



Final Plan to Study the Potential Impacts of Hydraulic Fracturing on Drinking Water Resources

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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.

EPA is committed to using:

- ✓ *Best available science*
- ✓ *Transparent, peer-reviewed process*
- ✓ *Quality assurance principles*
- ✓ *Independent sources of information*
- ✓ *Consultation with others*



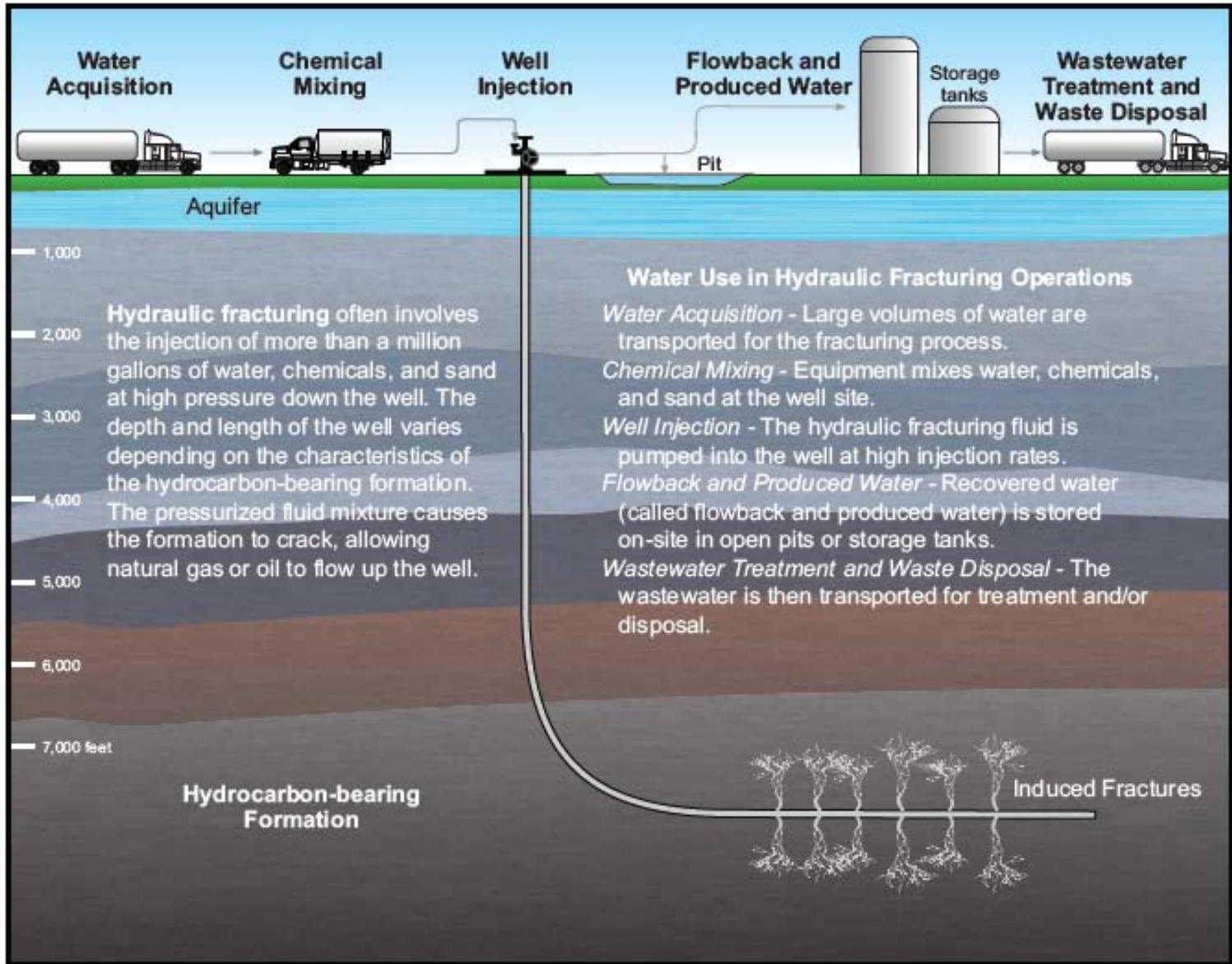
Study Plan Development

- Extensive stakeholder input
- Federal agency review
- Science Advisory Board review
- Final study plan released November 3, 2011

