



Assessment of the Potential Impacts of Hydraulic Fracturing for Oil and Gas on Drinking Water Resources

**Presentation by the
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Office of Research and Development**

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HF Study Background



- In FY2010, Congress urged EPA to study the relationship between hydraulic fracturing and drinking water
- EPA launched this study with the purpose to:
 - Assess whether hydraulic fracturing can impact drinking water resources (water quality and quantity)
 - Identify driving factors that affect the severity and frequency of any impacts

HF Study Progress



- EPA's HF study has produced multiple products:
 - 2011 Study Plan; 2012 Progress Report
 - 12 EPA technical reports
 - 4 journal publications from EPA scientists
 - 9 journal publications from colleagues at Lawrence Berkeley National Laboratory
 - **Draft Hydraulic Fracturing Drinking Water Assessment report**
- Completed products available online:
 - www.epa.gov/hfstudy

Draft HF Assessment Report



What it is:

- A state-of-the-science integration and synthesis of information concerning impacts on drinking water resources
- Based upon EPA research results, a robust literature review, and other information, including input from stakeholders
- Identifies potential mechanisms and addresses questions identified in the *Study Plan* and *Progress Report*

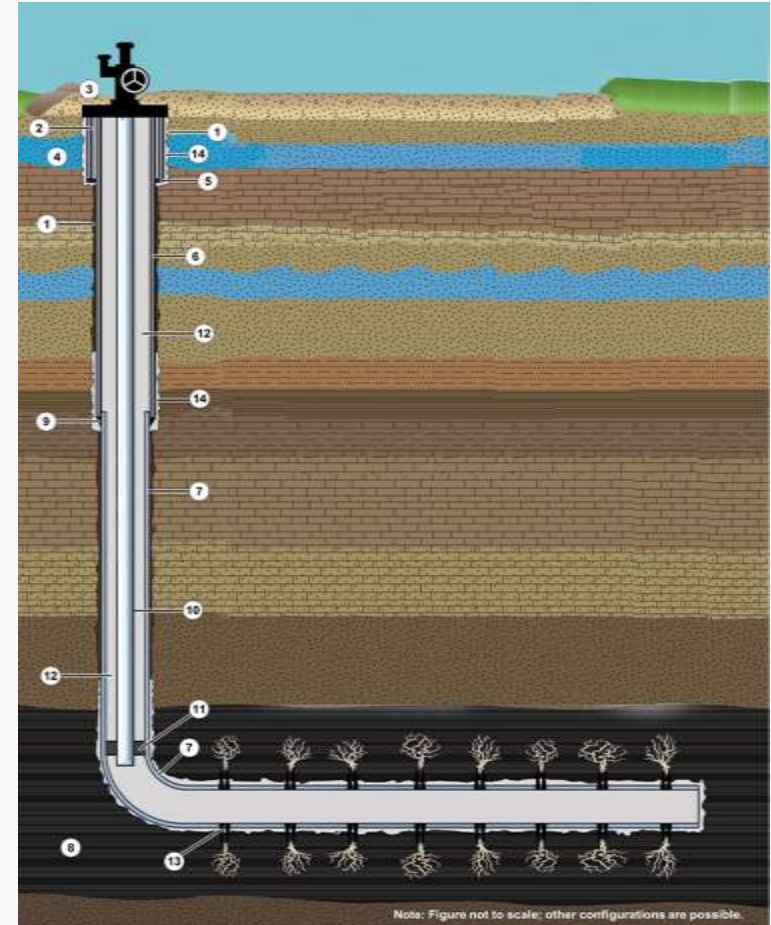
What it is not:

- Not a human health, exposure, or risk assessment
- Not site specific
- Does not identify or evaluate best management practices
- Not designed to inform specific policy decisions
- Does not identify or evaluate policy options

