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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?

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BACKGROUND

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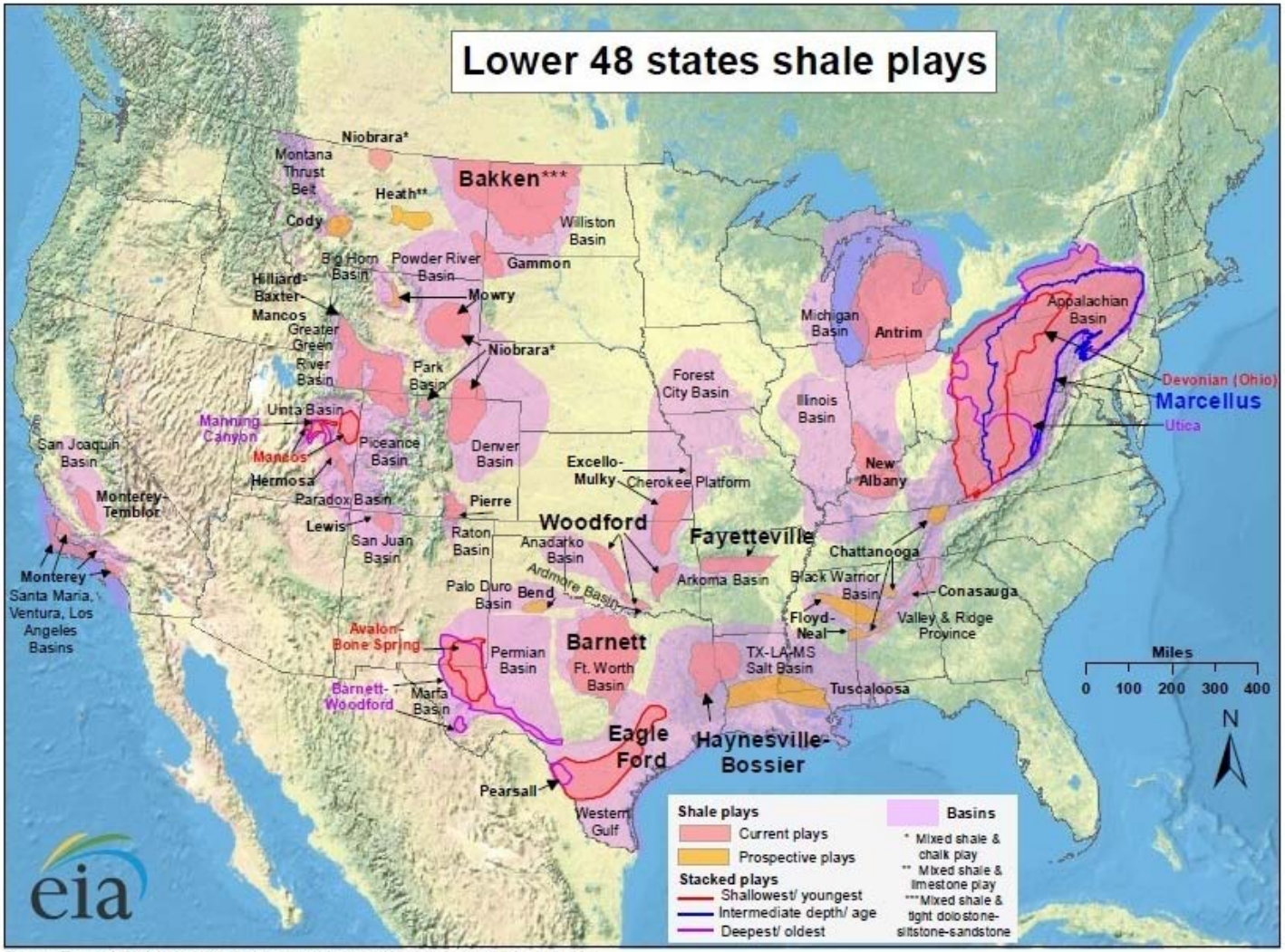
Oil & Gas Development

The combination of hydraulic fracturing and horizontal drilling has opened new areas for oil and gas development.



