Groundwater Issues in the United States Part 2: Hydraulic Fracturing in the Northeast

Hydraulic fracturing has become a hotly debated topic where gas development is occurring throughout the country, particularly in the northeast.

By Mike Price

The Empire State Water Well Drillers' Association Summer Meeting addressed a hot topic under the sweltering summer sun in Corfu, New York.

Throughout the country and specifically in the northeast where gas development occurs, hydraulic fracturing is being scrutinized. It's a petroleum industry process in which fluids, commonly made up of water and a small percentage of chemical additives, are combined with sand and pumped at high pressure into a geologic formation holding gas. The resulting fractures allow the release of natural gas, which can be collected.

Public health concerns have emerged in the United States over contamination of drinking water caused by hydraulic fracturing. Studies are investigating its effects in water above and below ground, regulatory agencies are setting drilling restrictions, and trade associations and environmental activists are stating their positions.

And in the middle are water well drillers being asked questions about a well stimulation method unfamiliar to most in the groundwater industry.

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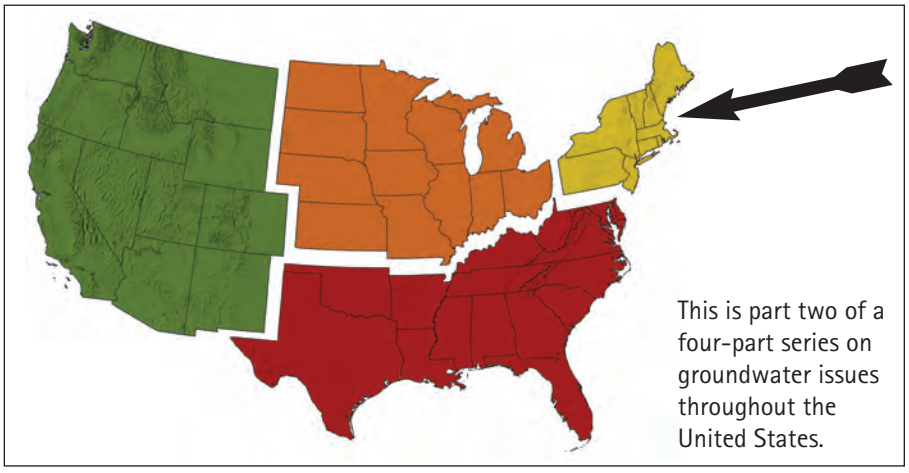

This is part two of a four-part series on groundwater issues throughout the United States.

Thus, New York's ESWWDA included a drilling demonstration during its July 14-15 summer meeting where nearly 150 attendees observed a third-party service company hydraulically fracture two vertical gas wells (approximately 1200 to 1300 feet deep) in the Medina formation in Corfu, about 30 miles east of Buffalo.

"The question was typically, 'What's all the hype about?'" says Bill Frey, MGWC, president of Frey Well Drilling Inc. in Alden, New York, whose company hosted the drilling demonstration. "All the hype is about if gas can migrate up into the water wells.

"Hydraulic fracturing, in my educated opinion, is not the issue. There are two sources for the problem: one, gas that's already in the water that the owner didn't know they had until the rig was in the front yard and then they were more aware of what was in their water, and two, poor cement or drilling practices where these shallower gases can escape up through. But there are no wells that I know of that are leaking up into the people's water wells from the designated production zone."

As oil and gas development increases in the country, hydraulic fracturing could play a major part, making it the focus in this second part of a four-part series looking at groundwater issues in the United States.

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First used in the United States in 1947, hydraulic fracturing began as a process for the stimulation of oil and gas wells.

The procedure was used commercially in 1949, and because of its success in increasing production from oil wells, was adopted industrywide. It's now practiced annually in thousands of oil and gas wells.

