Water Management Planning in the Eagle Ford Shale Play

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EAGLE FORD TECHNICAL WORKSHOP
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Prepared by J. Daniel Arthur, P.E., SPEC
Understanding the Eagle Ford Shale Play

- Eagle Ford Shale development is growing quickly, but still in the early stages.
- Concerns regarding water sourcing are growing.
- Water disposal challenges are arising.
- Water management planning for the lifecycle is a critical development element.

Source: Texas RRC (August 2011)

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Participants in the Eagle Ford is Growing

Top Producing Operators
- ANADARKO E&P COMPANY LP
- APACHE CORPORATION
- BURLINGTON RESOURCES O & G CO LP
- CHESAPEAKE OPERATING, INC.
- EOG RESOURCES, INC.
- GEOSOUTHERN ENERGY CORPORATION
- LEWIS PETRO PROPERTIES, INC.
- PETROHAWK OPERATING COMPANY
- ROSETTA RESOURCES OPERATING LP
- SM ENERGY COMPANY

Eagle Ford

Source: Texas RRC (August 2011)
San Antonio Current
“Final projections for the Eagle Ford have since been shifted up as high as 45,000 acre-feet (14.6 billion gallons) at peak production — now expected to hit seven years earlier in 2024. Last year, the formation required around 6,000 acre-feet of water. This year’s activity has been considerably more demanding that that, creating a market for water sales from the region’s ranches.”

Texas Water Development Board
“A report released in July by the TWDB estimated that industry uses about 12 billion gallons of water annually for hydrofracking in Texas now, but that demand will grow to 39.1 billion gallons before 2030.”

Standard-Examiner
“Amid the brutal drought, competing users and local groundwater conservation districts in this part of the state see the industry's unregulated, gluttonous use of fresh water as a huge problem. "I want them to quit using fresh water for fracking," said Slate Williams, general manager of the Crockett Groundwater Conservation District.”

Texas Oil & Gas Accountability Project
“Amid increasing scarcity of water supplies, the immense quantities of water required for hydraulic fracturing are not sustainable. Huge volumes of water are needed to extract shale gas. Estimates range from 1.5 million to five million gallons of water per well, and wells may be refracked several times over the life of each well. Recently, the oil and gas industry announced a new 12-stage completion method that uses over 9 million gallons of water per well.”

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Water Management is Simple – Right?

Non-Saline Water
- Surface water
- Groundwater
- Alternative Sources

Gas Production & Transportation

Produced Water

Land Owner Concerns

Seismic Operations

Economics

Droughts

Road and Lease Construction

Timing

Well Drilling

Evolving Regulations

Brackish/Saline Groundwater

Disposal Well

Frac Fluid Flowback

Risks

Well Completions

Compliance

Reuse

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A lifecycle approach is needed to address the many issues important to industry:

- Regulatory timing & vulnerabilities
- Legislative changes
- Public opposition
- Historical Activities
- Competition for resources
- Flowback recovery
- Third-party options and risks
- Environmental risks
- Etc...

- Pre-Development Assessment
- Water Sourcing Availability & Issues
- Well Site Construction & Drilling
- Water Conditioning/Pre-Treatment
- Well Completion/Fracturing
- Flowback/Produced Water
- Reuse/Disposal/Beneficial Use
Pre-Development Assessment Considerations

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Surface Water Sourcing Alternatives

Availability:
- Resource is well managed through system of reservoirs and water right permitting.
- Drought is increasing strain on supplies.

Sourcing Considerations:
- Little water is available for appropriation through TCEQ.
- Some river authorities are permitted to sell water for oil and gas use.
Groundwater Sourcing Alternatives

Availability:
- The Carrizo-Wilcox is the largest aquifer in the play.
- Minor aquifers are more susceptible to drawdown.
- The Gulf Coast Aquifer is a brackish water source in the eastern portion of the play.

Sourcing Considerations:
- Permits may be required depending on the depth and specific Groundwater Conservation District Rules.

Source: Various Sources (August 2011)
Water Sourcing Going Forward

Fresh Water
- Percentage of fresh water utilization should decrease over time

Recycled Water
- Anticipate increased utilization of recycled water as technology develops
- Highly dependent on companies’ scale of development

Alternative Water Sourcing
- Anticipate increased use of lower-quality groundwater, where available and feasible
- Utilization of alternative sources could supplement water demand
## HF Water Usage by Shale Play

<table>
<thead>
<tr>
<th>Shale Basin/Play</th>
<th>Maximum Observed Water Usage</th>
<th>Minimum Observed Water Usage</th>
<th>Well Sample</th>
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<td>Bakken</td>
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<td>Woodford-Caney</td>
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</table>

*Source: Various Sources (August 2011)*

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# HF Water Usage in the Eagle Ford

<table>
<thead>
<tr>
<th>Operator</th>
<th>Maximum Observed Water Usage</th>
<th>Minimum Observed Water Usage</th>
<th>Well Sample</th>
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</tbody>
</table>

Source: Various Sources (August 2011)
Hydraulic fracturing uses more water than drilling.

Fracturing fluid is >99% water and sand.

Understanding water requirements in relation to development pace is critical.

Pre-treatment and water conditioning increasingly important.

Chemical Screening a priority.
## Common Fracturing Additives

### Eagle Ford (Gas)
- Water
- Proppant (Sand/Quartz)
- Aliphatic acids
- Aliphatic Alcohols, ethoxylated #1
- Amine Derivative
- Carbohydrate polymer
- Citric Acid
- Ethane-1,2-diol
- Formic Acid
- Glutaraldehyde
- Hydrochloric Acid
- Methanol
- Propargyl Alcohol
- Sodium bromate
- Sodium erythorbate
- Sodium Hydroxide
- Sodium tetraborate
- Sodium Thiosulphate
- Synthetic organic polymer
- Tetrakis (Hydroxymethyl) Phosphorium Sulfate
- Tetramethylammonium chloride
- Tetrasodium ethylenediaminetetraacetate
- Trisodium Nitrilotriacetate

### Eagle Ford (Oil)
- Water
- Proppant (Sand/Quartz)
- Ammonium Persulfate
- Citric Acid
- Ethylene Glycol
- Hydrochloric Acid
- Hydrotreated light petroleum distillate
- Isopropanol
- Methanol
- Polyethylene glycol
- Potassium Carbonate
- Potassium Chloride
- Potassium Hydroxide
- Sodium Chloride
- Sodium Hydroxide

Source: Various Sources (August 2011)
Planning for Disposal Alternatives

Source: Texas RRC (August 2011)
Beneficial Use Alternatives

• Beneficial uses in unconventional plays such as CBM have been common.
• Beneficial uses for water produced from shale gas wells has potential (similar to CBM).
• Expect beneficial uses of Eagle Ford water in the future (but not like CBM).
As development in the Eagle Ford expands, all associated issues are likely to be increasingly scrutinized

- Threats of regulation of drilling waste and produced water under RCRA
- Increased stringency of UIC permits associated with disposal of water produced after fracturing
- Permitting, design and use of impoundments
- Increases regulation associated with water sourcing
- DOE & EPA Hydraulic Fracturing Study
- NY DEC Supplemental GEIS
- Challenges pertaining to beneficial use
- Plus tons of other stuff...
Citation Information

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