



Water Wells in Proximity to Natural Gas or Oil Development

Information for well owners

The National Ground Water Association encourages water well owners to test the quality of their water regularly.

As oil and gas development increases around the country, NGWA reminds water well owners about the importance of testing their water wells prior to oil and gas well installation. This provides a baseline for comparison after oil and gas production.

Relationship of hydraulic fracturing for oil or gas development and groundwater used for drinking supply

Hydraulic fracturing has captured headlines in areas where gas development is occurring. Hydraulic fracturing is a petroleum-industry process in which fluids, commonly made up of water and a small percentage of chemical additives, are combined with sand and are pumped at very high pressure into a geologic formation holding gas. The resulting fractures allow the release of natural gas, which can be collected.

A 2004 U.S. Environmental Protection Agency study of hydraulic fracturing of coalbed methane reservoirs found little or no threat to underground sources of drinking water. Currently, the U.S. EPA is studying whether hydraulic fracturing adversely affects groundwater quality as the practice expands rapidly into other types of geologic formations, particularly shales. A draft report is expected to be released for public comment and peer review in 2014. The primary questions the U.S. EPA hopes to answer in the study are:

- What hydraulic fracturing scenarios might cause impacts on drinking water resources?
- What approaches are effective for protecting drinking water?

Suggested options for water well owners

NGWA suggests all water well owners regularly test their water quality because:

- Many areas of the United States have geologic conditions that release natural constituents into groundwater.
- Water quality in private wells is not regulated by the federal government or by many state and local governments.
- Below-ground activities such as oil and gas drilling can potentially affect their drinking water quality.

It is difficult to give a universal recommendation for water testing that proves damage to a well has occurred. This is because the rate at which groundwater flows and the risk of water well contamination depend on site-specific geology, among other factors. NGWA encourages water well owners to review additional sources of information that may be relevant to your specific circumstances, or the state or county where you reside. One such information source will be listed later in this brief.

For some water well owners, the cost of water testing may be an issue. In the rare cases where regulatory or legal action is necessary, a comprehensive analysis is often better. However, water testing—especially for organic chemicals or chemicals in minute amounts—can be expensive.

NGWA has compiled a list of constituents to test in areas of oil or gas development. It includes the major ions in groundwater, which consist of calcium, magnesium, sodium, potassium, alkalinity (bicarbonate and carbonate), sulfate, and chloride. These usually make up more than 90% of all dissolved constituents in groundwater, and are used to define a water “type”

—similar to labeling blood types. Analyzing this suite of ions both pre- and post-drilling allows for quantitative changes in water quality to be determined.

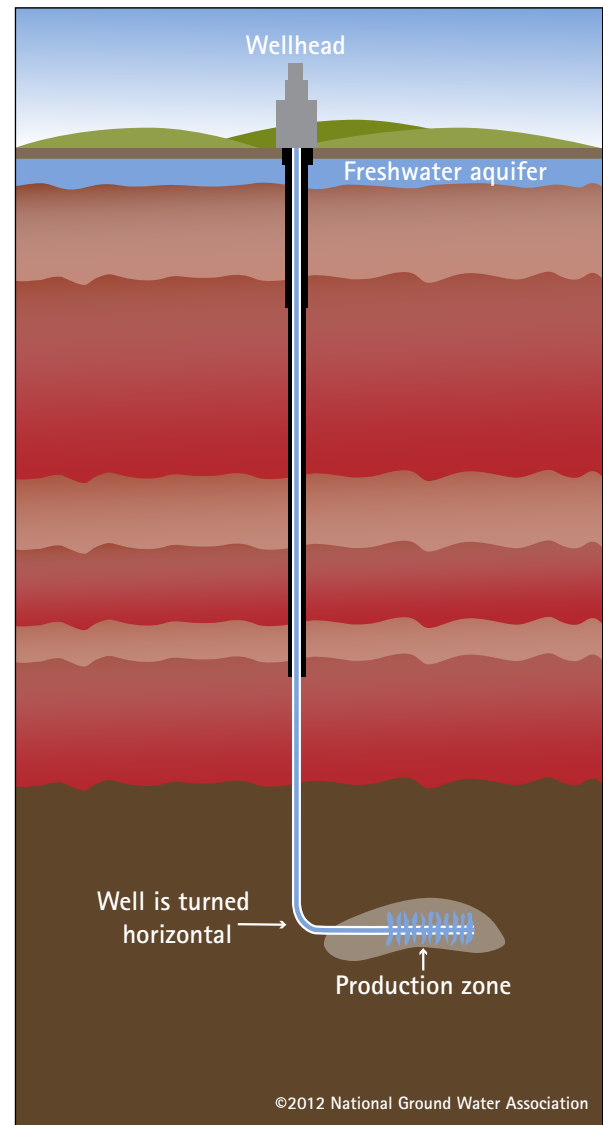
Bromide is an ion common to brackish water and brines. A measure of the ratio of bromide to chloride has been used to “fingerprint” saltwater—for example, to help distinguish whether salt contamination in a water well is from road salt or contamination from oil brines.

Barium is a potentially harmful element that sometimes can be an indicator of radioactive elements in oil brines or production fluids.

Uranium is a radioactive element that can occur naturally in groundwater or be released from a geologic formation by contamination from brine.

The **pH** of water is a measure of the water’s acidity or alkalinity, and can cause the release of other undesirable metals, such as iron, into groundwater.