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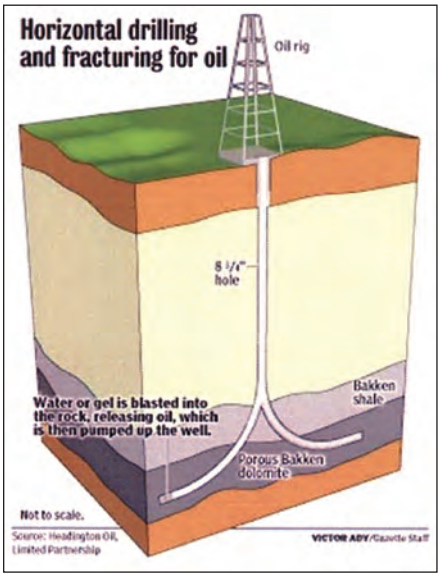
Hydraulic fracturing for oil.



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When using this procedure, sand props open the new fractures. Chemicals are added to condition the water to reduce friction, adjust viscosity, and inhibit microbe growth so that the sand is delivered to the fractures efficiently. This technique, combined with horizontal drilling technology, allows extraction of natural gas from tight shales (fine-grained, clastic sedimentary rock) that would otherwise not be productive.

To hydraulically fracture a shallow gas well like the ones at the ESWWDA drilling demonstration, the amount of equipment required is significant. Typically, two high-pressure pump trucks, two bulk storage sand trucks, one knuckle boom crane truck, one mixing truck, one tanker truck, and one mobile control center truck, along with 12 technicians, are deployed to execute the work.

The basic concept of hydraulic fracturing was introduced, modified, and adapted for the water well industry in the late 1960s and early 70s. The hydrofracking of water wells has proven beneficial in areas where water is difficult to locate or extract from underground (see "Hydraulic Fracturing: Well Water vs. Oil and Gas"). It's important to note that water well hydrofracking is performed at pressures much lower than oil and gas hydraulic fracturing, and normally the process does not fracture the rock but merely opens up existing fractures that provide higher water yields.

NGWA is planning to present a series of Webinars addressing U.S. aquifers and various aquifer characteristics, beginning this fall. Check *www.NGWA.org* for scheduling, topic, and registration information.

Since the 1960s, the oil and gas hydraulic fracturing process has become more common in areas where gas development is occurring in the country, and prompting environmental studies.

Among them was a 2004 U.S. Environmental Protection Agency study of hydraulic fracturing of coalbed methane reservoirs that found little or no threat to underground sources of drinking water. The EPA is currently studying whether hydraulic fracturing adversely affects groundwater quality as the process expands rapidly into other types of geologic formations, particularly shale. Preliminary results from this study are expected in late 2012.

The primary questions the 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?

In another study released this spring, Robert Jackson, Ph.D., and researchers at Duke University suggest shale gas extraction leads to methane contamination of underground water sources and calls for thorough surveys of methane levels at extraction sites.

Shale gas, or natural gas extracted from Marcellus shale—a unit of marine sedimentary rock found in eastern North America that is the second-largest gas field in the world—has been hailed as a "cleaner" energy source, releasing less than half the CO2 emissions of coal.

Jackson's study measured the methane concentration in 68 wells that drew water for human consumption from natural underground sources across northeast Pennsylvania and New York. The researchers took measurements in wells with similar geological characteristics within both active and non-active shale gas extraction sites to assess the extent of contamination.

The study revealed that, on average, methane concentrations were 17 times higher in wells near active hydraulic fracture sites (within 1 kilometer or 0.625 mile) than those in non-active sites and were well within "hazardous levels" as defined by the U.S. Department of the Interior. The concentration in the wells near active sites increased with increasing proximity to the precise hydraulic fracture location.

It was considered by the researchers that the contamination could be caused by the production of new cracks in the shale rocks, or by fractures caused during the hydraulic fracture process, which allows shale gas to escape.

