Why Horizontal Drilling and Hydraulic Fracturing of Gas Wells Should Be Banned in New York State

White Paper Prepared by Sustainable Otsego
for Congressman Michael Arcuri, November, 2009

www.SustainableOtsego.org
for additional shale gas drilling information

Contributors:

Richard Averett, Dr. Ron Bishop, James Herman, John Kosmer, Adrian Kuzminski, Sarah MacArthur, John Schwartz, Marti Stayton, Anita Weber, Lisa Wright

Contact:

Adrian Kuzminski, Sustainable Otsego Moderator
607-547-8586
adrian@oecblue.com

Contents

Summary

A Colorado family is living in fear that their house could go up in flames at any moment. Amee Ellsworth of Hudson can turn on a faucet in her kitchen or bathroom, light a match and watch as flames shoot out because natural gas from nearby wells have seeped into her groundwater supply.

Our conclusion, on the basis of the points below, is that shale gas drilling is unsafe given its current or any likely technology, and unjust given the current legal and regulatory framework, and should therefore at this time be banned in NYS.

New York State is poised for extensive extraction of natural gas from the Marcellus, Utica, and other shale formations by hydraulic fracturing of horizontal wells, a much more invasive process than old-style non-shale vertical gas drilling. Gas interests are racing to establish a production grip before the true scope and breadth of the dangers of horizontal fracking drilling are made public.

Industry representatives and many leaseholders have stressed the safety of extraction procedures and their financial benefits. Until now there has been very little systematic research into the consequences of shale gas drilling, allowing industry claims to go largely unchallenged.

The gas industry dismisses any and all hazards as fixable or isolated incidents, while they are in fact systemic and inexorably intertwined with shale gas drilling. It is time to slam on the breaks of this runaway train. There is no rush to get gas into production. Demand is low and global supplies high. In fact, the gas industry is trying to create demand to make shale gas drilling profitable.

Considerable new evidence indicates that shale gas drilling threatens to contaminate water quality and supply. In addition, it was discovered that wastewater from drilling operations can be radioactive. Recent evidence also has come to light demonstrating that the average true effective life of gas wells are significantly shorter than promoted by gas companies to attract support. Indeed, anecdotal accounts, investigative journalism, and professional research,

cumulatively considered, point to an inescapable conclusion: that shale gas drilling under current technologies is far too dangerous to be allowed under conditions found anywhere in NYS.

The New York City Department of Environmental Protection has reached this same conclusion, insisting that the NYC watershed in the Catskills, which includes the city's drinking water reservoirs, be exempt from shale gas drilling. If the risk is too great for the people of NYC, then it is surely too great for the rest of the state. New Yorkers deserve uniform protection under the law.

Two to eight percent of shale gas wells developed by the intensive new technologies commonly fail, according research by Dr. Ron Bishop, chemist at SUNY Oneonta. The results have been fouled surface waters and aquifers, polluted soil, contaminated groundwater, decreased livestock birth rates, and deaths from at least one explosion caused by infiltrating gas. This is far too great a risk to run of permanent damage to water quality, compromising drinking supplies and public health.

Shale gas drilling also brings serious violations of property and legal rights. So-called "compulsory integration," by which landowners may be forced to allow gas to be extracted from under their property against their wishes, is an outrageous taking and unconstitutional abuse of eminent domain, which must be corrected.

Further, citizens and communities have been deprived of adequate legal recourse against drilling companies by various restrictions. Shale gas drilling companies are exempt from all or parts of the following legislation: Clean Air Act, Clean Water Act, Comprehensive Environmental Response Act, Compensation and Liability Act, CERCLA or Superfund Act, Resource Conservation and Recovery Act, Safe Drinking Water Act, and Public Right-To-Know provisions under the Emergency Planning and Community Right-To-Know Act.

Other impacts of shale gas drilling are equally devastating. Hydrofracking in the Marcellus, Utica, and other NYS shale beds will involve construction and maintenance of a massive infrastructure of wellheads, pipelines, compressing stations, processing centers, storage tanks, etc., all spread across much of upstate NY.

The scale of this industry will rival the highway system and the electric grid. Unless provision is made, existing facilities and agencies -- highway departments, schools, health care responders and providers, police and fire departments, among others -- will be severely stressed.

The 40-acre spacing rule opens the door to widespread erosion and clear cutting across a large part of NYS, leading to a significant alteration of the landscape.

Wherever it occurs, shale gas drilling is likely to undermine property values and put increased tax burdens on local citizens. The US Department of Housing and Urban Development's FHA home lending guidelines state that the operations of oil and gas wells pose potential hazards to housing, including fire, explosion, spray, and other pollutions, with restrictions of existing dwellings located within 300 feet of an active or planned drilling site. What is the value of a house next to an industrial site with possible well contamination? Banks have widely refused to offer mortgages for properties with gas leases. A boom-and-bust economic cycle where a few benefit but many stand to suffer will disrupt and distort local communities.

These cumulative impacts -- extended and compounded through years or repeated hydrofracking -- are ignored in the NYS DEC's recent draft generic environment impact statement (DGEIS) on gas drilling.

The DGEIS is also flawed in its failure to consider the true costs, or "externalities," of shale gas drilling. Profits will be privatized but costs socialized. Individuals and communities will be responsible for cleanup and mitigation, and they will have to absorb losses in existing economic sectors -- such as agriculture, tourism, second-home buying, and recreation -- incompatible with mass industrial shale gas drilling. What is the value of a one-time trout stream meandering through a maze of gas drilling sites?

Further, the NYS DEC is seriously understaffed and under funded; further budget cuts are likely. The agency, as a consequence, is in no position to regulate drilling for shale gas in NYS at this time. It is a scandal that it thinks it can do so.

Finally, and perhaps most fundamentally, though not as dirty as other fuels, natural gas remains a polluting, non-renewable, net-CO2 emitting fossil fuel. No such resource should be developed at this time; shale gas reserves instead should be held in trust as an energy reserve of last resort. Conservation and the development of renewables should be our priorities.

The growing list (currently at 61 as of 11/15/09) of organizations that have issued statements in support of a statewide ban, and/or in support the Sierra Club resolution is listed below.

Atlantic Chapter of Sierra Club
ACORN NY
Action Otsego
Advocates for Springfield
Bronx Borough President Ruben Diaz, Jr.
Bronx Community Board 1
Bronx Community Board 2
Bronx Community Board 5
Bronx Community Board 7
Bronx Community Board 8
Bronx Community Board 9
Bronx Greens

Brooklyn Community Board 3
Brooklyn Community Board 10
Catskill Citizens for Safe Energy (CCSE)
CDOG (Chenango Delaware Otsego Gas Drilling Opposition Group)
Community Environmental Defense Council, Inc.
Concerned Citizens of Otego
Damascus Citizens for Sustainability
Delaware County Herbal Network Group
Delaware-Otsego Audubon Society
Democracy for NYC
Earth Day New York
East Harlem Preservation
Energy Justice Network
Environmental Work Group of Central New York
Franklin Local Ltd.
FWCanDo (Fort Worth Citizens Against Neighborhood Drilling Ordinance)
Friends of Brook Park
Friends of the Upper Delaware River
Green Party of New York State
Green Sanctuary Committee, Community Church of New York
Hands Across the Border
Haudenosaunee (Iroquois Confederation)
Manhattan Community Board 2
Manhattan Community Board 3
Manhattan Community Board 4
Manhattan Community Board 6
Manhattan Community Board 9
Manhattan Community Board 10
Manhattan Community Board 11
More Gardens!
National Alliance for Drilling Reform (NA4DR)
Neighbors of the Onondaga Nation (NOON)
New York Climate Action Group (NYCAG)
Northeast Organic Farming Association of New York (NOFA-NY)
Northern Catskills Audubon Society, New York
NYH2O
Protectors of Pine Oak Woods, Inc.
Queens Community Board 4
Queens Community Board 5
Schoharie Valley Watch, Inc
Shaleshock Citizens Action Alliance
Staten Island Community Board 2
Staten Island Community Board 3
Sustainable Otsego
Sustainable Tompkins
SWiM (Safe Water Movement)
The Committee to Preserve the Finger Lakes (of Yates County)
Tioga Peace and Justice
Ulster County Democratic Women

