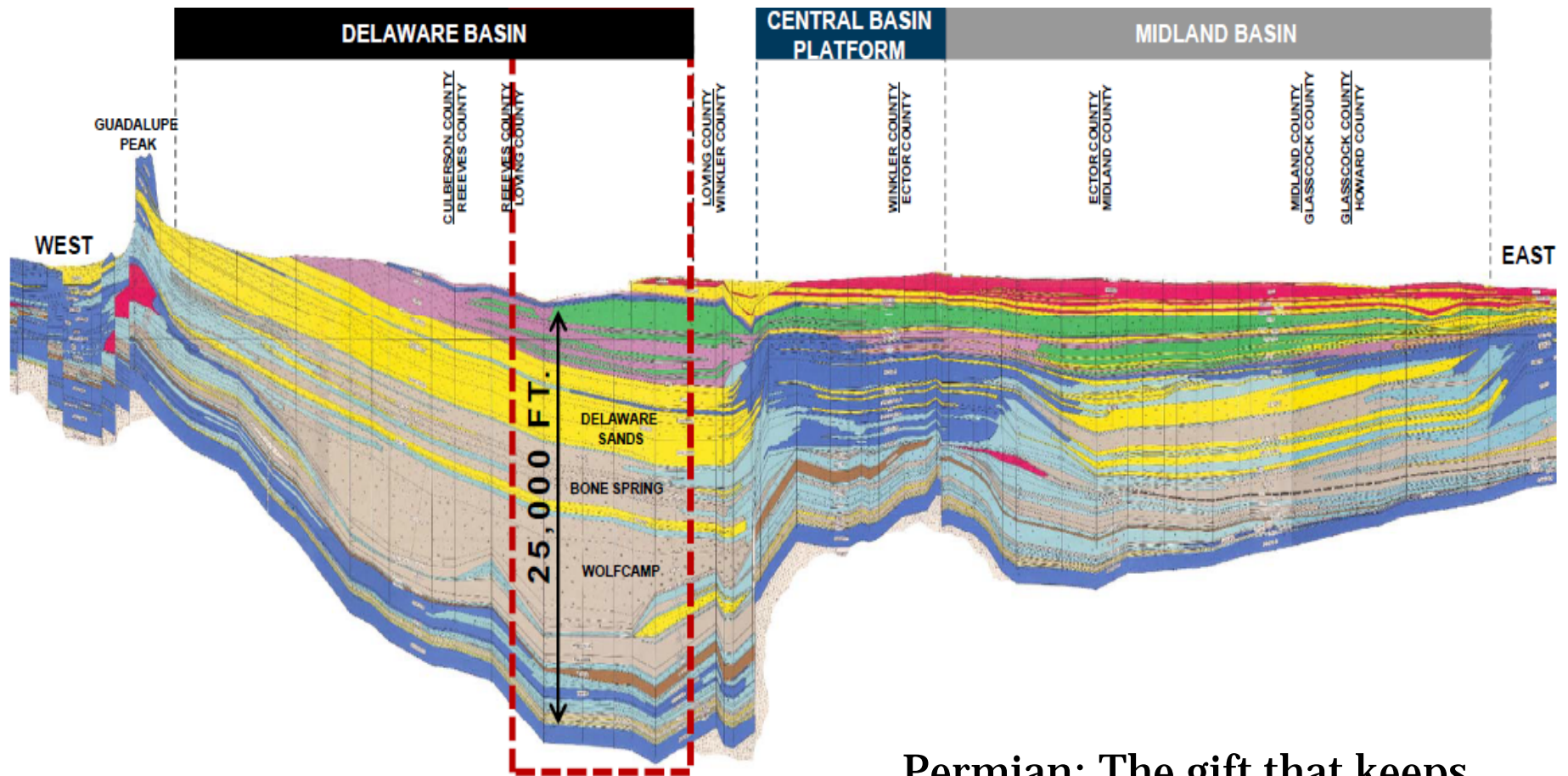
- 1 Water is rapidly transforming into an infrastructure business, both for take-away & completions supply**
- 2 The SWD Market is transitioning to focus on deeper injection intervals to avoid pressurization in shallower zones**
- 3 Cost effective water reuse will be the key to maintaining future growth and the competitiveness of the Permian Basin**

Understanding the Permian Basin

The Permian Basin consists of a number of sub-basins with different characteristics