The researchers analyzed the presence of different chemical forms (isotopes) of methane and more complex hydrocarbons, including ethane, propane, and butane. From this, they confirmed that the source of the methane contamination was the gas contained in the shale rocks, discounting the possibility that it was produced naturally by microbes that live in the water.

However, John A. Conrad, president and senior hydrogeologist of Conrad Geoscience Corp. in Poughkeepsie, New York, found fault in a number of areas with the study, including biased sample locations.

"The authors sampled water wells near certain recently drilled gas wells suspected by the Pennsylvania Department of Environmental Protection to have defective annular cement, yet the authors imply that methane in groundwater is to be expected wherever there are shale gas wells," says Conrad, who is a member of the Independent Oil & Gas Association of New York.

"The Duke study came out during a time of widespread confusion and misunderstanding about hydraulic fracturing, much of which has no basis in fact or science. This unfortunate situation is not the fault of Dr. Jackson, but the Duke paper has had the effect of feeding into that confusion and fear, even if that was not the intent."

Although methane dissolved in drinking water is not currently classified as a direct health hazard, if it accumulates in underground water sources or other enclosed spaces, there is a high risk of explosion, the researchers say.

They also tested for contamination of

the water in the wells by other fluids used in the hydraulic fracturing process, such as hypersaline (concentrated salt) brines, but found no evidence of contamination in any of the wells.

In light of their results, the scientists recommended a coordinated policy to collect data on the concentration and chemical form of methane present in groundwater before hydraulic fracturing is carried out at a site, also during the process, and after completion to assess the level of contamination.

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Hydraulic fracturing has taken center stage most notably in New York.

Both horizontal and vertical drilling are now allowed in New York, as is hydraulic fracturing using less than 300,000 gallons of water per well. These activities are covered by the original 1992 Generic Environmental Impact Statement (GEIS) under the New York State Department of Environmental Conservation oil, gas, and solution mining program.

There are more than 14,000 active oil and gas wells in New York, most of which have been hydraulically fractured. Most of them are conventional vertical wells of the type the ESWWDA demonstrated during its summer meeting in mid-July.

Deep, long, horizontal wells in tight shales require high-volume hydraulic fracturing (300,000-plus gallons) to be productive. Drilling permits for these kinds of wells will not be issued in New York until the NYSDEC completes its draft of the Final Supplemental GEIS, expected sometime in 2012. The purpose of this Final Supplemental GEIS is to examine what potential risks and impacts arise from the use of 4 million-plus gallons of water per well and to establish measures for reducing risks and mitigating impacts.

For more than three years, concerns over environmental safety and calls for either an outright ban or stringent regulations have been debated over gas extraction from Marcellus shale.

New York Governor Andrew Cuomo told *The Post-Standard* (Syracuse, New York) last fall that he had not made up his mind on the issue and was waiting for more information.

"There's tremendous economic potential. There's also potential for environmental harm," he said. "I don't think we have enough facts to make a decision. The [Department of Environmental Conservation] is supposed to do a report. EPA is going to do a report. Let's get the facts and then we'll decide."

At the ESWWDA summer meeting,

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Hydraulic Fracturing: Well Water vs. Oil and Gas

Hydrofracking of water wells is different than hydraulic fracturing for oil and gas production.

While there are some similarities between hydrofracking of water wells and hydraulic fracturing for oil and gas production, the two should not be confused with each other.

Some in the groundwater industry have concerns that policymakers or the general public may unknowingly link the two practices together under regulations intended to govern the oil and gas industry. To help clarify, the National Ground Water Association has defined "hydraulic fracturing" and terms associated with it in the Association's updated and revised *Lexicon of Groundwater and Water Well System Terms*.

The basic concept of hydraulic fracturing was introduced, modified, and adapted for the water well industry in the late 1960s and early 70s. The hydrofracking of water wells has proven beneficial in areas where water is difficult to locate or extract from underground, including Sterling, Massachusetts, where Kyle Equipment Co. Inc. has operated.

