

**The Potential Health Impacts of Hydraulic Fracturing
Testimony before the New York State Assembly Standing Committees
on Environmental Conservation and Health**

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Chairman Sweeney, Chairman Gottfried, and distinguished members of the committees:

Thank you for convening this hearing on a topic that is of urgent concern to all New Yorkers. Hydraulic fracturing relies on pressure, water, and high volumes of inherently toxic chemicals to shatter the bedrock beneath our feet and beneath our drinking water aquifers. Once shattered, the bedrock releases more than just bubbles of natural gas. The rock itself releases inherently toxic materials that have been bound together with the shale for 400 million of years. As we, in New York, consider whether to permit or prohibit this form of energy extraction, it is essential that we understand the possible consequences to public health as a prerequisite for making that decision. Once shale is shattered, it cannot be unshattered, nor groundwater unpoisoned.

Some of the chemicals used in hydraulic fracturing—or liberated by it—are carcinogens. Some are neurological poisons with suspected links to learning deficits in children. Some are asthma triggers. Some, especially the radioactive ones, are known to bioaccumulate in milk. Others are reproductive toxicants that can contribute to pregnancy loss. Cancer, miscarriage, learning disabilities, and asthma are not only devastating disorders, they are expensive. They add rocks to the pockets of our health care system and cripple productivity.[1] A recent analysis published in our nation's preeminent public health journal, *Health Affairs*, estimates that we now spend \$76.6 billion each year on health care for children exposed to toxic chemicals and air pollution.[2]

So it is right that we ask if hydraulic fracturing brings with it involuntary environmental exposures that may increase our disease burden here in New York. I applaud you for initiating this conversation. It feels like an historic moment.

My name is Sandra Steingraber. I'm a distinguished scholar in residence at Ithaca College, and my Ph.D. is in biology from the University of Michigan. More specifically, my training is in systems ecology, which means I'm interested in understanding how a dynamic web of direct and indirect interactions—from pollination to groundwater flow—helps shape the natural world.

Early on in my career as a biologist, I had a profound personal experience that led me to the work I do now, which is focused on understanding how the cumulative impacts of multiple environmental exposures to toxic chemicals create risks for *human* health.

At the age of 20, I was diagnosed with bladder cancer, a quintessential environmental cancer with well-established links to particular classes of chemicals. Questions about my possible chemical exposures posed to me by my own diagnosing physician led me, years later, to return to my hometown in Illinois and investigate an alleged cancer cluster there. Among other things, I discovered the presence of dry-cleaning fluid in the drinking water wells. That was a surprise because the underlying geology of the area should not have allowed toxic contamination to happen. But there it was. I came to appreciate how little we really know about the unmapped, subterranean landscape below our feet, which has intimate, unseen connections to the world above ground. It's not just an inert lump of rock down there.

My investigation of the environmental links to cancer became the topic of my book *Living Downstream*, which was released last year as a documentary film. I've also published two books on pediatric

environmental health, the most recent of which is *Raising Elijah: Protecting Children in an Age of Environmental Crisis*. The book's final chapter addresses the potential health threats of hydraulic fracturing, and I'm pleased to share the results of my research with you.

I'll begin by saying that a comprehensive study of the long-term, cumulative, public health impacts of fracking has not been done. However, we do know quite a lot about the risks to human health posed by some of the chemicals used in the process or released by it.

Health Effects from Air Pollution

Because breathing is our most ecological act—we inhale a pint of atmosphere with every breath—I'll begin with air.

Air pollution is an inevitable consequence of horizontal hydrofracturing. It is not the outcome of a catastrophic accident. It is not a hypothetical risk. Compromised air quality is a certainty. Because four to nine million gallons of fresh water are required to frack a single well and because wells must cover the landscape for Marcellus shale development to be profitable, fracking is a shock and awe operation. 77,000 wells are envisioned for upstate New York alone.[3] Each well requires 1,000 truck trips. 77,000 times 1,000 equals a number with six zeroes after it. This represents a prodigious amount of diesel exhaust. And, of course, in addition to endless fleets of 18-wheelers, gas production requires generators, pumps, drill rigs, condensers and compressors, which also run on diesel. At the same time, the wellheads themselves vent volatile organic chemicals—such as benzene and toluene—that are themselves highly toxic and can combine with combustion byproducts to create smog.[4]

This kind of air pollution is lethal. It contains large amounts of ultrafine particles, soot, ozone, and the carcinogen benzo-a-pyrene. In adults, these pollutants are variously linked to bladder, lung, and breast cancer, stroke, diabetes, and premature death. In children, they are linked to premature birth, asthma, cognitive deficits, and stunted lung development.[5]

Again, this harm comes with economic costs. Premature birth, which is the leading cause of disability in the United States, carries \$26 billion a year price tag. The direct and indirect costs of childhood asthma are \$18 billion a year.[6]

What's more, the airborne contaminants from gas drilling travel long distances, up to 200 miles.[7] That is to say, the health costs of drilling will be borne by children living in areas where no one is benefiting financially from land leases. Albany will be affected. So will New York City.

