

## OCC Hearing Exhibit 27

**From:** [Diane MacInnes](#)  
**To:** [Davidson, Florene, EMNRD](#)  
**Subject:** [EXT] WE NEED STRICT REGULATIONS TO PROTECT PUBLIC HEALTH  
**Date:** Tuesday, July 28, 2020 10:30:01 PM  
**Attachments:** [NYTimes-Gas Drilling-Urbina.pdf](#)  
[ATT00001.htm](#)  
[Waste Water Byproducts of Shale Gas Drilling and Fracking.docx](#)  
[ATT00002.htm](#)  
[Fracking Water- It's Just So Hard to Clean.docx](#)  
[ATT00003.htm](#)

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Dear Commission Clerk, Florene Davidson,

For years scientists and the public in states across the country have brought to the attention of government the extreme hazards associated with the use of produced water for anything other than reuse on site. Oil & gas companies have funded “research” to counteract the unbiased research which exists, particularly out of Cornell and other institutions in New York and Pennsylvania.

We attended the public meeting here in Santa Fe regarding produced water. I questioned the representative from the NM Environment Department about whether the industry would be involved in funding the research project. He emphatically stated that it would not. Shortly after that, it was reported in the newspaper that in fact the industry is a research partner with NMSU and helping to fund the research, along with the state. Research funded by the industry cannot be trusted, and the representative who made such an emphatic statement that they would not has lost all credibility, which reflects poorly on the NM Environment Department. This is very disappointing.

New Mexico must not be deluded by the oil and gas industry. It’s simple. People in New Mexico already have suffered enough toxic pollution from this extractive industry. It is completely irresponsible for the use of produced waste water to be used for any other purpose than repurposing it in fracking operations. The people of New Mexico deserve to be protected with strongly worded, enforceable regulations that prohibit the use of toxic wastewater beyond fracking operations.

Ian Urbina, an investigative reporter wrote an article in the NYTimes which addresses the issue of toxins in produced water. I’ve attached the article, but I would like to point out one small, but telling excerpt:

"A confidential industry study from 1990, conducted for the [American Petroleum Institute](#), concluded that “using conservative assumptions,” radium in drilling wastewater dumped off the Louisiana coast posed “potentially significant risks” of cancer for people who eat fish from those waters regularly. "

Clearly the petroleum industry knows that produced water is toxic and that no affordable, reliable methods exist to clean the water to be safe for use in agriculture, released into our rivers, and certainly not for human consumption. Please read the following articles.

## The New York Times

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February 26, 2011

### Regulation Lax as Gas Wells' Tainted Water Hits Rivers

<http://www.nytimes.com/2011/02/27/us/27gas.html?scp=4&sq=natural%20gas&st=cse>



Kevin Moloney for The New York Times

Wells for extracting natural gas, like these in Colorado, are a growing source of energy but can also pose hazards.

By [IAN URBINA](#)

The American landscape is dotted with hundreds of thousands of new wells and drilling rigs, as the country scrambles to tap into this century's gold rush — for [natural gas](#).

The gas has always been there, of course, trapped deep underground in countless tiny bubbles, like frozen spills of seltzer water between thin layers of shale rock. But drilling companies have only in recent years developed techniques to unlock the enormous reserves, thought to be enough to supply the country with gas for heating buildings, generating electricity and powering vehicles for up to a hundred years.

So energy companies are clamoring to drill. And they are getting rare support from their usual sparring partners. Environmentalists say using natural gas will help slow [climate change](#) because it burns more cleanly than coal and [oil](#). Lawmakers hail the gas as a source of jobs. They also see it as a way to wean the United States from its dependency on other countries for oil.

But the relatively new drilling method — known as high-volume horizontal hydraulic fracturing, or hydrofracking — carries significant environmental risks. It involves injecting huge amounts of water, mixed with sand and chemicals, at high pressures to break up rock formations and release the gas.

With hydrofracking, a well can produce over a million gallons of wastewater that is often laced with highly corrosive salts, carcinogens like benzene and radioactive elements like radium, all of which can occur

naturally thousands of feet underground. Other carcinogenic materials can be added to the wastewater by the chemicals used in the hydrofracking itself.

While the existence of the toxic wastes has been reported, thousands of internal documents obtained by The New York Times from the [Environmental Protection Agency](#), state regulators and drillers show that the [dangers](#) to the environment and health are greater than previously understood.

The documents reveal that the wastewater, which is sometimes hauled to sewage plants not designed to treat it and then discharged into rivers that supply drinking water, contains radioactivity at levels higher than previously known, and far higher than the level that federal regulators say is safe for these treatment plants to handle.

Other documents and interviews show that many E.P.A. scientists are alarmed, warning that the drilling waste is a threat to drinking water in Pennsylvania. Their concern is based partly on a 2009 study, never made public, written by an E.P.A. consultant who concluded that some sewage treatment plants were incapable of removing certain drilling waste contaminants and were probably violating the law.

The Times also found never-reported studies by the [E.P.A.](#) and a [confidential study](#) by the drilling industry that all concluded that radioactivity in drilling waste cannot be fully diluted in rivers and other waterways.

But the E.P.A. has not intervened. In fact, federal and state regulators are allowing most sewage treatment plants that accept drilling waste not to test for radioactivity. And most drinking-water intake plants downstream from those sewage treatment plants in Pennsylvania, with the blessing of regulators, have not tested for radioactivity since before 2006, even though the drilling boom began in 2008.

In other words, there is no way of guaranteeing that the drinking water taken in by all these plants is safe.

That has experts worried.

“We’re burning the furniture to heat the house,” said John H. Quigley, who left last month as secretary of Pennsylvania’s Department of Conservation and Natural Resources. “In shifting away from coal and toward natural gas, we’re trying for cleaner air, but we’re producing massive amounts of toxic wastewater with salts and naturally occurring radioactive materials, and it’s not clear we have a plan for properly handling this waste.”

The risks are particularly severe in Pennsylvania, which has seen a sharp increase in drilling, with roughly 71,000 active gas wells, up from about 36,000 in 2000. The level of radioactivity in the wastewater has sometimes been hundreds or even thousands of times the maximum allowed by the federal standard for drinking water. While people clearly do not drink drilling wastewater, the reason to use the drinking-water standard for comparison is that there is no comprehensive federal standard for what constitutes safe levels of radioactivity in drilling wastewater.

Drillers trucked at least half of this waste to public sewage treatment plants in Pennsylvania in 2008 and 2009, according to state officials. Some of it has been sent to other states, including [New York](#) and [West Virginia](#).

Yet sewage treatment plant operators say they are far less capable of removing radioactive contaminants than most other toxic substances. Indeed, most of these facilities cannot remove enough of the radioactive material to meet federal drinking-water standards before discharging the wastewater into rivers, sometimes just miles upstream from drinking-water intake plants.

In Pennsylvania, these treatment plants discharged waste into some of the state’s major river basins. Greater amounts of the wastewater went to the Monongahela River, which provides drinking water to more than [800,000 people](#) in the western part of the state, including Pittsburgh, and to the Susquehanna River,

which feeds into Chesapeake Bay and provides drinking water to more than six million people, including some in Harrisburg and Baltimore.

Lower amounts have been discharged into the Delaware River, which provides drinking water for more than 15 million people in Philadelphia and eastern Pennsylvania.

In [New York](#), the wastewater was sent to at least one plant that discharges into Southern Cayuga Lake, near Ithaca, and another that discharges into Owasco Outlet, near Auburn. In [West Virginia](#), a plant in Wheeling discharged gas-drilling wastewater into the Ohio River.

