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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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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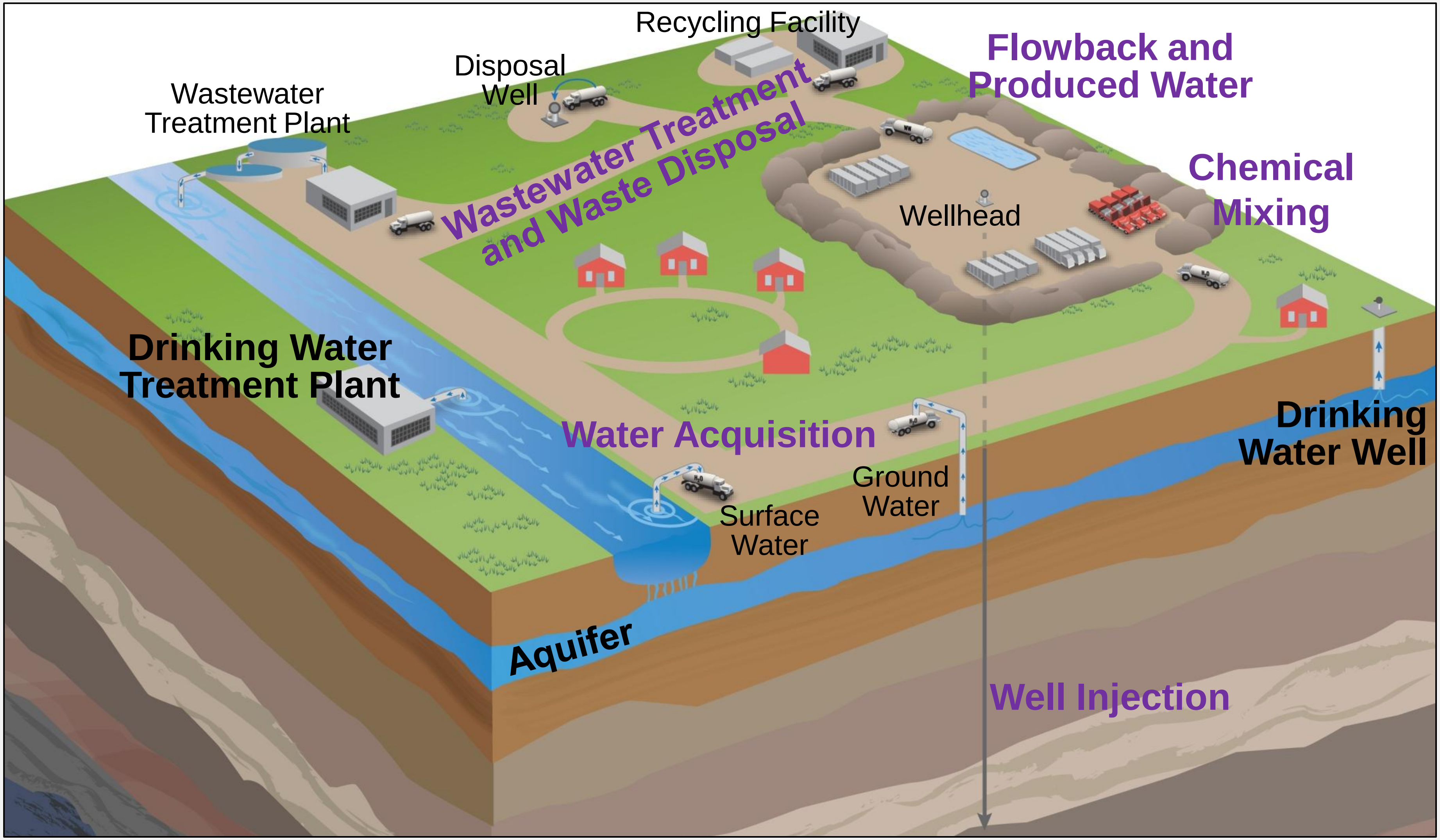
United States Environmental Protection Agency

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?

