Part I: New Ways of Thinking About Oilfield Water in the Permian Basin

Gabriel Collins, J.D.

Baker Botts Fellow in Energy & Environmental Regulatory Affairs
Baker Institute for Public Policy, Rice University
gabe.collins@rice.edu

Please Cite As:
Disclaimer

This analysis reflects my personal opinions and assessments only. It is designed solely to be illustrative and stimulate broader thought, with the objective of elevating the conversation in the energy and water space. It IS NOT an investment analysis or investment advice. It is also NOT offering any legal opinions or advice and does not create an attorney-client relationship with any reader or consumer of the information presented herein. Readers rely on the information in this analysis at their own risk. Neither the author nor the Baker Institute for Public Policy are liable for any loss or damage caused by a reader’s reliance on information contained in any of the charts, data series, opinions, or other information presented herein. I am not a hydrologist, geologist, or engineer and am not offering advice on technical aspects of any assets which may be discussed in this analysis, including, but not limited to geological factors and engineering challenges that may arise in an oilfield water development project. The information and opinions contained in, and expressed by this analysis, are based on sources deemed reliable. However, there is no warranty, assurance, or guarantee, express or implied, about the completeness, reliability, or accuracy of this content. The views expressed herein are my interpretations as of the date the report is published and are subject to change without notice.
Permian Basin Oilfield Water: Supply & Demand

Frac Water Volumes Pumped (Permian in red)

Water Injection—West Texas and SE New Mexico

Permian daily average equal to roughly what the City of San Antonio uses. Or, roughly 17 times the average daily water consumption of the City of Midland. New York City consumes approximately 700 million bbl of water per month—nearly 1.8 times the national monthly frac water usage.

Source: EIA, NM OCD, Texas RRC

https://data.cityofnewyork.us/Environment/Water-Consumption-In-The-New-York-City/ia2d-e54m
Permian Oil Production Growth Has Been a Major Global Shock Absorber

The Permian Basin is Now the World’s Premier Non-OPEC, Non-Middle East Source of Oil Supply Growth

Thought Exercise: What if the Permian Unconventional Space Hadn’t Taken Off?

Source: BP Statistical Review of World Energy 2018, EIA

Source: EIA, OPEC Monthly Oil Market Report
Frac source water: 76,000 metric tons
Produced water: Over 250,000 metric tons
Crude oil and liquids: 68,000 metric tons
Pipe, sand, misc. consumables: Approx. 10,000 metric tons

Source: CME Group, Empire State Realty Trust, FracFocus, TexasBrine.com

This analysis assumes 500,000 barrels of oil produced, with a water-to-oil ratio of 3:1. In many cases, wells will ultimately produce more oil and at a higher water cut.

Per Well

Empire State Building Weighs ~340,000 metric tons

Long-Lateral Permian Oil Well Inputs and Outputs Weigh ~405,000 metric tons

~450 wells drilled per month

Water will likely account for approximately 80% of lifetime “mass moved” for many Permian Basin wells.
Putting Oilfield Water Flows in Perspective: Fracs & Farms

**Encana RAB Davidson Pad:**
- 33 wells completed between April 2016 and April 2017
- ~3.2 million bbl of oil and 13.3 bcf of gas produced thru Jul-18
- 11.1 million bbl of water pumped
- Or, about as much water as 1,000 acres of cotton grown near Midland would use in a single season

Source: FracFocus, TX DOT, TX RRC

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value 1</th>
<th>Value 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cotton Estimated Irrigation Need (District 2)</td>
<td>18 ac-in</td>
<td></td>
</tr>
<tr>
<td>Estimated water system efficiency</td>
<td>95%</td>
<td></td>
</tr>
<tr>
<td>Estimated Annual Water Needs of 1,000 acres of cotton, AF</td>
<td>1,579</td>
<td></td>
</tr>
<tr>
<td>Estimated Annual Water Needs of 1,000 acres of cotton, barrels</td>
<td>12,249,474</td>
<td></td>
</tr>
<tr>
<td>Estimated Annual Water Needs of 1,000 acres of cotton, gal</td>
<td>514,501,579</td>
<td></td>
</tr>
<tr>
<td>Drip-irrigated cotton lint yield per acre, annual</td>
<td>1,500 lbs</td>
<td></td>
</tr>
<tr>
<td>Water use per lb of cotton lint</td>
<td>326 gallons</td>
<td></td>
</tr>
<tr>
<td>Cotton Price, USDA West Texas (2017)</td>
<td>$0.74 per lb</td>
<td></td>
</tr>
<tr>
<td>Cotton Estimated Economic Output Per Gallon</td>
<td>$0.002</td>
<td></td>
</tr>
</tbody>
</table>

