# Web Conference Summary of July 30, 2013 Technical Workshop on Case Studies to Assess Potential Impacts of Hydraulic Fracturing on Drinking Water Resources

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United States Environmental Protection Agency

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

*Study Goals:*

- Assess whether hydraulic fracturing may impact drinking water resources

- Identify driving factors that may affect the severity and frequency of impacts

For more information: http://www.epa.gov/hfstudy





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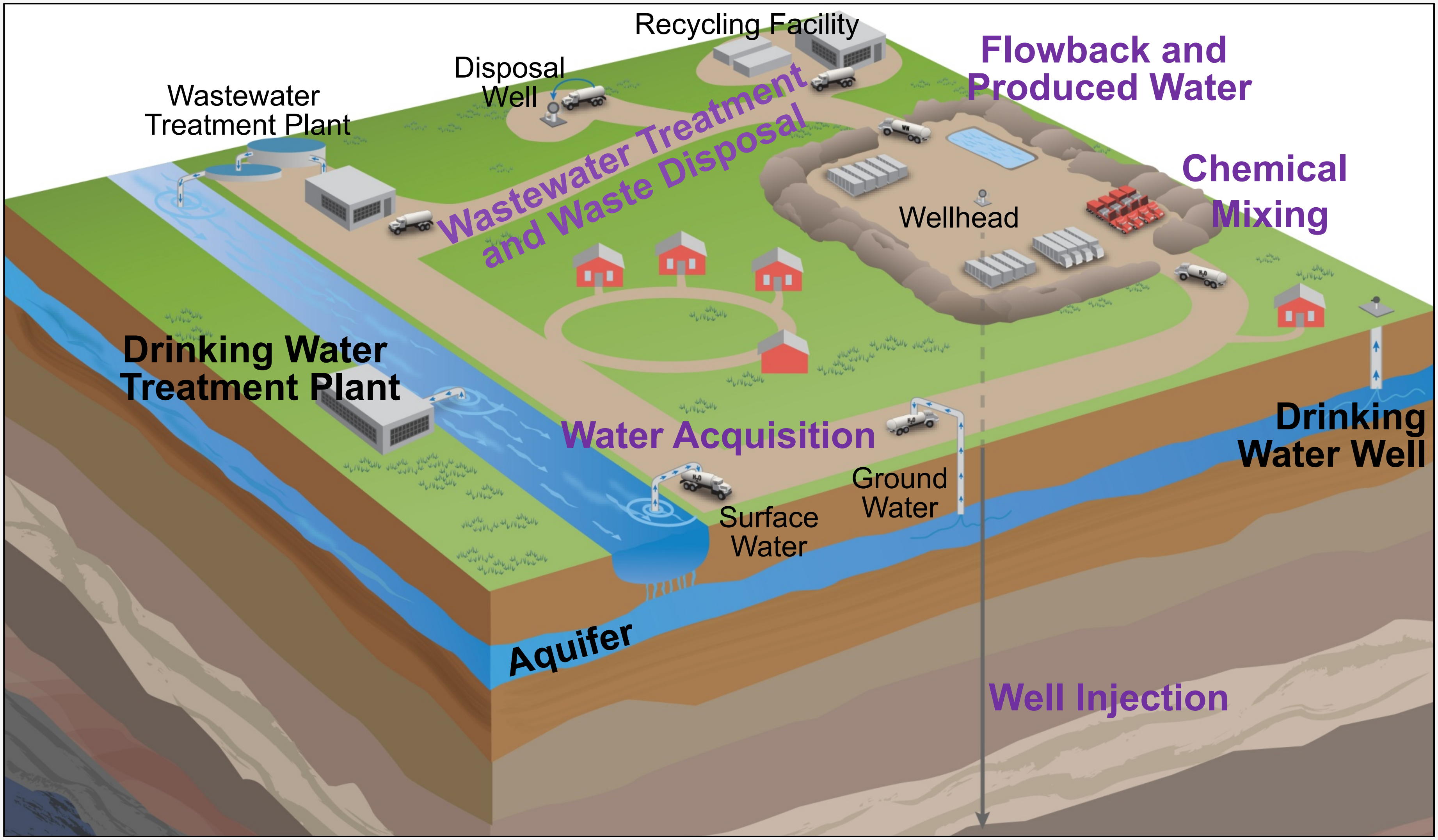
# Hydraulic Fracturing Water Cycle