Federal Policy Recommendations

Louis Meeks' well water contains methane gas, hydrocarbons, lead and copper, according to the EPA's test results. When he drilled a new water well, it also showed contaminants. The drilling company Encana is supplying Meeks with drinking water. (Abrahm Lustgarten/ProPublica)

With the loss of home rule over gas drilling in NYS in the 1980s, and the incapacity of the NYS DEC to regulate shale gas drilling responsibly, one remaining recourse for the protection of private and public resources threatened by shale gas drilling is the federal government. We recommend the following federal actions:

1. The priority action needed at the federal level is to reinstate previous health and safety protections. Exemptions for the gas and coal industry, sometimes called the Halliburton loophole, were pushed through by the Bush administration and inserted into the 2005 Energy Policy Act. We need federal recognition that water is more valuable than fossil fuel energy in the modern world; it is necessary - not optional - to sustain human life.

2. We request that Congressman Michael Arcuri not only support but strengthen the DeGette-Hinchey "frac" act, which would restore EPA authority over drinking water as originally established by the Safe Water Drinking Act of 1974.

3. As written, the "frac" act would require the disclosure of chemicals used in shale gas drilling which might pollute public drinking water sources. However, most of the shale gas drilling area in upstate NY is served by individual private wells not municipal systems. The "frac" act needs to be amended to include ALL drinking water sources, public and private, individual and communal. According to the U.S. Government Accountability Office, approximately half of the total U.S. population and 95% of our rural population obtain drinking water from underground water sources.

4. The "frac" act also ought to be amended to include the aggregation of various sources of water pollution. The EPA ought to apply the same standard of aggregation for estimating water quality pollution as it has just applied to air quality pollution in a recent ruling (14 October 2009) on a petition concerning oil and gas drilling from WildEarth Guardians in Colorado (see appendix).

5. Aggregation insists that for permitting purposes connected sources of pollution not be arbitrarily broken down into small, isolated units, but instead be considered as a single source. Given the interconnectedness of shale gas drilling sites and pipelines, aggregation must be applied to its water quality threats in NYS if we are to determine overall impacts.

6. "Compulsory integration," whereby a landowner can be coerced into selling mineral rights against his or her wishes, may constitute an unconstitutional "taking" of private property and should be prohibited by federal legislation.

7. Drilling companies ought to be made fully responsible for all damages resulting from their activities. It is vital to allow private right of action and citizen lawsuits to require natural gas firms to pay for any and all such damages.

8. Increase federal support of local soil and water agencies is needed to better protect water quality.

9. The burden of proof should be on the drilling companies to show that chemically treated injection fluids are safe. The current EPA thresholds hold the shale gas industry to a lower standard than other industries for regulating water quality. The EPA currently may not prescribe requirements that interfere with or impede underground injection related to certain oil or gas operations “unless such requirements are essential to assure that underground sources of drinking water will not be endangered by such injection.”

10. An in-depth review of all permitted natural gas activities is urgently needed. The lack of impartial, comprehensive scientific studies of shale gas drilling precludes any reasonable assessment of their impacts.

11. Sufficient regulatory controls and fees should be established to fund both the EPA and state regulatory agencies, including the Department of Environmental Conservation in New York State, in their appropriate roles.

12. Rigorous reporting requirements must be set for drilling companies for all leaks, spills, and uncontrolled releases of natural gas wastewater and hazardous wastes equal to the requirements of hazardous material petroleum spills.

13. Amend the Resource Conservation and Recovery Act (RCRA) to ensure that fracking fluids are safely processed and disposed. Detoxification methods should be developed to fully clean (not merely dilute) fracking fluids. Full disclosure of fracking fluid ingredients must be required. Verification of fracking fluid ingredients and successful detoxification should be conducted through unannounced field-testing at industry expense.

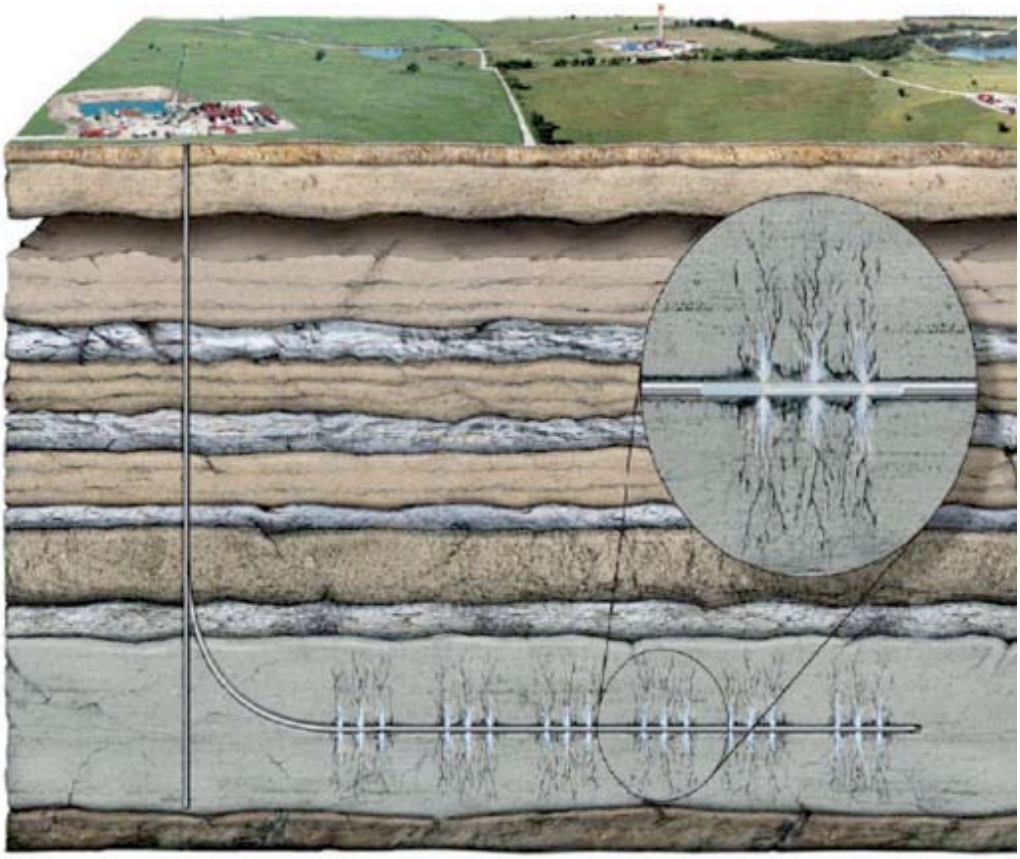
14. Natural gas firms should be required to post bonds or obtain comprehensive insurance coverage sufficient to pay for the remediation of any and all damages associated with their activities.

15. The Marcellus, Utica, and other gas shale beds should be designated as a strategic gas reserve to be held until such time as a clean technology is developed to utilize it efficiently.