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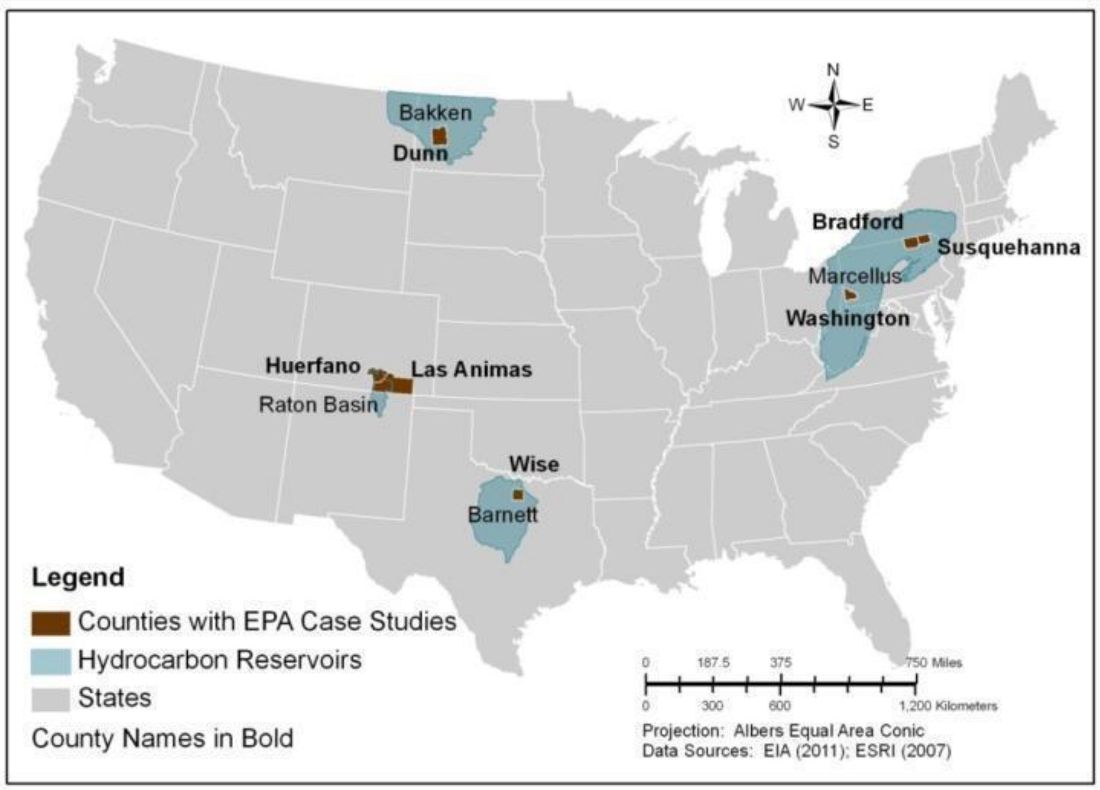
Retrospective Case Studies

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



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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

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

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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

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Baseline Monitoring

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Pad Installation / Well Drilling and Completion

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Hydraulic Fracturing and Flowback Management

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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 • Relatively shallow ground water of good quality • Nearby surface water resources with access for monitoring • Site topography provides good access for monitoring wells • Cooperative landowners (access)	• Review historical oil and gas activities and distances • Evaluate potential water quality impacts from local pre-existing land uses • Determine distance and flow path to surface water resources • Identify existing nearby ground water wells • Gather pre-existing water quality information • Site visit to confirm • 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 • Conduct baseline monitoring • Document baseline water quality	• Determine depth, direction and rate of ground water flow • Drill, log and install monitoring wells at multiple depths • Establish surface water monitoring locations • 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 • Document well integrity • Assess any impacts to water quality	• Observe pad construction • Observe drilling and completion of production well • Monitor ground and surface water for any impacts • 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 • Document fracture propagation • Document pressure monitoring • Document post-fracture mechanical integrity testing • Assess any impacts to water quality	• Observe hydraulic fracturing operations • Monitor ground and surface water for any impacts • Sample flowback • 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 • Evaluate any changes to water quality • Evaluate for any delayed impacts to ground or surface water	• Confirm with operator produced water management volumes and disposal methods • Monitor produced water for four quarters • Conduct four quarterly water quality and flow monitoring events

