

Anthony G. Hay Ph.D.

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Qualifications

Hay is an associate professor of Microbiology and Soil Ecotoxicology in the Department of Microbiology and in the graduate program of Comparative and Environmental Toxicology at Cornell University. He received his Ph.D. in Soil Science with an emphasis on Soil Microbiology from the University of California, Riverside in 1997. He performed post-doctoral research as a Hollaender Distinguished Post Doctoral Fellow at the Center for Environmental Biotechnology at the University of Tennessee, Knoxville for two years before joining the faculty at Cornell as an Assistant Professor in 1999. He currently serves as the director for the Institute for Comparative and Environmental Toxicology and was interim director of Cornell's Center for the Environment from 2007-2008. He teaches a graduate class called introduction to environmental toxicology and chemistry. His research interests include the microbial metabolism of organic pollutants such as industrial chemicals, pharmaceuticals, personal care products, and pesticides as well as their fate in the environment. He has directly supervised 11 Ph.D. students while co-advising 5 masters and 11 Ph.D. students. Together, their work has resulted in approximately 40 scientific publications. Dr Hay is currently a member of the Faculty Advisory Committees of both the Cornell Center for a Sustainable Future and the New York State Water Resources Institute.

Testimony

Thank you for the opportunity to share some of my concerns with you about the draft Supplemental Generic Environmental Impact statement governing natural gas drilling. As Director of Cornell's Institute for Comparative and Environmental Toxicology I am particularly concerned about the risk flowback fluids and production brines pose to human and environmental health. These risks stem from the presence of hazards such as the known carcinogens/mutagens benzene and 4-nitroquinoline-N-oxide and the potential endocrine disruptors nonylphenol and octylphenol in flowback fluids, as well as the presence of naturally occurring radioactive materials (NORMs) in brines. Risk can be mitigated by reducing exposure to hazards so my first suggestion is that the legislature considers requiring the use of enclosed collapsible reservoirs with secondary containment instead of open pits. Minimizing exposure is appropriate because we are not fully aware of all the risks posed by flow back fluids and this is likely to reduce the risk of accidental exposure. My second suggestion is that the legislature band specific constituents because they are particularly hazardous and more benign alternatives exist. Minimizing exposure and requiring the use of less hazardous alternative compounds (aka substitution) are well accepted forms of risk mitigation that should not pose an undue burden on the drilling companies and will reduce the risk to humans and wild life.

According to the S-GEIS Benzene, which is a known human carcinogen, was found in nearly half of all flowback waters from Pennsylvania and West Virginia (14/29 samples) at concentrations ranging from 15.7 to 1950 µg/L, with an average of 479.5 µg/L. This average number is nearly 100 times the maximum contaminant level (5 µg/L) established by the EPA. The maximum concentration was nearly 400 times higher. Even if one considers a dilution or attenuation factor, as is done at superfund sites, of as much as 100, it is possible that mishandling of flowback water could contaminate nearby aquifers or groundwater at levels that could exceed and MCL established by the EPA. Many drilling companies'

phased out the use of benzene in the 1990s so it should be possible for those working in the Marcellus Shales to do the same. In order to reduce the risk of contamination associated with spills or storage pond failure, I strongly urge the legislature to disallow the use of benzene and other petroleum distillates in drilling fluids since functional alternatives exist.

Of even greater concern was the S-GEIS's report of the extremely high concentrations (ranging from 1422 to 48336 mg/L, with an average of 13906 mg/L) of 4-nitroquinoline-N-oxide (Table 5-9). These concentrations of this one compound exceed the 0.5% total mentioned for all chemical additives listed on page 5-42. Although it has no established MCL, this compound is routinely used in animal studies to induce cancer formation. Its material safety and data sheet lists it as a human mutagen and that says that it may cause reproductive effects. The presence of this compound at such high concentrations in all of the flowback samples tested is disturbing, especially given that it was not listed as a constituent in fracking fluids. It is highly unlikely to be of natural origin and almost certainly must have been added, in all likelihood as a biocide. Since alternative biocides exist the legislature must prevent the use of this compound in drilling fluids and demand to know its origin and ascertain why it was not reported as a drilling fluid constituent earlier.

Other compounds of concern in fracking fluids are nonylphenol and octylphenol ethoxylate surfactants which can be degraded by microbes to become endocrine disruptors that mimic estrogen and may adversely affect the health of terrestrial and aquatic wildlife. The ethoxylate portion of these compounds are easily removed by microbes and result in the formation of nonylphenol and octylphenol which are both weakly estrogenic. Normal monitoring of the parent compounds used in fracking fluids would not pick up the presence of these degradation products so we have no idea if they are present or not, however, based on the similarity to other environmental exposure scenarios, it is reasonable to expect them to be present any time the parent surfactants are used in the environment. Exposure to these compounds, even at extremely low concentrations ($\mu\text{g/L}$) can cause feminization of fish. Alternative surfactants exist so banning these compounds should not pose an undue burden on drilling companies.

The final compounds of concern are NORMs in brines (Ch 5.16.7). Given the DEC's acknowledgment that more work needs to be done to understand the risk that NORMs pose, it seems premature to permit the spreading of brines (as proposed in Ch5.16.6) on roadways as alternative deicing compounds. A moratorium should be placed on this practice until we can get a clearer picture of the risks involved.

It is my opinion that by requiring management practices that reduce exposure to fracking fluids and brines and by requiring the substitution of known hazards with more benign alternatives the legislature will ensure greater protection to our citizens and the environment while not unduly impeding gas drilling.

Sincerely,

Anthony G. Hay Ph.D.