

HYDRAULIC FRACTURING LIFECYCLE

for Oil and Natural Gas Extraction

Hydraulic fracturing, commonly referred to as “fracking”, is a method used in the oil and natural gas industry for extraction of methane and hydrocarbons to be converted into energy. Fracking allows for extraction in areas that were previously unattainable due to rock formations not being permeable enough for conventional methods. The recent ability for horizontal drilling has greatly increased the efficiency of oil and natural gas extraction, and increased the use of fracking. This type of well can extend horizontally from the drilled opening in the formation, in any direction, reaching farther than the traditional method of vertical drilling. Although it is important to note that the fracking process can also be used to stimulate drinking water wells too, the purpose of this technical bulletin is to gain a preliminary understanding of fracking in the oil and gas industry. This will help to better evaluate the potential impacts on our water resources and how the water treatment industry can help. The US Environmental Protection Agency (EPA) has not confirmed fracking as the culprit for many drinking water contamination complaints, however, there is increasing public concern over fracking fluids and processes depleting and/or contaminating drinking water sources. Public health and environmental advocacy groups, news, media, and even organized protests have made the issue a priority for many state representatives. The issues related to drinking water are diverse, extending throughout the entire fracking lifecycle, from freshwater acquisition all the way to what happens after wastewater disposal.

Researchers and regulators are working to better understand the potential implications fracking has on our water resources. There have not been any publicly confirmed occurrences of fracking fluids contaminating drinking water wells. Also, the quantity of water fracking requires in times of increasing water scarcity and conservation is a very real problem as some areas are experiencing record droughts. In addition, safe storage and disposal of the fracking wastewater introduces another potential risk for environmental impact. In response to these concerns, Congress commissioned the US EPA to assess the hydraulic fracturing lifecycle impact on the quality and quantity of drinking water. The drinking water assessment report is expected to be open for public comment in 2014. Research strategies between the US EPA, Department of Energy, and Department of Interior will collaborate to produce policy-relevant research regarding fracking and water availability, water quality, air quality, longevity of oil and gas resources, human health, and ecological effects. The EPA study will provide much needed insight to all of the potential concerns for drinking water listed herein, and provide guidance for regulators to protect drinking water sources. Visit the EPA study website for more information, resources, and updates (<http://www2.epa.gov/hfstudy>).

The Fracking Process

Natural gas and oil extraction first must begin with sound construction of the well that complies with all state regulations. The State Review of Oil and Natural Gas Environmental Regulation's website has more information on these regulations (<http://www.strongerinc.org/>). The depth of the well will vary depending on the location and, in general, can range anywhere from 1,000 ft. to greater than 10,000 ft. below the surface. During the construction of the borehole and well, protective steel casings are cemented into place to protect the well from potential rock formations that could collapse, or any other malfunctions that could occur during the fracking lifecycle. Casings provide assurance that the well is isolated from the surrounding ground and, therefore, are a preventative measure against contamination from fracking fluids and natural gas/oil that pass through the borehole during extraction. Many argue that, although fracking typically occurs far below the aquifer, natural cracks in rock formation and abandoned, improperly sealed wells can provide avenues for contamination of drinking water sources.

Water usage in the fracking lifecycle varies greatly depending on the site, but extraction from shale formations can use up to 4 million gallons. Water recycling and reuse is a recommended water management practice of the American Petroleum Institute, with treatment approaches being tailored per site. Although water reuse is on the rise, mainly freshwater has been used in the past in order for the equipment and process to run efficiently. The largest shale formations being fracked for natural resources in the US are the Barnett Shale in Texas, Bakken Shale in North Dakota, and the Marcellus Shale in the Northeast. With horizontal drilling advancing the natural gas industry, fracking is projected to boom in the coming years.

Water is brought to the fracking site, where it is mixed with chemicals and solid material (sand or ceramic materials used to keep a hydraulic fracture open; called proppants) to become the "fracking fluid". The chemical concentrations added depend entirely on the specific well site and, including the sand/proppant, generally will not consist more than 2% of the total fluid; the remaining 98% is water. This fluid mixture is injected under high pressures (up to 13,500psi) into the well, releasing in the rock formation below. The pressurized injection is what creates fractures/cracks in the shale formation and the sand/proppant holds these open to allow the gas and hydrocarbons to escape up the well. The purpose of the chemical additives in the fracking fluid is to reduce friction, inhibit scale and corrosion, increase viscosity, iron control, and pH adjustment. Biocides are added to prevent microbial growth that can inhibit natural gas from releasing. Millions of gallons of fracking fluid means chemical volumes can reach upwards to 60,000 gallons at a single fracking site (Spellman 2013). In 2011, the US Committee on Energy and Commerce reported 750 different additives were used for fracking between the years 2005-2009. There also may be concern of introducing endocrine disrupting compounds to the environment from fracking fluid accidents or spills (Kassotis 2013).

