Agenda

• Introduction

• Water Management

• Produced Water Treatment and Reuse

• Produced Water Logistics Challenges

• Process and Technology Improvements

• Summary, Questions and Discussion
Devon Energy Overview
Q4 2016 Operations Report Highlights

• Oil production from Devon’s retained assets totaled 244,000 barrels per day in the fourth quarter.
• Overall, net production averaged 537,000 BOE per day
• At year-end, Devon’s proved reserves totaled 2.1 billion BOE
• 10 operated rigs running across its U.S. resource plays (Q4 2016)
• Devon expects to invest $2 to 2.3 billion of E&P capital in 2017
Our company’s success relies on executing a sustainable water-management strategy that balances ecological, economic, operational and social criteria. Devon is committed to the principles of water conservation and reuse in its operations through the following:

- **Stakeholder Engagement**
  - Educating and working closely with governmental authorities, communities, businesses and other stakeholders about water management needs and advocating for appropriate regulations

- **Water-Management Planning**
  - Identifying usage needs, determining resource availability, incorporating economically and operationally feasible alternatives to drinking water supplies, monitoring water use and continuously updating plans

- **Technology Evaluation and Deployment**
  - Identifying, testing and evaluating technologies related to sourcing, recycling, storing and moving water and deploying technology to reduce fresh-water demand

- **Best-Practices Development**
  - Identifying and implementing water management best practices that improve the economics, reliability and safety of using non-potable water supplies while protecting the environment
## Water Management Trends

**EWI 2014 Case Study Findings**

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

*Produced Water Reuse*

- Reduce cost and risk
- Produced water reuse logistics
  - Time and space
  - Adequate volumes
  - Suitable quality
- Produced water may be generated far from new activity.
- Large volumes of water must be stored prior to completions activity.
- Special care is required when moving and storing produced water.
Clean Brine Standard

Produced Water Reuse

• Many options for water treatment
• Historically treated to remove total dissolved solids
• Fluid chemistry improvements
• Currently target clean brine standard
  – Removal of oil residual
  – Removal of TSS
  – Removal of Iron
  – Bacteria Reduction
  – Turbidity <10 NTU
Logistics Challenges

*Produced Water Reuse*

- **Services**
  - Mob/demob rate ($)
  - Day rate ($/day)
  - Operating rate ($/bbl)
- **Infrastructure**
  - Capital payback period
- **Dynamic rig schedule**
  - Depends on phase of activity
    - Exploration
    - Appraisal
    - Development
  - Changes with recent results
  - Changes with oil/gas prices
Transportation Challenges

Produced Water Reuse

• Move to treat and then to frac
• Trucks
  – High operating costs
  – Increased traffic
  – Increased wear on infrastructure
• Temporary infrastructure
  – Routing and approvals
  – Additional operating costs/fees
  – Real and perceived risks
• Permanent infrastructure
  – Routing
  – High capital costs
  – Uncertain rate of return
Storage Challenges

Produced Water Reuse

• Siting
• Real and perceived risks
• Temporary
  – Adequate volumes
  – High costs
• Permanent
  – Permitting
  – High capital costs
  – Uncertain rate of return
• Monitoring and data quality
Pre-Job Planning for Water Transfer

Process Improvement

- Job-specific plan
- Transfer route and pump locations
- Evaluate hydraulics
- Highlight environmentally sensitive areas
- Highlight special safety issues
- Spill response plan
Standardizing Operations

*Process Improvement*

- Equipment rig up
- Pre-job testing
- Water transfer operations
- Spill response
- Post job flush
- Equipment rig down
- Equipment storage and maintenance
Lay Flat Hose

Technology Improvement

- Designed to eliminate leaks
- Fast and simple to deploy
- Durable for challenging environments
- Abrasion resistant
- Fewer connections
- Up to 150 bpm
- 200 psi working pressure
Evaporation Technology Improvement

- Removing the transportation cost/risk
- Small foot print
- Able to move from pad to pad
- Automation allows some systems to run unmanned
- Best results in low to moderate TDS areas
- Verify permissible emissions in evaporated steam
- Requires low-cost thermal energy
Above Ground Storage Tanks

*Technology Improvement*

- Flexible temporary storage
- Various sizes from 4,500 to 60,000 bbl
- Typical capacity 40,000 bbl
- 3 trucks +/- depending on size
- Single day rig-up (after site work)
- Integrated leak-detection systems
- Can be “nested”
Vertical Tank

Technology Improvement

- Smaller footprint
- 3600 to 6500 bbl capacity
- Delivered on 1 truck (M3600) or 1.5 trucks (M6500)
- Eliminates evaporation
- Easy secondary containment
- Easy tank setup
- Great stability under windy conditions
- Bladder can be filled with air for testing purposes prior to filling with fluid
- Gravity-feed – Reduce pumps needed
Modular Above Ground Tank
Technology Improvement

- Customizable footprint
- 10,000 to 100,000 barrels +
- Multiple heating options
- Sturdy steel panel wall units
- Quick assembly and disassembly
- After site preparation, typically installed in one to two days
- Impermeable liner and geotextile substrate provide water containment and a puncture-resistant ground covering
Engineered Ponds
*Technology Improvement*

- Pre-construction environmental assessments
- Double-lined impoundments
- Real-time leak detection between liners
- Hydro test all primary liners before initial use
- Detailed engineering and oversight
- Level monitoring
- Bird deterrents
Water Storage Pond Mapping
Technology Improvement

• Static volumetric analysis of water in storage resulting in a bathymetric image
• Remote controlled with GNSS positioning
• Better volume control
Automated Blending Technology Improvement

• Blending water sources
• Chemical injection ports
• Monitoring quality allows real-time adjustments
• Can be based on volume or salinity
• Results in consistent water quality, minimizes impact on frac

1. Fresh Water Inlet
2. Produced Water Inlet
3. Automated Blending Controller
4. Blending Manifold
Water Volume Monitoring
Technology Improvement

- Mobile and permanent options
- Better inventory management
- Fewer trips to remote sites
- Optimization of water sources
- Improved accounting
Summary

*Mitigating Produced Water Challenges*

- Water management is focused on cost and risk reduction
- Reusing produced water in operations provides benefits
- There are many logistical challenges related to reusing produced water
- Improvements in processes and technology are allowing greater use of this important resource
- Devon is continuously evaluating and deploying technologies where feasible to reduce impacts to fresh water resources
Thank you.