Devon Energy’s Delaware Basin Water Management Program

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Produced Water Workshop
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Agenda

• Introduction – Devon Overview
• Past Water Management Case Studies
• 2015 Water Management Case Study
  – Strategic Drivers
  – Regulatory Considerations
  – Water Infrastructure
  – Water Treatment
  – Timeline
• Continued progress
• Preparation for the future
Introduction

2015 Devon Overview

Total Company Key Stats

- **Net acres:** 6,200,000
- **Gross producing wells:** ≈ 29,900
- **Production (Q3 net):** 680 MBOED
  - 61% liquids
- **Reserves (12/31/14):** 2.8 BBOE
  - 53% liquids
- **2015e E&P CapEx:** ≈ $3.8 - 4.0 billion
- **2015e Drilling plans:** ≈ 720 gross wells
- **Operated rigs (9/30/15):** 18
Red areas on the baseline water stress map are places where a large portion of available water supply is already being used. The gray areas are dry and undeveloped. Black dots on the map represent wells hydraulically fractured.

For interactive map, see ceres.org/shalemap.

Water Stress Map

Case Study 1 – North Texas

- Drivers – Disposal capacity, water scarcity
  - Chemical pretreatment – clean brine
    - Remove solids, iron, oil, polymer
    - 10,000 bpd capacity per unit
- Distillation
  - Vaporizes water and condenses it - clean, distilled water
  - Remaining concentrate removed for disposal or utilized for as “kill fluid”
  - 2,500 bpd capacity per unit
- Regulatory engagement - RRC
- Multiple sites over nearly a decade of activity through 2013
Case Study 2 - Anadarko

- Drivers – drought, truck traffic
- High quality produced water
- Settling, Disinfection
- Centralized facility
  - Saltwater Disposal Well
  - 500,000 bbl storage pond
- Automated monitoring
- Pipeline network
  - 8”-12” fiberglass
  - Approximately 35 miles
- Regulatory engagement
- Maintained operations during dry periods
  - 2012-2014
Case Study 3 – Midland PBTX East

• Drivers - Water scarcity, disposal capacity
• Brackish groundwater wells
• ClO₂ treatment of produced water
• Covered brackish frac ponds
• 42,000 bbl ASTs for recycle
• Layflat hose for transfer
• Some permanent collection added
• Automated monitoring
• Data management pilot
• Near zero fresh water demand 2013-2014
• High Cost and Risk
• High Water Demand
• Freshwater Scarcity
  – No Surface Water Available
  – High Competition for Groundwater
• High Cost of Trucking and Disposal
Recycling Regulations  
*Delaware Basin New Mexico*

- NMOCDD Rule 34
  - Developed to encourage the recycling and reuse of produced water, drilling fluids, and other liquid oil field waste.
  - Authorizes the storage of produced water in double lined earthen impoundments.
  - Permit by Rule
  - Before Rule 34, large ASTs required lengthy permitting process to store produced water.
Environmental Protection
Delaware Basin New Mexico

- Pre-Construction Environmental Site Assessments
- Double-lined Impoundments
- Real-Time Leak Detection Between Liners
- Hydro Test all Primary Liners Before Initial Use
- Bird Deterrents
2015 - Infrastructure

Delaware Basin New Mexico

- 6 Completed Impoundments
- 7 Proposed Future Locations
- Permanent pipeline infrastructure being developed
  - 3rd party and Devon-owned
Water Treatment

*Clean Brine Standard*

- Removal of oil residual
- Removal of TSS
- Removal of Iron
- Bacteria Reduction
- Turbidity <10 NTU

Waste Sludge

- Treatment Targets Vary Depending on Use and Storage Method
- Waste is Either Pressed into Solids for Landfill or Disposed into SWD
## 2015 Case Study - Timeline

**Delaware Basin New Mexico**

### Timeline

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
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<tbody>
<tr>
<td>2012</td>
<td>Devon begins permitting for initial reuse pilot in Delaware basin and runs initial reuse pilot</td>
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<tr>
<td>December 2013</td>
<td>Devon runs 2(^{nd}) reuse pilot</td>
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<tr>
<td>February 2014</td>
<td>Devon’s 1(^{st}) full scale reuse project, using large AST’s</td>
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<td>2014</td>
<td>Devon reused 67 million gallons (1.6 mm bbl)</td>
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<td>March 2015</td>
<td>New Mexico allows produced water storage in impoundments (NMOCO rule 34)</td>
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<td>May 2015</td>
<td>Devon applied for first permit for produced water storage impoundment under rule 34</td>
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<td>August 2015</td>
<td>1(^{st}) reuse project started using impoundments</td>
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<td>November 2015</td>
<td>Devon had 5 water treatment facilities (capacity &gt; 50,000 bwpd)</td>
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<tr>
<td>2015</td>
<td>Devon reused 145 million gallons (3.5 mm bbl)</td>
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<td>2016</td>
<td>Devon will continue to reuse water and pilot new technologies where feasible</td>
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<td>YTD &gt;80% of completions water is recycled produced water</td>
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## Industry Trends

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<thead>
<tr>
<th>Industry Trends</th>
<th>Benefits</th>
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<tbody>
<tr>
<td>Improving Fracturing Chemistry</td>
<td>Increasing use of non-fresh water</td>
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<tr>
<td>Innovation in Treatment Technology</td>
<td>Increasing feasibility of produced water reuse</td>
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<tr>
<td>Increasing Water Conveyance Systems</td>
<td>Reducing truck traffic</td>
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<tr>
<td>New Water Storage Designs</td>
<td>Provides flexibility and reliability when using non-fresh water</td>
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<tr>
<td>Increasing Transparency</td>
<td>Improves relationships with stakeholders</td>
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<tr>
<td>Dedicated Water Staff</td>
<td>Improves water management, planning technical support and performance</td>
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Devon Water Management Team

Preparing for the future

• Dedicated Staff – Operations Excellence Water Team
• Tactical and strategic goals
• Focus areas to reduce cost and risk
  – Stakeholder Engagement
  – Standards
  – Technology
  – Planning