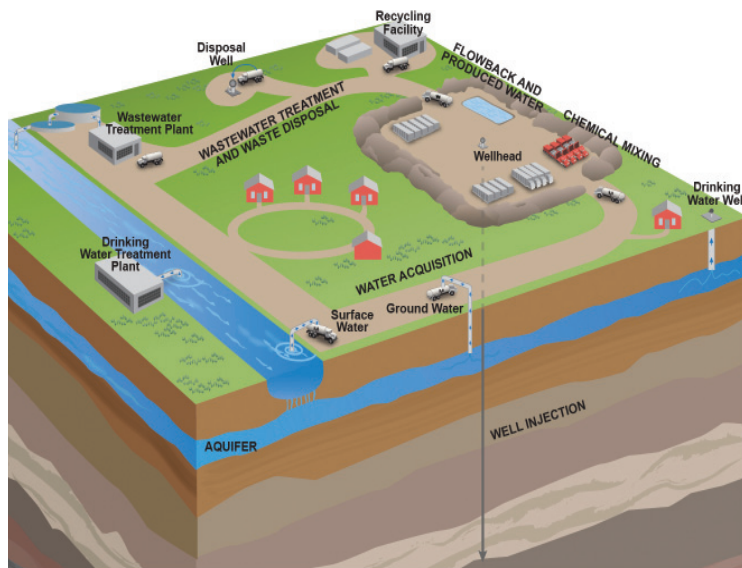


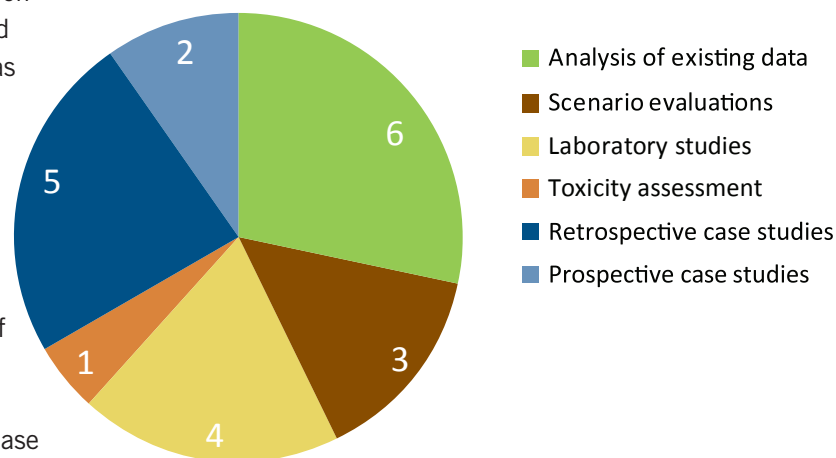


Hydraulic Fracturing Water Cycle

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.

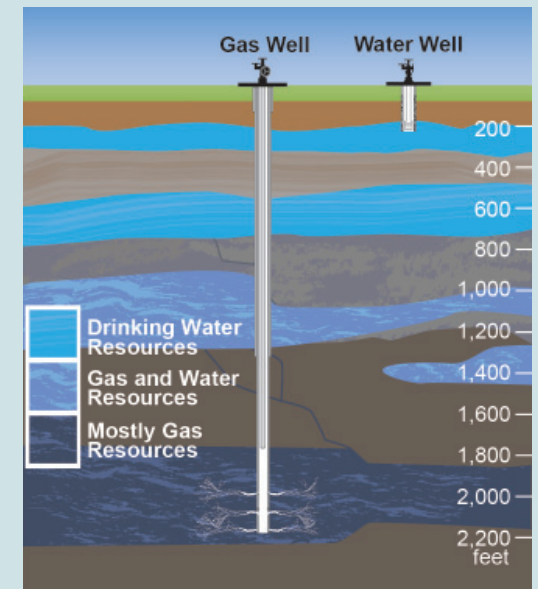
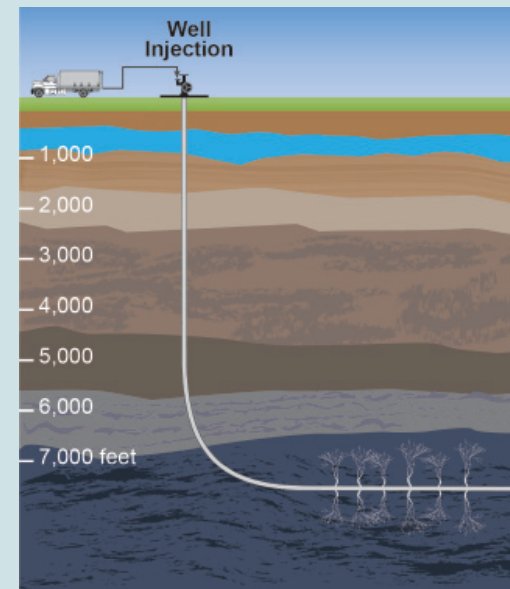
Number of Projects by Research Activity

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.



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

Well Injection



Well Injection

What is well injection?

- Process of pumping hydraulic fracturing fluid down the well at high pressures to create cracks in rock formations that allow oil or gas to flow from small pores to the production well

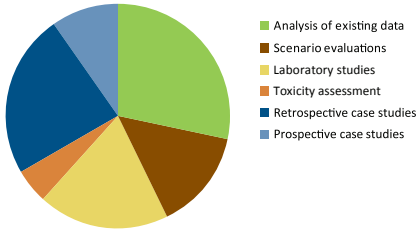
Why is the EPA looking at well injection as part of this study?

- Hydraulic fracturing fluids or naturally occurring substances may travel from fractures to drinking water resources
- Possible pathways may include faulty well construction, intersection of induced fractures with natural fractures or man-made structures (e.g., abandoned wells, shallow operations and fluid releases)

What are the possible impacts of the injection and fracturing process on drinking water resources?

Study Questions	Research Projects
How effective are current well construction practices at containing gases and fluids before, during and after hydraulic fracturing?	• Literature Review • Service Company Analysis • Well File Review • Subsurface Migration Modeling • Retrospective Case Studies
Can subsurface migration of fluids or gases to drinking water resources occur, and what local geologic or man-made features might allow this?	• Literature Review • Service Company Analysis • Well File Review • Subsurface Migration Modeling • Retrospective Case Studies

Research Projects



Literature Review

Review and summarize literature on possible subsurface migration due to:

- Faulty well construction
- Nearby natural or man-made conduits

Service Company Analysis

Review and summarize standard operating procedures provided by nine hydraulic fracturing service companies—owners and operators of production wells—for information on:

- Practices related to establishing the mechanical integrity of wells being hydraulically fractured
- Procedures used during injection of the fracturing fluid

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 review well construction data found in 333 randomly selected well files to assess the effectiveness of current well construction practices at isolating the wellbore from surrounding ground water

Subsurface Migration Modeling

Numerical modeling of five subsurface fluid migration scenarios that explore the potential for gases and fluids to move from the fractured zone to drinking water aquifers

Retrospective Case Studies

Consider potential impacts from shallow operations, fluid releases and poor well construction