“Hydrofracking impacts associated with health problems as well as widespread air and water contamination have been reported in at least a dozen states,” said Walter Hang, president of Toxics Targeting, a business in Ithaca, N.Y., that compiles data on gas drilling.

### **Problems in Other Regions**

While Pennsylvania is an extreme case, the [risks](#) posed by hydrofracking extend across the country.

There were more than 493,000 active natural-gas wells in the United States in 2009, almost double the number in 1990. Around 90 percent have used hydrofracking to get more gas flowing, according to the drilling industry.

Gas has seeped into underground drinking-water supplies in at least five states, including Colorado, Ohio, Pennsylvania, Texas and West Virginia, and residents blamed natural-gas drilling.

Air pollution caused by natural-gas drilling is a growing threat, too. Wyoming, for example, failed in 2009 to meet federal standards for air quality for the first time in its history partly because of the fumes containing benzene and toluene from roughly 27,000 wells, the vast majority drilled in the past five years. In a sparsely populated Sublette County in Wyoming, which has some of the highest concentrations of wells, vapors reacting to sunlight have contributed to levels of ozone higher than those recorded in Houston and Los Angeles.

Industry officials say any dangerous waste from the wells is handled in compliance with state and federal laws, adding that drilling companies are recycling more wastewater now. They also say that hydrofracking is well regulated by the states and that it has been used safely for decades.

But hydrofracking technology has become more powerful and more widely used in recent years, producing far more wastewater. Some of the problems with this drilling, including its environmental impact and the challenge of disposing of waste, have been documented by ProPublica, The Associated Press and other news organizations, especially out West.

And recent incidents underscore the dangers. In late 2008, drilling and coal-mine waste released during a drought so overwhelmed the Monongahela that local officials advised people in the Pittsburgh area to drink [bottled water](#). E.P.A. officials described the incident in an internal memorandum as “one of the largest failures in U.S. history to supply clean drinking water to the public.”

In Texas, which now has about 93,000 natural-gas wells, up from around 58,000 a dozen years ago, a hospital system in six counties with some of the heaviest drilling said in 2010 that it found a 25 percent asthma rate for young children, more than three times the state rate of about 7 percent.

“It’s ruining us,” said Kelly Gant, whose 14-year-old daughter and 11-year-old son have experienced severe asthma attacks, dizzy spells and headaches since a compressor station and a gas well were set up about two years ago near her house in Bartonville, Tex. The industry and state regulators have said it is not clear what role the gas industry has played in causing such problems, since the area has had high air pollution for a while.

“I’m not an activist, an alarmist, a Democrat, environmentalist or anything like that,” Ms. Gant said. “I’m just a person who isn’t able to manage the health of my family because of all this drilling.”

And yet, for all its problems, natural gas offers some clear environmental advantages over coal, which is used more than any other fuel to generate electricity in the United States. Coal-fired power plants without updated equipment to capture pollutants are a major source of radioactive pollution. Coal mines annually produce millions of tons of toxic waste.

But the hazards [associated](#) with natural-gas production and drilling are far less understood than those associated with other fossil fuels, and the regulations have not kept pace with the natural-gas industry’s expansion.

### **Pennsylvania, Ground Zero**

Pennsylvania, which sits atop an enormous reserve called the Marcellus Shale, has been called the Saudi Arabia of natural gas.

This rock formation, roughly the size of Greece, lies more than a mile beneath the Appalachian landscape, from Virginia to the southern half of New York. It is believed to hold enough gas to supply the country’s energy needs for heat and electricity, at current consumption rates, for more than 15 years.

Drilling companies were issued roughly 3,300 Marcellus gas-well permits in Pennsylvania last year, up from just 117 in 2007.

This has brought thousands of jobs, five-figure windfalls for residents who lease their land to the drillers and revenue for a state that has struggled with budget deficits. It has also transformed the landscape of southwestern Pennsylvania and brought heavy burdens.

Drilling derricks tower over barns, lining rural roads like feed silos. Drilling sites bustle around the clock with workers, some in yellow hazardous material suits, and 18-wheelers haul equipment, water and waste along back roads.

The rigs announce their presence with the occasional boom and quiver of underground explosions. Smelling like raw sewage mixed with gasoline, drilling-waste pits, some as large as a football field, sit close to homes.

Anywhere from 10 percent to 40 percent of the water sent down the well during hydrofracking returns to the surface, [carrying](#) drilling chemicals, very high levels of salts and, at times, naturally occurring radioactive material.

While most states require drillers to dispose of this water in underground storage wells below impermeable rock layers, Pennsylvania has [few such wells](#). It is the only state that has allowed drillers to discharge much of their waste through sewage treatment plants into rivers.

Regulators have theorized that passing drilling waste through the plants is safe because most toxic material will settle during the treatment process into a sludge that can be trucked to a landfill, and whatever toxic material remains in the wastewater will be diluted when mixed into rivers. But some plants were taking such large amounts of waste with high salt levels in 2008 that downstream utilities started complaining that the river water was eating away at their machines.

Regulators and drilling companies have said that these cases, and others, were isolated.

“The wastewater treatment plants are effective at what they’re designed to do — remove material from wastewater,” said Jamie Legenos, a spokeswoman for the Pennsylvania Department of Environmental Protection, adding that the radioactive material and the salts were being properly handled.

## Overwhelmed, Underprepared

For proof that [radioactive](#) elements in drilling waste are not a concern, industry spokesmen and regulators often point to the results of wastewater tests from a 2009 draft report conducted by New York State and a [1995 report](#) by Pennsylvania that found that radioactivity in drilling waste was not a threat. These two reports were based on samples from roughly 13 gas wells in New York and 29 in Pennsylvania.

But a review by The Times of more than 30,000 pages of federal, state and company records relating to more than 200 gas wells in Pennsylvania, 40 in West Virginia and 20 public and private wastewater treatment plants offers a fuller picture of the wastewater such wells produce and the threat it poses.

Most of the information was drawn from drilling reports from the last three years, obtained by visiting regional offices throughout Pennsylvania, and from [documents](#) or databases provided by state and federal regulators in response to records requests.

Among The Times's findings:

¶ More than 1.3 billion gallons of wastewater was produced by Pennsylvania wells over the past three years, far more than has been previously disclosed. Most of this water — enough to cover Manhattan in three inches — was sent to treatment plants not equipped to remove many of the toxic materials in drilling waste.

¶ At least 12 sewage treatment plants in three states accepted gas industry wastewater and discharged waste that was only partly treated into rivers, lakes and streams.

¶ Of more than [179 wells](#) producing wastewater with high levels of radiation, at least 116 reported levels of radium or other radioactive materials 100 times as high as the levels set by federal drinking-water standards. At least [15 wells](#) produced wastewater carrying more than 1,000 times the amount of radioactive elements considered acceptable.

Results came from [field surveys](#) conducted by state and federal regulators, year-end reports filed by drilling companies and state-ordered tests of some public treatment plants. Most of the tests measured drilling wastewater for radium or for “gross alpha” radiation, which typically comes from radium, uranium and other elements.

Industry officials say they are not concerned.

“These low levels of radioactivity pose no threat to the public or worker safety and are more a public perception issue than a real health threat,” said James E. Grey, chief operating officer of Triana Energy.

In interviews, industry trade groups like the Marcellus Shale Coalition and Energy in Depth, as well as representatives from energy companies like Shell and [Chesapeake Energy](#), said they were producing far less wastewater because they were recycling much of it rather than disposing of it after each job.

But even with recycling, the amount of wastewater produced in Pennsylvania is expected to increase because, according to industry projections, more than 50,000 new wells are likely to be drilled over the next two decades.

