Progress Update:

EPA's Study of the Potential Impacts of Hydraulic Fracturing on Drinking Water Resources

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Today’s Presentation

- Background on EPA’s study
- How EPA is ensuring the study’s scientific integrity
- Status of the work
- Next update
- Questions?
BACKGROUND
The combination of hydraulic fracturing and horizontal drilling has opened new areas for oil and gas development.
Purpose of EPA’s Study

- To assess whether hydraulic fracturing can impact drinking water resources
- To identify driving factors that affect the severity and frequency of any impacts

*EPA’s study plan focuses on the water cycle in hydraulic fracturing.*
Requests from Congress

As directed by Congress, EPA is conducting the study using...

- Best available science
- Independent sources of information
- Transparent, peer-reviewed process
- Consultation with others
- Rigorous quality assurance procedures
Water Cycle in Hydraulic Fracturing

Hydraulic fracturing often involves the injection of more than a million gallons of water, chemicals, and sand at high pressure down the well. The depth and length of the well varies depending on the characteristics of the hydrocarbon-bearing formation. The pressurized fluid mixture causes the formation to crack, allowing natural gas or oil to flow up the well.

Water Use in Hydraulic Fracturing Operations

Water Acquisition - Large volumes of water are transported for the fracturing process.
Chemical Mixing - Equipment mixes water, chemicals, and sand at the well site.
Well Injection - The hydraulic fracturing fluid is pumped into the well at high injection rates.
Flowback and Produced Water - Recovered water (called flowback and produced water) is stored on-site in open pits or storage tanks.
Wastewater Treatment and Waste Disposal - The wastewater is then transported for treatment and/or disposal.
Research Questions

What are the potential impacts on drinking water resources of:

- Water Acquisition: Large volume water withdrawals from ground and surface water?
- Chemical Mixing: Surface spills on or near well pads of hydraulic fracturing fluids?
- Well Injection: The injection and fracturing process?
- Flowback and Produced Water: Surface spills on or near well pads of flowback and produced water?
- Waste Water Treatment and Waste Disposal: Inadequate treatment of hydraulic fracturing waste waters?
Research Approach

- Analysis of Existing Data
- Case Studies
- Scenario Evaluations
- Laboratory Studies
- Toxicity Assessments
ENSURING SCIENTIFIC INTEGRITY
EPA’s Scientific Integrity Process

• High Quality Science
  – High Quality Data and Analysis
    • Quality Management Plans
    • Quality Assurance Project Plans (audits, record management)

• Peer review by the Science Advisory Board

• Transparency
  – Communication will explain findings, underlying assumptions, and uncertainties
  – Avoids conflicts of interest and ensures impartiality

EPA’s Scientific Integrity Policy:
http://www.epa.gov/osa/pdfs/epa_scientific_integrity_policy_20120115.pdf
Quality Assurance (QA)

• **Purpose**
  – To ensure results are scientifically defensible and data are of the needed and expected quality for their intended use

• **How do we do it?**
  – Quality Management Plan
  – Quality Assurance Project Plans (QAPPs)
    • Audits
    • QA review of work products
    • Records management
• EPA Requirements for Quality Management Plans:
• Quality Management Plan for this study:
• EPA Requirements for QA Project Plans:
• QAPPs for this study:
  – http://www.epa.gov/hfstudy/qapps.html
STATUS OF THE WORK
Status of the Work

- Analysis of Existing Data
- Case Studies
- Scenario Evaluations
- Laboratory Studies
- Toxicity Assessments
Analysis of Existing Data

Data sources include:

• Peer-reviewed literature
• State and federal agencies
• Industry responses to information requests
• Databases
Analysis of Existing Data

Data include:

- Well locations, construction practices, and water use
- Chemicals in HF fluids, flowback, and produced water
- Standard operating procedures
- Frequency, severity, and causes of spills
- Treatment and disposal practices
Information Requested from Industry

August 2011: EPA sent a letter to nine oil and gas companies requesting well files that contain data on well construction, design, and operation practices.

Types of information requested include:

- Quantity and quality of well cement
- Extent of integrity testing
- Identity of products or chemicals used
- Drinking water resources near the well or through which the well passes
- Extent of baseline water quality monitoring
- Source and quantity of water used
Well File Review

- To improve our understanding of well performance during HF, focusing on:
  - Well design
  - Construction
  - Completion practices
- Reviewing information from 9 companies
- Expecting 334 well files

Randomly chosen companies:

- Clayton Williams Energy
- ConocoPhillips
- EQT Production
- Hogback Exploration
- Laramie Energy II
- MDS Energy
- Noble Energy
- Sand Ridge Energy
- Williams Production

February 2012
# Retrospective Case Studies

<table>
<thead>
<tr>
<th>Location</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Bakken Shale (oil)</td>
<td>Killdeer, Dunn Co., ND</td>
</tr>
<tr>
<td>Barnett Shale (gas)</td>
<td>Wise Co., TX</td>
</tr>
<tr>
<td>Marcellus Shale (gas)</td>
<td>Bradford and Susquehanna Cos., PA</td>
</tr>
<tr>
<td>Marcellus Shale (gas)</td>
<td>Washington Co., PA</td>
</tr>
<tr>
<td>Raton Basin (coalbed methane)</td>
<td>Las Animas and Huerfano Cos., CO</td>
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Using a tiered study approach:

