<u>**Gas Drilling, Hydraulic Fracturing, and Water Quality**</u>

<u>**Purpose**</u>

Address the potential impacts of gas drilling operations involving horizontal drilling and hydraulic fracturing on water quality, both ground water and surface water, with emphasis on drinking water supplies.

Here's an outline of what will be covered:

<u>Background</u>

- Geology
- Quantities
- Contaminants
- Protective Measures

<u>Potential Impacts</u>

- Trucking
- Storage Facilities
- Vertical Migration
- Wastewater Treatment

<u>Contamination Issues</u>

<u>Conclusions</u>

<u>**Background**</u>

<u>Geology</u>

With all of the discussion on gas drilling in our area, we've all had a geology lesson, or two. We've heard that there are three shale bedrock layers of interest for gas drilling - Marcellus, Utica, and Trenton/Black River. For Otsego County, the Marcellus is not deep enough for gas. It outcrops at the surface in the northern part of the county, and then due to a dip in the sedimentary rock layers, it's 2,500 to 3,000 feet deep at the southern end of the county. However, the Utica and Trenton/Black River layers are deeper, starting at 1,000 to 2,000 feet at the northern end of the county to ~5,000 feet at the southern end. These depths are attractive for gas drilling.

In drilling for gas using horizontal drilling and hydraulic fracturing techniques, there is a reliance on vertical separation distance and low permeability of the intervening rock layers to prevent hydraulic communication between shallow aquifers and deeper gas bearing formations. However, throughout the shale-gas region in NYS, there are many geologically formed faults and fractures in the rock that serve as conduits that facilitate migration of contaminants, methane, or pressurized fluids from deep formations towards the surface, potentially impacting aquifers and ultimately surface waters.

Quantities

Using the Otsego Lake watershed as an example, here's what the numbers look like for gas drilling operations using horizontal drilling and hydraulic fracturing:

		Build-out	
Parameter	Per Well	Low	High
Area (sq mi)	-----	18	36
Area %	-----	24%	48%
No. of Wells	1	108	216
Site Disturbance (ac)	7	756	1,512
Water Use (MG)	4	432	864
Chemical Use (tons) (1% of frac fluid)	167	18,036	36,072
Flowback (MG) (Wastewater)	2	216	432
Truck Trips	1,200	129,600	259,200

(Total)			
Truck Trips (less water input)	415	44,826	89,652

Contaminants

Let's take a closer look at the chemicals used and wastewater generated by hydraulic fracturing.

An array of chemical additives are used to control the fluid properties during the hydraulic fracturing process. These chemicals are used as surfactants, friction reducers, gelling agents, scale inhibitors, pH adjusting agents, iron control agents, bactericides, and corrosion inhibitors. Many of the chemicals used are hydrocarbons, including toxic cyclic compounds such as benzene, toluene, and xylenes. In the discussion on quantities, it was assumed that the percent by weight was 1% of the total hydro-fracturing fluid. It ranges from 0.5% to 2% , which is a range of 84 tons to 334 tons per well for the first fracturing job. Over the life of a well, it could be re-fractured up to 8 times, which increases the range of chemicals used per well to 672 tons to 2,672 tons. Using the Otsego Lake example, the cumulative use of chemicals would be over 144,000 tons (288,000,000 pounds) for the low-end build-out. On a truck trips basis, that would be close to 7,000 truckloads of concentrated chemicals.

The flowback wastewater contains all of the chemical contaminants added to the hydro-fracturing fluid plus contaminants from the shale bedrock such as heavy metals, radionuclides (radium), and dissolved solids, or salt brine. The total number of chemical entities that could potentially be used in hydraulic fracturing fluids numbers over 300.

The DEC's dSGEIS included a section on the average concentrations of contaminants found in flowback wastewater. Comparing this to federal drinking water standards, there were a number of contaminants that far exceeded the maximum levels allowed in drinking water, including heavy metals, benzene compounds, radium, and chlorides.

How will these millions of gallons of contaminated wastewater by handled? In the draft SGEIS, DEC specifies that flowback wastewater be stored in tanks for each well pad. This is good. However, DEC will allow centralized storage of flowback wastewater for dilution and reuse. These will be open pits ranging in size from one to five acres, with a capacity of up to 16 million gallons.