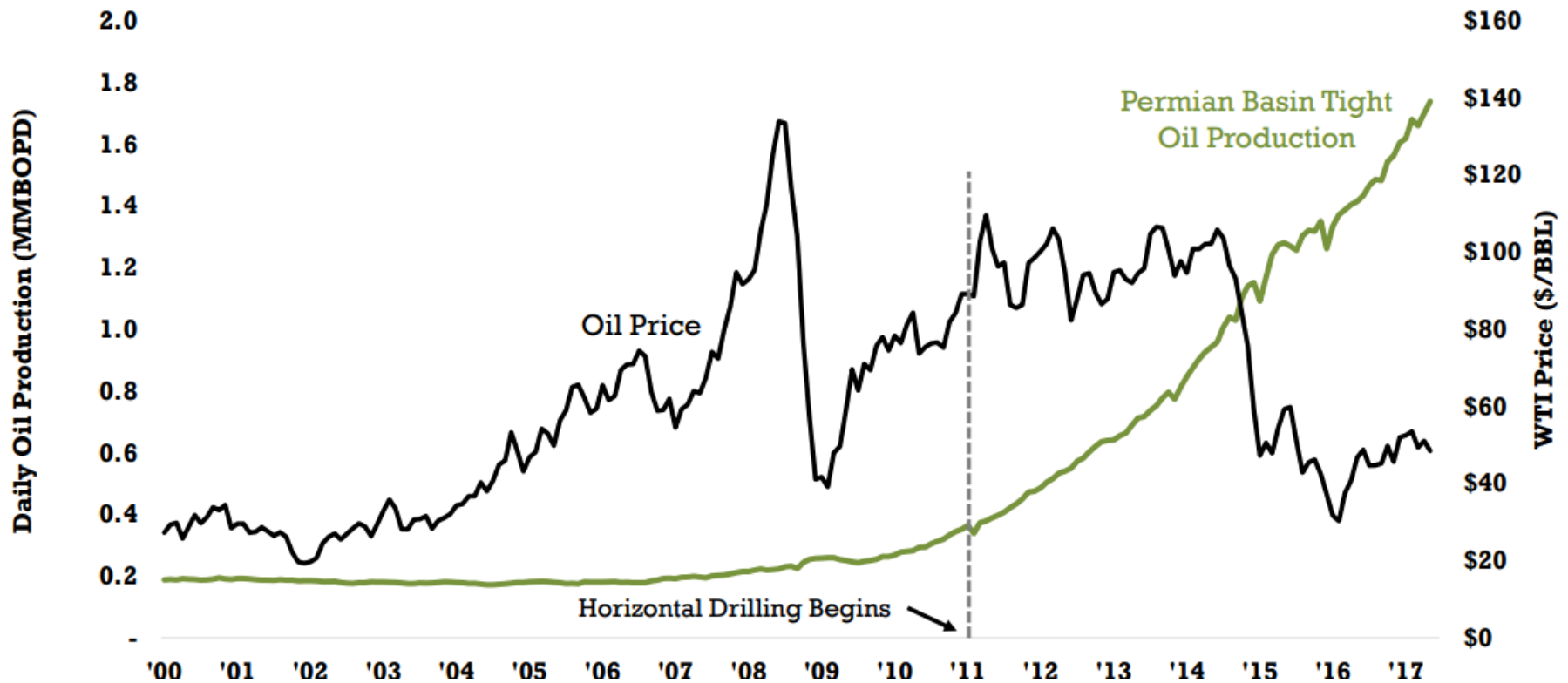
Unique Geology with Stacked Pay Zones



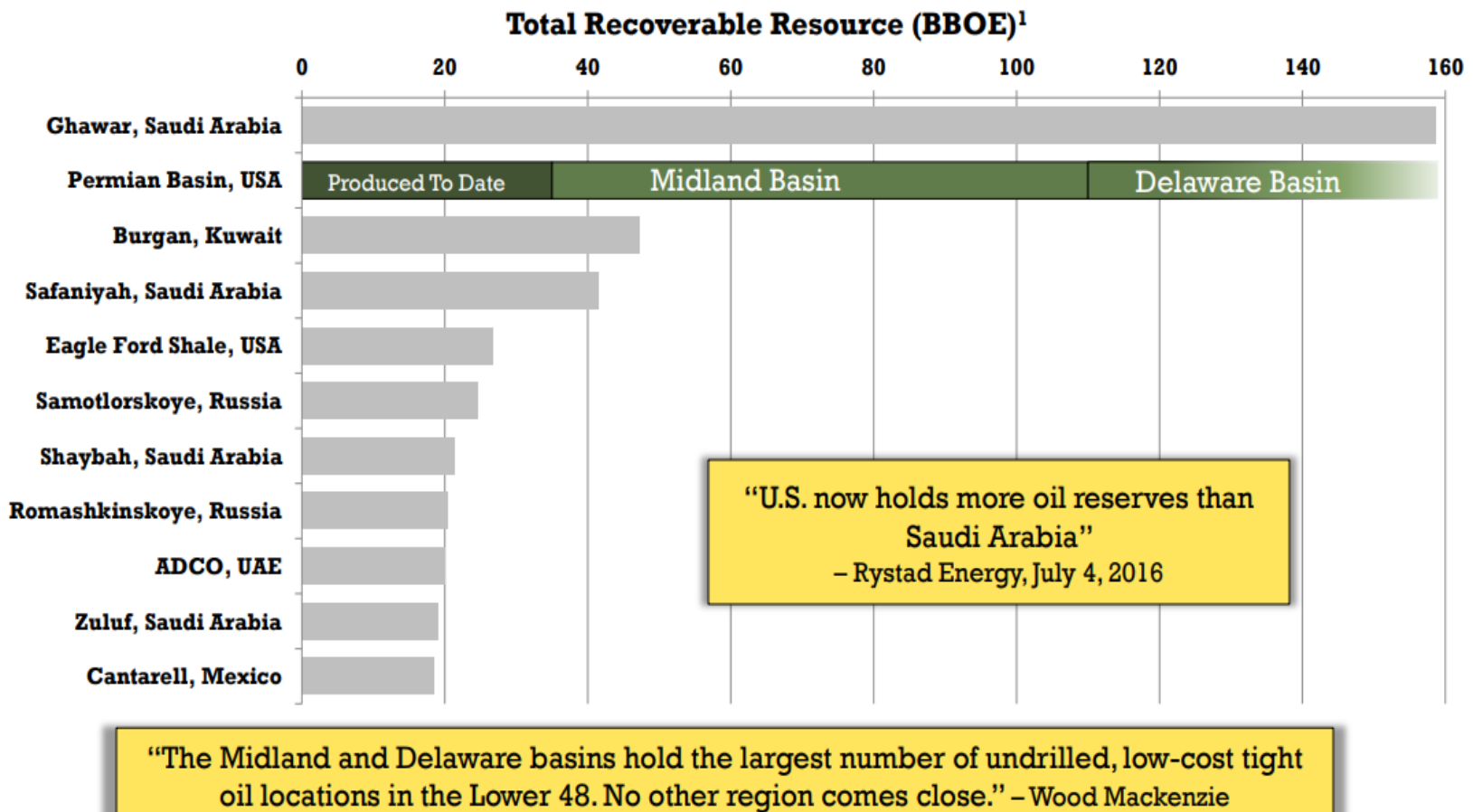
Permian: The gift that keeps giving!

Horizontal Drilling has been a Game Changer

The Permian Basin has produced >35 BBOE in the past 90 years with an estimated >150 BBOE recoverable resource remaining



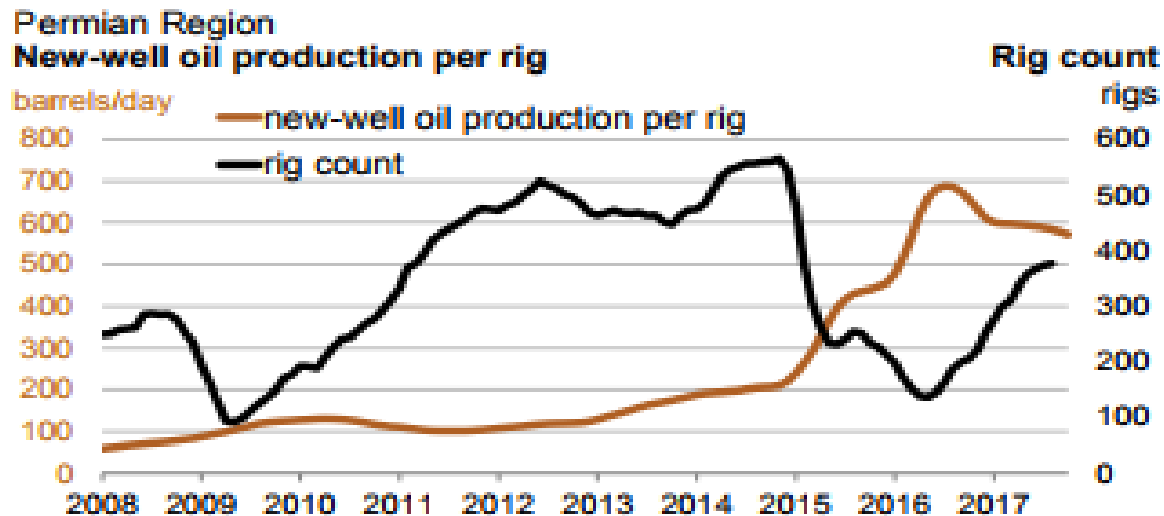
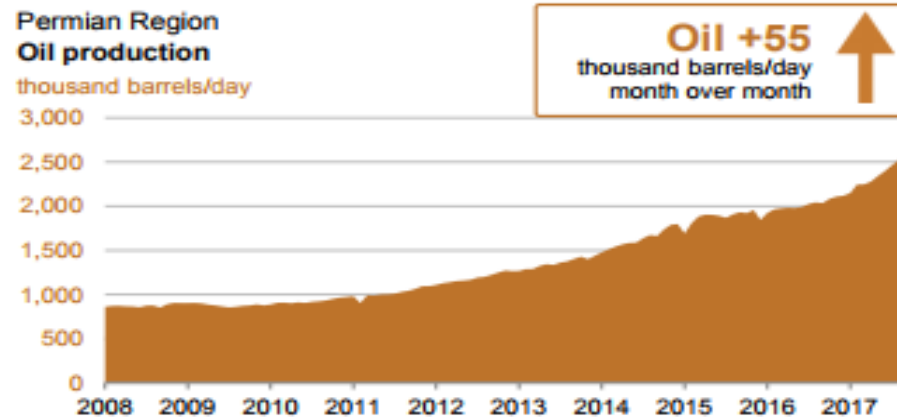
Permian Basin is Now a Global Swing Producer