A worldwide manufacturer of hydrofracking equipment for low-yield water wells, its sister company, Northeast Water Production, has worked jointly to create safe, reliable, and user-friendly hydrofracturing systems for more than 20 years.

Many think a fracture is being created during the hydrofracking process of a water well, but Sean Kyle, CWD, president of Kyle Equipment, explains why there isn't.

"The fractures already exist in the bedrock," he says. "What is actually happening is the existing fractures are either really small, or they're plugged with sediment. The Hydro-Frac® system cleans out these fractures, then actually wears away the sides of the fractures, making them larger. Therefore, more water is allowed to flow into the well. We use only potable water and do not add chemicals or propping agents."

NGWA Provides Online Resources:

NGWA's position paper, "Hydraulic Fracturing: Well Water vs. Oil and Gas," published in February 2010, is available online at *www.ngwa.org/Advocacy-Awareness/positions/Pages/default.aspx*.

NGWA's information brief, "Water Wells in Proximity to Natural Gas or Oil Development," published in June 2011, is available online at *www.ngwa.org/Media-Center/briefs/Pages/default.aspx*.

NGWA's updated and revised *Lexicon of Groundwater and Water Well System Terms* is available from its Online Bookstore at *www.NGWA.org*.

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a senior technical advisor addressed the membership prior to commencing with the hydraulic fracturing.

The advisor spoke of gas well construction practices as they relate to groundwater aquifer protection, indicating that many of the deep horizontal Marcellus wells are now being triple-cased in the upper zone as a precaution for groundwater aquifer protection. In the horizontal wells, there is a substantial distance of some 4000 to 5000 feet or more of separation between the lower portion of the groundwater aquifer area and the gas-producing zone.

"I personally believe that both resources can coexist with proper science and well construction techniques being utilized," says Art Becker, MGWC, CPG, key client manager for SGS's environmental drilling division in West Creek, New Jersey, who attended the drilling demonstration.

"It is incumbent upon the gas producers to make absolutely certain that groundwater aquifer protection is the number one priority in well construction and the costs associated with doing so are a part of doing business. I'm all for U.S.-based energy production and energy independence without compromising our groundwater resources. This will be a challenge every day for the gas producers and they must meet the challenge and execute in a manner that provides total and absolute groundwater protection."

Frey Well Drilling, family-owned and operated and serving western New York since 1960, completed its first gas well in September 1977. Since then the company has completed more than 1000 gas wells while doing as many as 78 in a single year in 1986.

The company has completed gas wells across all of New York with main areas of concentration in the Jamestown, Buffalo, Rochester, and Syracuse regions, but it has opted to drill gas wells (shallower than 1000 feet) in Pennsylvania rather than New York due to the ongoing regulations debate.

Pennsylvania is a large part of the natural gas boom. Some geologists estimate there is enough natural gas in Pennsylvania, New York, Ohio, and West Virginia to supply the entire East Coast for 50 years.

Becker, who serves as president of the National Ground Water Association, says efficient and safe energy production in the United States is good for its citizens and the country. But the natural gas boom carries with it social changes (rental and housing cost increases) as well as a significant increase in truck traffic (road damage) and noise in hotbed drilling areas.

Energy companies still see the potential. They have bought up leases on thousands of parcels of land for use as possible drilling sites in New York over the past few years.

In turn, issues could crop up with the lease-landowner agreement, particularly for farmers in Upstate New York. Leases currently being offered to landowners exceed more than $5000 per acre and more than 20% royalties.

"The gas drilling opportunities have caused the land to be worth so much money as a lease that the lease money is more than the farm is worth," Frey says. "So whoever holds the lease, it's a very valuable farm, but if the man doesn't want to sell the lease with the farm, it gets kind of complicated.

"I don't know where that's going to go or turn out. I think it means that the child can't come home and buy his dad's farm anymore." *WWJ*