

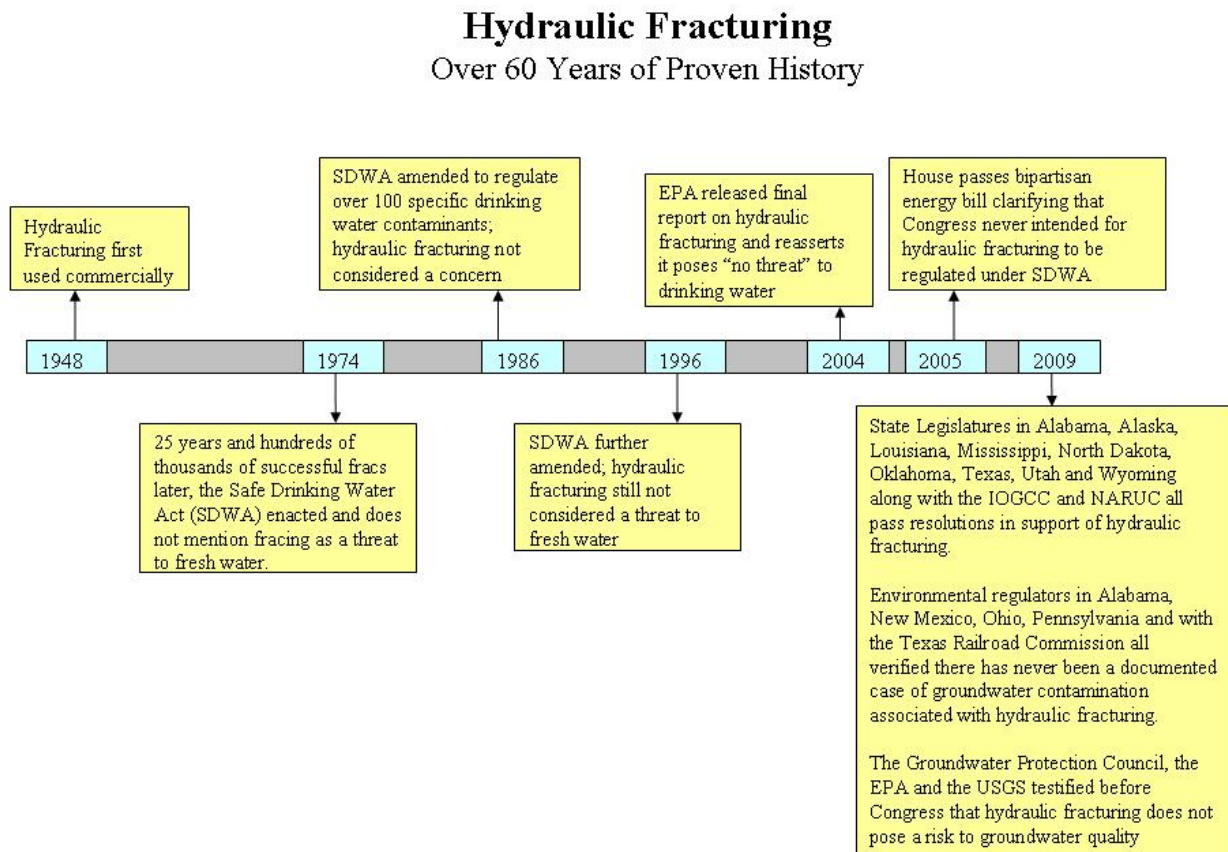
Virginia's Natural Gas Industry

Hydraulic Fracturing Facts

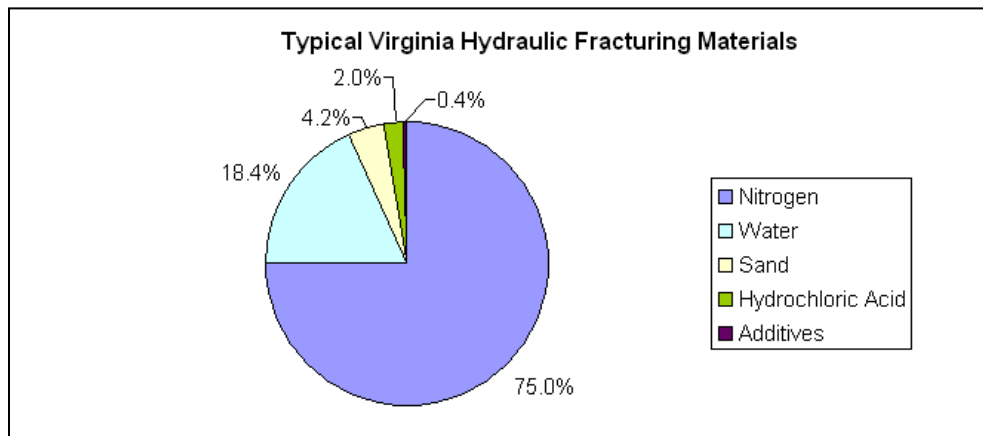
What is Hydraulic Fracturing?

Hydraulic fracturing is the process in which fluid pressure is applied to reservoir rock causing fracturing. The fluid carries a proppant (usually sand) into the fractures. The fractures close on the sand, which generally has a higher porosity than the reservoir rock. Natural gas can then flow more freely to the wellbore.

What is the history of Hydraulic Fracturing and associated regulations?



How much material is used during typical hydraulic fracturing in Virginia and what's in it?



Note: Every frac job will vary; these are average percentages

- 75% Nitrogen:
 - an inert gas
 - makes up 78% of the air we breathe and is not a greenhouse gas
- 18.4% Water:
 - approximately 25-35,000 gallons per frac job
- 4.2% Sand:
 - Common uses include: mortar for masonry, water treatment filtration, general construction
- 2% Hydrochloric Acid:
 - typically a 15% solution
 - Also known as Muriatic Acid and is the same thing as gastric acid
 - Common uses include pH control for swimming pools, toilet bowl cleaner, in medicines and pharmaceuticals
- 0.4% Additives:
 - Small amounts of additives are used as clay stabilizers, iron control additives, biocides for water treatment, friction reducers and fluid loss additives. Examples include:
 - Guar Gum – gelling agent also used as an ice cream thickener and in ketchup
 - Surfactant – foamer/friction reducer also used in dish detergent, fabric softener, shampoo and toothpaste
 - Biocide – bacteria control also used in swimming pools, municipal water treatment, and as a hospital disinfectant

Note that in Virginia, frac fluids return to the surface into a lined pit for proper disposal according to state regulations.

How do these materials compare to other areas?

Compared to fracture fluids used in other areas, Virginia uses much less water. As a comparison, a typical Marcellus horizontal completion in Pennsylvania uses 3 million to 6 million gallons of water. So the amount used in a typical Virginia vertical well is less than 1% of what is used for a Marcellus horizontal. This percentage is even less for Virginia's horizontal shale wells. Virginia's shale is very different than Pennsylvania's, and therefore water is not used during a horizontal shale completion. These stimulations only use nitrogen, an inert gas that is not considered a greenhouse gas.

How is Groundwater Protected in Virginia?

There are multiple strings of casing in each well that are cemented to the surface thereby isolating fresh water from any producing formations. Rock formations that are fractured are at least 500ft below fresh water zones.