Even if all these policy recommendations were implemented, it would still remain to be determined whether shale gas drilling could be carried out safely, and whether the overall costs to taxpayers, communities, other economic sectors, and the environment could be justified. The glaring inadequacies of state and local regulations would also have to be addressed before such a determination could be made.

In the meantime, all the available evidence indicates that shale gas drilling using current or likely technologies is simple too unsafe, too questionable an assault on property rights, and too costly to be justified. It should be banned, at least under the kinds of conditions present in the northeastern US, and perhaps elsewhere as well.

Horizontal Drilling and Hydraulic Fracturing



Traditionally, gas drilling meant drilling a hole into the earth to reach a pocket of gas that is under pressure in deep rocks, and having it flow through a pipe up to the surface. Much of the natural gas that now remains underground is distributed through shale and thus it requires much more elaborate techniques to extract the gas. Hydraulic Fracturing (also known as "fracking", "high-volume hydraulic fracturing" (HVHF), or "slick water fracturing") of horizontal wells involves drilling down to a shale layer, turning the drill bit 90 degrees, and drilling up to about a mile horizontally through the shale layer. Steel tubing is driven in and sealed with concrete. To access the small pockets of gas, the shale along the horizontal pathway is first fractured with explosive charges, then further fractured with a high pressure mixture of water, sand, and toxic chemicals. The sand props open the paths to the gas; the chemicals lubricate the drill, kill microbes, slow corrosion and promote penetration of the mixture into the rock.

Water Issues

A glass of milky brown drinking water from a residential well in Dimock, Pennsylvania, after natural gas drilling operations began nearby. (Photo: Tim Shaffer / Reuters)

Clean water is essential for life, and is becoming increasingly rare and valuable as the population of the world grows. We are already seeing shortages in some of the western states. How clean is the water that is treated and returned to our rivers? Well waste contains water-soluble toxins that are not removed by the usual water treatment processes. Many questions must be answered before horizontal drilling and fracking begin.

We must also assess the current state of the environment, availability of sufficient water, capacity of treatment facilities, quality of existing wells and reservoirs, and other areas likely to be impacted. This will help the EPA determine risk and needed remediation, clarify problems, and reduce the health and financial costs of cleanup.

Many of the water quality issues are left to the individual states, however both water shortages and water contamination issues cross state lines. Recent cuts in funding and manpower for New York State DEC make it unable to monitor wells properly and unable to enforce infractions related to both depletion and contamination of water resources.

Horizontal drilling and hydrofracturing for natural gas requires from 3 to 8 million gallons of water per well. This water consumption is some 50-fold greater than that used for traditional vertical drilling. This water is taken from a variety of sources including rivers and private wells. Some portion of this water remains underground, gone forever from sources available for plants, animals and other organisms. (A single dairy cow requires approximately 50 gallons of water every day.) Gone are the days when we regarded rivers as an endless source. We have

only to look west at the Colorado as it trickles into Mexico to realize that what has been treated as endless supply is, in fact, limited.

State regulations require that the well casings extend below the aquifers. DEC is responsible for monitoring the pouring of the casing, but with fewer than 20 employees who provide this service, how can they adequately cover a substantial increase in drilling? Even if the casing is acceptable on day one, how likely is the concrete to crack or deteriorate and permit toxic chemicals to enter the aquifer over the life of the well and beyond? And what happens when chemicals do leak into the wells and streams? How can we ensure that the water well owners are treated fairly? Municipal water supplies have some minimal protection, but private water wells are not included. Moreover, no studies have determined that underground gas structures (including pipelines) remain stable for the long term (e.g. 100 years).

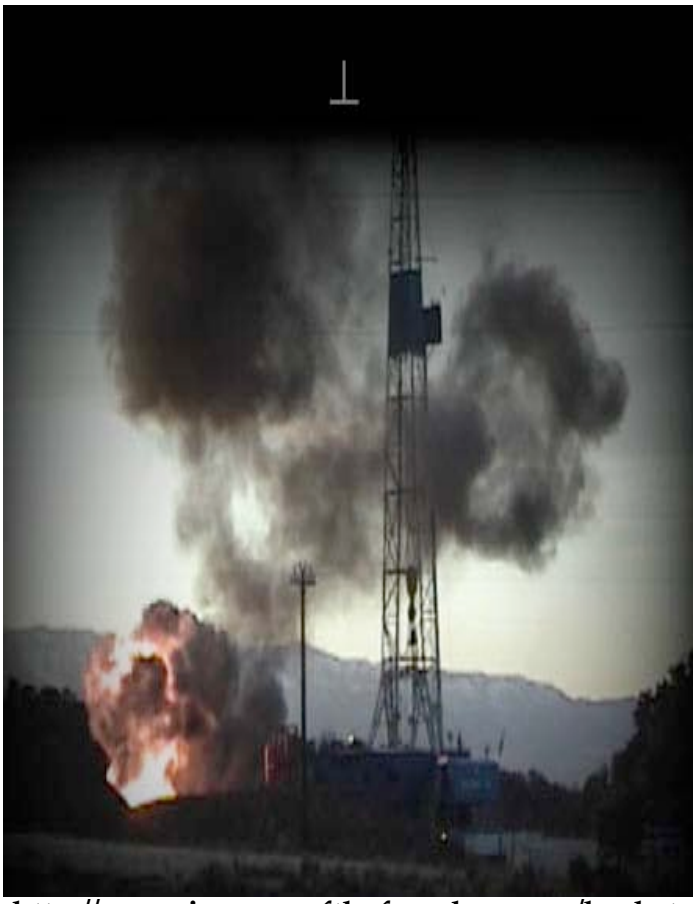
Open lined pit prone to seepage, ruptures and overflowing during heavy rains.

Gas well fluids that return to the surface contain chemicals found in the shale, in addition to those intentionally added. This slurry is often pumped into a holding pond where plastic liners tear or get punctured. Impoundment walls may give way; heavy rains may cause the fluids to overflow into soils and nearby water bodies. Even if no mishaps occur, heavy tanker traffic is required to truck the water away and, in the meantime, volatile chemicals evaporate into the air with adverse effects on air quality, wildlife, and human health.

Another means of disposing of the polluted water is by underground injection, also known as deep injection well disposal. In this process, a deep well bore such as an unproductive gas well is used as a reservoir into which millions upon millions of gallons of poisoned water are pumped into the ground. This would be a substantial risk to the ground water, especially as the toxins travel through the aquifer.

Pennsylvania DEP estimates that their oil and gas wells produce 9 million gallons of toxic waste fluids per day, and expect that to rise to at least 19 million gallons per day by 2011. (http://www.propublica.org/feature/wastewater-from-gas-drilling-boom-may-threaten-monongahela-river)

Air Issues



(photo: http://www.journeyoftheforsaken.com/backstory.htm)

"The Clean Air Act established a separate NESHAPs program to regulate individual small sources of toxic emissions. This program also has a substantial loophole for the oil and gas industry: Oil and gas wells and their associated equipment are not on the list of small hazardous air pollutant sources and are therefore exempt from this provision. While the EPA can regulate individual small oil and gas facilities like wells and pits if they are within a metropolitan area with a population greater than one million people, the Denver metropolitan area is the only place in the Rocky Mountain region that meets this condition, and the vast majority of small oil and gas operations in the region are outside this area. Oil and gas operations in the Rocky Mountain region, therefore, are virtually exempt from the provisions of the Clean Air Act intended to protect Americans from small sources of hazardous air pollutants" (Protecting Western Communities from the Health and Environmental Effects of Oil and Gas Production; Natural Resources Defense Council,

http://www.nrdc.org/land/use/down/down.pdf)

Like rural Colorado, upstate New York is vulnerable to this loophole. With hundreds of gas wells awaiting exploitation, our rural air and water are unprotected.

