State Oil and Gas Agency
Groundwater Investigations
And Their Role in Advancing Regulatory Reforms

GWPC Annual Forum
Atlanta, Georgia
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Scott Kell, Geologist
State geologists conducting water well video survey
Key Questions

• What are states actually finding through their groundwater investigations?

• What are states doing in response to investigation findings and determinations?
Objectives

• Categorize state investigation findings

• Evaluate evolution of state regulations that protect groundwater

• Measure state progress
Methods

• Develop incident classification scheme
• Establish state review periods
• State records review
• Classify incidents consistent with scheme
• Compile regulatory enhancement history
State Review Periods

- 16 years (1993-2008)
- 25 years (1983-2007)
Oil and Gas E&P Phases

1. Site Preparation
2. Drilling and Well Completion
3. Well Stimulation
4. Production, Transport, Storage
5. Waste Management/ Disposal
6. Plugging and Restoration
7. Orphaned Wells/ Sites
Context

• Demographics
• Climate
• Hydrogeology
• Groundwater usage
• History and scale of oilfield E&P activities
• Scope and history of regulated activities
Ohio Fresh Groundwater Withdrawals by User Category (Million Gallons per Day)

<table>
<thead>
<tr>
<th>Legend</th>
<th>Mil. Gallons per Day</th>
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</thead>
<tbody>
<tr>
<td>Public</td>
<td>488</td>
</tr>
<tr>
<td>Domestic</td>
<td>146</td>
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<tr>
<td>Irrigation</td>
<td>17.7</td>
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<tr>
<td>Livestock</td>
<td>7.7</td>
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<tr>
<td>Aquaculture</td>
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<tr>
<td>Industrial</td>
<td>149</td>
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<tr>
<td>Mining</td>
<td>112</td>
</tr>
<tr>
<td>Thermoelectric</td>
<td>22.5</td>
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</table>
Ohio Oil and Gas E&P Activities (1983-2007)

- >33,000 wells drilled
- ~28,000 wells plugged
- Producing wells increased by 73% (high of 64,830 in 1991)
- >222 million bbls of oil
- >3.2 tcf of natural gas
- >202 million bbls brine disposed
Total Incidents by Phase

<table>
<thead>
<tr>
<th>Phases</th>
<th>Number of Incidents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orphaned Wells &amp; Sites</td>
<td>41</td>
</tr>
<tr>
<td>Site Preparation</td>
<td>0</td>
</tr>
<tr>
<td>Drilling &amp; Completion</td>
<td>74</td>
</tr>
<tr>
<td>Well Stimulation</td>
<td>0</td>
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<tr>
<td>Production, On-lease Transport, &amp; Storage</td>
<td>39</td>
</tr>
<tr>
<td>Waste Management &amp; Disposal</td>
<td>26</td>
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<tr>
<td>Plugging &amp; Site Reclamation</td>
<td>5</td>
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</tbody>
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Incidents Caused by Regulated Activities by Year and Key Regulatory Reforms

- Authority to order water supply replacement
- Produced water tracking
- Established deep injection of produced water as preferred disposal method
- Closure of all produced water earthen pits
- Reserve pit construction standards
- Annular disposal mechanical integrity test
- Annular disposal rules
- Orphan well emergency program
- Urban drilling rules

Legend

- Green: Plugging & Site Reclamation
- Yellow: Waste Management & Disposal
- Light Blue: Production, On-lease Transport, & Storage
- Red: Drilling & Completion
- Dark Blue: Site Preparation
- Purple: Well Stimulation

Year
Hydraulic Fracturing Operation
Geauga County, Ohio
Bainbridge Township, 2007
Deficient primary cement job
Unsealed flow zone (Newburg dolomite)
Overpressurized annulus
Texas Fresh Groundwater Withdrawals by User Category
(Million Gallons per Day)

Legend

<table>
<thead>
<tr>
<th>User Category</th>
<th>Mil. Gallons per Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public</td>
<td>1,210</td>
</tr>
<tr>
<td>Domestic</td>
<td>257</td>
</tr>
<tr>
<td>Irrigation</td>
<td>6,120</td>
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<tr>
<td>Livestock</td>
<td>162</td>
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<tr>
<td>Aquaculture</td>
<td>5.41</td>
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<tr>
<td>Industrial</td>
<td>187</td>
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<tr>
<td>Mining</td>
<td>26.8</td>
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<tr>
<td>Thermoelectric</td>
<td>55.8</td>
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</table>
Texas Oil and Gas E&P Activities (1993-2008)

- 187,788 wells drilled
- 140,818 wells plugged
- 6.7 billion bbls. of oil
- 93.7 tcf of gas
- > 5 billion bbls. of produced water injected
O.C.F. Projects
Monitor wells
Scheduled sampling and analysis
Plume delineation
Contaminant migration evaluation
In-situ remediation projects
Water supply replacement
Hydraulic Fracturing Job in the Barnett Shale
Photo Courtesy of XTO Energy, a subsidiary of ExxonMobil
Misguided “Frack” Focus

“Many in the concerned public use the word “fracking” to describe all activities associated with shale gas development... rather than the process itself”

Secretary of Energy Advisory Board
Shale Gas production Subcommittee
90-Day Report
Ohio and Texas Reforms

Ohio: SB-165
Texas: HB-3328
Drivers of Regulatory Reform

- Federal environmental laws (SDWA, CWA, RCRA, etc.)
- GWPC Peer Reviews of state UIC Programs
- STRONGER Reviews of state waste management practices
- Heightened citizen expectations
- State groundwater investigations
State Investigations as Applied Science

- Qualified experts
- Evidence collected and analyzed according to standard methods
- Applies principals and methods generally accepted within specialized fields of science
- Sufficient facts and data to support “diagnosis”
- Subject to testing
Conclusions

• Sound science should be foundational to public policy
• Incidents are caused by diverse activities and differ from state to state
• State investigations are critical drivers of regulatory reform
• Reform is an ongoing process that addresses state-specific priorities shaped in part by groundwater investigation findings