Source: Energy Information Administration based on data from various published studies.
Updated: May 9, 2011

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*

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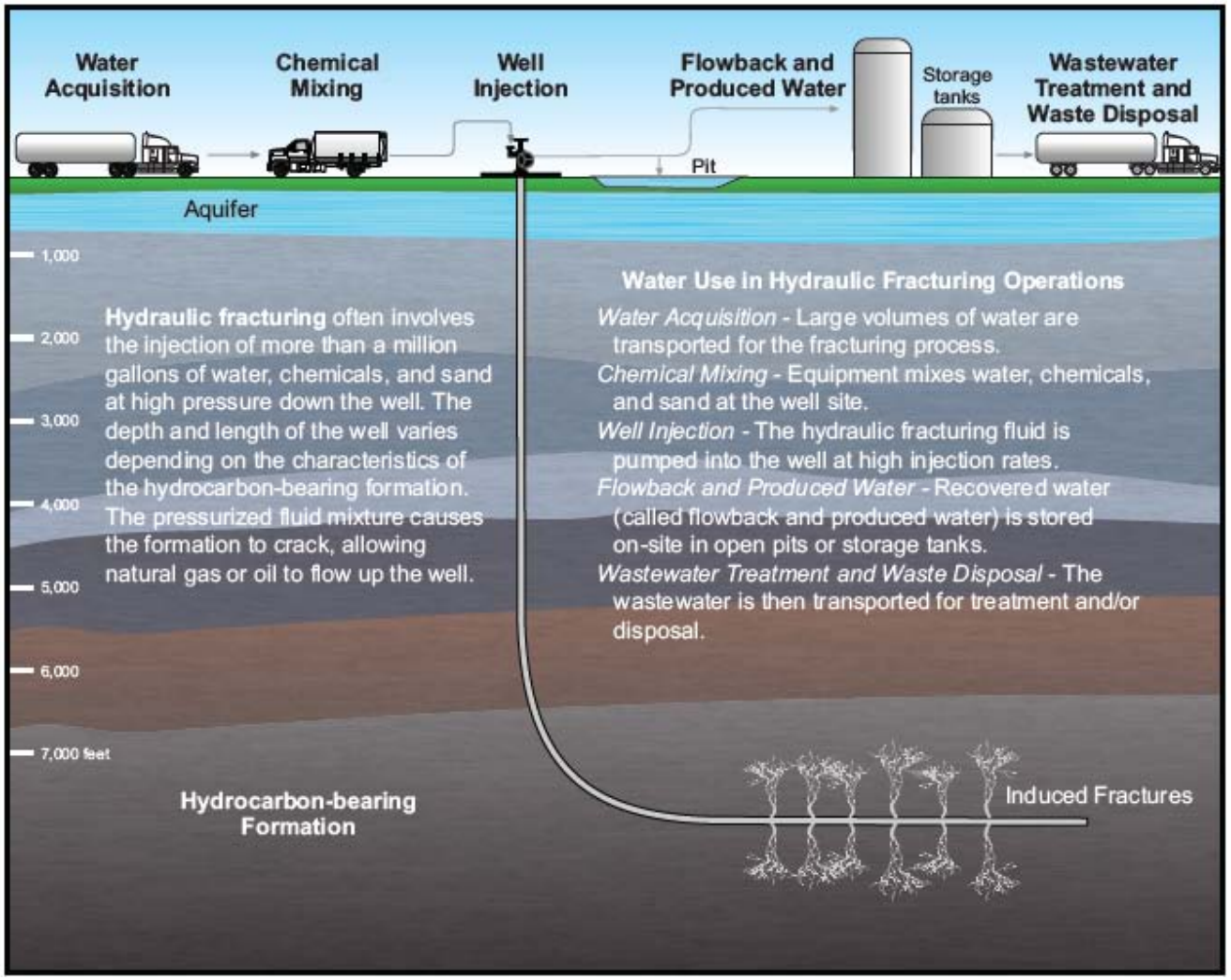
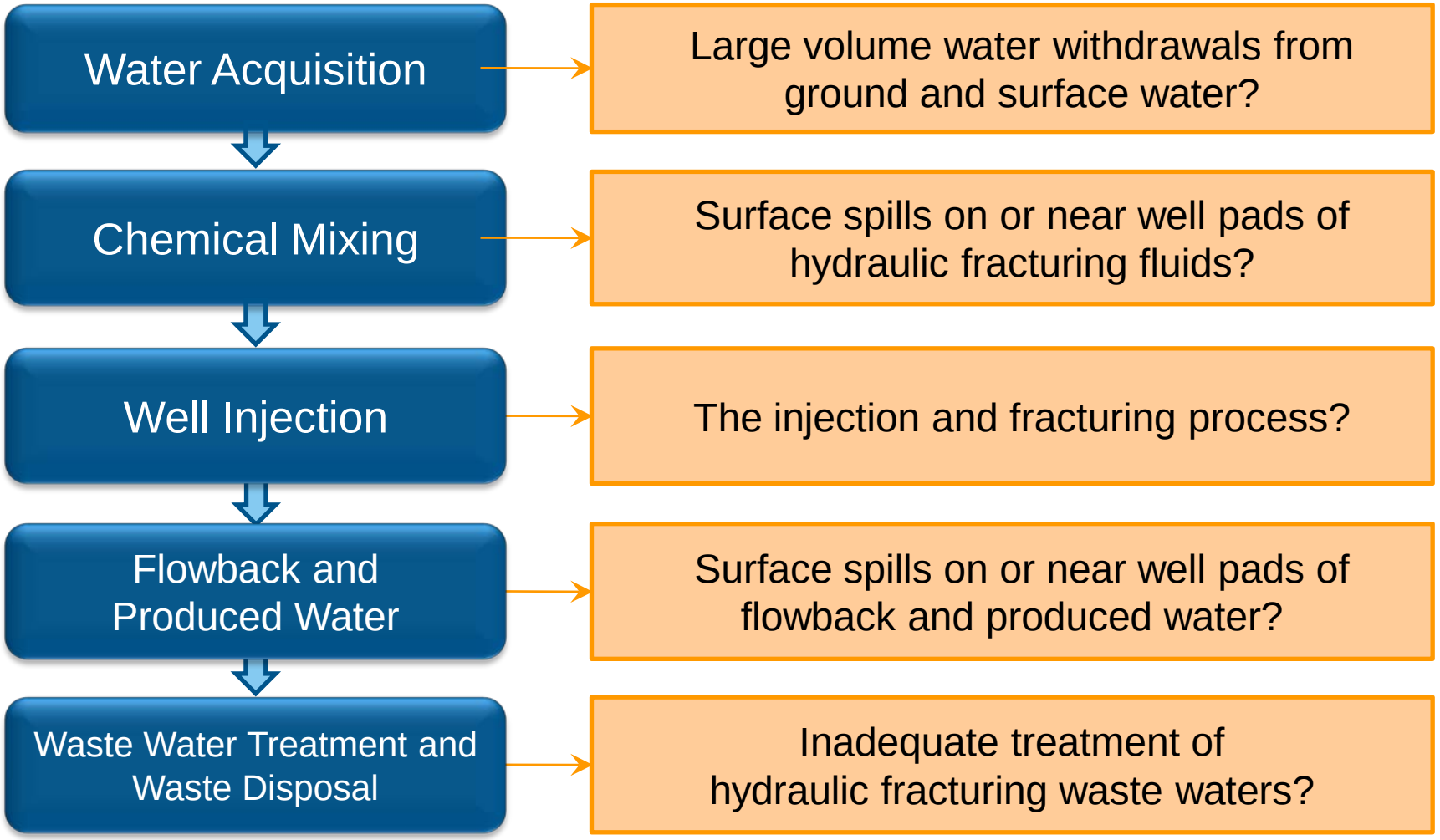
Water Cycle in Hydraulic Fracturing