This gas-drilling site doesn't look so bad to the naked eye. Courtesy Texas Commission on Environmental Quality.

But when seen through infrared camera, the same site is a toxic mess. Courtesy Texas Commission on Environmental Quality.

We think of natural gas as the clean fuel that cooks our dinners and warms our homes. This needs to be reevaluated to include the air and water damage during its extraction.

Each truckload of water is 10,000 gallons. Each million gallons of liquid transported in the drilling and fracking process requires 100 truck trips. Using the DEC estimate of 3 to 5 million gallons of water per well, about 400 truck trips will be required to deliver consumed water. Another 200 to 300 trips will be required to haul away the waste. Diesel fumes from these truck trips amount to tons of volatile organic compounds released into the air with each well that is developed. And this estimate doesn't include the output of stationary engines in drill rigs and compressors, or the pollution from heavy grading equipment.

Gas well flaring releasing toxic fumes into the environment.

Finally, air pollution poses a double threat, because it eventually pollutes water and soil as particulates settle on land and water bodies.

Socio-Economic Issues

The boom/bust cycle of extraction industries is well documented. Small rural communities are often unprepared for the immigration of workers and the social issues that accompany them. Job skills necessary for the industry are not often available in the local population and this fails to bring new jobs and prosperity to the native population. "Research has found that the rate of failure among small businesses in boomtowns is above the national average." (Jacquet quoting Davidson 1979)

Housing issues have already been stressed in Otsego County in our area by seasonal tourism and baseball camps that have skewed the market towards high-end tourists who can pay what might normally be a month's rent in a week, leaving low income families with diminished housing stock.

“In addition to growth uncertainty, local governments often face the brunt of the new service demand immediately after development occurs, yet additional revenue either does not arrive due to the taxation system or starts to flow several years after the impacts occur.” (Jacquet citing Ervin 1978).

Afterwards, when the commodity is depleted, the local economy contracts. In this case, when the gas stops flowing, so does the money. However, with significant changes in the landscape and transportation infrastructure affecting tourism, organic farming, and small business development, our local economy should not expected to return to its pre-extraction state, but to contract even further into severe recession.

Noise Issues

Compressors and heavy equipment can run 24/7

How loud is oil and gas noise? study in La Plata County, Colorado, reported noise levels for a number of oil and gas activities:[4]

Typical compressor station	50 dBA (375 feet from property boundary)
Pumping units	50 dBA (325 feet from well pad)
Fuel and water trucks	68 dBA (500 feet from source)
Crane for hoisting rigs	68 dBA (500 feet from source)
Concrete pump used during drilling	62 dBA (500 feet from source)
Average well construction site	65 dBA (500 feet from source)

The Bureau of Land Management (BLM) published different numbers. At 50 feet from the source, the measured noise levels were: well drilling - 83dBA; pump jack operations - 82 dBA; produced water injection facilities - 71 dBA; and gas compressor facilities - 89 dBA.[5]

In the same study, BLM also reported typical noise levels from construction equipment and oil and gas activity. These are presented in the chart below. Again, the sound levels were taken at a distance of 50 feet (15 meters). Estimates of noise attenuation at distances greater than 50 feet can be made by reducing noise levels by a factor of 6 dBA (A-weighted sound levels) for each doubling of distance. The actual noise levels experienced by a receptor, however, will depend on the distance between the receptor and the equipment, the topography, vegetation, and meteorological conditions (e.g., wind speed and direction, temperature, humidity).

Alberta, Canada: Alberta is a major oil and natural gas producing province in Canada. In Alberta, the Energy and Utilities Board has the responsibility for regulating noise from oil and gas operations. The EUB has produced what may be the most comprehensive noise regulations for the oil and gas industry across North America. The EUB essentially has a sliding scale noise standard whereby acceptable noise levels vary with the ambient noise. For example, if a citizen lives in an area where ambient noise is low (e.g., where housing density and traffic noise are low), then the oil and gas operator must ensure that noise reaching the receptor is no louder than 40 dBA. In some instances, if the ambient noise is very low (e.g., 30 dBA), companies may be required to mitigate noise to even lower levels (e.g., 35 dBA).

http://www.earthworksaction.org/noiseresources.cfm

Hidden Costs

Gas drilling companies pay very little in taxes, but cost the state, county and towns much for the repair of roads. Water tests are paid for, in large part, by private citizens concerned about wells and streams on their property. The drilling companies should pay at least their share of repairing damages and monitoring for health and environmental problems. And they should be taxed at a more appropriate level with those additional revenues invested in renewable energy. Accidents and explosions have occurred, leaving local, and in our case, volunteer squads to cope with serious and dangerous situations. Emergency rooms have little experience with the effects of toxic chemicals that are involved.

Gas exploration and drilling in Otsego County will inevitably put various business interests at odds with one another. Current federal legislation exemptions for the gas industry put other long-standing business interests at a disadvantage. Tourism is well developed in the 24th Congressional District and accounts for a major local government revenue stream in the form of sales tax. Our local dairy industry is showing some signs of conversion to meat farming, but all livestock may be threatened by events that have killed owls, hawks, large numbers of fish, and cows. Is a temporary boom a fair trade for ruining two major long-term local industries with history, culture and infrastructure built up over time?

Seventeen cattle dropped dead in a northwestern Louisiana field after apparently drinking from a mysterious fluid adjacent to a natural gas drilling rig, according to Louisiana's Department of Environmental Quality and a report in the Shreveport Times.

The Shreveport Times reports: "Chesapeake Energy Corp. waited five hours before notifying the state of a spill from a well site onto a south Caddo pasture that apparently killed 17 cows April 28, according to Louisiana Department of Environmental Quality files."

Leaks at a drilling site caused a fish kill in Dimock Twp. (PA) "A frac fluid that leaked an estimated 6,000-8,000 gallons from a pipe into a stream at a natural gas drilling site resulted in a fish kill last week. A fluid material, described as "frac gel," at a Cabot Oil and Gas Company well site on the Heitsman property off Troy Road in Dimock leaked from a pipe on Sept. 16 and entered Stevens Creek and a nearby wetlands area. According to Mark Carmon, a spokesman for the Pennsylvania Department of Environmental Protection, the pipe leaked twice during the incident. " (Frac gel spills in Dimock; TheDailyReview.com; Published: September 23, 2009
http://www.thedailyreview.com/news/frac_gel_spills_in_dimock)

Other hidden costs are financial. Legalized tax evasion by corporations shifts costs to the public. BusinessWeek asked the data tracking outfit Capital IQ (MHP) to calculate which companies in the Standard & Poor's 500-stock index spent the lowest percentage of their earnings in cash on taxes over the past five years. The data reflect the most recent five-year period available, 2002 to 2006. These are the companies that are, in other words, getting the most mileage out of the various exceptions in the tax code.

"At the head of the list: utility CMS Energy (CMS) (0% of earnings spent on taxes on average over the past five years); natural gas driller Chesapeake Energy (CHK) (0.3%); airplane manufacturer Boeing (BA) (0.7%); semiconductor maker Broadcom (BRCM) (1.1%); and utility Florida Power & Light (FPL) (1.2%). For the entire S&P 500, by contrast, the average percentage of earnings spent on taxes was 26%—still well under the 35% stated corporate tax rate. (A detailed list of the 100 companies that paid the lowest percentage of earnings in taxes is available at businessweek.com.)"