The [radioactivity](#) in the wastewater is not necessarily dangerous to people who are near it. It can be blocked by thin barriers, including skin, so exposure is generally harmless.

Rather, E.P.A. and [industry researchers](#) say, the bigger danger of radioactive wastewater is its potential to contaminate drinking water or enter the food chain through fish or farming. Once radium enters a person's body, by eating, drinking or breathing, it can cause cancer and other health problems, many federal studies show.

## Little Testing for Radioactivity

Under federal law, testing for radioactivity in drinking water is required only at drinking-water plants. But federal and state regulators have given nearly all drinking-water intake facilities in Pennsylvania permission to test only once every six or nine years.

The Times reviewed data from more than 65 intake plants downstream from some of the busiest drilling regions in the state. Not one has tested for radioactivity [since 2008](#), and most have not tested since at least 2005, before most of the drilling waste was being produced.

And in 2009 and 2010, public sewage treatment plants directly upstream from some of these drinking-water intake facilities [accepted](#) wastewater that contained radioactivity levels as high as [2,122 times](#) the drinking-water standard. But most sewage plants are not required to monitor for radioactive elements in the water they discharge. So there is virtually no data on such contaminants as water leaves these plants. Regulators and gas producers have repeatedly said that the waste is not a threat because it is so [diluted](#) in rivers or by treatment plants. But industry and federal research cast doubt on those statements.

A confidential industry study from 1990, conducted for the [American Petroleum Institute](#), concluded that “using conservative assumptions,” radium in drilling wastewater dumped off the Louisiana coast posed “potentially significant risks” of cancer for people who eat fish from those waters regularly.

The industry [study](#) focused on drilling industry wastewater being dumped into the Gulf of Mexico, where it would be far more diluted than in rivers. It also used estimates of radium levels far below those found in Pennsylvania’s drilling waste, according to the study’s lead author, Anne F. Meinhold, an environmental risk expert now at [NASA](#).

Other federal, state and academic studies have also found dilution problems with radioactive drilling waste.

In December 2009, these very risks led E.P.A. scientists to advise in a letter to New York that sewage treatment plants not accept drilling waste with radium levels [12 or more times](#) as high as the drinking-water standard. The Times found wastewater containing radium levels that were [hundreds of times](#) this standard. The scientists also said that the plants should never discharge radioactive contaminants at levels higher than the drinking-water standard.

In 2009, E.P.A. scientists studied the matter and also determined that certain Pennsylvania rivers were ineffective at sufficiently diluting the radium-laced drilling wastewater being [discharged into them](#). Asked about the studies, Pennsylvania regulators said they were not aware of them.

“Concerned? I’m always concerned,” said Dave Allard, director of the Bureau of Radiation Protection. But he added that the threat of this waste is reduced because “the dilutions are so huge going through those treatment plants.”

Three months after The Times began asking questions about radioactive and other toxic material being discharged into specific rivers, state regulators placed monitors for radioactivity near where drilling waste is discharged. Data will not be available until next month, state officials said.

But the monitor in the Monongahela is placed upstream from the two public sewage treatment plants that the state says are still discharging large amounts of drilling waste into the river, leaving the [discharges](#) from these plants unchecked and Pittsburgh exposed.

## Plant Operators in the Dark

In interviews, five treatment plant operators said they did not believe that the drilling wastewater posed risks to the public. Several also said they were not sure of the waste’s contents because the limited information drillers provide usually goes to state officials.

“We count on state regulators to make sure that that’s properly done,” said Paul McCurdy, environmental specialist at Ridgway Borough’s public sewage treatment plant, in Elk County, Pa., in the northwest part of the state.

Mr. McCurdy, whose plant discharges into the Clarion River, which flows into the Ohio and Mississippi Rivers, said his plant was taking about 20,000 gallons of drilling waste per day.

Like most of the sewage treatment plant operators interviewed, Mr. McCurdy said his plant was not equipped to remove radioactive material and was not required to test for it.

Documents filed by drillers with the state, though, show that in 2009 his facility was sent water from wells whose wastewater was laced with radium at 275 times the drinking-water standard and with other types of radiation at more than 780 times the standard.

Part of the problem is that industry has outpaced regulators. “We simply can’t keep up,” said one inspector with the Pennsylvania Department of Environmental Protection who was not authorized to speak to reporters. “There’s just too much of the waste.”

“If we’re too hard on them,” the inspector added, “the companies might just stop reporting their mistakes.”

Recently, Pennsylvania has tried to increase its oversight, doubling the number of regulators, improving well-design requirements and sharply decreasing how much drilling waste many treatment plants can accept or release. The state is considering whether to require treatment plants to begin monitoring for radioactivity in wastewater.

Even so, as of last November, 31 inspectors were keeping tabs on more than 125,000 oil and gas wells. The new regulations also allowed at least 18 plants to continue accepting the higher amounts set by their original permits.

Furthermore, environmental researchers from the [University of Pittsburgh](#) tested wastewater late last year that had been discharged by [two treatment plants](#). They say these tests will show, when the results are publicly released in March, that salt levels were far above the legal limit.

### **Lax Oversight**

Drilling contamination is [entering the environment](#) in Pennsylvania through spills, too. In the past three years, at least 16 wells whose records showed high levels of radioactivity in their wastewater also [reported spills](#), leaks or failures of pits where hydrofracking fluid or waste is stored, according to state records.

Gas producers are generally left to police themselves when it [comes to spills](#). In Pennsylvania, regulators do not perform unannounced inspections to check for signs of spills. Gas producers report their own spills, write their own [spill response plans](#) and lead their own cleanup efforts.

A review of response plans for drilling projects at four Pennsylvania sites where there have been accidents in the past year found that these state-approved plans often appear to be in violation of the law.

At one well site where several [spills occurred](#) within a week, including one that flowed into a creek, the well’s operator filed a [revised spill plan](#) saying there was little chance that waste would ever enter a waterway.

“There are business pressures” on companies to “cut corners,” John Hanger, who stepped down as secretary of the Pennsylvania Department of Environmental Protection in January, has said. “It’s cheaper to [dump](#) wastewater than to treat it.”

Records back up that assertion.

From October 2008 through October 2010, regulators were more than twice as likely to issue a written warning than to levy a fine for environmental and safety violations, according to state data. During this period, 15 companies were fined for drilling-related violations in 2008 and 2009, and the companies paid an average of about \$44,000 each year, according to state data.

This average was less than half of what some of the companies earned in profits in a day and a tiny fraction of the more than \$2 million that some of them paid annually to haul and treat the waste.

And prospects for drillers in Pennsylvania are looking brighter.

In December, the Republican governor-elect, Tom Corbett, who during his campaign took more gas industry contributions than all his competitors combined, said he would reopen state land to new drilling, reversing a decision made by his predecessor, [Edward G. Rendell](#). The change clears the way for as many as 10,000 wells on [public land](#), up from about 25 active wells today.

In arguing against a proposed gas-extraction tax on the industry, Mr. Corbett said regulation of the industry had been too aggressive.

“I will direct the Department of Environmental Protection to serve as a partner with Pennsylvania businesses, communities and local governments,” Mr. Corbett says on his Web site. “It should return to its core mission protecting the environment based on sound science.”

Published: February 26, 2011  
Drilling Down

## Documents: Natural Gas's Toxic Waste

Over the past nine months, The Times reviewed more than 30,000 pages of documents obtained through open records requests of state and federal agencies and by visiting various regional offices that oversee drilling in Pennsylvania. Some of the documents were leaked by state or federal officials. Here, the most significant documents are made available with annotations from The Times.