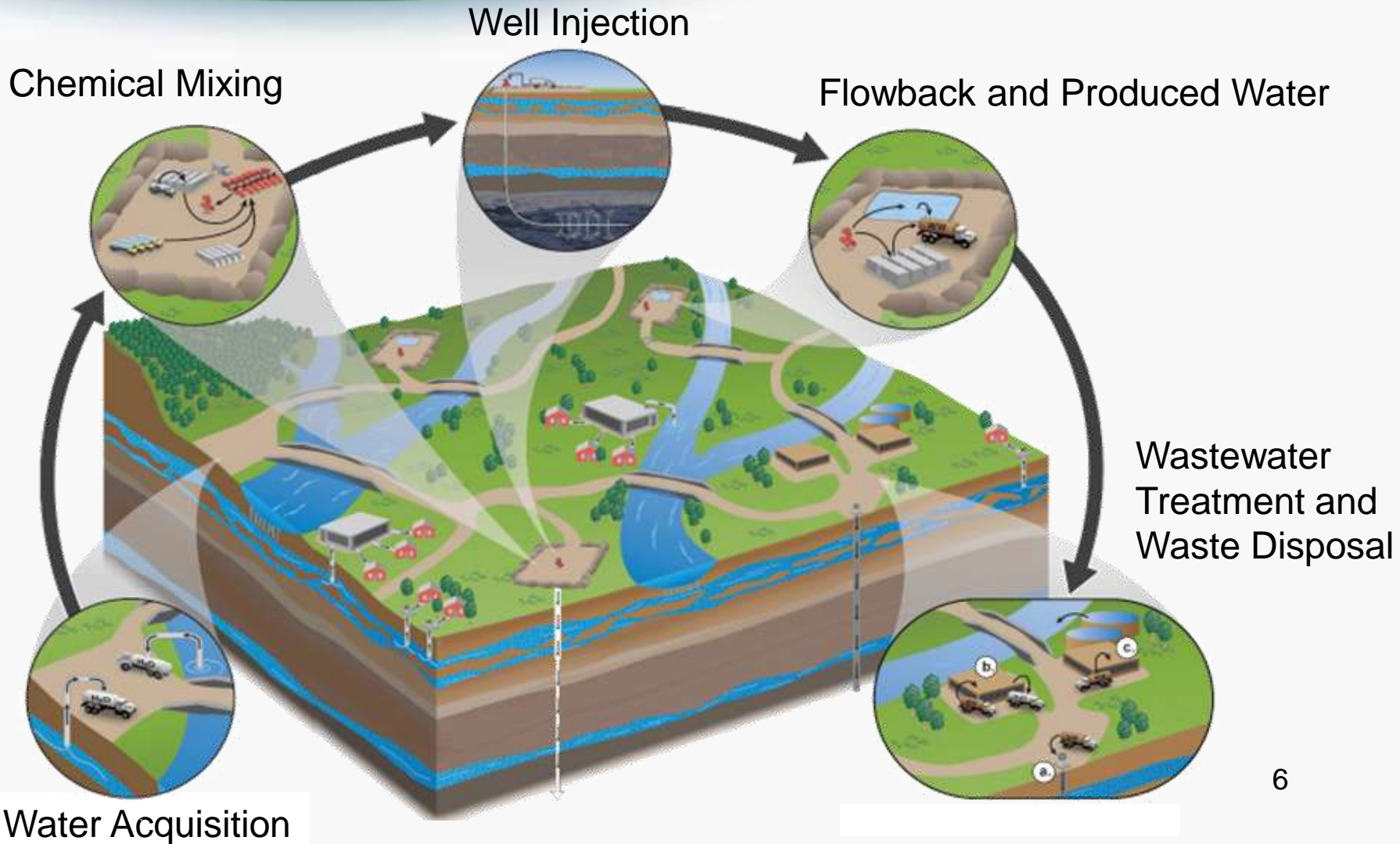
What is Hydraulic Fracturing?