(The Taxman Barely Cometh; BusinessWeek December 3, 2007
http://www.businessweek.com/magazine/content/07_49/b4061066.htm

Finally, as underground gas recovery infrastructure begins to break down – as well casings corrode and concrete seals crack, and as pipelines progressively rust out – questions of who will take responsibility for these structures and for the consequences of poisons seeping from them have not been raised, let alone addressed by corporate, state or federal officials. These last hidden costs may prove to be the most onerous of all.

Accident Reports

"On August 14, 2009 the EPA confirmed water contamination by toxic substances used in hydraulic fracturing in Pavillian, WY. The EPA's initial investigations found 11 of 39 tested drinking water wells were contaminated and included toxic substances used in oil and gas production." - Earthworks 2009 Press Releases, EPA Confirms Drinking Water Contamination by Toxics Used in Hydraulic Fracturing.
http://www.earthworksaction.org/PR_EPApavillionDrinkingWater.cfm

"Chesapeake Energy Corp. waited five hours before notifying the state of a spill from a well in a south Caddo pasture that apparently killed 17 cows on April 28th, according to Louisiana Department of Environmental Quality files." The Shreveport Times

The Fort Worth Weekly in an article by Peter Gorman called The Big Takeover on 8/26/09 quotes: "What I want to know," said Sharon Wilson, a longtime anti-drilling activist who maintains a running blog on problems associated with shale activity, "is how the gas companies can call fracking fluid 'salt water' when 1 percent of that fluid is enough to kill 17 cows, most of them within an hour?"

Bob Donaldson/Post-Gazette
Dead fish along the of Dunkard Creek that flows into the Monongahela

Dimock, PA "Pennsylvania environment officials are racing to clean up as much as 8,000 gallons of dangerous drilling fluids after a series of spills at a natural gas production site near the town of Dimock last week. The spills, which occurred at a well site run by Cabot Oil and Gas, involve a compound manufactured by Halliburton that is described as a "potential carcinogen" and is used in the drilling process of hydraulic fracturing, according to state officials. The contaminants have seeped into a nearby creek, where a fish kill was reported by the state Department of Environmental Protection. The DEP also reported fish "swimming erratically." (Frack Fluid Spill in Dimock Contaminates Stream, Killing Fish; Abrahm Lustgarten, ProPublica - September 21, 2009) (http://www.propublica.org/feature/frack-fluid-spill-in-dimock-contaminates-stream-killing-fish-921)

"Pennsylvania's Department of Environmental Protection soon identified the likely cause and came up with a quick fix. The Monongahela, a drinking water source for 350,000 people, had apparently been contaminated by chemically tainted wastewater from the state's growing natural gas industry. So the DEP reduced the amount of drilling wastewater that was being discharged into the river and unlocked dams upstream to dilute the contamination. But questions raised by the incident on the Monongahela haven't gone away. In August, contamination levels in the river spiked again …" (October 3, 2009 ProPublica http://www.propublica.org/feature/wastewater-from-gas-drilling-boom-may-threaten-monongahela-river)

Excerpts from Accident Reports

“The 20 miles of interstate highway between the small towns of Silt and Parachute in western Colorado slice through a landscape of sagebrush and mesas. There are few exits through this section of Garfield County, where the local population of deer and elk rivals the number of ranchers, retirees and others who live here.

“Susan Haire, 55 and a small-scale rancher, lived on top of one of the surrounding mesas for nearly a decade, but she says that in the last year, the landscape turned against her. When she drove down this stretch of highway, her nose bled, her eyes burned and her head pounded. She began wearing a respirator to clean the air in her car.

"I felt like an alien, like I didn't fit into my own environment," says Haire. "It's horrifying what's happening here. The changes that have happened in the past 18 months are so dramatic, it's just a nightmare."

“Hair’s doctor blamed her ill health on the changes that occurred around her: In the last two years, gas companies have drilled over 600 natural gas wells. Every few feet, 150-foot-tall drill rigs — all flying American flags — rise upwards into the sky. Banks of rectangular huts with five-foot diameter fans sit back from the road, pumping and moving the gas into underground pipelines. “ (Rebecca Clarren, July 16, 2008) (http://www.hcn.org/wotr/16376)

“The Superfund investigation follows a series of complaints by residents in the Pavillion area, some stemming back 15 years, that their water wells turned sour and reeked of fuel vapors shortly after drilling took place nearby. Several of those residents shared their stories with ProPublica [7], while other information was found through court and local records. Several years ago, one resident’s animals went blind and died after drinking from a well. In two current cases, a resident’s well water shows small pooling oil slicks on the surface, and a woman is coping with a mysterious nervous system disorder: Her family blames arsenic and metals found in her water. In two of those cases, the Canadian drilling company EnCana, which bought most of the area’s wells after they were drilled and assumed liability for them, is either supplying fresh drinking water to the residents or has purchased the land. In the third case, a drilling company bought by EnCana, Tom Brown Inc., had previously reached an out-of-court settlement to provide water filtering.

“EPA officials have repeatedly said that disclosure of the fluids used in fracking – something that would be required if the bill being debated in Congress were passed – would enable them to investigate contamination incidents faster, more conclusively and for less money. The current study, which is expected to end next spring, has already cost $130,000.

“Of particular concern were compounds called adamantanes, a natural hydrocarbon found in gas that can be used to fingerprint its origin, and 2-BE,

listed as a common fracturing fluid in the EPA's 2004 research report on hydraulic fracturing. That compound, which EPA scientists in Wyoming said they identified with 97 percent certainty, was suspected by some environmental groups in a 2004 drilling-related contamination case in Colorado, also involving EnCana.

"EPA investigators explained that because they had no idea what to test for, they were relegated to an exhaustive process of scanning water samples for spikes in unidentified compounds and then running those compounds like fingerprints through a criminal database for matches against a vast library of unregulated and understudied substances. That is how they found the adamantanes and 2-BE.

"Now that the EPA has found a chemical used in fracturing fluids in Pavillion's drinking water, Chavez said the next step in the research is to ask EnCana for a list of the chemicals it uses and then do more sampling using that list. (An EnCana spokesman told ProPublica the company would supply any information that the EPA requires.) The EPA is also working with area health departments, a toxicologist and a representative from the Centers for Disease Control's Agency for Toxic Substances and Disease Registry to assess health risks, he said. "

http://www.propublica.org/feature/epa-chemicals-found-in-wyo.-drinking-water-might-be-from-fracking-825

The dreadful noise generated by a nearby large compressor station. The noise was so loud that our dog was too frightened to go outside to do his business without a lot of coaxing. Noise that sounds like a jet plane circling over your house for 24 hours a day. Noise that is constant. Noise that drives people to the breaking point. My neighbor called the sheriff, state officials and even the governor and was told nothing could be done about the noise. Like I said, the noise drives people to the breaking point, and my neighbor fired 17 rifle shots toward the station.