### [Challenges of Handling Natural Gas Waste](#)

- [Confidential E.P.A. Draft Document](#)
- [E.P.A. Briefing on Hydrofracking](#)
- [Conference Call Between State and Federal Regulators](#)

### [Disposal of Natural Gas Waste](#)

- [Internal E.P.A. Presentation](#)
- [Tracking Document for Gas Industry Wastewater](#)
- [Pennsylvania Fines Jersey Shore for Sewage Violations](#)

### [Contaminants in Natural Gas Wastewater](#)

- [E.P.A. Scientist Discusses Radioactivity in Waste](#)
- [E.P.A. Draft Document for New York State](#)
- [Field Study of Radioactivity at Marcellus Shale Wells](#)

### [Spills and Spill Plans in Pennsylvania](#)

- [Cabot Oil and Gas's Spill Plan](#)
- [E-mail on Suspected Illegal Dumping into Mine Void](#)
- [Federal Natural Gas Drilling Tip Line](#)

To see the entire series about natural gas extraction by Ian Urbina which includes interactive and video: [http://topics.nytimes.com/top/news/us/series/drilling\\_down/index.html](http://topics.nytimes.com/top/news/us/series/drilling_down/index.html)

Important documents pertaining to the EPA, NY state and other Marcellus Shale documents see: [http://www.toxicstargeting.com/MarcellusShale/documents/epa\\_state\\_other\\_110303](http://www.toxicstargeting.com/MarcellusShale/documents/epa_state_other_110303)

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March 1, 2011

# Wastewater Recycling No Cure-All in Gas Process

<http://www.nytimes.com/2011/03/02/us/02gas.html?scp=6&sq=natural%20gas&st=cse>



Jessica Kourkounis for The New York Times

Carl Orso, a truck driver, filled a beaker with wastewater from a natural gas drilling site for testing before unloading at Eureka Resources, a waste water treatment facility, in Williamsport, Penn.

By [IAN URBINA](#)

As drilling for natural gas started to climb sharply about 10 years ago, energy companies faced mounting criticism over an extraction process that involves pumping millions of gallons of water into the ground for each well and can leave significant amounts of hazardous contaminants in the water that comes back to the surface.

So, in a move hailed by industry as a major turning point, drilling companies started reusing and recycling the wastewater.

“Water recycling is a win-win,” one drilling company, Range Resources, says on its Web site. “It reduces fresh water demand and eliminates the need to dispose of the water.”

But the win-win comes with significant asterisks.

In Pennsylvania, for example, natural-gas companies recycled less than half of the wastewater they produced during the 18 months that ended in December, according to state records.

Nor has recycling eliminated environmental and health risks. Some methods can leave behind salts or sludge highly concentrated with radioactive material and other contaminants that can be dangerous to people and aquatic life if they get into waterways.

Some well operators are also selling their waste, rather than paying to dispose of it. Because it is so salty, they have found ready buyers in communities that spread it on roads for de-icing in the winter and for dust suppression in the summer. When ice melts or rain falls, the waste can run off roads and end up in the drinking supply.

Yet in Pennsylvania, where the number of drilling permits for gas wells has jumped markedly in the last several years, in part because the state sits on a large underground gas formation known as the Marcellus Shale, such waste remains exempt from federal and state oversight, even when turned into salts and spread on roads.

When Pennsylvania regulators tried to strengthen state oversight of how drilling wastewater is tracked, an industry coalition argued vehemently against it. Three of the top state officials at a meeting on the subject have since left the government — for the natural-gas industry.

One executive at a drilling wastewater recycling company said that for all the benefits of recycling, it was not a cure-all.

“No one wants to admit it, but at some point, even with reuse of this water, you have to confront the disposal question,” said Brent Halldorson, chief operating officer of Aqua-Pure/Fountain Quail Water Management, adding that the wastewater contains barium, strontium and radioactive elements that need to be removed.

Mr. Halldorson emphasized that he had not seen high radioactivity readings at the plant he operates in Williamsport, Pa. He said he firmly believed in the benefits of recycling — to reduce the waste produced and water used and to help promote a shift toward natural gas, which burns cleaner than coal for producing electricity. “But there still needs to be a candid discussion, and there needs to be accountability about where even the recycled wastewater is going,” he added.

More than 90 percent of well operators in Pennsylvania use this process, known as hydrofracking, to get wells to produce. It involves injecting water mixed with sand and chemicals at high pressures to break up rock formations and release the gas. Between 10 percent and 40 percent of the water injected into each well resurfaces in the first few weeks of the process.

Many states send their drilling waste to injection wells, for storage deep underground. But because of the geological formations in Pennsylvania, there are few injection wells, and other alternatives are expensive. So natural-gas well operators in the state have turned to recycling.

“The technical breakthroughs that have allowed us to lead the nation in water recycling are complemented by a carefully orchestrated water-management system, involving a combination of on-site and off-site treatment, depending on specific geography and economics,” said Kathryn Klaber, president of the Marcellus Shale Coalition, an industry trade group.

State and company records show that in the year and a half that ended in December 2010, well operators reported recycling at least 320 million gallons. But at least 260 million gallons of wastewater were sent to plants that discharge their treated waste into rivers, out of a total of more than 680 million gallons of wastewater produced, according to state data posted Tuesday. Those 260 million gallons would fill more than 28,800 tanker trucks, a line of which would stretch from about New York City to Richmond, Va.

While the total amount of recycling in the state is nowhere near the 90 percent that the industry has been claiming over the past year, the practice has undoubtedly been on the rise in recent months. The amount reported recycled in the past six months is roughly 65 percent of the total produced, up from roughly 20

percent during the 12 months before that. At least 50 million additional gallons of wastewater is unaccounted for, according to state records.

The fate of more of the wastewater is unknown because of industry [lobbying](#). In 2009, when regulators tried to strengthen oversight of the industry's methods for disposing of its waste, the Marcellus Shale Coalition staunchly [opposed](#) the effort.

"There is no other industry in Pennsylvania that is required to have a manifest system for residual waste," industry officials [argued](#), according to notes from a meeting on March 11, 2009, with state regulators and officials from the governor's office. Under the proposed system, a manifest would have been required so that each load of wastewater was tracked from the well to its disposal, to verify that it was not dumped at the side of the road.

After initially [resisting](#), state officials [agreed](#), adding that they would try to persuade the secretary of Pennsylvania's Department of Environmental Protection to agree, according to the notes. In the end, the state's proposed manifest system for tracking was not carried out.

Three of the top state officials in the meeting — K. Scott Roy, Barbara Sexton and J. Scott Roberts — have since left their posts for jobs in the natural-gas industry.

The tracking system that was put in place requires monthly or yearly reports to the state from well operators indicating where their waste was taken, but offers no way for the state to guarantee that the waste actually reached the disposal sites.

The challenges of tracking all of the industry's drilling waste and disposing of it will not go away soon. At least 50,000 new Marcellus wells are supposed to be drilled in Pennsylvania over the next two decades, up from about 6,400 permitted now.

Wells also create waste that is not captured by recycling, because operators typically recycle only for the first several months after a well begins producing gas.

Though the amount of wastewater decreases over time, the wells can continue to ooze for decades after they have been hydrofracked. There are regulations, however, that govern how gas wells are plugged and abandoned.

"This is important because as the well ages, the fluids that come up from it become more toxic, and the state or companies are even less likely to be tracking it," said Anthony Ingraffea, a drilling expert and professor of civil and environmental engineering at Cornell.

State regulators predict that the heaviest burdens are still to come.