Source: TAMU Agricultural Extension (District 6 crop budgets), USDA
Thinking About Water Footprints

The US produced 83 billion eggs in 2015, implying that the “virtual water” content of domestic egg output came out to roughly 15.4 million acre-feet: approximately 50 times the City of Houston’s net water use in 2014, according to the TWDB.

Uses ~37 gallons of water all in.

The US market consumed ~1.26 million tonnes of coffee in the 2016/17 market year: nearly 115 billion cups’ worth, implying that US coffee drinkers’ “virtual water” consumption equaled 95% of Texas’ statewide 2014 water use volume.

Uses ~450 gallons of water all in.

U.S. consumers buy roughly 26,000 tonnes of chocolate candies during Valentine’s week.

Thinking About Water Footprints: Part 2

*How about that ethanol in your gasoline?*

<table>
<thead>
<tr>
<th>Crop</th>
<th>Water footprint per litre of biofuel</th>
<th>Total gal of water per gal of ethanol</th>
<th>Ethanol CBOT March 2017 Price, 20 Feb. 2017 (USA), USD/gal</th>
<th>USD per AF in Economic Value Generated</th>
<th>AF of water per Billion USD in Economic Value Generated</th>
<th>Gallons of water per 20 gal gasoline tank fill*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Green</td>
<td>Blue</td>
<td>Grey</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sugar beet</td>
<td>736</td>
<td>229</td>
<td>223</td>
<td>314</td>
<td>$1.52</td>
<td>$1,578</td>
</tr>
<tr>
<td>Sugar cane</td>
<td>1,400</td>
<td>575</td>
<td>132</td>
<td>557</td>
<td>$1.52</td>
<td>$890</td>
</tr>
<tr>
<td>Potatoes</td>
<td>1,458</td>
<td>251</td>
<td>483</td>
<td>579</td>
<td>$1.52</td>
<td>$855</td>
</tr>
<tr>
<td>Cassava</td>
<td>2,477</td>
<td>1</td>
<td>60</td>
<td>671</td>
<td>$1.52</td>
<td>$739</td>
</tr>
<tr>
<td>Maize</td>
<td>2,212</td>
<td>190</td>
<td>453</td>
<td>754</td>
<td>$1.52</td>
<td>$657</td>
</tr>
<tr>
<td>Barley</td>
<td>2,796</td>
<td>182</td>
<td>302</td>
<td>867</td>
<td>$1.52</td>
<td>$572</td>
</tr>
<tr>
<td>Rye</td>
<td>3,271</td>
<td>58</td>
<td>229</td>
<td>940</td>
<td>$1.52</td>
<td>$527</td>
</tr>
<tr>
<td>Rice, paddy</td>
<td>2,640</td>
<td>785</td>
<td>430</td>
<td>1,018</td>
<td>$1.52</td>
<td>$486</td>
</tr>
<tr>
<td>Wheat</td>
<td>2,943</td>
<td>789</td>
<td>478</td>
<td>1,112</td>
<td>$1.52</td>
<td>$445</td>
</tr>
<tr>
<td>Sorghum</td>
<td>6,585</td>
<td>237</td>
<td>201</td>
<td>1,855</td>
<td>$1.52</td>
<td>$267</td>
</tr>
</tbody>
</table>

*Assuming 10% ethanol by volume

M.M. Mekonnen and A.Y. Hoekstra, "The green, blue and grey water footprint of crops and derived crop products," December 2010
Putting Oilfield Water Flows in Perspective: Frac Flowback

Bilbrey 34/27 B2MD #1H: Lea County, NM 502,000 bbl of water pumped in completion 2nd Bone Spring, 2-mile lateral

Perspective:
- This well’s cumulative 90 day flowback volume could fill about 19 Olympic-size swimming pools (660k gallon pool size)
- Now scale this out for a pad drill project with 5, 7, or even 30 wells, with many of them flowing back simultaneously post-completion.
- The resulting water management challenges—from both the perspective of managing peak flow and that of just managing the sheer volume—are substantial.