--Excerpted from CBM Destroys Retirement Dream.
(http://earthworksaction.org/noiseresources.cfm)

Drilling Chemicals

"EPA Scientists Find 2-BE in drinking water wells near drilling operations reads in part: "Among the contaminants found in some of the wells was 2-butoyethanol, or 2-BE, a solvent used in natural gas extraction, which researchers say causes the breakdown of red blood cells, leading to blood in the urine and feces, and can damage the kidneys, liver, spleen and bone marrow. http://www.reuters.com/article/latestCrisis/idUSN27311701)

"The Pennsylvania Department of Environmental Protection provided a list of chemicals, known to them to be used in hydraulic fracturing in Pennsylvania, to The River Reporter, a newspaper based in Sullivan County, New York. The list was evaluated by The Endocrine Disruption Exchange. Of the 54 chemicals listed, 21 are readily airborne, and 34 are soluble, meaning they travel through water. A majority of the chemicals are known to have health effects even as single ingredients. (It is well established that combinations of toxic chemicals are even more toxic than their component single chemicals.) Health effect categories included gastrointestinal & liver, respiratory, skin, eye and sensory organ, cardiovascular & blood, brain & nervous system, kidney, immune, developmental, reproductive, mutagen, endocrine disruptors, cancer, & "other." (http://www.un-naturalgas.org/hydraulic_fracturing_a-z.htm)

EPA's Resource Conservation and Recovery Act (RCRA) " gives EPA the authority to control hazardous waste from the "cradle-to-grave." This includes the generation, transportation, treatment, storage, and disposal of hazardous waste. RCRA also set forth a framework for the management of non-hazardous solid wastes. The 1986 amendments to RCRA enabled EPA to address environmental problems that could result from underground tanks storing petroleum and other hazardous substances."
http://www.epa.gov/lawsregs/laws/rcra.html)

Recognizing that each natural gas well is unique, we advocate a chemical use reporting system that reflects on-site decisions that must be made by natural gas drillers and well operators. This reporting would begin with full disclosure of default methods and materials used to commence drilling, stimulation and production activities. Under such a system, the emergence of special conditions (eruption of hydrogen sulfide gas, observations of excessive corrosion, elevated radioisotope concentrations, the presence of liquid hydrocarbons) should be noted along with steps taken (including chemical additives used) to manage each special condition.

Standardized comprehensive testing protocols should be developed by an independent organization at gas industry expense to assess the water quality of every well and aquifer within 400 yards of the outer ends of horizontal fracking natural gas drilling sites in upstate New York. The pre-drilling condition of key assets and resources including public roads, access roads and pads, pipelines, livestock, croplands, wildlife habitats and pipeline routes should be evaluated and documented along with other factors such as existing radioactivity levels.

Appendix

Beyond MSDS: A Review of Hazardous Materials Used by New York's Natural Gas Industry

Dr. Ronald E. Bishop

The New York Department of Environmental Conservation (DEC), in response to a Freedom of Information Law request from the Committee to Preserve the Finger Lakes, sent material safety data sheets (MSDS's) for 48 products permitted for use in the drilling and development of natural gas wells in New York. These are posted online by the Finger Lakes chapter of the Sierra Club: http://newyork.sierraclub.org/fingerlakes/gasinfo.html.

From these and many other documents, Steve Coffman of the Committee to Preserve the Finger Lakes, developed a wonderful article: "The Safety of Fracturing Fluids – A Quantitative Assessment", available at http://www.preservethefingerlakes.com/id18.html. In it, he systematically presented the hazards listed in the MSDS's, along the way correlating product names with some of their specific chemical components.

However, Steve's approach had limitations. MSDS's are good at describing the hazards of chemicals or mixtures in their pure states, but they don't tell us much about the health risks of residues where these products are diluted. They also don't help much to assess relative risks – which products are more or less dangerous than others.

A particular problem with MSDS's submitted by energy industry representatives is that many of them do more to hide chemical composition than to reveal it. Their intentionally vague language reminded me of that generally found in patents, where the goal is to protect as much intellectual turf surrounding an invention as possible. Therefore, I researched patent applications related to these products, where the actual chemicals in use are usually listed as the most "preferred embodiment" of each protected idea.

In this article I will draw connections between different terms used for identical compounds, point out families of chemicals that have similar properties, and offer toxicity information that delves deeper than typical material safety data sheets (MSDS's). In addition to MSDS's and patents, I've consulted various texts and dissertations, peer-reviewed journal articles, reports from the Environmental Protection Agency (EPA), the Food and Drug Administration (FDA), the National Toxicology Program (NTP), the Centers for Disease Control (CDC), and related agencies in Canada and Australia where available. The Endocrine Disruption Exchange (http://www.endocrinedisruption.com/home.php) has been a major information resource. Please note that my comments should be considered in addition to MSDS's, not in isolation from them.

Now, on to the materials:

Biocides

1. MAGNACIDE 575

This product contains bis[tetrakis(hydroxymethyl)phosphonium] sulfate.

Bis[tetrakis(hydroxymethyl)phosphonium] sulfate was first used as a flame retardant for cotton fabrics, called Retardol S. Since its use as a biocide is fairly recent, toxicity studies are incomplete. It is known to be highly toxic to aquatic organisms, and is suspected to promote cancer in rodents. Its toxicity in mammals is selective for liver tissue. However, compared to the other biocides in this list, it is probably the easiest for humans to handle with relative safety.

2. BIO CLEAR 200

This breathtakingly toxic mixture of 2,2-dibromo-3-nitrilopropionamide (DBNPA) with polyethylene glycol (PEG) behaves differently in different organisms. The decomposition products noted in the MSDS arise from metabolism in microbes and many aquatic organisms. (In fact, DBNPA is damaging or lethal to brown trout, Daphnia magna and bay oysters at concentrations so low they cannot be chemically detected.) However, in mammals, this mixture chiefly leads to formation of aldehydes which stress antioxidant defenses, particularly enzymes called glutathione-dependent peroxidases. Therefore, chronic exposure should be expected to influence aging in humans.

Polyethylene glycol is essentially non-toxic; it's used solely to thicken the solution.

3. BE-3S

This product contains 2-bromo-3-nitrilopropionamide and 2,2-dibromo-3-nitrilopropionamide.

This mixture of the biocide 2-bromo-3-nitrilopropionamide (BNPA) with the related chemical DBNPA (discussed above) has essentially the same toxicity profile as DBNPA alone: very severe, especially for aquatic organisms.

4. BE-6

This product contains 2-bromo-2-nitro-1,3-propanediol.

The biocide 2-bromo-2-nitro-1, 3-propanediol (BNPD) presents human health hazards similar to BNPA and DBNPA, above, except that it is also a suspected carcinogen. However, it is much more harmful to aquatic organisms than BNPA

or DBNPA – and they are highly toxic to aquatic organisms. This is a terrible environmental poison.

5. ALDACIDE G

This product contains gluraraldehyde.

The biocide glutaraldehyde is extraordinarily poisonous: harmful if inhaled or absorbed through the skin. It is capable of causing permanent eye damage upon exposure, and can cause potentially lethal chemical pneumonia if lung tissue is exposed (e.g., after deep aspiration). Harmful exposure levels for mammals extend as low as 50 parts per billion.

Corrosion Inhibitors

6. CORROSION INHIBITOR A261

This product contains aromatic ketones, aliphatic alcohol polyglycol ether, methanol, aliphatic acid, aromatic hydrocarbons, formaldehyde and propan-2-ol.

Aromatic ketones (most likely acetophenone or 3-hydroxy-1-phenylpropan-1-one, which comprise the bulk of this product) tend to be much less hazardous than aromatic hydrocarbons such as benzene, ethylbenzene, toluene and xylenes (BTEX), which are all highly toxic, especially to liver tissue, at very low concentrations. Aromatic hydrocarbons also tend to be carcinogenic (they promote cancers), at low doses.

The term "aromatic" (in aromatic ketones and aromatic hydrocarbons) refers to a set of shared chemical characteristics, not how these chemicals smell.

Aliphatic alcohol polyglycol ether refers to a family of compounds, not a single pure substance. Most of them are non-ionic surfactants of low toxicity, although this cannot be said for certain glycol ethers, to which they are chemically related.

