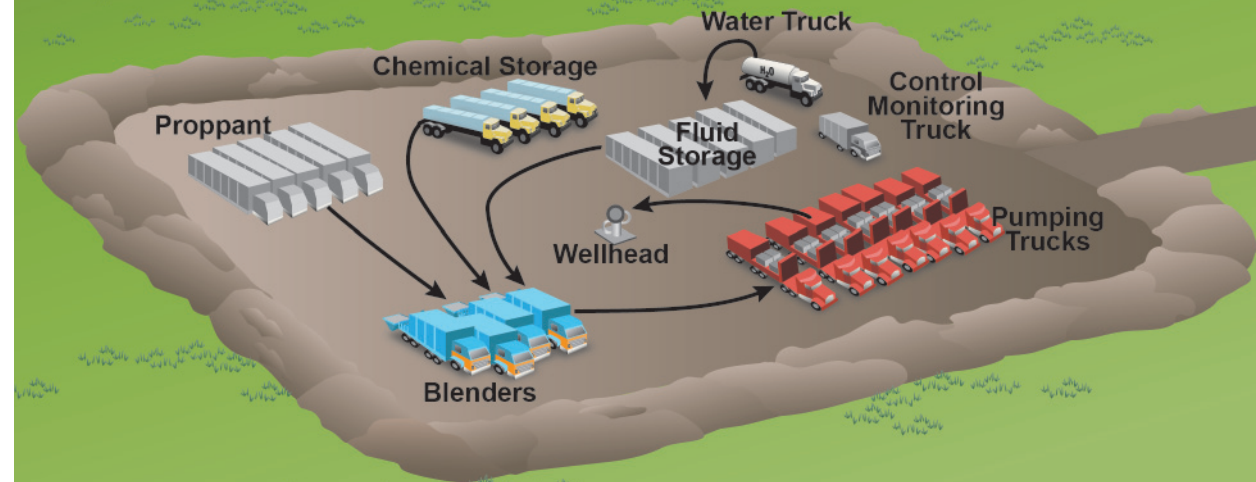


Hydraulic Fracturing Water Cycle

The EPA's study includes research on hydraulic fracturing of shale formations to extract natural gas and oil. The scope of the research is defined by the hydraulic fracturing water cycle—five areas where the process has the potential to impact drinking water resources. It begins with water acquisition and ends with treatment and/or disposal of wastewater.

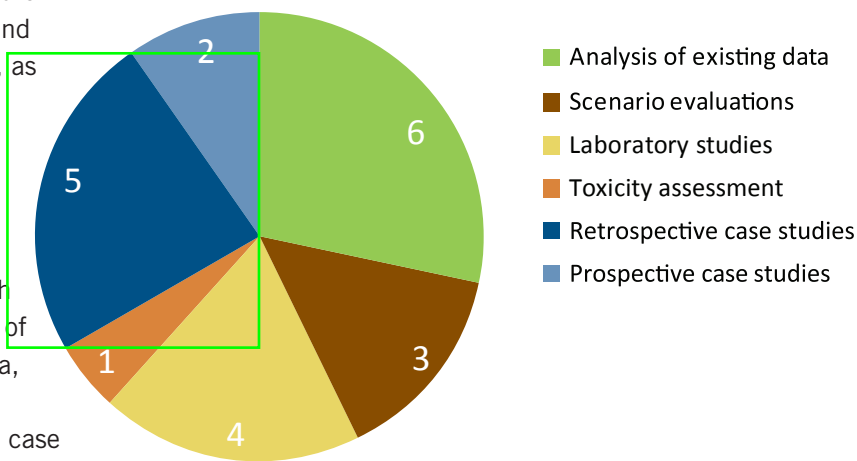
Study of the Potential Impacts of Hydraulic Fracturing on Drinking Water Resources 2012 Progress Report

Chemical Mixing



Number of Projects by Research Activity

The EPA is using a variety of research activities to answer five primary and 16 secondary research questions, as outlined in the Agency's *Plan to Study the Potential Impacts of Hydraulic Fracturing on Drinking Water Resources*, www.epa.gov/hfstudy. EPA researchers are conducting 21 individual research projects that fall under five types of activities: analysis of existing data, scenario evaluations, laboratory studies, toxicity assessments and case studies. Research progress for each type of research activity is summarized in the 2012 Progress Report.



Chemical Mixing

What is chemical mixing?

- Water and chemicals are mixed onsite to produce fracturing fluid
- The fracturing fluid is used to create pressure to fracture rock formations and carry proppant—sand or ceramic beads—that holds the fractures open and allows oil and gas flow

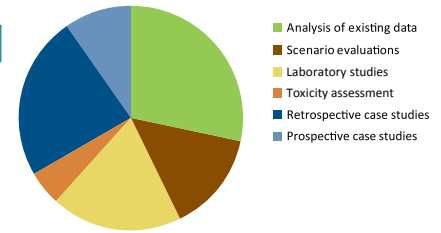
Why is the EPA looking at chemical mixing as part of this study?

- Onsite storage, mixing and pumping may result in accidental releases
- Released fluids may flow into nearby surface water or ground water, potentially reaching drinking water resources
- Need better understanding of fluid composition

What are the possible impacts of surface spills on or near well pads of hydraulic fracturing fluids on drinking water resources?

Secondary Research Questions	Research Projects
What is currently known about the frequency, severity, and causes of spills of hydraulic fracturing fluids and additives?	<ul style="list-style-type: none"> • Literature Review • Spills Database Analysis • Service Company Analysis • Well File Review
What are the identities and volumes of chemicals used in hydraulic fracturing fluids, and how might this composition vary at a given site and across the country?	<ul style="list-style-type: none"> • Literature Review • Service Company Analysis • FracFocus Analysis • Analytical Method Development
What are the chemical, physical and toxicological properties of hydraulic fracturing chemical additives?	<ul style="list-style-type: none"> • Toxicity Assessment
If spills occur, how might hydraulic fracturing chemical additives contaminate drinking water resources?	<ul style="list-style-type: none"> • Literature Review • Retrospective Case Studies

Research Projects



Literature Review

Review and summarize literature on:

- Spills of hydraulic fracturing fluids or chemical additives
- Chemicals used in hydraulic fracturing fluids
- Environmental fate and transport of selected chemicals in hydraulic fracturing fluids

Spills Database Analysis

Compile and evaluate spill information from three state databases (Colorado, New Mexico and Pennsylvania) and one national database (National Response Center)

Service Company Analysis

Evaluate information provided by nine hydraulic fracturing operators on:

- Spills of hydraulic fracturing fluids or chemical additives
- Chemicals used in hydraulic fracturing fluids from 2005-2010

Well File Review

Well files are a record of activities that occurred at production wells that have been provided by the nine hydraulic fracturing operators. This effort will summarize spill data from 333 randomly selected well files

FracFocus Database Analysis

Compile a list of chemicals reported at FracFocus.org—a voluntary industry database—and summarize chemical usage by frequency and geographic location

Analytical Method Development

Develop analytical methods for the detection of selected chemicals reported to be in hydraulic fracturing fluids

Toxicity Assessment

Compile or estimate the chemical, physical and toxicological properties for chemicals with known chemical structures that are reported to be in hydraulic fracturing fluids

Retrospective Case Studies

Consider whether spills of hydraulic fracturing fluid may be a possible source of reported changes in water quality of local drinking water wells