- Hydraulic fracturing is a technique to increase oil and gas production from rock formations.
- Fluids are injected under pressures great enough to fracture the formations
- The fluid generally consists of water, chemicals, and proppant (commonly sand)
- Oil and gas flow through the fractures and up the production well to the surface



Hydraulic Fracturing Water Cycle: Follow the water



Water Acquisition: Sources and volume



- Sources of water used for HF include surface water, ground water, and reused wastewaters
- Cumulative water use nationally is at least 44 BG/year; Median water use for a well is approximately 1.5 MG
- HF water use is small (usually $< 1\%$) compared with total water use and consumption at the national, state, and most county spatial scales.
- Potential for impacts on drinking water resources is greatest in areas with high hydraulic fracturing water use, low water availability, and frequent drought.

Chemical Mixing: HF Chemical Additives

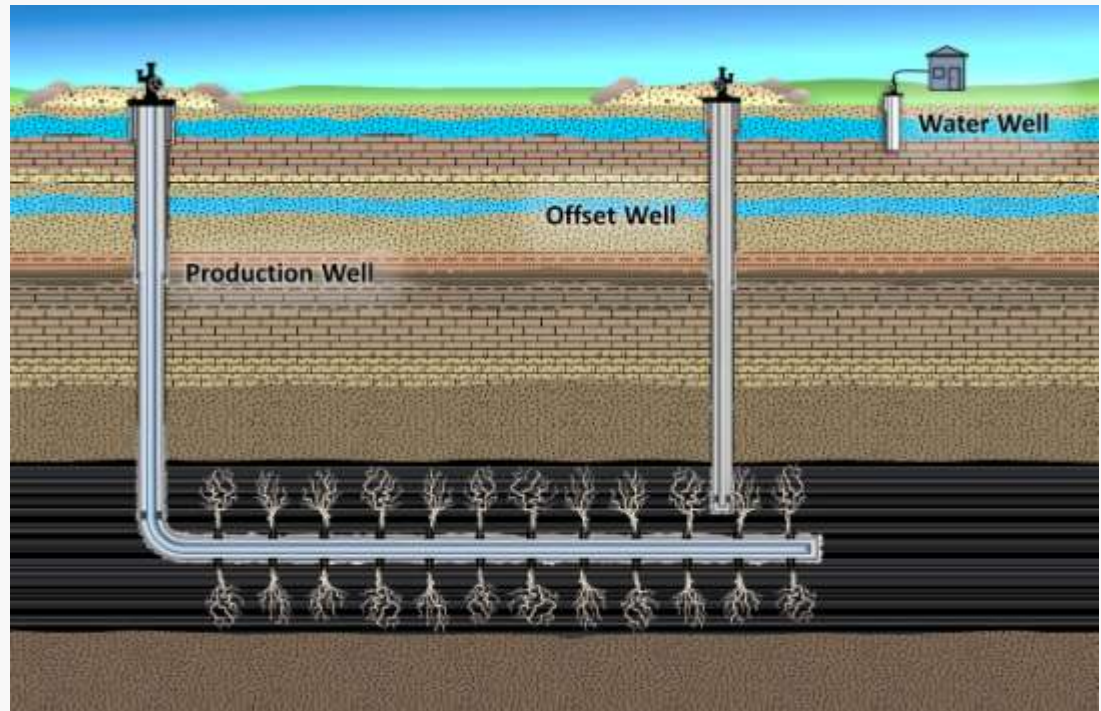


- Chemical additives:
 - Perform multiple functions
 - Generally comprise <2% of injected fluid volumes
 - Thousands of gallons are potentially stored on-site and used in the HF process
- We identified more than 1000 chemicals used as components of HF fluids:
 - Median of 14 unique chemicals used per well
 - No single chemical used at all well sites across country
 - Chemicals used at >65% of well sites include: methanol, hydrotreated light petroleum distillates, hydrochloric acid

Well Injection: Potential subsurface pathways



- Movement of gas or liquids from the wellbore into a drinking water resource
- Movement of gas or liquids from production zone through subsurface rock formations into a drinking water resource