Increased Rig Count and Increased Production



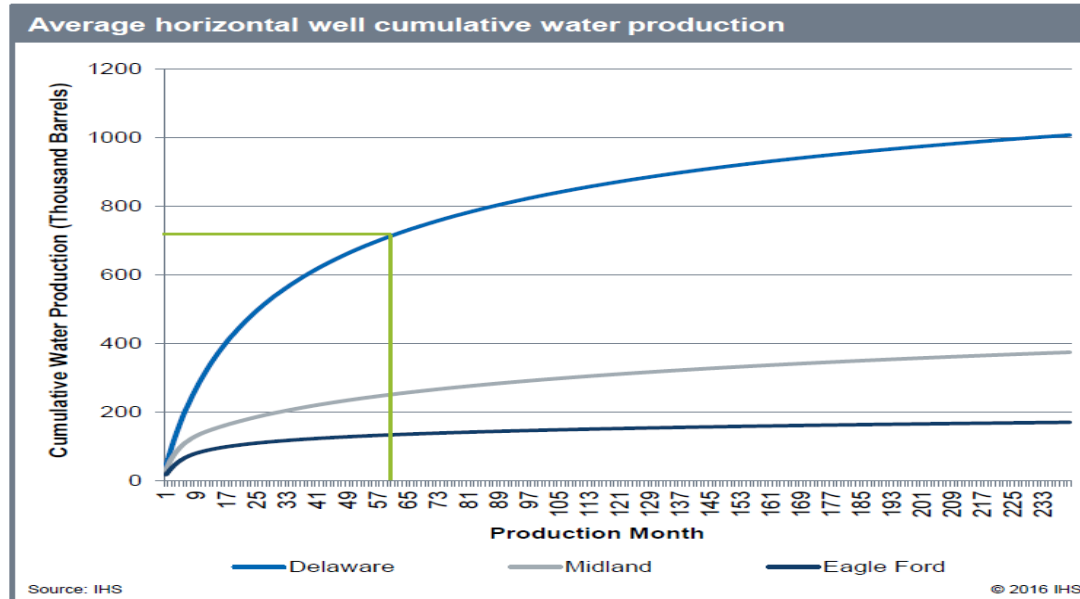
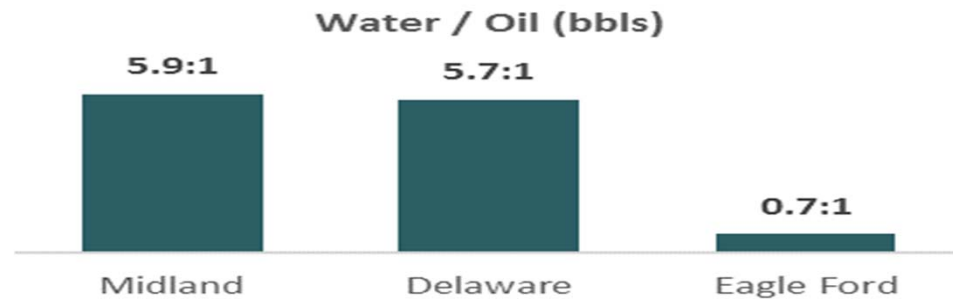
EIA Drilling Report September 2017



Produced Water Volumes are Growing Rapidly



Permian Basin average oil to water ratio is 5.9:1 ~6X higher than Eagle Ford wells. As fields age, the water cuts increase.

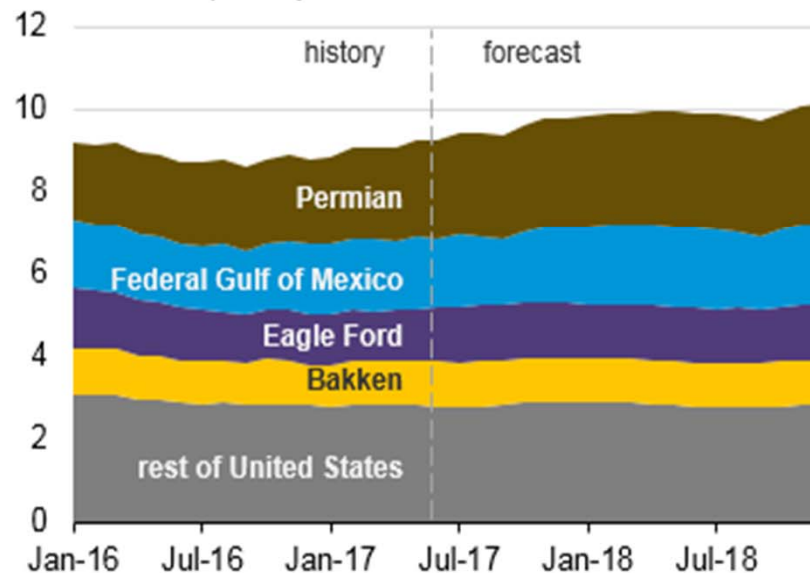


US Crude Oil Production Forecast; Permian Leads

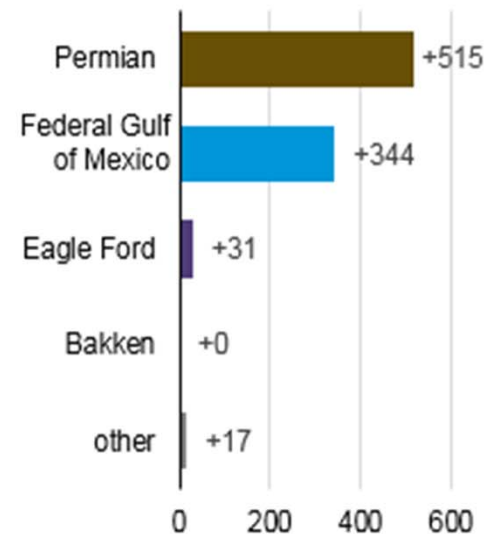


- The EIA projects that the Permian is expected to produce 2.9 million b/d of oil by the end of 2018, about 0.5 million b/d more than est. 2017 production level, nearly 30% of total U.S. crude oil production in 2018. **Based on the Permian oil water ratio's, this is an est. 17 million b/d of produced water and est. 2.95 million b/d more than water produced in June 2017.**
- In June 2017, 366 of the 915 onshore rigs in the Lower 48 states were operating in the Permian which constitutes approx. 40% of all operating rigs.