Research Questions

What are the potential impacts on drinking water resources of:



Research Approach

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

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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

QA Documents

- EPA Requirements for Quality Management Plans:
  - http://www.epa.gov/quality/qs-docs/r2-final.pdf
- Quality Management Plan for this study:
  - http://www.epa.gov/hfstudy/HF-QMP-1-19-2012.pdf
- EPA Requirements for QA Project Plans:
  - http://www.epa.gov/quality/qs-docs/r5-final.pdf
- QAPPs for this study:
  - http://www.epa.gov/hfstudy/qapps.html

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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

Retrospective Case Studies

Location
Bakken Shale (oil) *Killdeer, Dunn Co., ND*
Barnett Shale (gas) *Wise Co., TX*
Marcellus Shale (gas) *Bradford and Susquehanna Cos., PA*
Marcellus Shale (gas) *Washington Co., PA*
Raton Basin (coalbed methane) *Las Animas and Huerfano Cos., CO*

Status of Retrospective Case Studies

Using a tiered study approach:

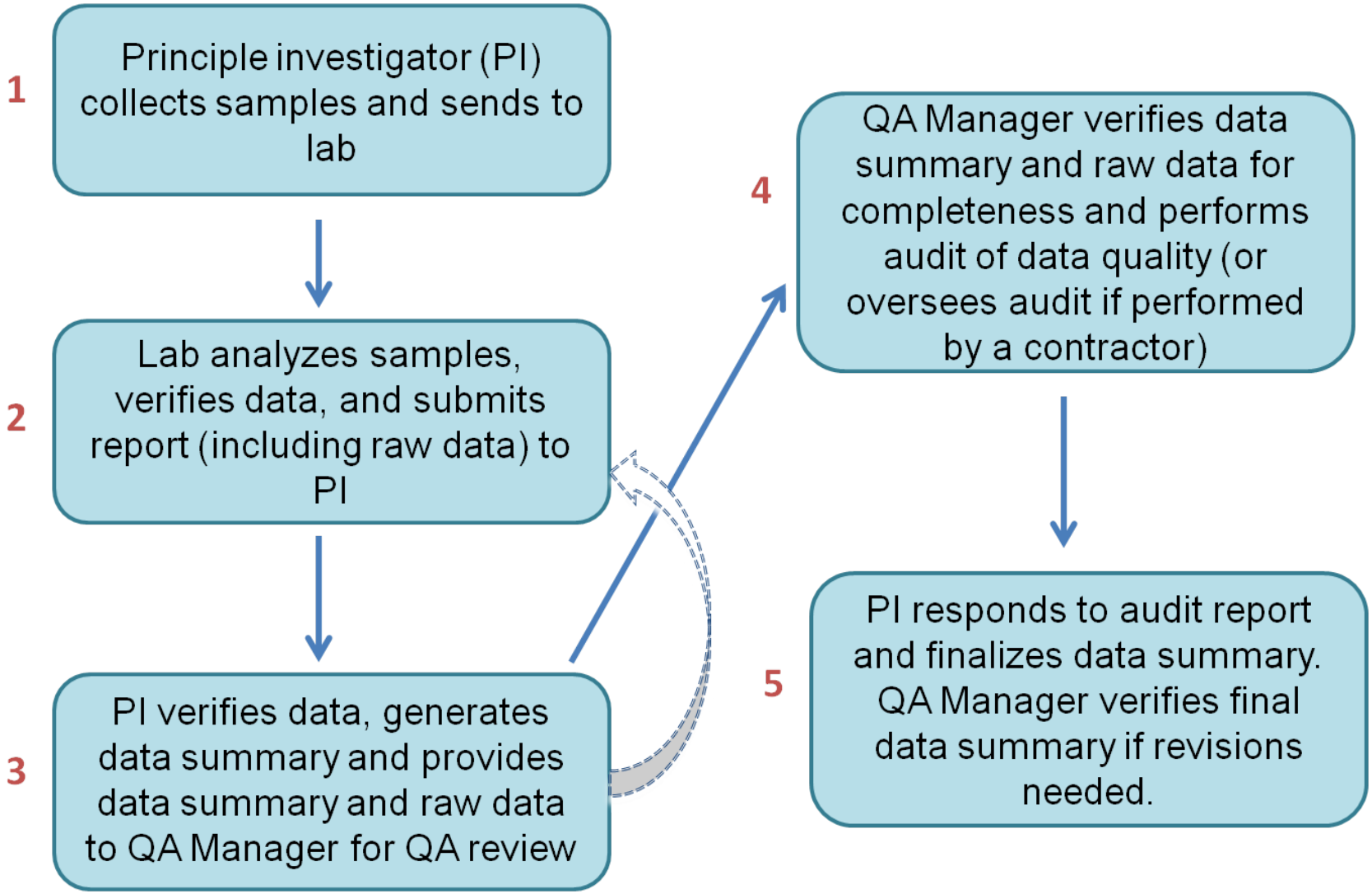
Tier	Research Approach
Tier 1	Verify potential issue
Tier 2	Determine approach for detailed investigation
Tier 3	Conduct detailed investigation
Tier 4	Determine source(s) of any impacts

Status of Retrospective Case Studies

Case Studies	Tier 1	Tier 2	
• **Bakken Shale – Killdeer, Dunn Co., ND** • **Barnett Shale – Wise Co., TX** • **Marcellus Shale – Bradford & Susquehanna Cos., PA** • **Marcellus Shale – Washington Co., PA** • **Raton Basin – Las Animas & Huerfano Cos., CO**	Completed	**What's been sampled?**	Domestic, Industrial, Production, Monitoring, and Municipal Wells; Surface Water
		When were samples taken?	July-November 2011
		Data Quality Audits:	Underway
		Next Steps:	Final QA/QC
		Next Sample Collection:	March-July 2012*

* Future dates are estimates.

Case Study Data Generation and Review Timeline



Wastewater Treatment and Waste Disposal

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.