Collaboration is Key

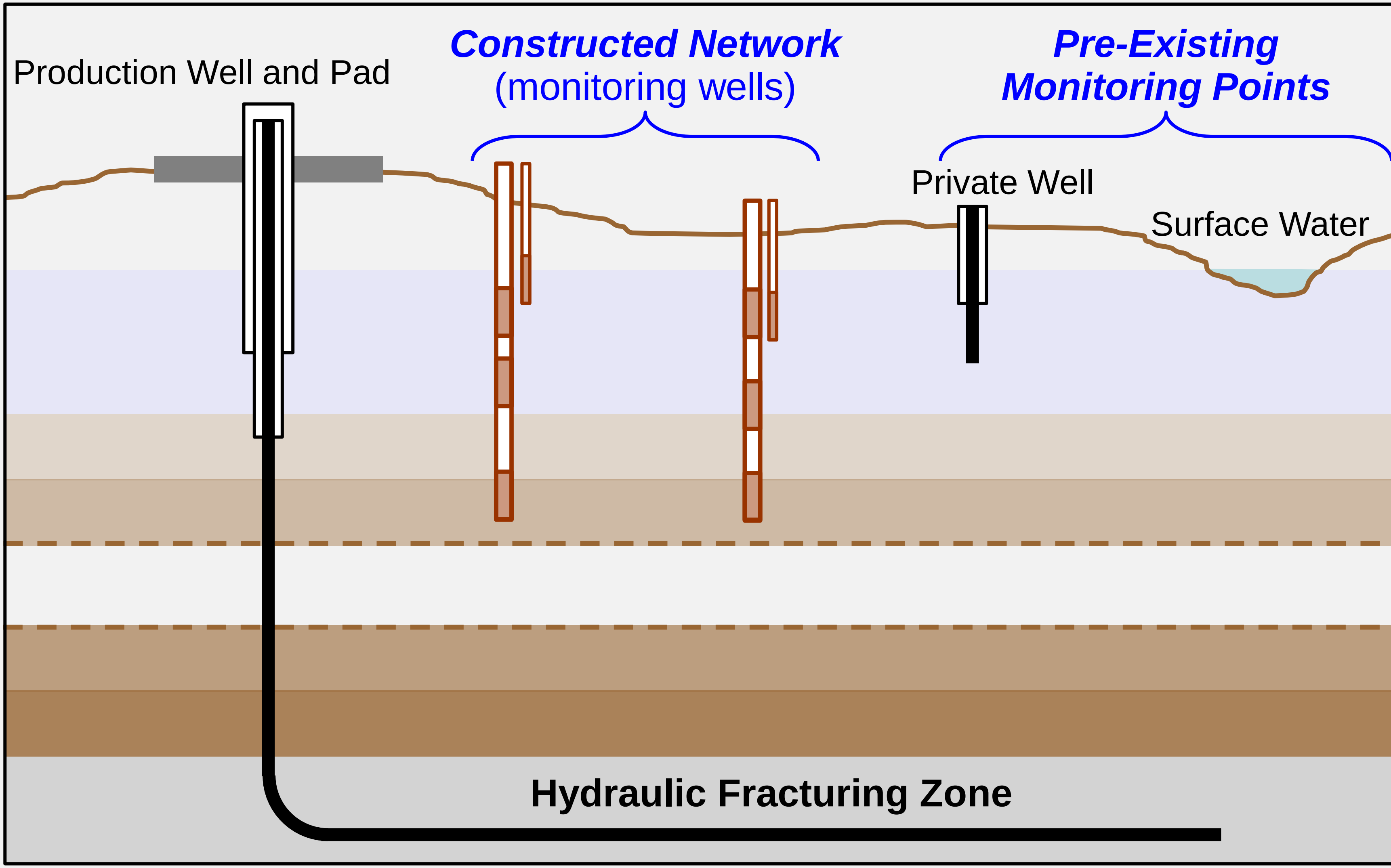
Partners: US EPA, US Department of Energy, US Geological Survey, host well owner/operator, state agencies, landowners and others