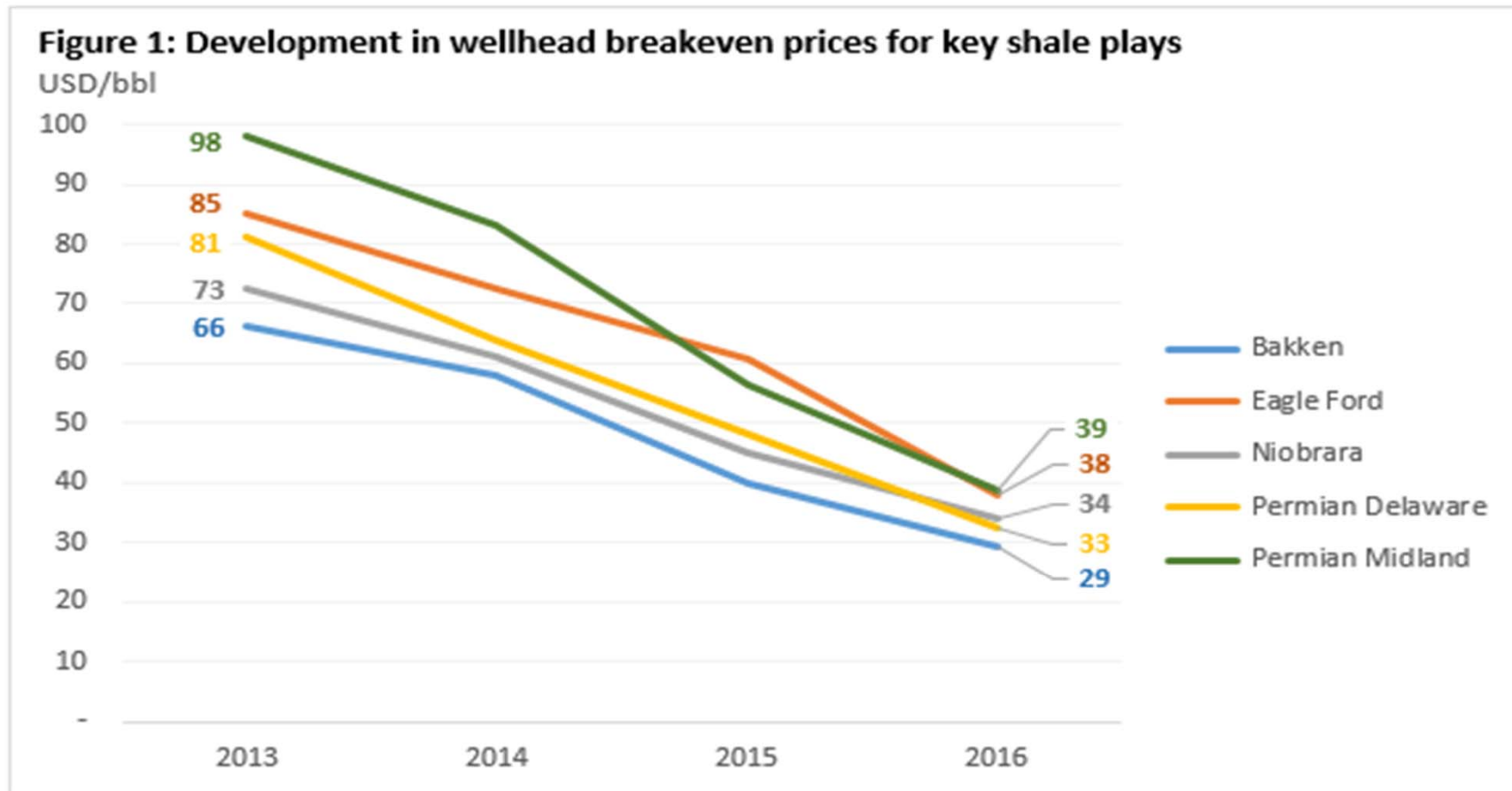
Monthly U.S. crude oil production by region
Jan 2016 - Dec 2018
million barrels per day



Forecasted change
Jun 2017 - Dec 2018
thousand barrels per day



Trending Down: Breakeven Prices Across the US



Source: Rystad Energy NASWellCube

Comparative Breakeven Prices for New Wells

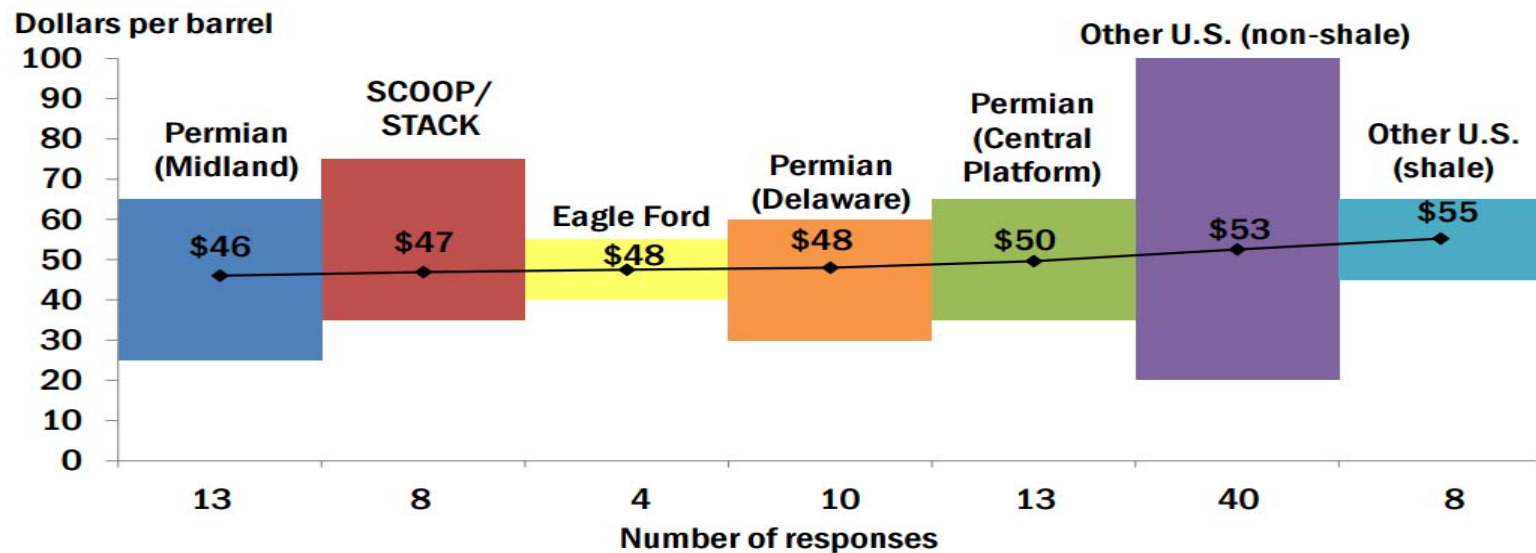


Lower commodity prices have forced operational efficiencies, which together with technology improvements have dramatically reduced breakeven prices

Breakeven Prices for New Wells

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Federal Reserve Bank of Dallas

NOTES: Line shows the mean, and bars show the range of responses. 62 E&P firms answered this question from March 15-23, 2017.
SOURCE: Federal Reserve Bank of Dallas.