In the gas-producing areas of Utah and Wyoming, formerly pristine air now contains more ozone than downtown Los Angeles.[8] As the mother of a child with a history of asthma, this concerns me deeply. New York is not Wyoming. Our starting point here is not pristine, and our population density is much greater. The cumulative impact of the air pollution that would be generated by hydraulic fracturing and the air pollution already here in our state is a question that, I submit, requires investigation before any permits are issued.

Health Effects from Water Pollution

We are each of us in this room 65 percent water by weight. As such, we enjoy an exquisite communion not only with the atmosphere but with the water cycle, too.

Fracking turns millions of gallons of fresh water into poisonous flowback fluid that requires permanent disposal. The technology does not exist to turn this waste into drinkable water nor remove the radioactive isotopes. You cannot filter radioactivity. This much we know with certainty. The unfolding nuclear disaster in Japan illustrates the point.

We also know that there are many documented cases of surface and ground water contamination with compounds associated with gas extraction, including the carcinogen benzene.[9] However, because hydraulic fracturing has been granted the environmental equivalent of diplomatic immunity—and enjoys special exemptions from both the Clean Water Act and the Clean Drinking Water Act—it is difficult for those of us in the research community to quantify the public health consequences. Researchers lack knowledge about the behavior of groundwater, and, because of trade secrets, they also don't know what chemicals to test for.[10]

We do know, from a study released earlier this month, that drinking water wells near gas extraction sites in Pennsylvania and New York have, on average, 17 times higher methane levels than wells located farther away.[11]

Other than possible explosions, what are the health consequences of drinking and inhaling methane? For pregnant women? For children? For anybody? We don't know. Those studies have never been done. The federal government does not regulate methane in drinking water.

We do know that disinfection byproducts are created when water containing carbon-based contaminants is chlorinated. These include trihalomethanes, such as chloroform, which are, in fact, linked to both bladder and colon and cancers.[12] Can methane serve as a raw material for the creation of carcinogenic compounds during the disinfection of public drinking water? To my knowledge, we in the scientific community don't have an answer to that question.

I have brought with me a jar of water from my kitchen tap in the village of Trumansburg, which comes from a municipal well sunk into a groundwater aquifer next to Cayuga Lake, where fracking fluid from Pennsylvania has been dumped. Every day, I pour this water into glasses and hand them to my children. Every day, this water becomes their blood plasma. It becomes their tears. It becomes their cerebral spinal fluid. According to the most recent annual Drinking Water Quality Report for my village, this water contains 29.2 parts per billion trihalomethanes. That's not in violation of regulatory limits, but it's worrisome as there is no documented safe threshold level of exposure. This water also contains nitrates, probably as the result of agricultural run-off. Their presence in this jar is, all by itself, not a call for alarm. But it is a sign that our municipal water, which draws from an unconfined aquifer, is vulnerable to chemical contamination. It shows that there exist hidden connections between the surface of the earth and the watery vaults of groundwater deep beneath our feet.

What would happen to this water if the fields that surround my village—many of which are already leased to gas industry—become a staging ground for fossil fuel extraction?

This is not a hydrological experiment that I am interested in running.

Impact on Food

I have also brought with me a loaf of bread and a bag of flour. Both are made from organic heirloom wheat and rye that is grown in my home county and milled right in my village. You can find similar loaves of artisanal bread—made from this same flour—in Brooklyn bakeries. This particular loaf was created by Stefan Senders of the Wide Awake Bakery in Mecklenburg, New York. Baker Senders asked me to submit this loaf as his personal testimony to the Assembly today. And it comes with a message:

“Please tell the committees that bread is mostly water. The flour and the yeast are just a matrix to make water stand up. I can't bake bread without a source of clean water.”

He also told me that the farmers who grew the organic wheat to make his flour are surrounded by leased land. He believes whole farm-to-table enterprise is threatened by fracking.

Baker Stefan and his suppliers have reason to feel concern. Organic farmers who raise food near fracking operations are facing potential boycotts and will lose their certification if their crops and animals are chemically contaminated.

Upstate New York was recently identified by the *New York Times* as a national hotspot for organic agriculture, which itself is the most rapidly expanding sector of the food production system that has continued to grow even during the economic downturn.[13] Cows, wheat fields, vineyards, maple syrup, and apple orchards: they are all part of a healthy human food chain. They all require clean water, and they are all affected badly by exposure to air pollution.