- Design
- Observation
- Interpretation

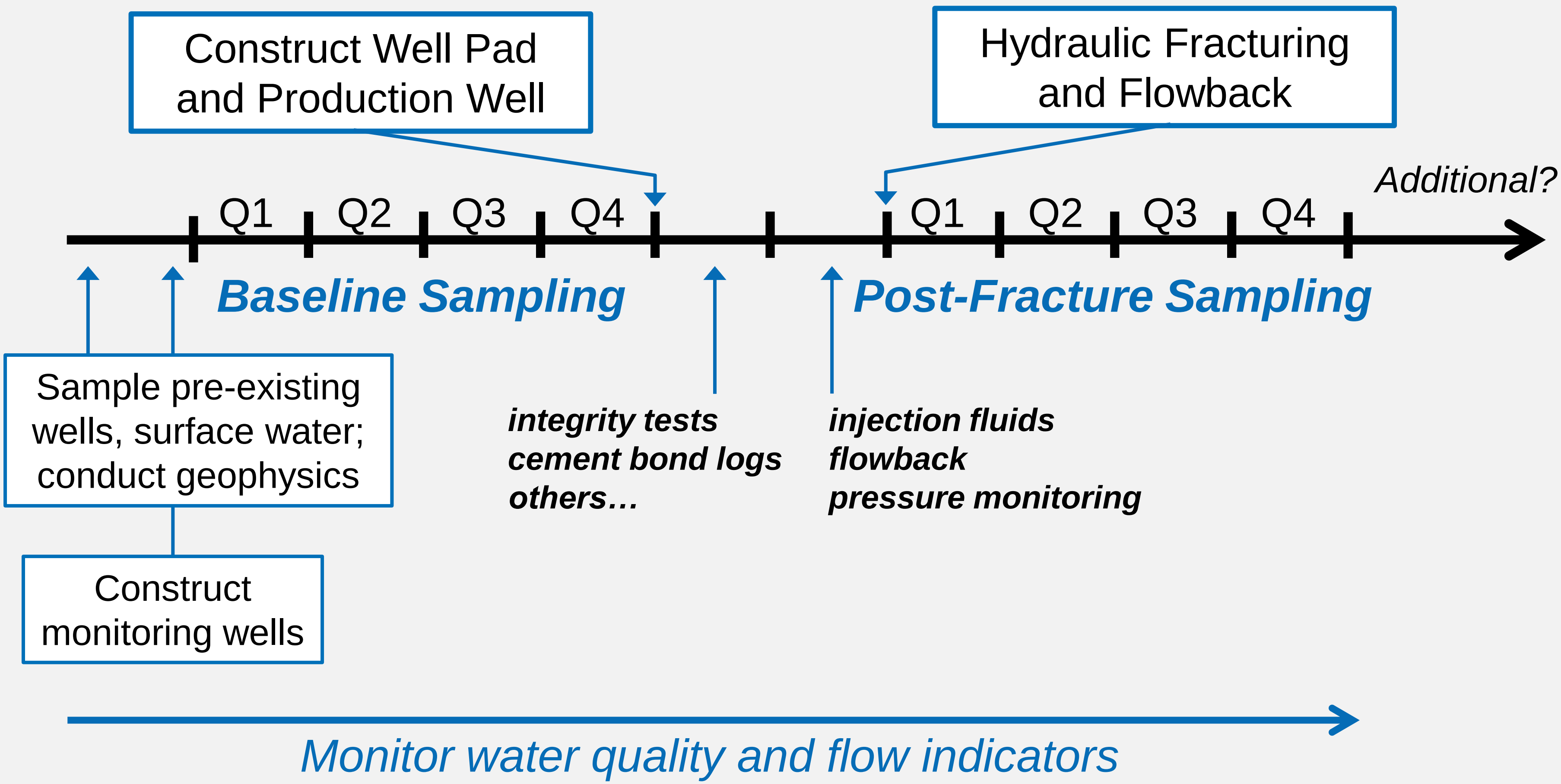
Water Quality Monitoring

- **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