Demand for Effective Water Management Growing



- Water use in the Permian has risen six-fold since the start of the shale oil boom, from more than 5 billion gallons (158M/B) in 2011 to almost 30 billion (952M/B) last year
- Energy research firm IHS Market predicts demand will double by the end of this year, to 60 billion gallons, and more than triple by 2020, to almost 100 billion
- This is a stunning amount of water:
 - where will the water come from?
 - Fresh
 - Brackish
 - Reuse
 - how will produced water be disposed of cost effectively?
 - who will develop, fund and operate the infrastructure to support this growth?

Producers are increasingly concerned and looking for sustainable solutions

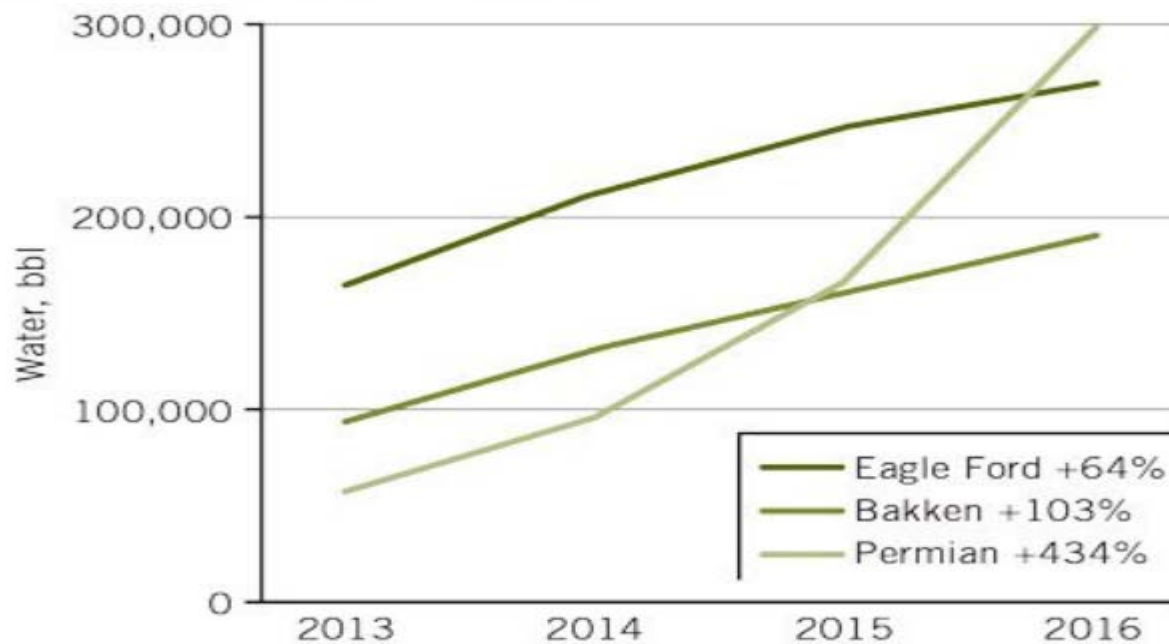
Water Use per Well Continues to Increase



Permian Basin water demand continues to grow with longer lateral lengths, and a increase in water used per completion. Mega fracs can use over 1M/b per well with fracs with 2 miles laterals trending generally toward 500,000/b per frac

WATER USE/FRACTURE JOB

FIG. 2

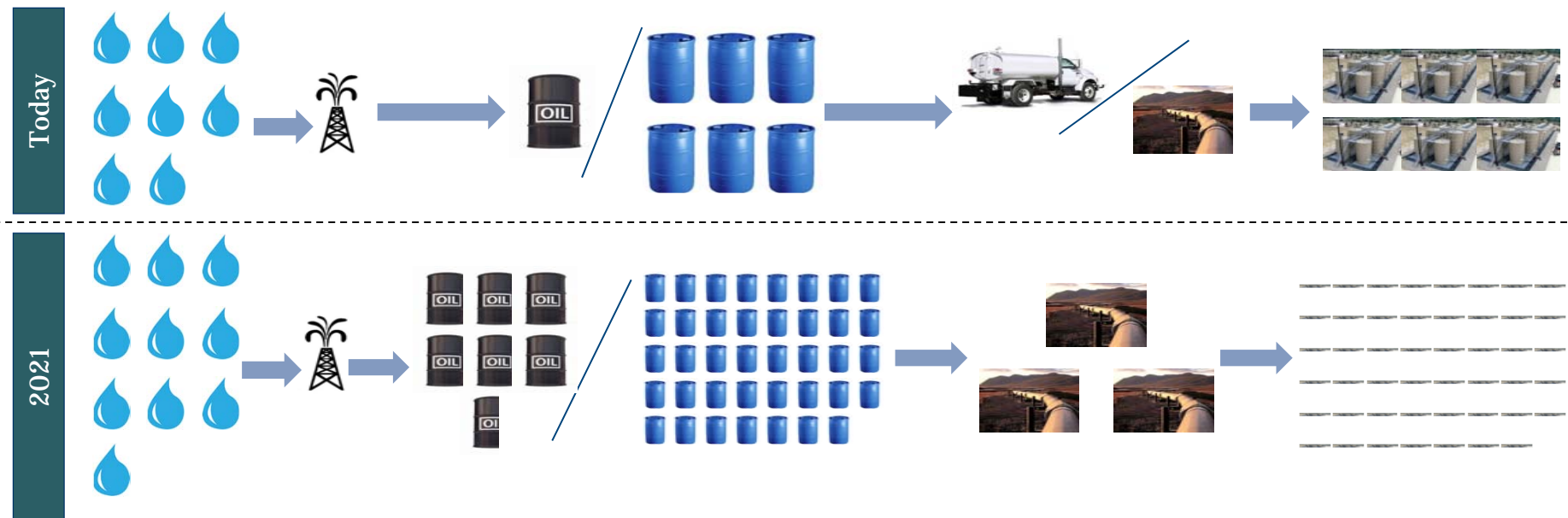


Source: Digital H₂O

Illustrative Water Infrastructure Needs



- Example operator has 500,000 gross acres currently producing ~20,000 Boe/d reaching over 130,000 Boe/d by 2021 requiring potentially over \$400M in infrastructure investment
- Operator requires 300,00-500,000 barrels of sourced water per frac and manages ~ 4-6 barrels of produced water for every barrel of oil produced, presenting a critical logistical and operational challenges