"The waste that flows back slowly and continuously over the 20- to 30-year life of each gas well could produce 27 tons of salt per year," Pennsylvania officials [wrote](#) in new rules adopted last August about salt levels in drilling wastewater being sent through sewage treatment plants. "Multiply this amount by tens of thousands of Marcellus gas wells," they said, and the potential pollution effects are "tremendous."

In an interview on Sunday, John Hanger, who in January stepped down as secretary of Pennsylvania's Department of Environmental Protection, pointed to these rules as some of the strongest in the country and cited other accomplishments during his term, including increasing inspections of drilling industry trucks, more than doubling his department's natural-gas staff and improving well design requirements.

The natural-gas industry uses a number of methods to recycle drilling waste.

Some drillers have used recycling equipment at the well site or trucked the water to a dedicated recycling facility. The wastewater is filtered, [evaporated](#) and then distilled, to be used again at the well. Other

companies add fresh water to the wastewater, to dilute the salts and other contaminants, before pumping it back in the ground for more hydrofracking.

Any sludge that settles from these various processes is taken to landfills, which in Pennsylvania are equipped with radiation monitors, or is sent to injection disposal wells.

But drilling experts say that virtually all forms of recycling still result in liquid waste that can be [more toxic](#) than it was after the first use.

“The wastewater that comes up from the well will likely increase to some degree in many contaminants such as salts and possibly radium and other radionuclides with each new fracking, but the data is very limited on this issue so not much is known,” said Radisav Vidic, an environmental engineering professor and drilling expert at the [University of Pittsburgh](#). “There needs to be more data on this.”

Industry officials said there was no reason for concern about radioactivity levels in wastewater.

“All of our reports indicate that this industry operates within the same standards set forth and observed by all water consumers in Pennsylvania,” said Matt Pitzarella, a spokesman from Range Resources-Appalachia, a part of the Range Resources natural-gas company.

Some energy companies have found more profitable options for getting rid of their drilling wastewater. In West Virginia, for example, environmental regulators and highway officials last year announced plans for the state to start paying around five cents per gallon for gas drilling wastewater known as brine, which tends to be extremely salty, to melt ice on roads.

They planned to buy about 1.2 million gallons of the wastewater at more than 120 sites around the state and to buy more as needed.

West Virginia’s water and waste management director, Scott Mandirola, has said that he recognized that some Marcellus waste may have radioactive contaminants and that some of the waste could find its way to the state’s waters.

But he added that it would be highly diluted by rain or snow and that de-icing the roads was important. State officials also said that only wastewater from shallow wells would be used, thereby reducing levels of radioactivity.

Pennsylvania also allows salty brine produced from the wastewater to be spread on roads for dust suppression or de-icing.

More than 155,000 gallons of this wastewater was sent by a drilling company called Ultra Resources to nine towns for dust suppression in 2009, [state records show](#). The water came from two gas wells in Tioga County and contained radium at almost 700 times the levels allowed in drinking water.

“I was told nothing about frack water or any gas-well brines or anything else,” said Deborah Kotulka, the secretary of Richmond Township, in Tioga County, whose name appears on the state record. Her township received 101,640 gallons of the water from wells with high radioactivity, [those records](#) show.

As gas producers have tried to find new ways to get rid of their waste, they have sought reassurances from state and federal regulators that the industry’s exemptions from federal laws on hazardous waste were broad enough to protect them.

In late 2009, for example, officials from an industry trade group, the Pennsylvania Oil and Gas Association, wrote to regulators to confirm that drilling waste, regardless of how it was handled, would remain exempt from the federal law governing hazardous materials. The association said it was asking in case companies sought to distill the waste into salts for de-icing roads.

“The query has monumental significance,” Steve Rhoads, then the president of the association, [wrote](#) in a September 2009 e-mail to state regulators explaining his members’ concerns about any attempt by federal officials to categorize drilling waste as hazardous material. The correspondence was obtained through open-records requests filed with the state.

If drillers were to lose the exemption from federal law that allowed their waste not to be considered hazardous, they would probably be forced, at great expense, to start more rigorously testing the waste for toxicity.

They might also have to do what most other industries do: ship any sludge or salts that are high in radioactivity to Idaho or Washington State, where there are some of the only landfills in the country permitted to accept such waste.

Instead, federal regulators informed the industry that their exemption remained intact, a decision that association officials quickly passed on to their members. State regulators declined to comment on the exchange because it concerns a federal, not state, exemption. Federal officials said the salts were regulated by the states.

“In short,” Mr. Rhoads wrote his members, the [Environmental Protection Agency](#) has determined that the exemption “remains in effect once the waste is generated, regardless of how the waste is treated or managed.”

To see the entire series about natural gas extraction by Ian Urbina which includes interactive and video: [http://topics.nytimes.com/top/news/us/series/drilling\\_down/index.html](http://topics.nytimes.com/top/news/us/series/drilling_down/index.html)

Important documents pertaining to the EPA, NY state and other Marcellus Shale documents see: [http://www.toxictargeting.com/MarcellusShale/documents/epa\\_state\\_other\\_110303](http://www.toxictargeting.com/MarcellusShale/documents/epa_state_other_110303)

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March 3, 2011

## Politics Seen to Limit E.P.A. as It Sets Rules for Natural Gas

By [IAN URBINA](#)

[http://www.nytimes.com/2011/03/04/us/04gas.html?\\_r=1&hp=&pagewanted=all](http://www.nytimes.com/2011/03/04/us/04gas.html?_r=1&hp=&pagewanted=all)

When Congress considered whether to regulate more closely the handling of wastes from [oil](#) and gas drilling in the 1980s, it turned to the [Environmental Protection Agency](#) to research the matter. E.P.A. researchers concluded that some of the drillers' waste was hazardous and should be tightly controlled.

But that is not what Congress heard. Some of the recommendations concerning oil and gas waste were eliminated in the final report handed to lawmakers in 1987.

"It was like the science didn't matter," Carla Greathouse, the author of the study, said in a recent interview. "The industry was going to get what it wanted, and we were not supposed to stand in the way."

E.P.A. officials told her, she said, that her findings were altered because of pressure from the Office of Legal Counsel of the White House under [Ronald Reagan](#). A spokesman for the E.P.A. declined to comment.

Ms. Greathouse's experience was not an isolated case. More than a quarter century of efforts by some lawmakers and regulators to force the federal government to police the industry better have been thwarted, as E.P.A. studies have been repeatedly narrowed in scope, and important findings have been removed.

For example, the agency [had planned](#) to call last year for a moratorium on the gas-drilling technique known as hydrofracking in the New York City watershed, according to internal documents, but the advice was removed from the publicly released [letter](#) sent to New York.

Now some scientists and lawyers at the E.P.A. are wondering whether history is about to repeat itself, as the agency undertakes a broad new study of [natural gas](#) drilling and its potential risks, with preliminary results scheduled to be delivered next year.

The documents show that the agency dropped some [plans](#) to model radioactivity in drilling wastewater being discharged by treatment plants into rivers upstream from drinking water intake plants. And in Congress, members from drilling states like Oklahoma have [pressured](#) the agency to keep the focus of the new study narrow.

They have been helped in their lobbying efforts by a compelling storyline: Cutting red tape helps these energy companies reduce the nation's dependence on other countries for fuel. Natural gas is also a cleaner-burning alternative to coal and plentiful within United States borders, so it can create jobs.

But interviews with E.P.A. scientists, and confidential documents obtained by The New York Times, show long and deep divisions within the agency over whether and how to increase regulation of oil and gas drillers, and over the enforcement of existing laws that some agency officials say are clearly being violated.