Source: Well Report Data
Companies Are Gearing Up to Recycle More Produced Water

Non-Commercial Fluid Recycling Pit Capacity
Companies Have Sought Texas RRC Approval For

Company-level Permian Recycling Plans

- **Apache**—“...by year-end, we feel like we’ll be able to utilize about 80% of recycled water for our fracs [at Alpine High].” (2Q2018 Earnings Call)
- **Devon**—“~80% of total water used in operations is recycled” [NM Delaware Basin] (EnergyPlex Presentation, 2018)
- **Encana**—“We expect average 40% recycled water use in the basin with some cubes as high as 80%...” (2Q2018 Earnings Call)
- **Guidon Energy**—“Once infrastructure was built, we began using 13/87 produced/fresh mix for all fracs.” (May 2018 Presentation)
- **Noble**—“And by the end of the year [2018], I’d expect over 30% of the water used in our fracs to be recycled produced water.” (2Q2018 Earnings Call)
- **Pioneer Natural Resources**—“Right now, we’re increasing our reuse volumes of our produced water to the point where it’s going to represent 15% to 20% of our water volumes in the fourth quarter this year.” (2Q2018 Earnings Call)
- **Cimarex**—87% recycled PW in Culberson Wolfcamp completions, 46% recycled PW in Reeves Wolfcamp completions. (November 2018 Investor Presentation)
How Much Produced Water Are Permian Operators Actually Recycling?

Estimated Daily Average Recycled Water Volumes by Selected Permian Operators, Bpd

<table>
<thead>
<tr>
<th>Operator</th>
<th>2Q2018 Volumes</th>
<th>3Q2018 Volumes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Devon (NM)</td>
<td>32,007</td>
<td>13,565</td>
</tr>
<tr>
<td>Laredo</td>
<td>25,565</td>
<td>16,680</td>
</tr>
<tr>
<td>Concho</td>
<td>13,996</td>
<td>22,298</td>
</tr>
<tr>
<td>Apache</td>
<td>38,537</td>
<td>29,042</td>
</tr>
<tr>
<td>EOG (Permian)</td>
<td>35,439</td>
<td>38,539</td>
</tr>
<tr>
<td>XTO (Permian)</td>
<td>32,990</td>
<td>39,461</td>
</tr>
<tr>
<td>Pioneer</td>
<td>55,407</td>
<td>42,377</td>
</tr>
<tr>
<td>Cimarex</td>
<td>29,050</td>
<td>91,933</td>
</tr>
<tr>
<td>Oxy (NM)</td>
<td>84,752</td>
<td>93,026</td>
</tr>
</tbody>
</table>

Estimated Proportion of Recycled Water as % of Total Frac Fluid Stream, 3Q2018

Source: Company Reports, Credit Suisse, Author’s Estimates

- Methodology: Take management statements to investors, any other corporate communications I could locate detailing produced water re-use intentions or actual volumes/proportions, and a Credit Suisse research report on the same topic, apply these numbers to frac water usage data each operator reported to FracFocus and estimate recycling volumes for 2Q2018 and 3Q2018.
Accommodating Future PW Volumes Might Require Unorthodox Solutions

Example: What might the economics of piping produced water down to the Gulf Coast and discharging treated PW into the ocean or disposing of it in depleted offshore fields look like?

Initial model based on Vista Ridge water pipeline to San Antonio.
- 142 miles
- $930 million project cost
- 54-inch steel line
- Projected to move ~1 million bwpd.