## WATER CYCLE STAGES

Water Acquisition → Chemical Mixing → Well Injection → Flowback and Produced Water → Wastewater Treatment and Waste Disposal



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# Primary Research Questions

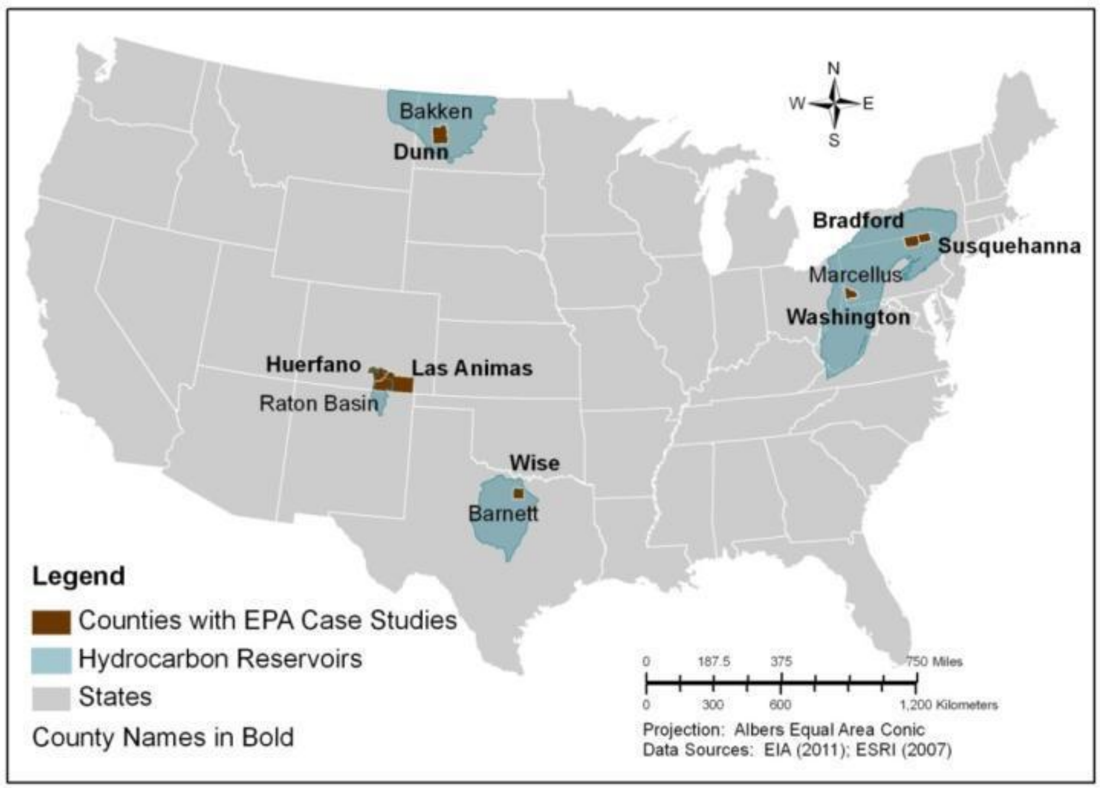
## What are the potential impacts on drinking water resources of:

| | |
|---|---|
| **Water Acquisition** | Large volume water withdrawals from ground and surface waters? |
| **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? |
| **Wastewater Treatment and Waste Disposal** | Inadequate treatment of hydraulic fracturing wastewaters? |

# Retrospective Case Studies

**Purpose:** To determine if drinking water contamination has occurred at the case study locations and, if so, identify possible sources of contamination