Well Construction and Integrity



- Multiple barriers act together to prevent migration of gases and liquids
- Inadequate construction, defects and degradation of casings or cement, or absence of redundancies can create pathways leading to contamination of drinking water resources
- EPA's Well File Review Report:
 - Estimated 66% of wells had one or more uncemented intervals
 - Estimated 3% of wells did not have cement across a portion of the operator defined drinking water zone
- Specific rate of well failures unknown but generally increases over time

Sub-Surface Movement



- Physical separation between the production zone and drinking water resources can minimize impacts
- Deep HF operations are unlikely to create direct flow paths from fracture production zones to shallow drinking water resources
- In some cases, the production zone is co-located with drinking water resources:
 - Estimated 0.4% of wells fractured in 2009 and 2010 showed evidence of fracturing directly within a drinking water resource
 - Use of the drinking water resource not well characterized
- Well-to-well communications are also pathways for fluid movement into drinking water resources

Flowback and Produced Water



- Flowback and produced water come out of the well when pressure is released
- Amount of fracturing fluid returned to surface is generally 10% to 25% of injected fluid and varies widely
- Data on produced water composition limited:
 - 134 chemical detected specifically in FB/PW
 - High total dissolved solids
 - Metals, organics
 - Naturally occurring radionuclides
- High TDS present analytical challenges for characterizing chemical composition

Spills of HF Fluids and Produced Waters



- Spills of HF fluids and produced waters have occurred; when spills occur, they can and have reached drinking water resources through multiple pathways
- Total number and frequency of spills due to HF activities unknown at the national level
- Based upon spill data reviewed:
 - Hundreds of spills of hydraulic fracturing fluids and produced waters have occurred
 - Spill volumes varied greatly: 2 gallons to 1.3 Million gallons
 - Most common causes of spills were equipment failure and human error
 - Of those spills reviewed, 8% of documented spills reached a surface or ground water resource; 64% reached soils

Hydraulic Fracturing Wastewater



- HF produces large volumes of wastewater
- Most HF wastewater is disposed of using underground injection control (UIC) wells
- UIC disposal varies geographically:
- Wastewater reuse varies geographically
- Other disposal options for HF wastewater:
 - Centralized wastewater treatment facilities (CWT)
 - Evaporation pits, land irrigation and road spreading
- Inadequately treated wastewater increases constituent concentrations in receiving waters

HF Chemical Characterization



- 1,173 chemicals reportedly used in HF fluids or detected in FB/PW
- 147 have human oral toxicity reference values.
- Absence of toxicity reference values limits ability to conduct future site specific exposure/risk assessments
- CBI limits complete characterization of chemical use in HF operations:
 - From EPA's analysis of the FracFocus 1.0 database
 - One or more ingredients were claimed as confidential in more than 70% of disclosures
 - Operators designated 11% of all ingredient records as confidential business information

Assessment Conclusions



- Assessment identified existing and potential mechanisms and impacts to drinking water resources due to hydraulic fracturing activities
- These mechanisms include:
 - Water withdrawals in areas with low water availability
 - Spills of HF fluids and flowback/produced water
 - HF conducted directly in formations containing drinking water resources
 - Well integrity failures
 - Subsurface migration of gases and liquids
 - Inadequately treated wastewater

Assessment Conclusions



- The number of documented impacts to drinking water resources is small relative to the number of fractured wells
- Despite vulnerabilities, there is no evidence of widespread, systemic impacts on drinking water resources due to hydraulic fracturing activities

Sources of Uncertainties



- Insufficient pre- and post-fracturing data on the quality of drinking water resources
- The paucity of long-term systematic studies
- Insufficient data available to characterize well integrity over time
- The presence of other sources of contamination precluding a definitive link between hydraulic fracturing activities and a potential impact
- The inaccessibility of some information on hydraulic fracturing activities and potential impacts

What's Next



- Science Advisory Board (SAB) review of draft assessment:
 - Public, open process
 - Charge questions discussed during teleconference September 30
 - Panel meeting held October 28-30; Additional teleconference scheduled December 3.
 - Opportunity to provide comments on the draft assessment: throughout SAB review process
- Agency will use comments from public and SAB to revise draft assessment and release as final