Using Vista Ridge’s economics as a baseline, installing 5 X 54-Inch, 650-mile long water pipelines between Orla and Corpus Christi would cost about $16 billion and financed at a 4.5% interest rate over 20-years, would yield an estimated CAPEX cost of $0.66/bbl and OPEX cost of $0.23/bbl, for a delivered cost to the Gulf Coast of $0.89/bbl.
A Few Permian Oilfield Water Predictions

A. Within 12 months from today (start date August 2018)
   – A major Permian-focused water midstream firm goes public or has a similarly large liquidity event
   – At least 3 additional large private equity companies enter the space
   – At least 3 sizeable (80 kbd+ avg. actual volume handled) water midstream firms in the Permian will be acquired by a larger player

B. Within the next 24 months
   – There will have been a billion-dollar oilfield water transaction in the Permian
   – At least five Permian-focused entities other than Pioneer Water Management will be transporting and injecting 500 kbd or more of produced water

C. Within the next 36 months (i.e. by August 2021)
   – At least 4 million bpd of incremental produced water (relative to August 2018) must be handled
Part II: The Economics of Produced Water
Produced Water Is Transitioning From a Liability Into an Asset

## Significant Value At Stake

### A Hypothetical “Billion Dollar Water Midstream” Company

<table>
<thead>
<tr>
<th>Frac Source Water</th>
<th>Produced Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average daily sales, thousand bbl</td>
<td>100</td>
</tr>
<tr>
<td>Average daily volume gathered, thousand bbl</td>
<td>400</td>
</tr>
<tr>
<td>Gross sales price, $/bbl</td>
<td>$0.40</td>
</tr>
<tr>
<td>Quoted charge per bbl of PW</td>
<td>$0.75</td>
</tr>
<tr>
<td>Water production cost (fresh or brackish from wells), $/bbl</td>
<td>$0.03</td>
</tr>
<tr>
<td>Gathering charge, $/bbl</td>
<td>$0.20</td>
</tr>
<tr>
<td>Water distribution cost, $/bbl</td>
<td>$0.15</td>
</tr>
<tr>
<td>Daily gathering revenue</td>
<td>$80,000</td>
</tr>
<tr>
<td>Impaired water acquisition and treatment cost, $/bbl</td>
<td>$0.25</td>
</tr>
<tr>
<td>Disposal Charge, $/bbl</td>
<td>$0.55</td>
</tr>
<tr>
<td>Net frac water revenue/bbl</td>
<td>$0.11</td>
</tr>
<tr>
<td>Daily disposal revenue</td>
<td>$220,000</td>
</tr>
<tr>
<td>Net daily sourcewater revenue</td>
<td>$11,000</td>
</tr>
<tr>
<td>Skim oil revenue, $/bbl</td>
<td>$0.20</td>
</tr>
<tr>
<td>Annual source water revenue (Million USD)</td>
<td>$4</td>
</tr>
<tr>
<td>Daily skim oil revenue</td>
<td>$80,000</td>
</tr>
<tr>
<td>Injection disposal cost, $/bbl (opex + royalty)</td>
<td>$0.35</td>
</tr>
<tr>
<td>Daily disposal cost</td>
<td>$70,000</td>
</tr>
<tr>
<td>Net PW daily revenue</td>
<td>$310,000</td>
</tr>
<tr>
<td>Net PW revenue per bbl of system intake</td>
<td>$0.78</td>
</tr>
<tr>
<td>Annual produced water revenue (Million USD)</td>
<td>$113</td>
</tr>
</tbody>
</table>

Other operating expenses (salaries and misc.), Million USD | $11 |

Annual Operating Income, Million USD | $106 |

Depreciation & Amortization (est.), Million USD | $20 |

EBITDA, Million USD | $126 |

Enterprise Valuation Multiple (X of annual EBITDA) | 8.0 |

Implied Enterprise Value (Million USD) | $1,008 |

### Key Assumptions

- Frac water transported an average distance of 15 miles, produced water 20 miles. Pipeline water movement assumed to cost $0.01/bbl/mile.
- Disposal royalty of $0.15/bbl; Injection cost of $0.20/bbl; “Impaired water” means sourced from brackish aquifers, municipal effluent, or reused produced water. Impaired water assumed to constitute 1/2 of total frac water sales. Skim oil of 0.42% by volume of incoming produced water, WTI price of $60/bbl.