- Bradford County, PA
- Las Animas/Huerfano Counties, CO
- Dunn County, ND
- Washington County, PA
- Wise County, TX



# Las Animas/Huerfano Counties (Raton Basin), CO

## HF Target Formation

- Coal Bed Methane (Vermejo & Raton Formations)

## Drinking Water Resources

- Poison Canyon Formation and nearby underground sources of drinking water

## Research Focus

- Ground water and surface water

## Sampling events

- October 2011
- May 2012
- November 2012
- April/May 2013



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# Bradford County, PA

## HF Target Formation

- Marcellus Shale

## Drinking Water Resources

- Stratified drift & bedrock aquifers and surface water

## Research Focus

- Ground water and surface water studies
- Reports of methane in multiple drinking water wells

## Sampling events

- October/November 2011
- April/May 2012
- May 2013

# Washington County, PA

## HF Target Formation

- Marcellus Shale

## Drinking Water Resources

- Surficial & shallow confined aquifers and surface water

## Research Focus

- Reported changes in drinking water quality
- Reported methane in wells

## Sampling events

- July 2011
- March 2012
- May 2013

# Wise County, TX

## HF Target Formation

- Barnett Shale

## Drinking Water Resources

- Trinity aquifer and surface water

## Research Focus

- Drinking water wells

## Sampling events

- September 2011
- March 2012
- September 2012
- December 2012
- May 2013

# Dunn County (Killdeer), ND

## HF Target Formation

- Bakken Shale

## Drinking Water Resources

- Killdeer aquifer

## Research Focus

- Drinking water aquifer

## Sampling events

- July 2011
- October 2011
- October 2012

# Session 1: Retrospective Case Studies: Background Assessment and Characterization

**Participants considered two questions:**

1. What are the relative strengths of different approaches to assess background conditions?
2. What are practical approaches to overcoming the challenges in developing a representative background assessment and characterization for a case study?

# Session 1: Retrospective Case Studies: Background Assessment and Characterization

*Key Themes*

**Approaches for assessing and characterizing background conditions**

- Site-specific geochemistry and background data
- Conceptual site models
- Site characterization to identify appropriate tracers and indicators
- Quantitative “cut-points” rather than absolute values
- Short- and long-term monitoring plans with defined objectives, sampling frequency, and parameters

# Session 1: Retrospective Case Studies: Background Assessment and Characterization

*Key Themes*

## Issues regarding background data

- Anthropogenic vs. background contamination
- Importance of geochemistry
- Sample collection and analysis methods may be unknown-quality uncertain
- Regional scales may be useful for identifying trends
- Local scales may be useful for identifying impacts
- Aquifer-specific (depth-related) background and water quality trends

# Session 1: Retrospective Case Studies: Background Assessment and Characterization

*Key Themes*

## Statistical approaches

- Averaged and pooled data may dilute signal
- Historical data with "impacted" data may bias the signal
- Stiff and Piper diagrams for graphical presentation of data
- Aquifer-based analysis focused on individual cases

# Session 1: Retrospective Case Studies: Background Assessment and Characterization

*Key Themes*

**Ground water contamination occurrence and exposure**

- Indicators of water contamination
- Cumulative exposure and exposure to mixtures of multiple contaminants
- Clearly define "impact" and how it relates to risk
- Trace contamination to possible sources and provide context

# Session 1: Retrospective Case Studies: Background Assessment and Characterization

*Key Themes*

## Practical approaches for overcoming challenges

- Preliminary results from the U.S. DOE NETL studies with tracers
- Geochemical data analysis using appropriate techniques
- Industry and university data may be useful if available
- Collect distributed samples using approved methods
- Case control design

# Prospective Case Study Goals

- Understand how site-specific hydraulic fracturing practices prevent impacts to drinking water resources
- Evaluate any changes in water quality over time

# Study Approach

## Follows development of production well

Site Selection

↓

Baseline Monitoring

↓

Pad Installation / Well Drilling and Completion

↓

Hydraulic Fracturing and Flowback Management

↓

Oil and/or Gas Production

# Site Selection

Example **environmental management practices** conducted by well operator

- Consider nearby water resources, slope, etc.