Legend



Trend One: Water is now an Infrastructure Business

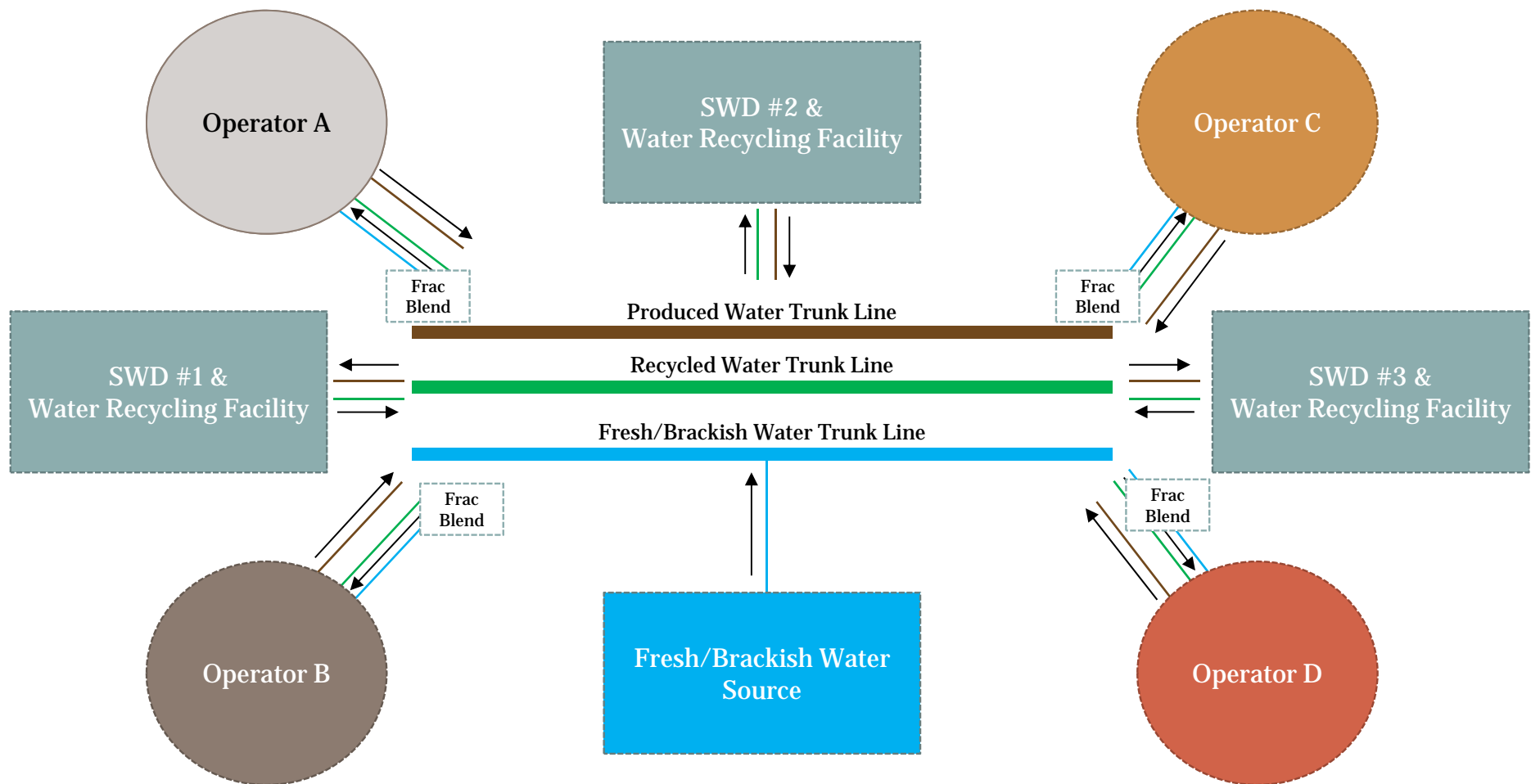
Oilfield Water Evolving to an Infrastructure Business



Water as an Oilfield Services Business		Water as Midstream Infrastructure	
Assets	<ul style="list-style-type: none"> • Water hauling trucks • Saltwater disposal wells • Environmental cleaning facilities 	Assets	<ul style="list-style-type: none"> • Fresh & produced water pipeline infrastructure • Saltwater disposal wells • Treatment & reuse facilities
General Contract Terms	<ul style="list-style-type: none"> • Primarily call out or ad-hoc • High degree of spot market rates 	General Contract Terms	<ul style="list-style-type: none"> • Infrastructure build-out with dedicated operator acreage and/or volumes • Long-term contractual partnerships between operators and service/infrastructure providers
Operational Conditions	<ul style="list-style-type: none"> • Manual process subject to significant HS&E challenges, including spills, contamination and exposure • Subject to significant truck traffic and weather risk 	Operational Conditions	<ul style="list-style-type: none"> • Automated process; data driven operations • Significant reduction in personnel needs • Improved HS&E levels and reduced trucking • Economies of scale for cost structure (CAPEX vs. OPEX)
Capital Markets Treatment	<ul style="list-style-type: none"> • Viewed as cyclical oilfield services business • Typically does not trade at a premium multiple 	Capital Markets Treatment	<ul style="list-style-type: none"> • MLP qualified income and “bankable” • Long-term contracts and stable cost structure

- **Large-scale infrastructure investment required to create reliable & redundant systems that service multiple operators**
- **Transition from “mom and pop” SWDs & trucks to well-capitalized midstream participants**
- **Lower capital / higher operating cost → higher capital / lower operating cost**