Sources: Bluefin Water Solutions (transfer cost), NGL (skim), Oasis Midstream Partners (D&A data), Author’s Analysis

Full Presentation Available At:

Gabriel Collins, “What Does it Take to Create a Billion Dollar Oilfield Water Midstream Company?,” The Produced Water Society Permian Basin 2018 Symposium, 9 August 2018, Midland County Horseshoe Arena & Pavilion,

Permian Profitability Is an Infrastructure and Integration Game

- The molecular endowment of a given block of acreage is geologically fixed, but the other elements of the unconventional oil & gas development equation are highly dynamic. These include drilling and completion costs, materials sourcing, and midstream services to evacuate oil, gas, and produced water. All are subject to cost reduction via technological improvements—and most of all—solutions delivered through more deeply integrated infrastructure and when feasible, economies of scale.

What Management Said Almost 2 Years Ago:
“The majority of these cost savings are expected to be sustainable due to significant enhancements in the power and water-handling infrastructure over the past few years.”
—Devon Q4 2016 Operations Report,

What is Happening Now:
The company’s investments in fixed infrastructure like power and pipelines, as well as sand, dedicated rigs, and frac crews appear to be delivering lower operating expenses even as activity heats back up and service cost inflation looms Basin-wide.

Cost savings ultimately accrue to the bottom line, as Devon reported $66 million in free cashflow on $322 million of revenue in 2Q2018 for its Delaware Basin assets.
Permian Basin Oilfield Water Space Ripe for Consolidation and Organic Growth

If sponsors and management teams were so inclined, the simple math is that combining 2-3 of the yellow highlighted PE-backed entities could create an entity that would have the nameplate capacity to handle enough water to potentially justify a billion dollar enterprise valuation.

“PE” = Private Equity-Backed

Source: Texas RRC, NM OCD, Company Reports, Shutterstock (Pac-Man), Author’s Analysis
Thinking About “Pac-Man”: The Case for Water Midstream M&A

Source: New Mexico Oil Conservation Division, Texas RRC

NGL Permian Water Received, Bpd

Solaris Water Midstream Water Received, Bpd

Consolidator Profile

Target Profile

Source: New Mexico Oil Conservation Division, Texas RRC
Is Texas Becoming New Mexico’s Water Disposal Hinterland?

In-County Injection Proportion of PW Generally Declining in Eddy & Lea Counties Despite 2X Increase in PW Volumes

Anecdotal Well Data Suggests Rising Proportion of NM-Origin Water Headed Across the Border to Texas Disposal Wells

Source: NM OCD

Source: TX RRC
Midstream parties acknowledge the risk...

OMP, 2017 10-K, P.29

Potential third-party customers could decide to process and dispose of their produced and flowback water internally or develop their own midstream infrastructure systems for produced water and flowback water gathering and freshwater distribution...”

Source: https://diginomica.com/2014/08/12/rackspace/

But do they really think it will happen?

Permian Operators Control Substantial Water System Capacity

Source: Texas RRC, NM OCD, Company Reports, Author’s Analysis
Possible Adverse Economic Situations

What do water midstream economics look like in a de-rated injection environment?

Sample System Cost Rough Estimate for a 200 Kbd Network

<table>
<thead>
<tr>
<th>Material</th>
<th>Outside Diameter (in)</th>
<th>Installed Cost, $/ft</th>
<th>Installed Cost, $/mile</th>
<th>Gathering Mileage</th>
<th>Water Distribution Mileage</th>
</tr>
</thead>
<tbody>
<tr>
<td>HDPE</td>
<td>26</td>
<td>$172</td>
<td>$910,000</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Subtotal Cost, Million USD</td>
<td>$36</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Material</th>
<th>Outside Diameter (in)</th>
<th>Installed Cost, $/ft</th>
<th>Installed Cost, $/mile</th>
<th>Gathering Mileage</th>
<th>Water Distribution Mileage</th>
</tr>
</thead>
<tbody>
<tr>
<td>HDPE</td>
<td>10</td>
<td>$66</td>
<td>$350,000</td>
<td>80</td>
<td>80</td>
</tr>
<tr>
<td>Subtotal Cost, Million USD</td>
<td>$56</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Material</th>
<th>Outside Diameter (in)</th>
<th>Installed Cost (on surface), $/ft</th>
<th>Installed Cost, $/mile</th>
<th>Gathering Mileage</th>
</tr>
</thead>
<tbody>
<tr>
<td>HDPE</td>
<td>4</td>
<td>$25</td>
<td>$132,000</td>
<td>80</td>
</tr>
<tr>
<td>Subtotal Cost, Million USD</td>
<td>$11</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Capacity per well, bpd</th>
<th>Interval</th>
<th>Cost per well (including facilities)</th>
<th>Number of Wells</th>
</tr>
</thead>
<tbody>
<tr>
<td>20,000</td>
<td>Delaware</td>
<td>$6,500,000</td>
<td>3</td>
</tr>
<tr>
<td>30,000</td>
<td>Ellenburger/Devonian</td>
<td>$12,000,000</td>
<td>5</td>
</tr>
<tr>
<td>Subtotal Cost, Million USD</td>
<td>$80</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Size, bbl</th>
<th>Built Cost/bbl of Capacity</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>500,000</td>
<td>$1.50</td>
<td>3</td>
</tr>
<tr>
<td>Subtotal Cost, Million USD</td>
<td>$2</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Miscellaneous Costs</th>
<th>Assume 10% of other total costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Million USD</td>
<td>$18</td>
</tr>
<tr>
<td>$26</td>
<td>$18+26=$291</td>
</tr>
</tbody>
</table>