The **total dissolved solids (TDS)** is a measure of the sum of all dissolved constituents in water. It can be used to compare samples for any net increase in salt or other dissolved constituents. It also can be used to see if all of the changes in subsequent water sampling have been accounted for, since the TDS should about equal the sum of all other dissolved constituents in the sample. If it doesn’t, then there may be other constituents in the water that have been overlooked.



The **specific conductance** is a measure of the electrical current that can be transmitted by the water, and is directly proportional to the amount of dissolved solids. It can be used in subsequent sampling as a cost-effective screening tool to determine if more comprehensive sampling may be needed.

Iron, manganese, selenium, chromium, arsenic, and boron are other naturally occurring minor and trace elements that may cause cosmetic or ill health effects to consumers. An increase in the concentration of these constituents may indicate changes in the aquifer due to the drilling process or stimulation fluids.

Organic chemicals such as toluene, benzene, oil, and grease may be by-products of oil and gas production, or well stimulation activities.

Methane is a naturally occurring gas that can dissolve into groundwater. It is common to areas with oil and gas development because the rocks underlying these areas by nature contain petroleum, natural gas, and coal. Methane can seep to the surface and into fresh groundwater under natural conditions. Processes near the earth's surface (e.g., decomposition of organic matter in swamps and wetlands) can also produce methane, so the mere presence of methane in well water does not immediately indicate contamination related to oil and gas production.

However, an unusual change in the amount of methane in water may indicate changing conditions underground. In this case, enhanced analysis of the gas can help determine its origin.

Turbidity is a measure of the cloudiness of a water sample from suspended particles, and may indicate disruption of the flow system that provides water to a well.

NGWA has developed Best Suggested Practices (BSPs) for groundwater professionals on topics that include reducing problematic concentrations of arsenic, boron, iron and manganese, methane, and uranium in well water.

NGWA also has developed a BSP for reducing problematic concentrations of methane in residential water well systems.

It is important to collect a sample before oil and gas drilling in your area to establish the baseline conditions of your groundwater supply. It is also important to test after completion of drilling activities. Some states require energy companies to collect samples and may have time limits for sample collection. So, each water well owner should contact their state or local regulatory authority to find out about any requirements.

States also may have agreements with energy companies detailing constituents that the company will cover for pre- and post-drilling well water quality testing. In the absence of such programs, the list in this brief provides constituents to test in order to establish a water quality baseline.

Following are steps well owners can take before and after oil and gas production takes place.

Step 1. Prior to oil and gas operations, have a professional, such as a qualified water well system professional, test your groundwater quality for appropriate constituents to establish a water quality baseline for post-fracturing or drilling analysis.

When seeking a qualified drinking water testing lab, check with your state or local health department, or go to NGWA's website www.wellowner.org and click on "Water Quality" on the menu and then "Water Testing" beneath. If local labs do not test for substances you wish to check, there are national water testing labs that may be able to help, such as the National Testing Labs (www.ntllabs.com) and Underwriters Laboratories (www.ul.com).

Step 2. In the absence of a list developed specifically for your area by a credible source, the following list from NGWA includes basic constituents that should be considered for water quality analysis prior to oil and gas operations.

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Major Ions:

alkalinity, calcium, chloride, magnesium, potassium, sodium, sulfate

Minor and Trace Elements:

arsenic, barium, boron, bromide, chromium, iron, manganese, selenium, uranium

Water Quality Parameters:

pH, specific conductance, total dissolved solids (TDS), turbidity

Organic Chemicals:

benzene, toluene, ethyl benzene, xylene (BTEX); diesel range organics (DRO);
dissolved methane; gasoline range organics (GRO); total petroleum hydrocarbons or oil
and grease (HEM)

Examples of other localized water quality testing recommendations can be found at http://wri.eas.cornell.edu/gas_wells_5_1489175471.pdf.

When testing for the presence of dissolved methane, multiple analyses conducted over time may be needed to properly establish a baseline.

Step 3. Once hydraulic fracturing has taken place, water well owners should consider retesting their water quality against the baseline results and against any additional fracturing fluid chemicals that have been voluntarily disclosed. The Ground Water Protection Council (GWPC) Frac Focus website (<http://fracfocus.org>) lists chemicals used in fracturing fluids voluntarily disclosed by some companies.

To learn more about laws regarding disclosure of chemicals, visit GWPC's "Chemicals and Public Disclosure" and "Find a Well by State" sections of its Frac Focus Web page.

Post-drilling water quality testing should be done within six months of completion of drilling and fracing. Continued sampling should be done at least annually as long as practicable. Subsequent screening using the pH and specific conductance, or total dissolved solids measurements, can be less expensive ways to see if changes



have occurred. An increase in the concentration or occurrence of these constituents could indicate that further, more sophisticated water quality testing should be done.

You can learn more about the toxicity of chemicals by searching for the chemical using the name or CAS number on the U.S. EPA National Center for Computational Toxicology website. The U.S. EPA also maintains a Drinking Water Hotline that is available Monday through Friday from 8:30 a.m. to 4:30 p.m. ET at 800 426.4791. Only a trained water quality professional can tell you if your water is safe to drink.

What to do if water quality changes

If there is a change in water quality, the well owner should discuss it with local or state health or environmental protection authorities.

Most constituents can be treated by in-home systems. When considering a water treatment device, make sure its specifications match the substances and concentrations you wish to treat. You may want to check with the Water Quality Association (www.wqa.org) and NSF International (www.nsf.org) to determine whether the technology being considered has been performance tested.

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