Methanol and formaldehyde were discussed above.

Propan-2-ol is another name for isopropyl alcohol, also known as 2-propanol or rubbing alcohol. It is much less toxic than methanol, and is a minor component of this product.

"Aliphatic acid" is a non-specific term that refers to a one or more fatty acids extracted from coconut or rapeseed oil. Its hazard is negligible.

7. FE-5A

This product contains thioglycolic acid.

Thioglycolic acid is best known as that terrible-smelling chemical used by cosmetologists to straighten unruly hair. While it is certainly hazardous in concentrated form, its use by natural gas operators as a corrosion inhibitor doesn't pose much risk to health. Besides, its wretched odor tends to alert people to spills or other accidental releases.

8. FR-46

This product contains ammonium bisulfate.

Ammonium bisulfate has been used with thioglycolic acid (above) as a hair-care agent. While it is very corrosive in a concentrated state, our greatest health concern would be with chronic exposure to it: This salt tends to accumulate in tissues, especially lung and mucous membranes. Therefore, its use as a corrosion inhibitor in gas extraction poses moderate hazard.

9. CL-14

This product contains methanol and propargyl alcohol.

Propargyl alcohol is the greater hazard here; so bad that, according to industry advertisements (for other products), oil and gas field workers have complained about having to work with it. Exposure to it causes awful respiratory, skin and eye symptoms, and many of these persist long after exposure has stopped. Propargyl alcohol can accumulate in liver, kidney, arterial, bronchial and brain tissues, to cause multi-organ chronic health problems.

This chemical is significantly toxic to aquatic organisms, especially fathead minnows and daphnids; however, it is rapidly biodegraded in water or soil.

Propargyl alcohol and prop-2-yn-1-ol (next section) are different names for the same chemical; a third name often encountered is acetylenic alcohol.

Methanol (also known as methyl alcohol or wood alcohol) is rapidly metabolized by most organisms to formaldehyde, which is a really dangerous poison known to cause long-lasting skin and respiratory tract damage. At extremely low concentrations, formaldehyde can also promote a variety of cancers.

10. HAI-OS ACID INHIBITOR

This product contains propargyl alcohol and methanol, discussed above.

<u>Surfactants</u>

11. FR-48

This product is claimed to contain no hazardous substances. From the physical description, it is most likely a micro emulsion of acrylic beads in water.

12. FLOWMAX 50 (Two related MSDS's)

This product contains isopropyl alcohol, limonene, and a non-ionic surfactant.

Isopropyl alcohol (a secondary alcohol, as listed in one of the MSDS's) was discussed above.

One of the proprietary constituents of this product is limonene, the chief component of lemon oil. Limonene is very familiar to gas industry operators, since many natural gas odor markers consist of sulfur compounds derived from it. Limonene is non-toxic as used.

The other proprietary constituent is an unspecified non-ionic surfactant. All the choices listed in the patent, however, exhibit low toxicity.

13. Ezeflo F108 Surfactant

This product contains a proprietary amine derivative.

The "amine derivative" in this product is a cationic gemini surfactant. This bears some explanation. In the mid-1980's, Dow Corning developed the viscoelastic surfactant erucyl-bis (2-hydroxyethyl) methylammonium chloride, which was mixed with isopropyl alcohol and trademarked by Schlumberger as ClearFRAC. This product was relatively safe for handling by humans, but sufficiently toxic to algae and other marine organisms that it was restricted or banned by Scandinavian countries.

By cross-linking this (and similar) compounds with epichlorohydrin, scientists in Australia produced the first cationic gemini surfactants. Their greatest advantages are that they viscosify (thicken) solutions (similarly to ClearFRAC) at one-tenth the concentration needed for that agent. However, these "gemini quats" are also toxic to algae, and they have not been sufficiently tested for biosafety with us or our environment to be assessed.

14. FAW-5

This product contains 2-butoxyethanol, methanol, ethyl alcohol and ammonia.

2-Butoxyethanol is the major threat in this product. The MSDS details its devastating effects at high concentrations, but at vanishingly small concentrations it still promotes infertility, birth defects and rare adrenal tumors. Women are at special risk, somewhat of a surprise to toxicologists who first uncovered its reproductive effects in male rats.

2-Butoxyethanol is a glycol ether, a member of the family of chemicals noted just above. Some members of this chemical family are not highly toxic; they are commonly used as non-ionic detergents.

Ammonia is a potent toxin, but people generally respond to its familiar acrid odor by getting out of its way. This effectively limits the danger it poses.

Methanol (discussed above) is another word for methyl alcohol, also known as wood alcohol. Ethanol is another word for ethyl alcohol, also known as grain alcohol or just "alcohol". 2-Propanol (also discussed above) is another word for isopropyl alcohol or rubbing alcohol. This kind of terminology is typical for these liquids.

15. INFLO-102

This product contains methanol, isopropanol and 2-butoxyethanol, discussed above.

16. MULTIFUNCTIONAL SURFACTANT F105

This product contains two proprietary polyethoxylated alkanols, 2-butoxyethanol and butan-1-ol.

The term "polyethoxylated alkanol" refers to a family of glycol ethers used as non-ionic surfactants that, in this particular product, are moderately toxic.

Butan-1-ol, also known as butanol or butyl alcohol, is more dangerous than the alcohols discussed above, because it is an endocrine disruptor at very low concentrations.

2-Butoxyethanol was discussed above.

Lubricants

17. ACTIVATOR 78-ACTW

This product contains secondary C12-14 ethoxylated alcohols and methanol.

These low molecular weight fatty alcohols are typically extracted from fats rather than synthesized, and the number of ethoxy functional groups may vary; therefore, they comprise a family of molecules, not a single pure substance. Even though this mixture of glycol ethers is hazardous in concentrated form, the product as used is only moderately toxic. It is moderately biodegradable as well.

Methanol was discussed above.

18. LGC-35 CBM

This product contains paraffinic solvent and polysaccharide.

Paraffinic solvent is probably best known as mineral spirits, also called deodorized kerosene or hydrotreated light petroleum distillate. If lung tissue is

exposed, this solvent can induce potentially lethal chemical pneumonia, but the major target organ appears to be the liver, where chronic exposure to low doses may promote cancer. Kerosene is harmful to amphibians and many aquatic organisms, and is not very biodegradable.

Polysaccharide in this product is guar gum. This carbohydrate is non-toxic, but its use as a viscosifier (thickener) requires addition of a borate-based cross-linker, which introduces reproductive toxins to the mix. Further, since this starch is a favorite food for bacteria, algae and fungi, its use also requires significant addition of biocides.

19. FRW-14

This product contains hydrotreated light distillate and ethoxylated alcohol.

Hydrotreated light distillate, better known as deodorized kerosene, was discussed above.

Ethoxylated alcohol refers to a range of glycol ethers, discussed above.

20. Water Friction Reducing Agent J313

This product contains hydrotreated light petroleum distillates and ethoxylated octylphenol.

Hydrotreated light petroleum distillates, better known as deodorized kerosene, were discussed above.

Ethoxylated octylphenol is an aromatic glycol ether, better known (to biochemists, anyway) as Triton X-100. It is only mildly irritating to humans, but is highly toxic to aquatic and marine organisms, particularly salmon, cod and shrimp.

21. SANDWEDGE WF

This product contains heavy aromatic petroleum naphtha, methanol and isopropanol.

"Heavy aromatic petroleum naphtha" refers to polycyclic aromatic hydrocarbons (PAH's), which are extremely dangerous environmental toxins. They are biodegraded very slowly, and are potent human carcinogens at very low levels of exposure.