Science Advisory Board Peer Review

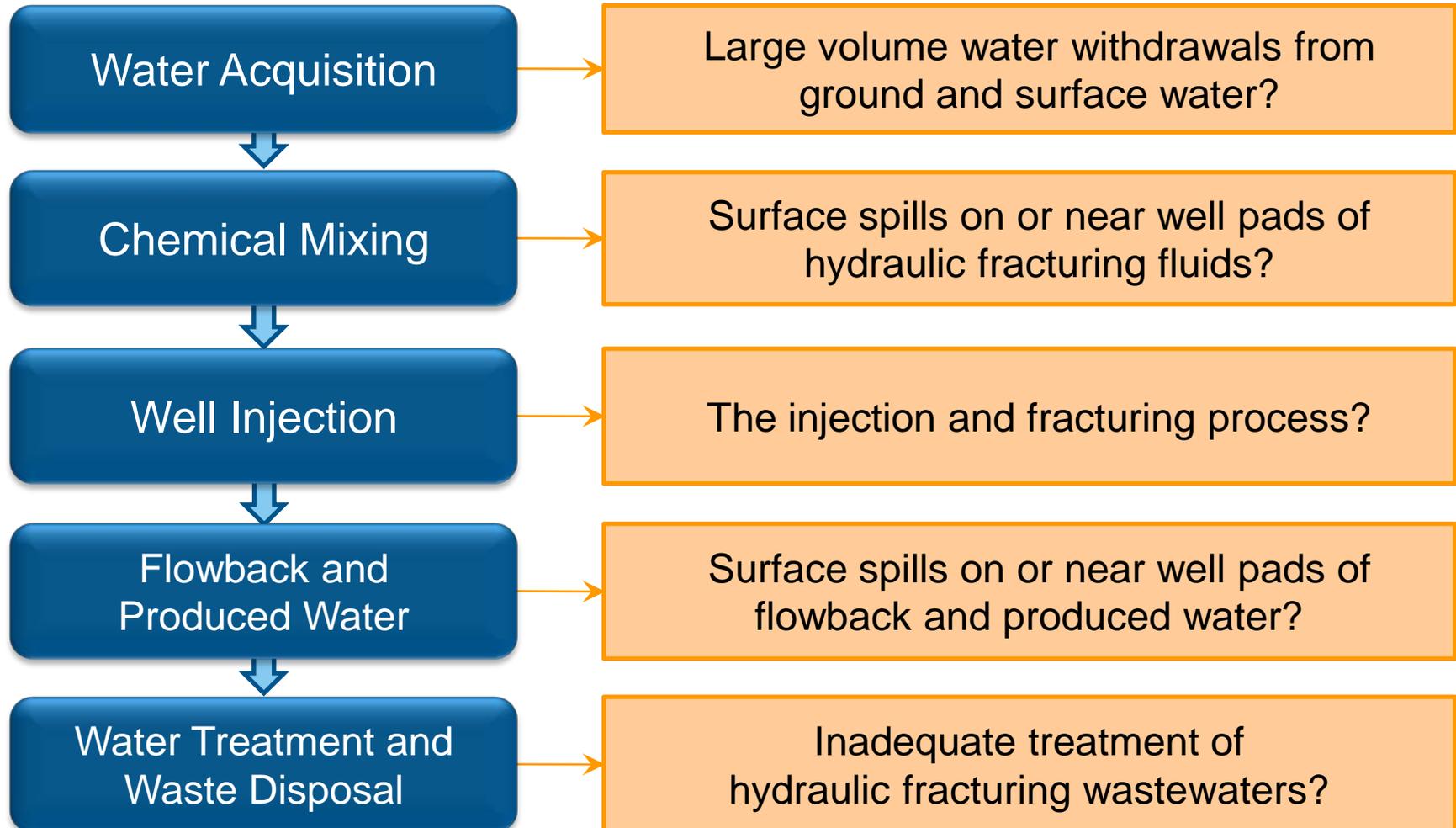
- SAB found study plan to be “appropriate and comprehensive”
- Response to SAB recommendations:
 - Core research questions and general approach are unchanged
 - More focused research questions
 - More detail about how questions will be addressed

Water Cycle



Research Questions

What are the potential impacts on drinking water resources of:





Research Approaches

- Gather and analyze existing data
- Case studies
- Scenario evaluations
- Laboratory studies
- Toxicity assessments