Water Infrastructure Require Integrated Water Systems



Trend Two: Producers Transitioning to Deeper Injection Intervals

Shallow Disposal Zones Impacting Drilling



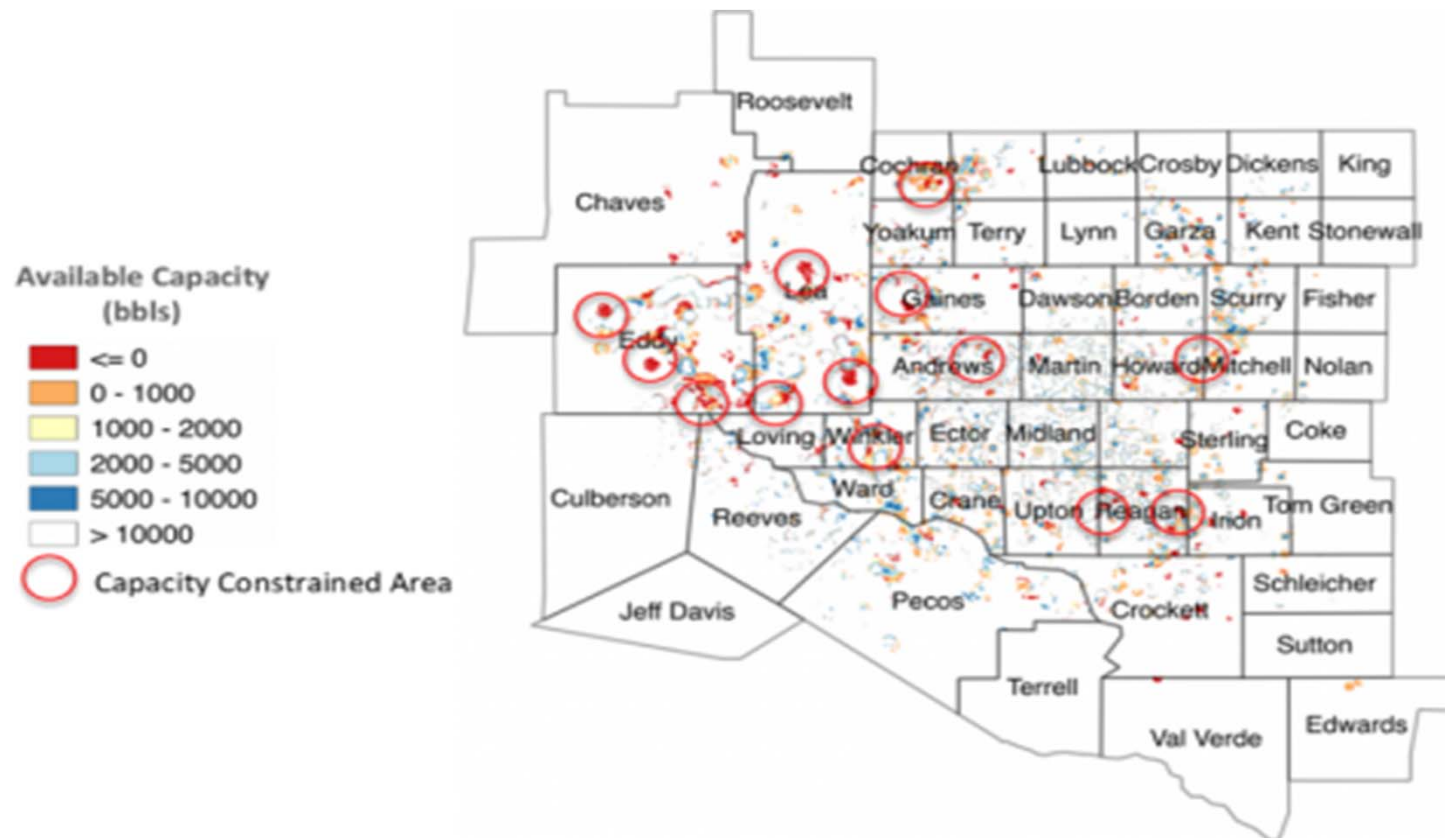
- **Shallow injection zones are causing pressurization & drilling challenges**
 - Impact is most pronounced in Midland & Martin Counties with significant legacy production.
 - Operators in these areas are requiring an additional string of casing to combat pressure issues that arise from San Andres disposal
- **Operators are shifting towards deeper interval SWDs to combat drilling and completion issues**
 - San Andres and Delaware sands: ~5,000 ft.
 - Midland Basin - transitioning to Ellenburger interval SWDs: ~11,000-13,000 ft.
 - Delaware Basin - transitioning to Devonian interval SWDs: ~15,000-19,000 ft.
- **Deeper interval wells require significantly more capital and represent higher drilling & completion risk**
 - San Andres SWD: ~\$1.0 million drilling & completion
 - Ellenburger SWDs: ~\$3.5 million drilling & completion
 - Devonian SWD: ~\$7.0 million drilling & completion
- **Additional capital required enhances need for well capitalized midstream partners**
 - Significantly more capital required.
 - Additional drilling & completion costs can be offset through higher utilization associated with a multi-operator infrastructure system.
 - Water recycling reduces the industry need for disposal wells.

Potential SWD Bottlenecks; Capacity Constraints



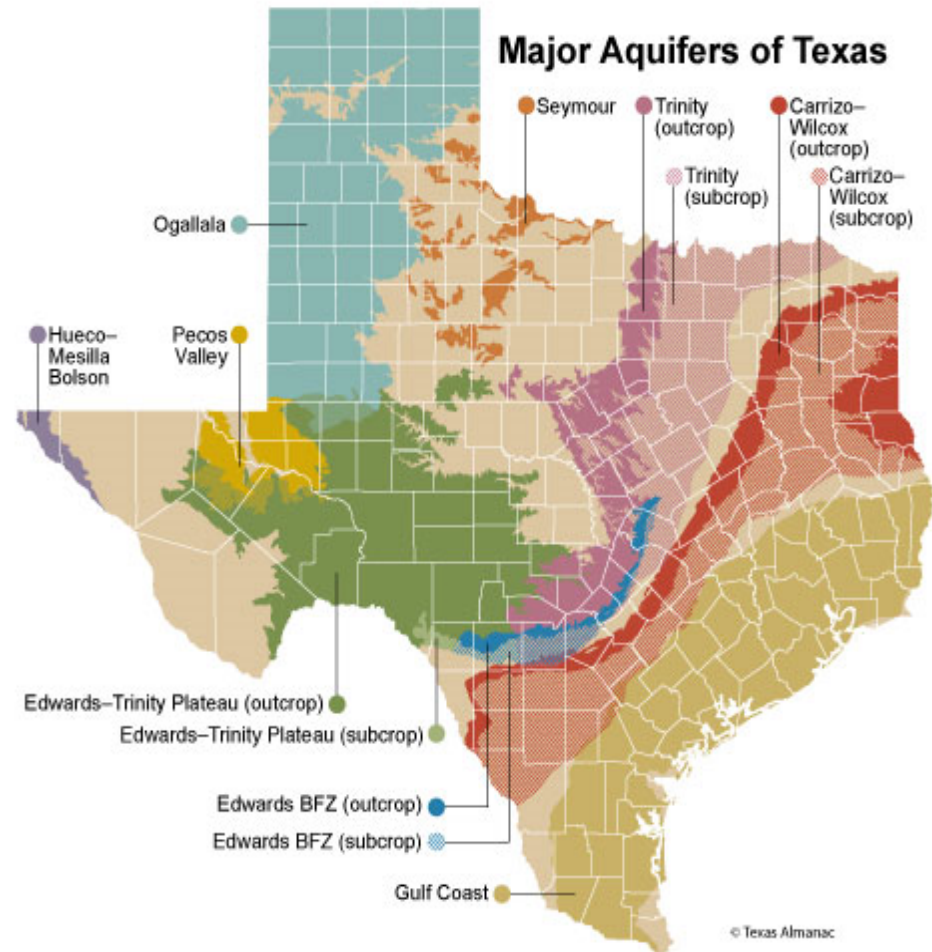
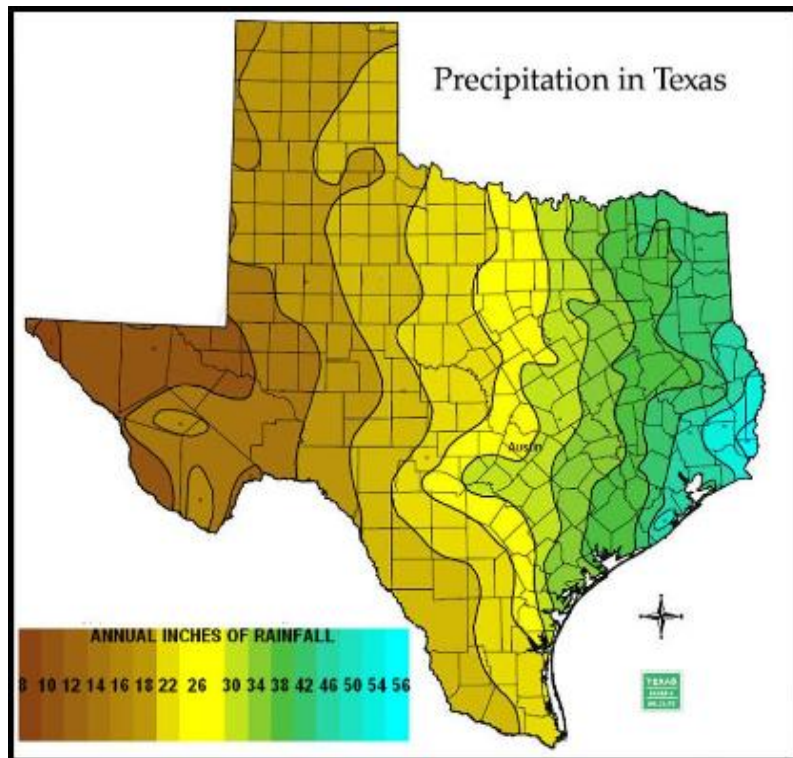
As producers push to move to deeper disposal intervals, constraints are already impacting excising shallow disposal wells exacerbating the challenge for infrastructure to keep up with growth.