Methanol and isopropanol were discussed above.

Cross-Linkers

22. FDP-S798-05

This product contains sodium perborate tetrahydrate.

Sodium perborate tetrahydrate can be really corrosive in concentrated form, but it is not much of a health threat as used by gas industry operators. It is a moderate oxidizing (bleaching) agent, not as harsh at low concentrations as hydrogen peroxide.

23. OptiKleen-WF

This product contains sodium perborate, discussed above.

24. BORATE CROSSLINKER J532

This product contains aliphatic polyol and sodium tetraborate decahydrate.

The "aliphatic polyol" is most likely glycerol. It is practically non-toxic.

Sodium tetraborate decahydrate is better known as borax. It has been shown to be a significant reproductive poison implicated in infertility and birth defects.

25. BC-140

This product contains monoethanolamine, ethylene glycol and boric acid.

The major health and environmental threat in this mixture is ethylene glycol, discussed above.

Monoethanolamine , or simply ethanolamine, and boric acid are both corrosive in high concentrations. They are fairly tame at moderate to low concentrations. However, boric acid has been used for many years as a roach and ant pesticide, occasionally poisoning young children who eat it.

26. FE-1A

This product contains acetic anhydride and acetic acid.

Acetic anhydride is an incredibly reactive chemical, so in high concentrations it is extremely hazardous. However, by reacting with just about everything (including the compounds it was meant to derivatize), it quickly degrades, and therefore tends to pose no chronic health threat.

Acetic acid is what gives vinegar its flavor; it is of little concern as used in this product.

<u>Breakers</u>

27. CLA-STA XP Additive

This product contains polyepichlorohydrin trimethylamine quaternized.

Polyepichlorohydrin trimethylamine quaternized is a flocculent designed to "break" (clarify) solutions thickened by advanced viscosifiers called cationic gemini surfactants. Recently developed in Australia, its biological safety has not been studied in any detail.

28. GBW-30 Breaker

This product contains hemicellulase enzyme and carbohydrates.

Hemicellulase is an innocuous enzyme also used in baking and paper manufacturing.

The specific carbohydrates aren't listed, but are unlikely to be hazardous.

29. Breaker J218

This product contains diammonium peroxydisulfate.

Diammonium peroxydisulfate is a corrosive oxidizing agent that is irritating in concentrated form, but its major health threat arises from its ability to cause allergic sensitization upon repeated exposure.

Scale Inhibitors

30. FERROTROL 300L

This product contains citric acid, which is non-toxic unless very high concentrations are involved. As used for inhibiting iron-based scale formation, it is of little concern.

31. HC-2

This product contains sodium chloride and inner salt of alkyl amines.

Sodium chloride is our familiar "table salt"; it is not hazardous as used in this product.

The term "inner salt of alkyl amines" refers to a family of chemicals called chelating agents. They are used to break down scale that has built up in well bores, pipes, etc.

In high concentrations, these chemicals are health hazards because they trap metal ions (such as calcium, magnesium and iron) needed for many body functions. At low concentrations, they pose some risks to aquatic and soil

organisms. Because this product contains a variety of chelators, including EDTA, NTA, DTPA and others, I can't offer a more specific hazard assessment.

32. SCALEHIB 100

This product contains ethylene glycol.

Ethylene glycol is the primary chemical in automobile antifreeze. This is not to suggest that it's not hazardous: It can accumulate in kidney, liver, and brain tissues, and it is a carcinogen. What's worse, it has a sweet taste, which promotes its ingestion by cats and other domestic animals.

Clay Stabilizers

33. TEMPORARY CLAY STABILIZER L64

This product contains tetramethyammonium chloride (TMAC).

Tetramethylammonium chloride is the most basic of the quaternary alkyl amines, a reactive family of chemicals often used as microbicides. This product is very poisonous, made worse by the fact that it has practically no odor. It is biodegraded in water or soil very slowly.

Most of the newest slickwater surfactants (such as ClearFRAC and cationic geminis) are members of this family of compounds, but they are all much less hazardous than TMAC.

34. Clay Treat 3C

This product contains tetramethylammonium chloride, discussed above.

Carbohydrate Gelling Agents

35. FRP-121 (Two related MSDS's)

This product contains anionic polyacrylamide polymer beads in microemulsions. It is essentially non-toxic.

36. FRW-14

This product contains unspecified carbohydrates, which are non-toxic. As noted above, use of starch-based gelling agents requires the accompanying use of cross-linkers and biocides.

.

37. WATER GELLING AGENT J580

This product contains unspecified carbohydrates, discussed above.

Conditioners / Other

38. LP-65

This product contains ammonium chloride.

Ammonium chloride can irritate the skin, eyes and respiratory tract in concentrated form, but is on the low end of the toxicity spectrum as used.

39. GAS PERM 1000

This product contains isopropanol, discussed above.

40. FDP-S819

This product contains isopropanol, discussed above.

41. HYDROCHLORIC ACID (Three related MSDS's)

Also known as muriatic acid or stomach acid, this is a very strong acid, even at fairly low concentrations. The solutions used by gas extraction operators are much more concentrated than what is found in your stomach. Its health effects are related to its corrosiveness to tissues.

42. FE Acid

This product contains hydrochloric acid, discussed above.

43. LIQUID NITROGEN

This is an extremely cold liquid, which is practically its only hazardous property. However, in enclosed spaces, its vapor can pose an asphyxiation hazard.

References and Resources

"Modern Shale Gas Development in the United States: A Primer", Prepared by the Ground Water Protection Council, Oklahoma City, OK and ALL Consulting, Tulsa, OK for the US DOE, Office of Fossil Energy and the National Energy Technology Laboratory; (April 2009; "Chemical Descriptions for Marcellus Shale Wells", Fortuna Energy, Inc.). Document: http://fossil.energy.gov/news/techlines/2009/09024-Shale_Gas_Primer_Released.html)

Considine, Timothy, Robert Watson, Rebecca Entler, & Jeffery Sparks. 2009. "An Emerging Giant: Prospects and Economic Impacts of Developing the Marcellus Shale Natural Gas Play", The Pennsylvania State University College of Earth & Mineral Sciences Department of Energy and Mineral Engineering, (July 24, 2009. http://www.pamarcellus.com/EconomicImpactsofDevelopingMarcellus.pdf)

Davidson, D. 1979 "Overview of the Boomtown Phenomenon and Its Effect on Women and Minorities" U.S. Commission on Civil Rights Energy Resource Development Washington, D.C.: U.S. Government Printing Office

Ervin, O. 1978 "Local Fiscal Effects of Coal Development: A Framework for Analysis and Management" Policy Studies Journal Vol. 7:1

"Hometown Energy: The Facts About Natural Gas Exploration of the Marcellus Shale", Independent Oil & Gas Association of New York, Lakeview NY. (http://www.iogany.org <http://www.iogany.org/}

Jacquet, Jeffery. 2009. "Energy Boomtowns & Natural Gas: Implications for Marcellus Shale Local Governments & Rural Communities", NERCRD Rural Development Paper No. 43, The Northeast Regional Center for Rural Development - The Pennsylvania State University, University Park PA, January 2009. ttp://nercrd.psu.edu/Publications/rdppapers/rdp43.pdf

Mall, Amy, Natural Resources Defense Council Contributing Authors Sharon Buccino, Natural Resources Defense Council
Jeremy Nichols Rocky Mountain Clean Air Action Drilling Down: Protecting Western Communities from the Health and Environmental Effects of Oil and Gas Production