## Research Approach

| EXAMPLE GOALS | EXAMPLE IMPLEMENTATION TASKS |
|---|---|
| • New development area<br>• Relatively shallow ground water of good quality<br>• Nearby surface water resources with access for monitoring<br>• Site topography provides good access for monitoring wells<br>• Cooperative landowners (access) | • Review historical oil and gas activities and distances<br>• Evaluate potential water quality impacts from local pre-existing land uses<br>• Determine distance and flow path to surface water resources<br>• Identify existing nearby ground water wells<br>• Gather pre-existing water quality information<br>• Site visit to confirm<br>• Sign access agreements |

# Baseline Monitoring

Example **environmental management practices** conducted by well operator

- Conduct water quality monitoring

## Research Approach

| EXAMPLE GOALS | EXAMPLE IMPLEMENTATION TASKS |
|---|---|
| • Install monitoring network<br>• Conduct baseline monitoring<br>• Document baseline water quality | • Determine depth, direction and rate of ground water flow<br>• Drill, log and install monitoring wells at multiple depths<br>• Establish surface water monitoring locations<br>• Conduct four quarterly water quality and flow monitoring events |

# Pad Installation / Well Drilling and Completion

Example **environmental management practices** conducted by well operator

- Install liners, construct berms
- Install casing and cement, conduct mechanical integrity tests
- Construct secondary containment for tanks/impoundments

## Research Approach

| EXAMPLE GOALS | EXAMPLE IMPLEMENTATION TASKS |
|---|---|
| • Document well construction details<br>• Document well integrity<br>• Assess any impacts to water quality | • Observe pad construction<br>• Observe drilling and completion of production well<br>• Monitor ground and surface water for any impacts<br>• Receive company-provided details on geology, casing materials and depths, cement details and evaluation tools, mechanical integrity test results, etc. |

# Hydraulic Fracturing and Flowback Management

Example **environmental management practices** conducted by well operator

- Choice of hydraulic fracturing fluid components
- Fracture propagation assessment / microseismic monitoring
- Pressure monitoring
- Post-fracture mechanical integrity testing

## Research Approach

| EXAMPLE GOALS | EXAMPLE IMPLEMENTATION TASKS |
| --- | --- |
| • Document hydraulic fracturing and flowback process<br>• Document fracture propagation<br>• Document pressure monitoring<br>• Document post-fracture mechanical integrity testing<br>• Assess any impacts to water quality | • Observe hydraulic fracturing operations<br>• Monitor ground and surface water for any impacts<br>• Sample flowback<br>• Receive company-provided microseismic data; hydraulic fracturing reports on fluid volumes, pressure curves and chemical additives; mechanical integrity test results; etc. |

# Oil and/or Gas Production

Example **environmental management practices** conducted by well operator

- Monitor oil, gas and water production

## Research Approach

| EXAMPLE GOALS | EXAMPLE IMPLEMENTATION TASKS |
|---|---|
| • Document water management practices<br>• Evaluate any changes to water quality<br>• Evaluate for any delayed impacts to ground or surface water | • Confirm with operator produced water management volumes and disposal methods<br>• Monitor produced water for four quarters<br>• Conduct four quarterly water quality and flow monitoring events |