Agency lawyers are in a heated debate over whether to intervene in Pennsylvania, where drilling for gas has increased sharply, to stop what some of those lawyers say is a clear violation of federal pollution laws:

drilling waste [discharged](#) into rivers and streams with minimal treatment. The outcome of that dispute has the potential to halt the breakneck growth of drilling in Pennsylvania.

The E.P.A. has taken strong stands in some places, like Texas, where in December it overrode state regulators and intervened after a local driller was suspected of water contamination. Elsewhere, the agency has pulled its punches, as in New York.

Asked why the [letter](#) about hydrofracking in the New York City watershed had been [revised](#), an agency scientist who was involved in writing it offered a one-word explanation: “politics.”

Natural gas drilling companies have major exemptions from parts of at least seven of the 15 sweeping federal environmental laws that regulate most other heavy industries and that were written to protect air and drinking water from radioactive and hazardous chemicals.

Coal mine operators that want to inject toxic wastewater into the ground must get permission from the federal authorities. But when natural gas companies want to inject chemical-laced water and sand into the ground during hydrofracking, they do not have to follow the same rules.

The air pollution from a sprawling steel plant with different buildings is added together when regulators decide whether certain strict rules will apply. At a natural gas site, the toxic fumes from various parts of it — a compressor station and a storage tank, for example — are counted separately rather than cumulatively, so many overall gas well operations are subject to looser caps on their emissions.

### **An Earlier Reversal**

The E.P.A. also studied hydrofracking in 2004, when Congress considered whether the process should be fully regulated by the Safe Drinking Water Act.

An early draft of the study discussed potentially dangerous levels of contamination in hydrofracking fluids and mentioned “possible evidence” of contamination of an aquifer. The final version of the report excluded these points, concluding instead that hydrofracking “poses little or no threat to drinking water.”

Shortly after the study was released, an E.P.A. whistleblower said the agency had been strongly influenced by industry and political pressure. Agency leaders at the time stood by the study’s findings.

“It was shameful,” Weston Wilson, the E.P.A. whistleblower, said in a recent interview about the study. He explained that five of the seven members of that study’s peer review panel were current or former employees of the oil and gas industry.

“The study ended up being the basis for this industry getting yet another exemption from federal law when it should have resulted in greater regulation of this industry,” Mr. Wilson added.

Some E.P.A. scientists say this pattern may be playing out again in the [national study](#) of hydrofracking that Congress will consider as it decides whether drillers will have to operate under stricter rules.

Internal documents from [early](#) meetings, obtained through public-records requests filed by The Times and provided by E.P.A. officials who are frustrated with how research is being handled, show agency field scientists demanding that certain topics be included in the study. And [earlier versions](#) of the research [plan](#) indicate that many of those topics were to be included.

For example, the study was to consider the dangers of toxic fumes released during drilling, the impact of drilling waste on the food chain and the risks of this [radioactive](#) waste to workers.

But many of these concerns, cited by field scientists in earlier documents as high priorities, were cut from the [current study plan](#), according to a version of it made public on Feb. 8.

Earlier planning documents also called for a study of the risks of contaminated runoff from landfills where drilling waste is disposed and included detailed [plans](#) to model whether [rivers](#) can sufficiently dilute hazardous gas-well wastewater discharged from treatment plants.

These topics were cut from the current study plan, even though E.P.A. officials have acknowledged that sewage treatment plants are not able to treat drilling waste fully before it is discharged into rivers, sometimes just miles upstream from drinking water intake plants.

In interviews, several agency scientists and consultants, who declined to be named for fear of reprisals, said the [study](#) was narrowed because of pressure from industry and its allies in Congress, as well as budget and time constraints.

Brendan Gilfillan, an agency spokesman, said that the plan remained broad and that the agency had taken additional steps to investigate the impacts of drilling, including recently issuing a subpoena against the energy services company [Halliburton](#) to force the company to provide fuller disclosure about its drilling operations.

Federal scientists also say the national study is being used to squelch other research by the E.P.A. on hydrofracking. At a January meeting in Washington, Jeanne Briskin of the [E.P.A.'s Office of Research and Development](#) informed regional directors that the national study would be the [only forum](#) for research on hydrofracking.

This meant, these scientists said, that some projects under way in regional offices would probably have to be stopped.

“That may impact our plans to pursue some of the other research,” wrote Ron Landy, regional science liaison of E.P.A. Region 3, in an [e-mail](#) to another agency official in January in which he complained about the new directive.

He suggested that until the directive was lifted, his staff should keep quiet about its continuing hydrofracking research and instead emphasize its work on coal to superiors. “I think we can go ahead, but keep the focus on mining, and prepare for moving these efforts into hydraulic fracking once these limitations are lifted,” Mr. Landy wrote.

Though the E.P.A. has emphasized the importance of openness and public involvement in the study, internal e-mails show agency officials expressing concern about the reaction if the public were to learn of the narrowing scope of the study.

In those e-mails, these officials strongly discourage anyone from putting anything in writing about the national study unless it is vetted by managers.

In one [e-mail](#), forwarded to The Times by David Campbell, director of the [E.P.A. Region 3 Office of Environmental Innovation](#), described the instructions he had been given by the agency’s regional administrator, Shawn M. Garvin.

“He could not have been more adamant or clear about the development of any documentation related to our efforts on Marcellus,” Mr. Campbell wrote last December, referring to the Marcellus Shale, a gas-rich rock formation that stretches under Pennsylvania and other states. “His concern is that if we spell out what we think we want to do (our grandest visions) that the public may have access to those documents and challenge us to enact those plans.”

Mr. Gilfillan, the E.P.A. spokesman, said the e-mail exchange — which was shown to him for comment — did not reflect the agency’s efforts to understand the impacts of natural gas extraction better. But in interviews, agency scientists and lawyers said Mr. Garvin’s office had been most resistant to stepping up its regulatory role in Pennsylvania.

These scientists and lawyers said that high-level agency officials in Washington had made it clear in meetings that some of the resistance to more rigorous enforcement was also coming from members of the environmental and energy staff at the White House.

Clark Stevens, a spokesman for the White House, rejected these assertions and argued that the Obama administration had taken “unprecedented steps” to study the impacts of natural gas drilling.

### **Support in Washington**

In its efforts to oppose new federal regulations, the oil and gas industry has found strong allies in Congress to [lobby the agency](#) about its current research.

“I am confident this study, if truly focused on hydraulic fracturing,” [wrote](#) Senator [Tom Coburn](#), Republican of Oklahoma, last April to the E.P.A. administrator, [Lisa P. Jackson](#), “will prove the process indisputably safe and acceptable.”

Last September, Senator [James M. Inhofe](#), also a Republican from Oklahoma, wrote to agency officials to offer his guidance about who should be allowed to review the research.

“We caution against potential panelists who have been longtime critics of hydraulic fracturing,” he [wrote in a letter](#).

Over their careers, the two lawmakers from Oklahoma, a major drilling state, have been among the Senate’s top 20 recipients of oil and gas campaign contributions, according to federal data.

The oil and gas industry has not hesitated to convey its views to the agency about the study now under way, frequently quoting the language used in 2010 by a Congressional committee, which urged the E.P.A. “to carry out a study on the relationship between hydraulic fracturing and drinking water.”

In one [comment](#) submitted to the agency, Chad Bradley, a lobbyist for [Chesapeake Energy](#), criticized the E.P.A., saying it was going beyond its “mandate” from Congress, adding new topics resulting in “mission creep.”

Virtually all of the companies [echoed](#) his comments.

But Representative [Maurice D. Hinchey](#), Democrat from New York, who wrote the original language, said his words were being taken out of context. He added that the E.P.A. had full jurisdiction to study other risks from hydrofracking, like air quality or toxic waste being discharged into rivers.