Total System Investment Cost, Million USD: $203 + $291 = $494
Can Greater Recycling Help Optimize the Oilfield Water Investment Cycle?

**CAPEX to Dispose of 50 kbd of Produced Water**

**Option 1: Delaware Sands SWD**
- 2 wells @ 25 kbd per well
- $5 million-to-$6.5 million per well
- $10 million-to-$13 million

**Option 2: Devonian/Ellenburger SWD**
- 2 wells @ 25 kbd per well
- $8 million-to-$12 million per well
- $16 million-to-$24 million

**Option 3: Recycling**
- 1000 kb pond capacity @ $1.25/bbl of built storage
- $1,000k for process units
- $2.25 million

- CAPEX differences favor recycling. OPEX parameters will vary depending on scale and quality of incoming water, as well as E&P customer needs.

- The core question is: do recycling investments early in a play’s development when frac’ing is most intense and the demand for feedstock water is highest help defer SWD investments that can then be made later when PW flows are more predictable and capital and capacity optimization are easier to do?

**Water Production Profile of Top-Tier Wells in Lea County, NM**

Examined sample of approximately 600 wells completed in Lea County by Apache, COG, Devon, EOG, and Mewbourne and ranked them according to the cumulative oil volume produced in their first 6 months of reported production. Curve built from average of data from the 10 wells clustered around the 75th and 50th percentiles, respectively.

**Source:** NM OCD, Author’s Analysis

*Peaky, front-loaded flows.*
Tradable Produced Water: The New “WTS?”

**Food For Thought**
- “WTS” is current parlance is the abbreviation for West Texas Sour, a crude oil with an API gravity of 30.2 and sulfur content of between 1.5% and 2.8% by weight.
- In the Permian oilfield water world, there is a case to be made for what we can somewhat facetiously call the new WTS—as in “West Texas Salty” for the highly saline produced waters that flow up from wells in the region.
- Instead of API gravity and sulfur content, perhaps the quality specs for this hypothetical benchmark for recyclable produced water would be XX ppm total suspended solids, XX ppm of iron and other precipitate-forming ions, and levels of XX * 10^x per barrel or less of bacteria.

At least one Texas-focused operator has already contemplated a world in which produced water carries a commercial price tag.

---

**Halcón Field Services**

**Water Management Advantages**

- **Key Infrastructure for Cost Control**
  - **Operational Advantages**
    - Eliminates dependence on 3rd party sources for water disposal and completions
    - Simplifies operations to handle and source all water within own field
    - Central control over deployment of infrastructure, especially water infrastructure
  - **Value of these assets growing rapidly as production and expansion of capacity continues**

---

**Halcón Resources Investor Presentation**

February 28, 2018

---

(5) Assumes commercial water sourcing costs of $0.35 / bbl for produced water and $0.50 / bbl for fresh water.
Oilfield Input Transitions Can Happen Fast

- Consider the velocity at which E&Ps are adopting In-Basin frac sand.
- It took a while for the transition to reach a tipping point, but now sand suppliers are scaling up at warp speed to meet demand.

Source: YouTube, Midland Reporter Telegram

Source: TWDB, Author’s Analysis
Cutting-Edge Texas Groundwater and Oilfield Water Research