<table>
<thead>
<tr>
<th>Tier</th>
<th>Research Approach</th>
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</thead>
<tbody>
<tr>
<td>Tier 1</td>
<td>Verify potential issue</td>
</tr>
<tr>
<td>Tier 2</td>
<td>Determine approach for detailed investigation</td>
</tr>
<tr>
<td>Tier 3</td>
<td>Conduct detailed investigation</td>
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<tr>
<td>Tier 4</td>
<td>Determine source(s) of any impacts</td>
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</tbody>
</table>
# Status of Retrospective Case Studies

<table>
<thead>
<tr>
<th>Case Studies</th>
<th>Tier 1</th>
<th>Tier 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Bakken Shale – Killdeer, Dunn Co., ND</td>
<td>Completed</td>
<td>Domestic, Industrial, Production, Monitoring, and Municipal Wells; Surface Water</td>
</tr>
<tr>
<td>• Barnett Shale – Wise Co., TX</td>
<td>What’s been sampled?</td>
<td></td>
</tr>
<tr>
<td>• Marcellus Shale – Bradford &amp; Susquehanna Cos., PA</td>
<td>When were samples taken?</td>
<td>July-November 2011</td>
</tr>
<tr>
<td>• Marcellus Shale – Washington Co., PA</td>
<td>Data Quality Audits:</td>
<td>Underway</td>
</tr>
<tr>
<td>• Raton Basin – Las Animas &amp; Huerfano Cos., CO</td>
<td>Next Steps:</td>
<td>Final QA/QC</td>
</tr>
<tr>
<td></td>
<td>Next Sample Collection:</td>
<td>March-July 2012*</td>
</tr>
</tbody>
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* Future dates are estimates.
Case Study Data Generation and Review Timeline

1. Principle investigator (PI) collects samples and sends to lab

2. Lab analyzes samples, verifies data, and submits report (including raw data) to PI

3. PI verifies data, generates data summary and provides data summary and raw data to QA Manager for QA review

4. QA Manager verifies data summary and raw data for completeness and performs audit of data quality (or oversees audit if performed by a contractor)

5. PI responds to audit report and finalizes data summary. QA Manager verifies final data summary if revisions needed.
What are the potential impacts from surface water disposal of treated hydraulic fracturing wastewater on drinking water treatment facilities?
Surface Water Transport of Hydraulic Fracturing-Derived Waste Water

Objectives

• Identify potential impacts to drinking water treatment facilities from surface water discharge of treated hydraulic fracturing wastewaters

• Identify conditions under which impacts to drinking water intakes may occur, and conditions under which impacts of concern are unlikely
Surface Water Transport of Hydraulic Fracturing-Derived Wastewater

Approach

- Use empirical models to simulate a generic river situation to screen for conditions which may result in impacts (2012)
- Simulate one or more actual river networks to identify conditions that may result in problematic situations (2014)

Current Status

- Scenarios being developed from:
  - Waste disposal data from Pennsylvania/EPA Region 3
  - USGS streamflow gauge data
- Scenarios include:
  - Variation in mass input, concentration, discharge volume, treatment capacity
  - High, medium, and low flow conditions
  - Varying distance to public water supplies
  - Primary focus on bromide, total dissolved solids, and radium
    - Example indicators of hydraulic fracturing flowback and produced water
Disinfection By-Products (DBPs)

Objective
- Understand to what extent discharge of treated wastewater from hydraulic fracturing (HFWW) may contribute to the formation of DBPs at downstream drinking water treatment plants

Approach
- Conduct laboratory (bench top) experiments
- At applicable dilution rates, describe the kinetics and formation potential of brominated DBPs from HFWW
- Control for: natural organic matter (NOM), chlorine, chloramine

Current Status
- QAPP in place
- Data and literature review in progress
- Bench top research has begun on DBP formation
- Preliminary results expected in April 2012
Fate, Transport, Characterization of Residuals; and Effects on Activated Sludge Processes

Objective

• Assess the fate, transport, and efficacy of wastewater treatment on constituents in HF wastewaters

Approach

• Monitor effects on the activated sludge process
• Determine concentrations of contaminants (inorganic and organic) and chemical speciation (inorganics) in wastewater treatment residuals
• Analytes include: barium, strontium, sodium, potassium, ethylene glycol monobutyl ether, ethylene glycol, BTEX, alkylphenols

Current Status

• QAPP in place
• Data and literature review in progress
• Bench top research planned to start in April 2012
Environmental Justice Screening

Objective

• Assess whether HF occurs more often in counties home to predominantly low-income, minority, young, or elderly populations

Approach

• Screening level analysis to compare county level demographic data with the density of wells hydraulically fractured by nine oil and gas companies in 590 counties across the U.S.
  – Limited resolution
  – Reflects demographics in areas with HF
  – Uses geographical information system (GIS) mapping

Next steps

• Evaluate initial screening and consider ways to develop a more robust analysis
Status of the Work

✔ Analysis of Existing Data
✔ Case Studies
✔ Scenario Evaluations
✔ Laboratory Studies
  • Toxicity Assessments
Next Update

May-June 2012
Questions?

- For further information, see: www.epa.gov/hfstudy
- We will post copies of these slides.