After the fracking fluids are injection into the borehole, produced water, returns containing the desired natural gas/oil, fracking fluids, and any naturally occurring constituents picked up during the process. The natural gas/oil is separated and transported to be turned into energy. The wastewater requires further treatment before it can be reused or disposed of. . Some naturally occurring contaminants with health effects may be picked up during the fracking lifecycle, such as radiologicals like radium 226/228 and uranium; or other regulated contaminants like bromide, or other ions.

Significance to Water Treatment Industry

There are several ways water treatment professionals can use their expertise to contribute improving the fracking process to protect drinking water. Water professionals can partner with the industry to develop techniques for water reuse/recycling. There is also potential for water professionals to help the natural gas/oil industry explore recycling wastewater from other industries to be used instead of freshwater. There are many benefits to using recycled water, including reduced costs for disposal as well as freshwater acquisition. Some of the additives in fracking fluids are for maintaining the water quality of the well, water professionals can offer recommendations for treatment options. Below is a table that outlines some of the areas in which the water treatment industry can provide services and products to help support and improve the fracking lifecycle.

High Water Demand Process

Water scarcity:

- Drought-stricken areas
- Short and long term impacts are not known
- Water shortages impact water quality

Opportunity for Water Treatment Industry to Help: Water professionals can help the natural gas industry reduce water usage by treating and recycling wastewater

Chemical Additives

Contamination

- On-site chemical spills
- Fracking fluid leakage into surface and groundwater

Opportunity for Water Treatment Industry to Help: Water professionals can help the industry use less additives for bacteria, iron, corrosion, and other contaminant treatments

Pressurized Injection and Flowback

Contamination

- Movement of naturally occurring radiologicals and metals from shale formations
- Malfunctions causing aquifer contamination
- Fractures and fracking fluids could possibly reach aquifers via abandoned wells

Opportunity for Water Treatment Industry to Help: Water professionals can combat contamination through POE/POU residential water treatment

Wastewater Treatment and Disposal

- Stored in tanks at the site then treated for reuse or disposal

Opportunity for Water Treatment Industry to Help: Water professionals assist in safe and efficient treatment of wastewater

REGULATIONS

Well construction requirements to protect groundwater resources are regulated by state oil and gas boards or natural resource agencies. This includes permitting and oversight for the construction, production, and proper abandonment of natural gas wells. Agencies in local counties can also mandate requirements, as well. To find a list of fracking regulations by state, go to <http://fracfocus.org/regulations-state>.

Certain aspects of fracking fall under Federal laws like the Clean Air Act (CAA), Clean Water Act (CWA), and the Safe Drinking Water Act (SDWA). Fracking is not regulated under the SWDA, with the exception of when diesel fuel is used in fracking fluids, and/or if the wastewater is being disposed of by underground injection. Diesel fuel used in fracking to make the fracking fluids more viscous is not exempt because it may contain benzene, toluene, ethylbenzene, and/or xylenes (also known as BTEX).

Best practices have been written by the industry; for example, the American Petroleum Institute's best practices for hydraulic fracturing. Also, a new ASTM subcommittee on Hydraulic Fracturing has formed to develop a standard to model best practices in the industry. Another opportunity for water treatment professionals to get involved is by offering to perform water analyses of the surrounding source waters prior to the start of fracking, and continued monitoring throughout the process.

Additionally, reducing the use and using more bio-degradable chemicals and water reuse are opportunities for the water treatment industry to help. Water professionals can may have a vital role to help the oil industry provide for US energy needs all while keeping the groundwater safe.

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ACKNOWLEDGEMENT

WQA wishes to express sincere appreciation for the unselfish contributions of the members of WQA who contributed their time and expertise toward the completion of this bulletin.

Arvind Patil, Ph.D., CWS-I
Gary Hatch, Ph.D.
Charles Michaud, CWS-VI
Mark Brotman, CWS-VI
P. Regunathan, Ph.D.
Rebecca Tallon, P.E.

Richard Andrew
Shannon Murphy
Steve VerStrat
Pauli Undesser, M.S., CWS-VI
Kimberly Redden, CWS-VI

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This reference document is published by:



National Headquarters & Laboratory

**4151 Naperville Road • Lisle, Illinois 60532
Tel: 630 505 0160 • Fax: 630 505 9637**

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