Permian SWD Available Monthly Volume Capacity July 2017. Digital H2O

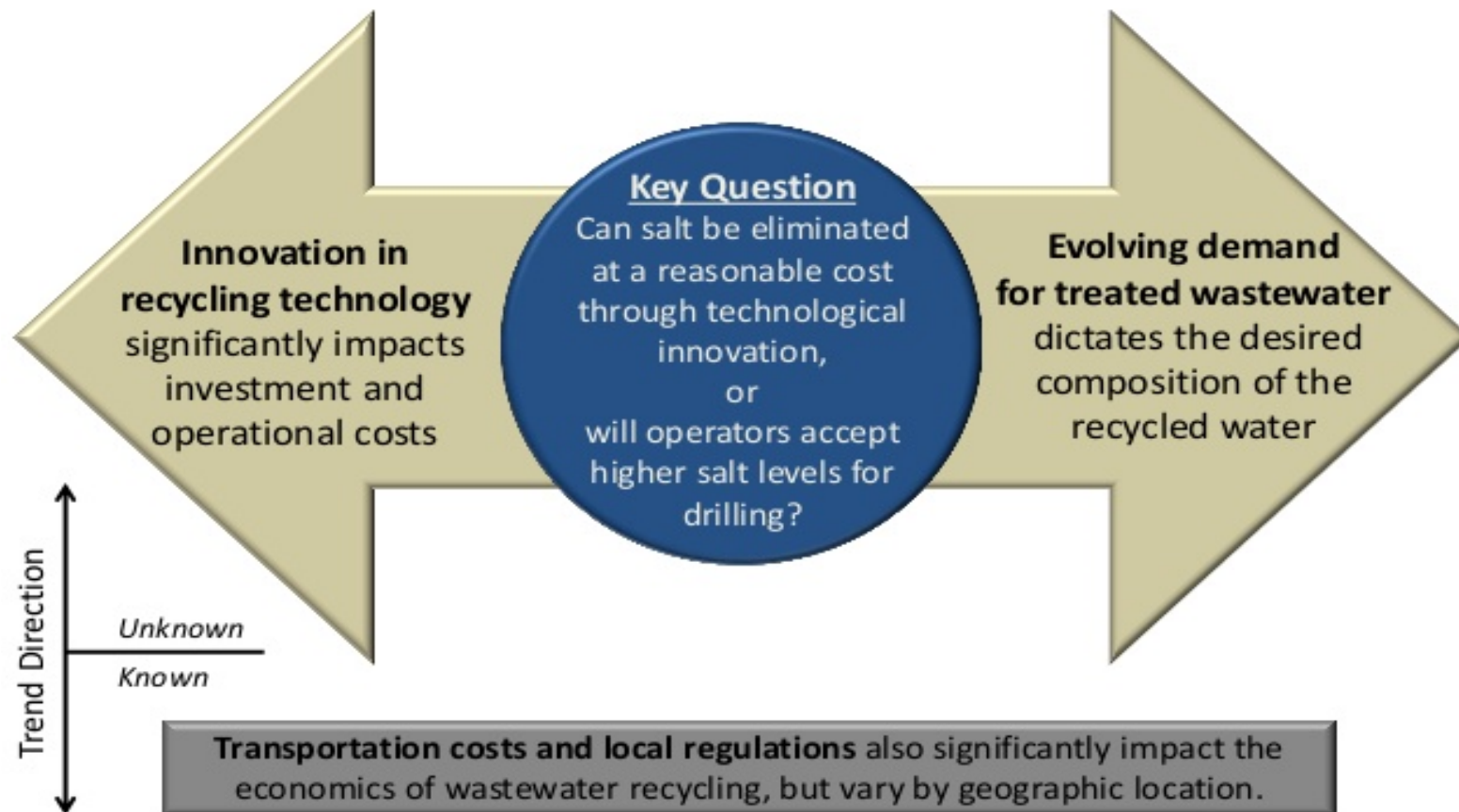


Trend Three: Water Reuse is Continuing to Gain Traction

The Permian has to Rely on Ground Water Withdrawals



Two major dynamics will determine economic feasibility of water recycling in the Permian Basin



Wilson PerumaI & Company, Inc.

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Operators Recognizing Value of Reuse



*"In 2017, **we expect to use 25% recycled water in the Permian**, which contributes to savings of about \$300,000 per well and operating savings of about \$0.80 per BOE. In Martin County, we expect to recycle 100% of our produced water for the remainder of the year".*



*"Our contiguous acreage holdings facilitated the building of a centralized water infrastructure to handle water recycling, transportation and storage ... **We are recycling approximately 35% of our produced water**, drastically reducing the need to dispose of produced water and have plans to expand our water recycling infrastructure".*



*"And then you add to the fact that we have the Odessa water that **we can blend it with and all of our Santa Rosa, and the massive infrastructure that we have, we're able to manage this. It's just a matter of reaching the critical mass to where you have the timing issues worked out.** Because where you produce it and where you need it, as you drill more wells, it becomes easier to manage. And that's why you'll see us here in the near term and the near future continuing to use more produced water".*

Water Reuse Mitigates Basin-Wide Water Challenges



Operator Benefits from Water Recycling

- **Operators now accept a wider range of water specification for completions; treating less. Increased treatment to meet higher water specifications for reuse, drive costs**
- **Improved LOE/bbl versus fresh water sourcing**
 - Fresh/brackish water sourcing: average \$0.40-\$1.50/bbl or more for water depending on the location (before transfer).
 - Water recycling represents a significant savings per barrel depending on treatment requirements.
- **Reduces strain on local water resources**
- **Improves reliability and ability to meet frac schedule**
- **Reduces the number of SWDs required**

Water Reuse only Works when Economics work

- **Water recycling can be implemented in a “closed loop” system that integrates fresh water sourcing, produced water transfer, and produced water disposal**
- **Infrastructure providers will be able to offer “on-demand” water sourcing through trunk lines that run through major production corridors**

Conclusion



- **The Permian Basin began a rapid transformation from a declining conventional basin in 2012 to a Super Basin, defined as cumulative production of more than 5 Billion BOE**
- **One of the fundamental challenges in the Permian is how to manage and fund the infrastructure needed to support this growth**
- **Significant increase in water production and demand for source water is a key challenge, with bottlenecks in SWDs and infrastructure**
- **Reuse will become integral to managing the water mass balance and can be economic with changing frac designs**
- **The big question is who is going to pay for all of the water infrastructure needed to support the production growth in the Permian? Single producer systems vs. shared infrastructure**
- **The market needs capitalized Midstream Infrastructure players to cost effectively develop, invest in and operate reliable and safe integrated systems**
- **In order to succeed, Water Midstream Infrastructure players are going to have to be well capitalized, understand and stay ahead of the trends and adopt an integrated model, balancing disposal and reuse, while delivering multi operator systems**