# Collaboration is Key

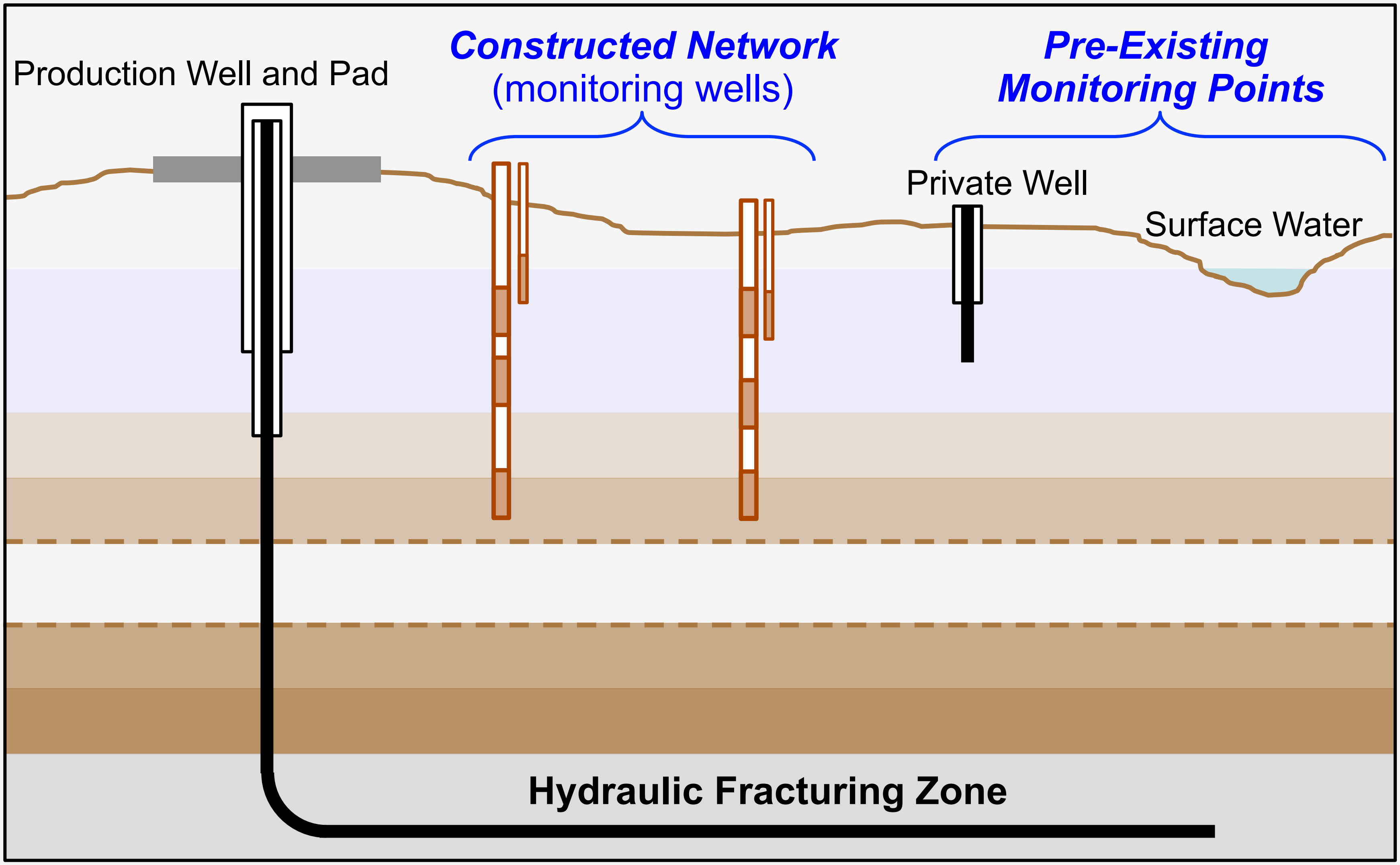
**Partners:**  US EPA,  US Department of Energy, US Geological Survey, host well owner/operator, state agencies, landowners and others