Protective Measures

How will our fresh water resources be protected from gas drilling operations that use hundreds of tons of chemicals and generate millions of gallons of wastewater per well? The primary way, per the dSGEIS, is through "setbacks", or distances from a water bodies. Here's a summary of the proposed setbacks:

Water Body	Well Pad	Centralized Impoundment
Streams, ponds, lakes	150'	500'
Reservoirs (e.g. NYC watershed)	300'	1,000'
Public Wells	2,000'	300'
Private Wells	150'	300'

It's important to note that these setback distances are not absolute. Gas drilling can occur within these setbacks as long as a site-specific SEQRA review is conducted. Some further notes: (a) The 150' setback from streams, ponds and lakes is unchanged from DEC's recommendation in 1992 for the original GEIS, long before high-volume hydraulic fracturing, (b) The setback of 300' from a reservoir for a well pad would allow the horizontal wellbore and the hydraulically fractured area to be under a drinking water supply, (c) the 150' setback of a well pad from private wells and the 300' setback of an impoundment from both public and private wells are based on old DOH Public Health regulations that simply don't relate, and (d) regarding the 2,000' setback of a well pad from a public well, NYC's DEP is recommending a 7-mile buffer separating gas drilling from the NYC watershed's underground infrastructure.

Net, DEC's proposed setbacks to protect ground and surface waters are woefully inadequate.

Potential Impacts

The potential for contamination of fresh water resources comes from multiple sources, and can originate at the surface or subsurface. Here's a brief review:

Trucking Accidents

Large tank trucks will used to haul concentrated chemicals and flowback wastewater, carrying over 5,000 gallons per load. Given the huge volume of trucks travelling over secondary roads, which may be in poor shape due to heavy truck traffic, the chance of an accident is real. (Otsego Lake watershed scenario - Over the build-out period, the cumulative number of trucks for the low-end projection would be close to 45,000 truckloads without re-fracturing, and up to 360,000 truck loads with re-fracturing. The numbers would double for the high-end projection.

Storage Tank Leaks

With tanks and pipelines, there's always the chance for leaks, especially with the flowback water returning from the well under pressure.

Centralized Impoundment Overflows and Leaks

These impoundments will have rubber liners that can develop leaks over time. Also, a torrential rainstorm, like we had here in 2006, can cause an impoundment to overflow.

Vertical Migration of Hydro-Fracturing Fluids

Recall the earlier discussion of faults and fractures in the bedrock overlying the gas-bearing shale. These are conduits that allow the chemicals in hydro-fracturing fluids and the contaminants in the shale (heavy metals, radionuclides, and brine) to reach freshwater aquifers. (Note: This is the more likely source for groundwater contamination versus the vertical part of the wellbore, which is cased with steel and concrete.) Groundwater contamination can also move to surface waters.

Wastewater Treatment

Flowback wastewater, containing hydrocarbons, heavy metals, radionuclides, and high total dissolved solids and chlorides is considered an industrial waste. Few, if any, public wastewater treatment plants are capable of treating the high volumes of these wastes without violating their permits and impacting receiving waters. In addition, there are no dedicated treatment facilities in the state for these wastes.

Contamination Issues

The contamination of water resources comes down to this. Given the multiple potential sources of contamination, there is a real possibility of ground and surface drinking water supplies becoming contaminated with toxic hydrocarbons, heavy metals, radionuclides, and high levels of chlorides. An argument can be made that if there's a spill, dilution will bring the contaminant concentrations below drinking water MCL's (Maximum Contaminant Level). However, those in the water business know that the solution to pollution is NOT dilution! The toxic chemicals remain. Also, there are those, DEC included, who think that as long as a public water supply is filtered, contaminants can be removed. This is not the case because the contaminants are in solution (dissolved), and cannot be removed by conventional filtration technology.

Thus, the key issue and question regarding contamination, that has not been addressed by either the DEC or DOH, is this: Assuming (a) that surface spills, both chronic and acute, cannot be avoided over a long time period, (b) that there is the potential for subsurface migration of toxic hydro-fracturing chemicals to ground and surface drinking water supplies, and (c) that the contaminants cannot be removed from water supplies, what is the long-term effect on public health of low-level exposure to toxic chemicals?

Conclusions

Given the current state of the technology for high-volume hydraulic fracturing, the threat to ground and surface drinking water supplies is unacceptable. The known and unknown impacts of gas drilling cannot be justified. Thus, gas drilling using this technology should be prohibited in drinking water watersheds, and there needs to be much larger buffer zones around both public and private wells.

And, finally, gas drilling using high-volume hydraulic fracturing should not be allowed in NYS until there is sufficient capability and capacity to handle the treatment of flowback wastewater.