The Future of Water Management in the Permian Basin

TIPRO Summer Conference

August 20, 2024 Robert Crain- Executive Vice President Texas Pacific Water Resources



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High Water Cuts Pervasive Throughout the Delaware

Water:Oil Well Composition Since 2020

High Water Cut (First 12-months WOR > 4x) Well Count: ~2,700



Average Water Cut (First 12-month WOR 2x – 4x) Well Count: ~2,800



Low Water Cut (First 12-months WOR < 2x) Well Count: ~1,600



Texas Delaware Basin: Average Static Pressure Gradients From 2017 (+/- 1.0 Std. Dev.)

IONAHANS Static Wellhead Pressure ÷ Interval Top depth (PSI/ft) FORT STOCKTON 0.25 0.20

Static Pressure at Surface to Interval Top

Texas Delaware: Average Static Pressure Gradients from 2017 (+/- 1.0 Std. Dev)



+/- 20% increase in formation pressure

High intensity spatial zones have experienced even greater pressure increases

Future SWD permits of 0.5 psi/ foot necessary for economic injection

Driving need for beneficial reuse and/or out of basin disposal

0.10

0.00

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Texas Delaware Basin Disposal Volumes & Operational Capacity



Pressurization of Delaware Mountain Group continues across Texas Delaware Basin

Demand for disposal could exceed current operational injection capacity around 2030

Development of out-ofbasin disposal and beneficial reuse becoming increasingly critical to facilitate continued upstream development

Growing Demand for Out-of-Basin Disposal, Though Costs Will Likely Rise

Key Takeaways

- The construction of an 80-mile pipeline, with the purpose of transporting produced water out-of-basin for disposal will require a substantial amount of capital and resources to ensure project success
- With breakeven gathering fees above \$1.00/bbl, operators will incur significant increases to their disposal costs

Key Model Assumptions

Pipeline Length	~80 Miles
Pipeline Capacity	~350 MBD
Initial Investment (Including Construction, ROW, G&A, etc.)	~ \$150 MM
Annual OPEX	~ \$20 MM
Annual OPEX/BBL	~ \$0.16



Although Higher Water Cuts to Impose Additional Costs Burden, Upstream Well Development Still Retains Attractive Economics

Breakeven Oil Prices at Various Water Disposal Rates

Lease operating expenses in the Delaware are set to increase as prime in-basin SWD disposal capacity becomes fully utilized

High water cut intervals / regions within the Delaware Basin will experience more pronounced economic impacts

Even with added LOE costs, break-evens remain well below current oil prices and general mid-cycle consensus oil prices of \$75 - \$90 / bbl



Water Disposal Rates (\$/bbl)

Permian Combines Top-Tier Economics with Massive Inventory Runway



Beneficial Re-Use Could Become an Attractive Option Both Commercially and Environmentally



Illustrative Disposal Cost Trends for Produced Water Solutions

2024

2030+

The 4 Major Hurdles

Commercial

- Commercial Contracts must benefit:
- Operator:
 - Price "competitive" alternative to disposal
 - Total effect to BOE \$ given W/O Ratio
 - Strategic site locations utilizing existing transport infrastructure
 - Recycled fresh water supply (desal pretreatment)
 - Liability considerations

Treatment Provider:

- Commercial Pricing to justify capital
- Power considerations
- Shared capital investment

Land Owner:

Royalties

Capex / Opex

- Vastly different ROI compared to current gathering & disposal operations
 - Significantly higher capital investment
 - Less economies of scale
 - Fixed
- Capital Share option (w/ operator) is attractive to keep BOE \$ price reduced
- Increased OPEX per BBL until economies of scale are reached
- Power is key variable in costs:
 - Ranges from 60-90% of OPEX costs based on technology and throughput

Liability

- The RRC or TCEQ permit holder is liable for damages
- Batch-release style systems allow for QA/QC checks prior to release

Other options besides Environmental Release:

- Drilling Use
- Brackish water supplement to reduce liability of highvolume transport
- Construction & Cooling
- Hydrogen Production
- Nuclear, etc.
- The above options require additional infrastructure and permitting plus access to fresh and brackish water resources

Regulatory

- **RRC Land Application:** Irrigation of Inedible Crops or Native Plants
- Pros:
 - No interaction with surface or ground water
 - Crops inedible to humans
 - <1000 TDS</p>
- Cons:
 - Large amounts of contiguous surface & increased opex
 - Only pilot permit available (1-yr terms)
 - Volume is ambient temp. dependent
- TCEQ/TPDES: Discharge to Waters of Texas
- Pros:
 - Minimal ops costs
 - Existing long-term permitting structure
- Cons:
 - Increased liability
 - Tighter water quality requirements

Economies of Scale and kWh Influence



kWh/BBL usage can greatly influence price per BBL:

- 5 kWh/BBL prices range from (\$0.10-0.45) in power
- 20 kWh/BBL prices range from (\$0.40-1.80) in power
- kWh per BBL may improve using larger equipment on full-scale commercial sites

Additional \$/ BBL Considerations: • Labor

- High-Cost Variability
- Low volume +/- 15%
- High Volume +/- 5%
- Chems
 - Pre-Treatment Required?
 - Fixed \$/ BBL Costs
- Brine Disposal
 - Fixed pending Commercial Agreement
 - Additional chems required
- Repair & Maintenance
 - Highly variable depending on technology
- G&A
 - Highly variable depending on structure and scope

Economies of scale expected for:

 Power, R&M, G&A, and Labor will improve as sites grow in size and quantity

Regulatory Updates

RRC Land Apply

NPDES

Future: Aquifer Recharge

Land Apply- Texas RRC

- Texas RRC open to discussions and issuance of pilot permits utilizing treated produced water for land application and irrigation of non-edible crops.
- Permits require:
 - Detailed INF/EFL analysis
 - Soil Analysis,
 - Strict siting requirements to protect surface and GW resources
 - Produced Water Origin
 - Treatment specifics
 - 1 year duration, with option to re-apply
- Texas RRC to gather data from land apply pilot projects to develop an official land application permit for large-scale beneficial reuse projects

TPWR's Active Land Application Pilot

TPDES & Aquifer Recharge

- Permitting structure exist to discharge treated PW into waters of Texas, but Permian permits have not yet been granted
- There have been at least 2 applications submitted for discharge in the Permian Basin (one from TPWR)
- Both permits have been deemed administratively complete and are undergoing technical review
 - Draft permits/comments expected by Dec 2024
 - TCEQ may require additional analyte testing or regulate additional contaminants
- The passing of House Bill 4856 confirmed TCEQ's authority to permit Aquifer recharge utilizing treated produced water
- This permitting structure has not been built yet
- TPWR believes this will be the safest and most viable option to beneficially utilize large quantities of treated, desalinated produced water
 - Vast unconfined aquifer overlain by sand formations allow for infiltration-based systems to recharge millions of gallons to the Pecos Valley Aquifer
 - Infiltration through sand formations provides additional polishing of treated water prior to recharge
 - Larger dilution coefficient in comparison to TPDES





Texas Pacific Land Corporation

1700 Pacific Avenue, Suite 2900 Dallas, Texas 75201