- Design
- Observation
- Interpretation

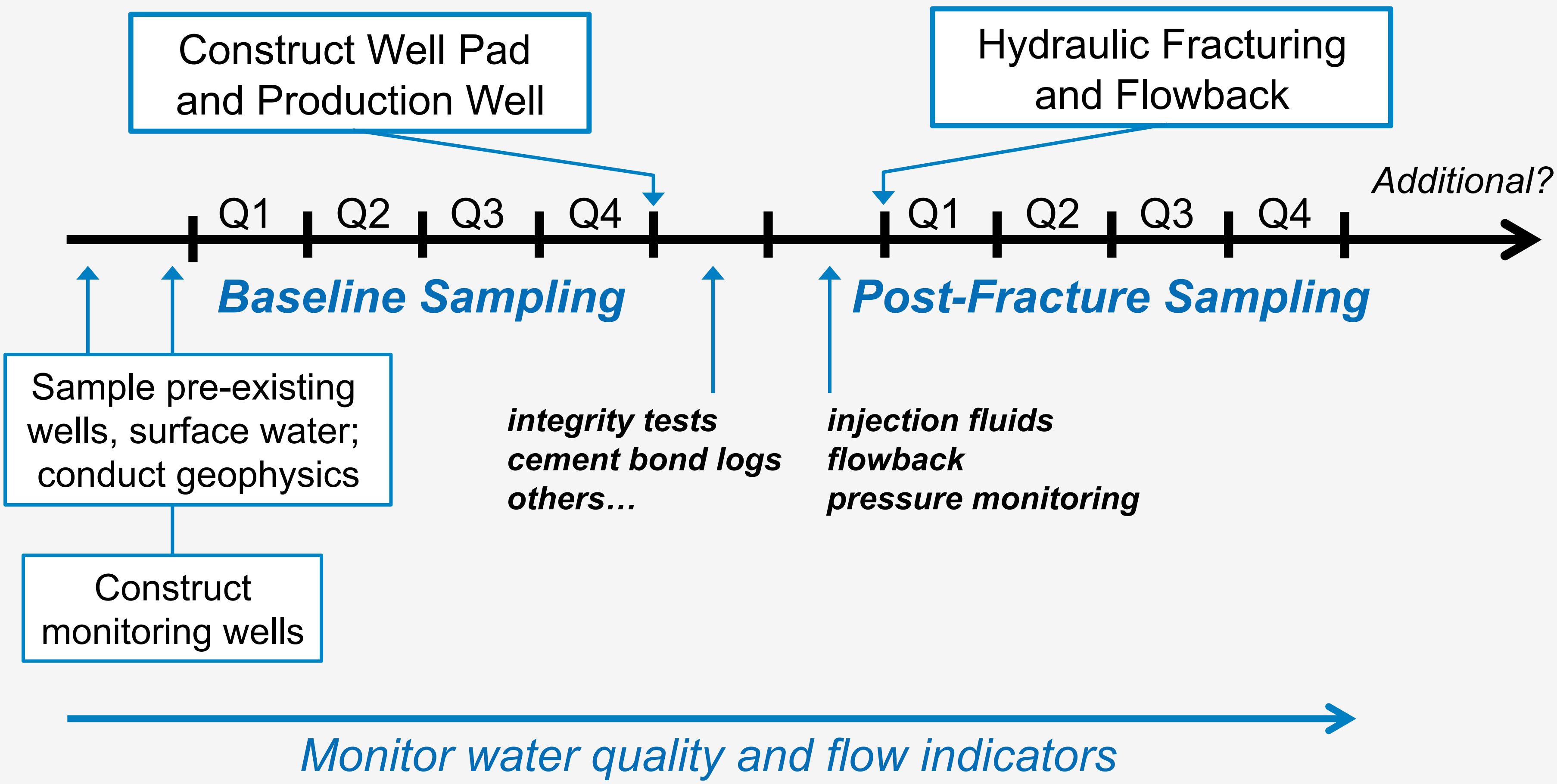
# Water Quality Monitoring

- **Use pre-existing monitoring points**
  - Private, public, industrial, agricultural wells
  - Springs and surface water bodies within local drainage system
- **Install additional targeted monitoring wells**
  - Location, depth and number depend on local ground water depth, flow rate and direction
  - Target anticipated flow paths within aquifers