Of course, public health is also served by employment opportunities in the form of non-toxic jobs. The above-mentioned mill and bakery are currently hiring. They both have plans to grow their businesses as demand for locally produced, organic bread is rising. The grain farmers, too, are seeking additional land. However, as baker Stefan Senders informs me, concern about the area gas leases and the possible end of the current state moratorium on horizontal drilling have negatively affected plans for locally expanding organic wheat agriculture and artisanal bread baking. This raises a question: is the human health of New York best served by jobs that involve organic bread production or fossil fuel extraction?

Conclusions

I fervently hope that these hearings are the beginning, not the end, of an essential conversation. In its current incarnation, the New York State Department of Environmental Conservation's draft Supplemental Environmental Impact Statement—on which the future of hydraulic fracturing hangs—considers neither human health consequences nor the cumulative impacts of the numerous hazards that gas drilling has brought to our doors.

The human health impacts of fracking cannot be understood by looking at one chemical exposure by itself, one river at a time, one well pad in isolation. We all know that it is not just the last straw that breaks the backs of camels. I urge the Assembly to look at the all straws, employing the new tools of cumulative impacts assessment to do so.[14] Until that work is complete, benefit of the doubt goes to New York's children, water, cows, and wheat fields, not to things that threaten them.

[1] President's Cancer Panel, *Reducing Environmental Cancer Risk: What We Can Do Now, 2008-2009 Annual Report* (National Cancer Institute, May 2010)

[2] L. Trasande and Y. Lui, "Reducing the Staggering Costs of Environmental Disease in Children, Estimated at \$76.6 Billion in 2008," *Health Affairs* 30 (5): 863-70, 5 May 2011.

[3] This estimate is based on assumptions about how much of the shale will be tapped over what period of time. 77,000 wells assumes that 17 New York State counties are drilled and that the shale is 70 percent developed over 50 years at a density of eight wells per square mile. T. Engelder, "Marcellus 2008 Report Card on the Breakout Year for Gas Production in the Appalachian Basin," *Forth Worth Basin Oil and Gas Magazine*, Aug. 2009, pp. 18-22, and Anthony Ingraffea, Ph.D., personal communication.

[4] C.D. Volz et al., "Potential Shale Gas Extraction Air Pollution Impacts," *FracTracker—Marcellus Shale Data Tracking*, Foundation for Pennsylvania Watersheds, 24 Aug. 2010.

[5] American Lung Association, "Health Effects of Ozone and Particle Pollution," *State of the Air, 2011*; President's Cancer Panel, *Reducing Environmental Cancer Risk: What We Can Do Now, 2008-2009 Annual Report* (National Cancer Institute, May 2010).

[6] American Lung Association, *Asthma and Children Fact Sheet*, Feb. 2010; J.M. Perrin et al., "The Increase of Childhood Chronic Conditions in the United States," *Journal of the American Medical Association* 297 (2007); U.S. Centers for Disease Control, *Summary Health Statistics for U.S. Children: National Health Interview Survey, 2006* and "Premature Birth," 2010.

[7] S. Kemball-Cook et al., "Ozone Impacts of Natural Gas Development in the Haynesville Shale," *Environmental Science and Technology* 15 (2010): 9357-63.

[8] M. Bernard, "Air Pollution Becoming a Basin Concern," *Vernal Express*, 5 Oct. 2010; D.M. Kargbo et al., "Natural Gas Plays in the Marcellus Shale: Challenges and Potential Opportunities," *Environmental Science & Technology* 44 (2010): 5679-84.

[9] A. Lustgarten and ProPublica, "Drill for Gas, Pollute the Water," *Scientific American*, 17 Nov. 2008.

[10] For example, U.S. Agency for Toxic Substances and Disease Registry, *Evaluation of Contaminants in Private Residential Well Water, Pavillion, Wyoming, Fremont County*, August 2010.

[11] S.G. Osborne et al., "Methane Contamination of Drinking Water Accompanying Gas-Well Drilling and Hydraulic Fracturing," *Proceedings of the National Academy of Sciences*, May 2011, epub before print.

[12] R.D. Morris et al., "Chlorination, Chlorination By-products and Cancer: A Meta-analysis," *American Journal of Public Health* 82 (1992); H.W. Weinberg et al., "Disinfection By-Products (DBPs) of Health Concern in Drinking Water: Results of a Nationwide DBP Occurrence Study (Athens, GA: EPA National Exposure Research Laboratory, 2002).

[13] H. Fairfield, "The Hot Spots for Organic Food," *New York Times*, 3 May 2009.

[14] "Cumulative impacts" refers to the combined effect of numerous adverse impacts on public health or ecosystems from environmental hazards. The Science and Environmental Health Network has launched a new website that describes the latest science on cumulative impacts assessment: www.cumulativeimpacts.org.