“The language I authored does not at all limit the scope of the E.P.A.’s study, rather it sets forth the minimum that Congress expects,” he added. “Any assertion otherwise by industry is a blatant attempt to misrepresent Congress’s intentions.”

The [argument](#) over the scope of the study will affect whether certain exemptions for the oil and gas industry will remain intact.

These exemptions have led to conflicting impulses in Washington for a long time. For example, [Carol M. Browner](#), the E.P.A. administrator in the first Clinton administration, has argued both for and against these sorts of exemptions.

“Whatever comes out of the ground, you don’t have to test it, you don’t have to understand what’s in it, you can dump it anywhere,” Ms. Browner, said in a 1997 interview on “60 Minutes,” discussing exemptions for toxic wastes from the oil industry, which also apply to natural gas drillers.

“That’s how broad the loophole is,” she added at the time (her office declined to answer questions about those comments). “There’s nothing like it in any environmental statute. Congress should revisit this loophole.”

And yet, Ms. Browner, who announced in January that she was stepping down as [President Obama](#)’s top adviser on energy and [climate change](#), has also been a strong supporter over the years of natural gas drilling. For example, she helped ensure in 1995 that hydrofracking would not be covered by certain parts of the Safe Drinking Water Act.

### **Exemptions Stymie E.P.A.**

The natural gas drilling boom is forcing the E.P.A. to wrestle with questions of jurisdiction over individual states and how to police the industry despite its extensive exemptions from federal law.

In Wyoming, for example, the agency is investigating water-well contamination in an area of heavy drilling, even though some within the E.P.A. said in interviews that because of industry exemptions, the agency might not have powers to conduct such an investigation.

In Texas, after an aquifer was contaminated, E.P.A. officials in December ordered a drilling company to provide clean drinking water to residents despite strong resistance from state regulators who said the federal action was premature and unfounded.

The stakes are particularly high in Pennsylvania, where gas drilling is expanding quickly, and where E.P.A. officials say [drilling waste](#) is being discharged with inadequate treatment into rivers that provide drinking water to more than 16 million people.

Drillers throughout the country are watching Pennsylvania to see whether the federal agency will overrule the state’s decisions on how to dispose of drilling waste.

The central question on this issue: Should drillers in Pennsylvania be allowed to dump “mystery liquids” into public waterways?

Under federal law, certain basic rules govern sewage treatment plants. At their core, these rules say two things: operators have to know what is in the waste they receive, and they have to treat this waste to make it safe before discharging it into waterways.

But in Pennsylvania, these rules are being broken, according to some E.P.A. lawyers.

“Treatment plants are not allowed under federal law to process mystery liquids, regardless of what the state tells them,” explained one E.P.A. lawyer in an internal draft memo obtained by The Times. “Mystery liquids is exactly what this drilling waste is, since its ingredient toxins aren’t known.”

This fact has led to a heated fight within the E.P.A.

Some agency lawyers say the state is not policing treatment plants properly in some instances and is acting beyond its authority in others — allegations that state officials reject.

These lawyers are calling for the E.P.A. to revoke, at least temporarily, Pennsylvania’s right to give treatment plants operating permits to handle drilling waste. Last year, state regulators created their own pretreatment standards for plants handling this waste, even though these regulators lacked federal permission to do so, agency lawyers say.

E.P.A. scientists working on the agency’s national hydrofracking study have also emphasized that sewage treatment plants are not, technically speaking, treating the waste.

For example, when one agency scientist wrote in a draft plan for the national study that wastewater could be “discharged to surface water after treatment to remove contaminants,” another scientist corrected the statement in the margin.

Using the federal definition of treatment, the second scientist wrote, “we really don’t fully treat the waste.”

Nevertheless, the E.P.A. Region 3 office, which oversees Pennsylvania, has staunchly resisted calls from agency lawyers to order the state to stop issuing permits to treatment plants handling drilling waste.

“The bottom line is that under the Clean Water Act, dilution is not the solution to pollution,” the enforcement lawyer wrote. “Sewage treatment plants are legally obligated to treat, not dilute, the waste.”

“These plants are breaking the law,” the lawyer said. “Everyone is looking the other way.”

To see the entire series about natural gas extraction by Ian Urbina which includes interactive and video:  
[http://topics.nytimes.com/top/news/us/series/drilling\\_down/index.html](http://topics.nytimes.com/top/news/us/series/drilling_down/index.html)

Important documents pertaining to the EPA, NY state and other Marcellus Shale documents see:  
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# Waste Water Byproducts of Shale Gas Drilling and Fracking

## A Look at Flowback and Produced Water Fracking Waste

BY WENDY LYONS SUNSHINE

Updated October 29, 2019

Natural gas is retrieved from underground shale deposits through a process called hydraulic fracturing. This procedure is also referred to as hydrofracking, hydro-fracturing, or fracking. During hydrofracking, millions of gallons of water mixed with industrial chemicals and proppant—[sand](#) or ceramic particles—are blasted into the well bore to release [natural gas](#). In the Marcellus Shale formation in the Northeastern United States, for example, fracking a single well can require 1–5 million gallons of this water mixture.

### Types of Fracking Waste Water

Wastewater from shale gas drilling goes by two names: **flowback** and **produced water**. These terms are often used interchangeably, but they have different meanings. The amount of flowback and produced water varies greatly among wells, and not all shale formations produce a lot of water. Two that produce little or no water are the Lewis Shale, located in the San Juan Basin of New Mexico and Colorado, and the Fayetteville Shale in Arkansas.

### Flowback

After the hydraulic fracturing procedure is completed, pressure in the well is released. The direction of fluid flow reverses, and water and excess proppant flow back through the wellbore to the surface. Both the process and the returned water are commonly referred to as flowback.

### Produced Water

After drilling and fracturing a well, water may come out of it along with the natural gas. Some of the water is returned fracturing fluid, and some of it occurs naturally in the geological formation. These produced waters move back through the wellhead with the gas.

## Fracking Waste Water Contents

Flowback and produced water—which contain salt, industrial chemicals, hydrocarbons, and radioactive materials—are considered hazardous waste and must be disposed of safely. According to the [Environmental Protection Agency](#) (EPA), produced waters should be disposed of in deep wells or non-potable coastal waters.

Flowback and produced water are highly salty because salts are added to the fracturing fluid and also released from the geologic formation. Produced water is so famous for salinity that the hydrocarbon industry often refers to it simply as saltwater or brine. In the Marcellus Shale, flowback water has been measured at 32,300 mg per liter (mg/L) of sodium. For comparison, EPA guidelines call for a maximum of 20 mg/L in drinking water.

Flowback and produced water also contain chemicals that have been injected into the well to facilitate drilling. For example, in the Marcellus Shale, flowback water contains high concentrations of sodium, magnesium, iron, barium, strontium, manganese, methanol, chloride, sulfate and other substances. Produced water can contain hydrocarbons—including the toxic substances benzene, toluene, ethylbenzene, and xylene—which can be freed during the drilling process.

Water returned to the surface during drilling can carry naturally occurring radioactive materials, referred to by the industry as “NORM.” Flowback and produced water from several large U.S. shale formations have been found to contain the radioactive element radium, and when produced water is salty and rich in chlorides, radium tends to be present in higher concentrations. The EPA allows a maximum of 5 picocuries of radium per liter of drinking water. Produced water has been found to contain [radium](#) levels as high as 9,000 picocuries per liter.

# Fracking Water: It's Just So Hard to Clean

5 MINUTE READ

PUBLISHED OCTOBER 4, 2013

ANOTHER CRACK IN the “fracking is safe” story for the industry to address.