# Conceptual Framework for Monitoring



# Anticipated Timeline



# Technical Challenges

- **Legacy or active fossil fuel extraction and other land use**
  - Existing historical/active fossil fuel extraction (oil, gas or coal), other commercial/private sources (USTs)
  - Prior industrial or commercial activity

*Affects analyte choice and interpretation*

- **Site-specific aquifer properties**
  - Direction of ground water flow within study area
  - Rate of ground water flow

*Affects monitoring well location and frequency/duration of sampling*

# Implementation Challenges

- **Access**
  - Involves well owner/operator and landowner
- **Timing**
  - Well development
  - Corridor planning and development

*Best approaches to align research and commercial timelines?*

# Session 2: Prospective Case Studies

**Participants considered two questions:**

1. What types of conditions, tests, monitoring, sampling, and analysis are needed to assess impacts from hydraulic fracturing processes on drinking water resources in a prospective case study, and why?
2. What approaches can be used in situations where historic and/or ongoing industrial practices (e.g., mining, oil, gas, agriculture, etc.) may confound assessment of impacts of hydraulic fracturing processes on drinking water resources?

# Session 2: Prospective Case Studies
## *Discussion*

- Select sites where geology is well characterized (e.g., Marcellus)
- Longer-term studies may add value (if stray gas causes immediate impacts)
- Study effects on production string cement
- Consider regional variation (e.g., produced water management)
- Obtain hydrogeological data
- Consider use of horizontal wells for monitoring shallow ground water under production well pad
- Sample for microbial indicators
- Build conceptual models using lessons learned from retrospective case studies
- ISCMEM's work to advance environmental modeling

# Next Steps

- Reconvene Technical Roundtable on October 23, 2013
- Information on technical workshop series:
  http://www.epa.gov/hfstudy/techwork13.html

# New Ways to stay connected!

- www.cluin.org
- Follow CLU-IN on Facebook, LinkedIn, or Twitter

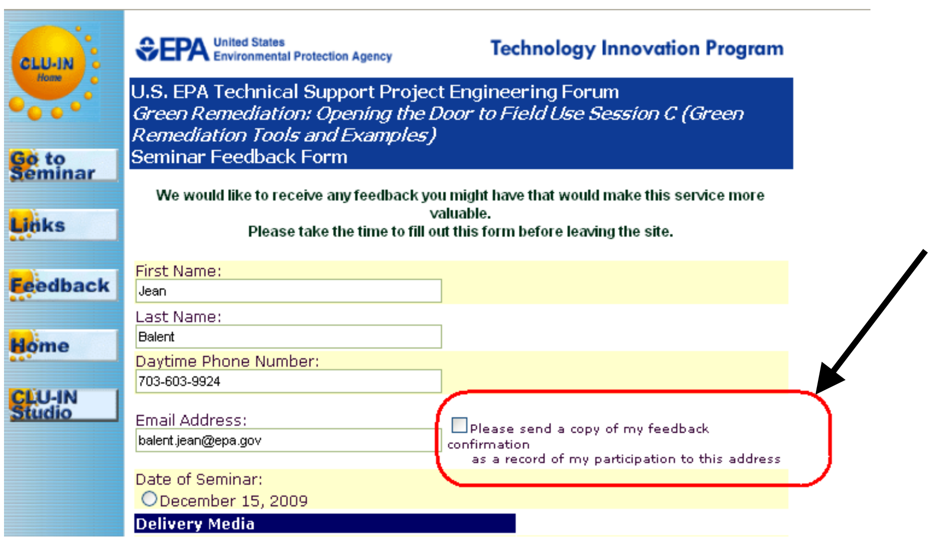
https://www.facebook.com/EPACleanUpTech

https://twitter.com/#!/EPACleanUpTech

http://www.linkedin.com/groups/Clean-Up-Information-Network-CLUIN-4405740

# Resources & Feedback

- To view a complete list of resources for this seminar, please visit the **Additional Resources**
- Please complete the **Feedback Form** to help ensure events like this are offered in the future




Need confirmation of your participation today?

Fill out the feedback form and check box for confirmation email.