Analysis of Existing Data

Data sources include:

- Peer-reviewed literature
- State and federal agencies
- Information requests from industry

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

Selecting Case Study Locations

- Site nomination through stakeholder outreach
- Site selection criteria included:
 - Applicability to and coverage of core research questions
 - Geologic, geographic, and hydrologic diversity
 - Potential human exposure
 - Ability to develop partnerships with stakeholders (prospective studies)

Case Study Locations

Prospective Case Studies

Haynesville Shale – DeSoto Parish, LA

Marcellus Shale – Washington County, PA

Retrospective Case Studies

Bakken Shale – Killdeer, Dunn County, ND

Barnett Shale – Denton County, TX

Marcellus Shale – Bradford and Susquehanna Counties, PA

Marcellus Shale – Washington County, PA

Raton Basin – CO

Retrospective Approach

Study of locations where hydraulic fracturing has already occurred

- Determine whether drinking water resource is impacted
- If so, determine what factors may have contributed to the impacts
- Use a tiered study 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

Prospective Approach

Collection of data prior to, during, and after hydraulic fracturing activities at new sites

- Characterize pre- and post-fracturing conditions
- Improve understanding of potential impacts of hydraulic fracturing
- Use a tiered study approach
 - Tier 1: Collect existing data
 - Tier 2: Construct conceptual site model
 - Tier 3: Conduct field sampling
 - Tier 4: Determine impact(s), if any

Evaluate Potential Scenarios for Water Impacts

- Explore potential cumulative impacts from **water withdrawals**
- Model various failure scenarios to determine conditions under which **subsurface contaminant migration** may occur
- Explore potential cumulative impacts from **surface water disposal** of treated HF wastewater

Types of Laboratory Work

- Explore reactions between hydraulic fracturing fluids and shale
- Determine the effectiveness of HF wastewater treatment using conventional wastewater treatment technologies
- Assess potential for treated wastewater to impact drinking water resources
- Modify analytical methods, as necessary

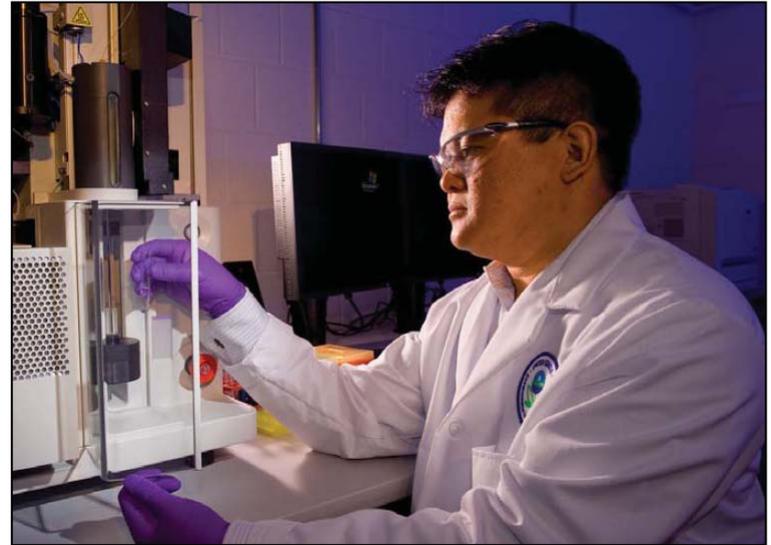
Toxicity Assessments

Focused on: Hydraulic fracturing fluids, wastewater, and naturally occurring substances in the subsurface

- Summarize known chemical, physical, and toxicological properties
- Estimate chemical, physical, and toxicological properties using structure-activity relationships
- Screen chemicals for priority attention

Reporting Results

- 2012
 - Analysis of existing data
 - Retrospective case studies
 - Scenario evaluations
 - Laboratory studies
- 2014
 - Analysis of existing data
 - Retrospective and prospective case studies
 - Scenario evaluations
 - Laboratory studies
 - Toxicity assessments



***See Figures 10 & 11 and Appendix A
of study plan for details***

Stakeholder Engagement

- EPA plans to provide quarterly updates on progress of research
- Additional suggestions?

EPA's Plan to Study the Potential Impacts of Hydraulic Fracturing on Drinking Water Resources
<http://www.epa.gov/hydraulicfracturing>