You know that fracking thing? For the uninitiated, hydraulic fracturing (a.k.a. fracking) is the technique of injecting water, sand and chemicals at high pressures into shale and other tight rock formations to release the fuel trapped inside. Combined with horizontal drilling, [fracking has allowed us to access huge amounts of heretofore unrecoverable natural gas.](#)

What a bonanza: a [new and sizable source of natural gas.](#) And, at first blush, a [fuel that's good for the environment:](#) natural gas is the cleanest of the fossil fuels and has already begun [displacing coal, the dirtiest fossil fuel, in U.S. power plants.](#)

## Complications With Fracking

But alas, as with most too-good-to-be-true things, fracking's got some downsides. Among the more vexing is the potential for significant environmental costs. Measurements suggest that, at least in some cases, [drilling operations that include fracking have caused contamination of surface and drinking water,](#) and [fracking operations, like all natural gas drilling, cause the leakage of methane,](#) a powerful greenhouse gas, into the atmosphere. Since the fracking rush is way past the start phase, these are probably not non-starters for fracking, but they do represent huge challenges for industry and government who need to make sure they are appropriately addressed.

## Wastewater Complication

Now a [paper](#) published this week in the journal *Environmental Science and Technology* by Nathaniel Warner formerly of Duke University and colleagues focuses on another of those environmental costs: disposal of wastewater.

Hydraulic fracturing, as the term implies, involves water — both at the front end with [fracking fluid](#), the water-based chemical cocktail that is injected into the shale, and at the back end where there is flowback water and produced water.

Flowback water (which literally “flows back” during the fracking process) is a mixture of fracking fluid and formation water (i.e., water rich in brine from the targeted shale gas-rich rock). Once the chemistry of the water coming out of the well resembles the rock formation rather than the fracking fluid, it is known as produced water and can continue to flow as long as a well is in operation. (For more, see [“Natural Gas, Hydrofracking and Safety: The Three Faces of Fracking Water.”](#))

As a general rule, you would not want to take a shower much less drink flowback or formation water, nor would you want to just pour the stuff into a river or stream (although that has been known to happen, as described [here](#) and [here](#)). Fracking wastewater can contain massive amounts of brine (salts), toxic metals, and radioactivity. And so the gas companies have a problem: what to do with the stuff.

Ideally, the water would be reused or recycled, eliminating the need for immediate disposal. And indeed there is a lot of that. In the Marcellus Shale gas country of Pennsylvania, for example, a [large percentage of the water, in the vicinity of 70 percent, is currently reused](#). And methods to reuse more are being developed. Even so, that leaves a massive amount of toxic wastewater to be disposed of.

One disposal route is injection into deep wells, and a good deal of flowback and produced water from the Marcellus Shale is transported to Ohio for just such a deep burial. But this method has its own problems — the injection process has the inconvenient habit of [causing an earthquake every now and again](#).

Another alternative is waste treatment: removing the contaminants and then dumping the “clean” water into a nearby sewer or river. But you can’t use a standard municipal water treatment plant to treat flowback and produced water as those facilities are just not designed to handle the level of contamination, especially radioactivity, found in these waters. (See [here](#), [here](#), [here](#), [here](#) and [here](#).)

But there are so-called brine treatment plants that are at least in principle equipped to handle that level of contamination. Although they’ve been in use for [quite some time to treat water from conventional oil and gas operations](#), many facilities of this type have been found lacking and [some have even incurred fines for failure to meet Clean Water Act](#) or other regulatory standards.

**Left: contaminated water in. Center: sludge. Right: cleaner water out. Operators at an oil and gas wastewater treatment plant I visited last year claim the cleaned water on the right is suitable for dumping into the municipal waste water stream.**

LEFT: CONTAMINATED WATER IN. CENTER: SLUDGE. RIGHT: CLEANER WATER OUT. OPERATORS AT AN OIL AND GAS WASTEWATER TREATMENT PLANT I VISITED LAST YEAR CLAIM THE CLEANED WATER ON THE RIGHT IS SUITABLE FOR DUMPING INTO THE MUNICIPAL WASTE WATER STREAM.

So how well do these facilities really do? What is their downstream impact? Warner and his colleagues set out to find out.

**The Effluent From a Plant Designed to Treat Fracking Effluent**

Specifically, the authors looked at the effluent from the Josephine Brine Treatment Facility in western Pennsylvania and its impact on downstream water quality and sediment. The plant, which only treats oil and gas wastewater, dumps its effluent into Blacklick Creek, a [kayaking](#) and [whitewater](#) destination. Over a two-year period beginning in August 2010, Warner et al. collected effluent as well as downstream and background water and sediment samples, and analyzed them for key contaminants and radioactivity.

You could say that the results raise some concerns:

- While radioactive “radium [was] substantially (>90%) reduced in the treated effluents,” stream sediments at the point of discharge were about 200 times background levels. The good news is that most of the radium appears to be localized in those nearby sediments\*\*. The concern is that by hanging around at elevated concentrations, it can potentially be a long-term source of radiation for nearby aquatic life. It also has the potential to be remobilized and transported downstream eventually.
- Chloride and bromide concentrations downstream of the plant were on average 4.5 and 12 times background levels. The plant was found to contribute about 90 percent of the downstream chloride content. Bromide enrichment can be a problem for downstream drinking water treatment facilities given that carcinogenic compounds form during chlorination in the presence of bromide.

Indeed, these problems have been on the radar of the U.S. Environmental Protection Agency and the Pennsylvania

Department of Environmental Protection [“since at least July 2011, when the agency tested the sediments at Blacklick Creek and found radioactivity higher than the base line established by EPA.”](#) (Read [more here.](#)) In a [settlement \[pdf\]](#) with EPA, Fluid Recovery Services LLC, the parent company of the Josephine Brine Treatment Plant and two other facilities where contamination was found, agreed to required upgrades, tighter treatment standards, and monitoring for radioactivity once the plant begins accepting shale gas wastewater. (More [here \[pdf\].](#))

### **The Effluent From a Plant Designed to Treat Fracking Effluent**

Effluent isn't the only byproduct. As part of the treatment, chemicals are added to the fracking wastewater to precipitate out salts and metals. And just like the water from the plant, plant operators must have a place to send the precipitates to. Warner et al. calculate that each kilogram of the resulting sludge could contain roughly 900 becquerels of radium\* (at 900 becquerels of radioactivity, 900 atoms of radium decay every second emitting a high-energy alpha particle and leaving behind a radioactive gas, radon). This level of radiation exceeds the level for application to soil and may also [exceed some landfill limits as well](#). And if it exceeds landfill limits, then it has to be treated as a hazardous waste, which is another can of radioactive and contaminated worms in its own right.

Are all treatment plants like Josephine? I suspect not. One advanced plant I visited during an eco-fact-finding trip to Pennsylvania in June 2012, run by [Eureka Resources](#), appeared to do a pretty thorough job of getting contaminants out of wastewater from fracking operations (see photo), but even it has [garnered some air quality violations from EPA](#). And plants like Eureka's are not a panacea: even these plants have to deal with the sludge that's left behind; they are expensive, and at least for now, their current capacity is quite limited.

You gotta feel bad for the gas companies. Their shale gas boom keeps coming up with cracks they need to seal up — in this case the crack is leaking some really foul water.

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### **End Note**

\* Assumes half of the wastewater treated at the facility is wastewater from Marcellus Shale gas wells.

\*\* In 2011, the Pennsylvania Department of Environmental Protection [found levels of radium were still elevated in samples collected 20 meters downstream](#) from the point of discharge.