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Hearing on Waste Water and Cuttings as they pertain to hydraulic fracturing
Senate Standing Committee on Environmental Conservation
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Professional Qualifications & Experience

Dr Brian G Rahm is currently a Post-doctoral Research Associate with the New York State Water Resources Institute where he is engaged in education and research on topics related to the State's water resources. He received his M.S. in environmental engineering from the University of California at Berkeley and Ph.D from Cornell, where he worked on bacterial remediation of groundwater contamination. He then moved to New Zealand and spent a year engaged in climate change policy analysis for Wellington City Council. Since then he has performed research on greenhouse gas emissions from wastewater treatment plants, and has also developed and taught a course on the role of microorganisms in climate change at the American Museum of Natural History.

Testimony of Brian G. Rahm

Thank you for the opportunity to participate in this discussion.

My testimony will address the following subjects:

1. **Pertinent wastewater and cuttings data from Pennsylvania (PA) related to similar issues potentially faced by NY**
2. **Wastewater acceptability at Publically Owned Treatment Works (POTWs) in NY with an emphasis on recommendations provided by the New York Water Environment Association (NYWEA)**
3. **Wastewater treatment capacity in the Southern Tier of NY and thoughts on future development**

Throughout my testimony I will try to highlight relevant language and proposals as they currently exist in the Revised Draft Supplemental Generic Impact Statement (SGEIS), as well as NY regulations. In some cases, I will quote directly from, or paraphrase, previously published reports, or reports that are in the process of being published.

1. **Pertinent wastewater and cuttings data from Pennsylvania (PA) related to similar issues potentially faced by NY**

In order to understand the data that is available, it is first important to understand basic distinctions and options related to wastewater management and shale gas development. A general set of definitions is as follows:

Brine & frac fluid – Also known as flowback and produced water, includes water used for hydraulic fracturing, as well as water naturally present within the shale. In the Marcellus Shale, frac fluids consist of water mixed with approximately 8 to 15 chemical additives per well. According to Susquehanna River Basin Commission (SRBC) data from 2008 to 2011, about 10 percent of the water injected into the ground returns to the land surface within 30 days (“flowback water”), and the rest remains underground, absorbed by the relatively dry shale bed. Once the well is in production, relatively low volumes of “produced water” or brine continue to return to the surface throughout the operational life of the well.

Drilling muds – Muds include fluids used during the drilling process to cool and lubricate the drill bit and motor, and to transport cuttings to the surface. Overall mud volumes are not high compared to flowback, but can contain chemical additives requiring treatment.

Cuttings – According to the SGEIS (§5.2.4) these are rock chips and fine-grained rock fragments removed by the drilling process and returned to the surface in the drilling fluid.

With these definitions in mind, I'd like to introduce the most likely options available for wastewater treatment and/or disposal. Shale gas wastewaters present treatment challenges because they can contain high amounts of total dissolved solids (TDS) - salts, metals, and naturally occurring radioactivity picked up from the rock, as well as chemical additives used for fracturing. Current options for treatment of wastewater include:

1. On-site or off-site industrial treatment facilities
2. Reuse with pretreatment on-site or off-site
3. Underground injection via federally regulated deep wells
4. Publically owned treatment works (POTWs)

In PA, it is possible to get information on trends in wastewater treatment and disposal because of the recent establishment of a statewide tracking system. No state in the region other than Pennsylvania has yet reported data on Marcellus wastewater management, so it is not clear if these numbers reflect current or future water flows across the region. New York has proposed such a system.

How are certain PA wastes being handled? (based on information from PADEP Jan-Jun 2011):

Brine and frac fluid –

- Roughly half is reused for subsequent frac jobs (likely following industrial or on-site treatment); SGEIS states “reuse” expected to be significant [1.1.1.2]
- Roughly one third is sent to industrial treatment facilities, none located in NY
- About five percent goes to deep injection well, mostly in Ohio
- Less than one percent going to POTWs (all in PA)
 - PADEP asked operators to voluntarily stop using POTWs by May 2011 because of water quality concerns related to Total Dissolved Solids (TDS), especially Bromide, and their effects on drinking water facilities on rivers already impacted by acid mine drainage (from coal development)

Drilling muds & other liquid wastes –

- Roughly split between reuse and industrial treatment facilities
- One to two percent each for POTW and landfill

Solid waste (cuttings) –

- Almost all landfilled
- Mostly in PA (~60%), but significant amount in NY (30%)

It is worth mentioning that treatment of these wastewaters, even at sophisticated industrial facilities, usually leads to solid or concentrated liquid wastes that must be either landfilled or sent to deep well injection facilities. New treatment technologies are being developed by a growing water service industry in PA, although many are not yet in wide use.

2. Wastewater acceptability at Publically Owned Treatment Works (POTWs) in NY with an emphasis on recommendations provided by the New York Water Environment Association (NYWEA)

In this section I briefly give an engineer's perspective on the issue of POTWs and their use to treat shale gas wastewater in NY by paraphrasing recommendations compiled by NYWEA, a professional association that I had the opportunity to work with on this and related topics.

According to NYWEA, existing or new POTWs that utilize physical/chemical treatment processes may have the ability to successfully treat specific shale gas wastewaters. However, only two such systems currently exist in NY. Successful treatment depends on the ability to understand and characterize waste composition over time and the capabilities of the treatment system. Biological treatment plants – the vast majority of facilities in NY – likely will not be able to accept wastewaters without significant pre-treatment (with the possible exception of some drilling muds).

If treating shale gas wastewaters were to be an option, NYWEA recommends that each POTW wishing to accept this waste conduct a review that includes:

- An examination of its ability to treat wastewater while meeting regulatory obligations
- Revisiting, with input from NYSDEC, the assimilative capacity of receiving water bodies, particularly with respect to TDS
- Confirmation that it can protect treatment plant personnel and equipment from harm/damage
- Analysis of the effect wastewater may have on treatment plant sludge/residuals and whether the POTW can cost effectively manage and dispose of them.

NYWEA also recommends that POTWs confirm they have the authority to stipulate monitoring requirements, as well as the ability to reject wastewater that does not meet agreed upon standards. Lastly, NYWEA recommends that POTWs give consideration to testing each load of new wastewater, especially for radioactivity.

The revised draft of the SGEIS, as well as new proposed regulations (6 NYCRR Part 750) address some of these concerns by requiring the following:

- Each batch of wastewater leaving a well pad be tested for TDS, NORM, BTEX
- Testing for influent and treatability at both public and private facilities
- Fluid disposal plan which estimates flowback constituents based on additives used
- Wastewater volume monitoring and reporting

3. Wastewater treatment capacity in the Southern Tier of NY and thoughts on future development

So far, I have provided some information on how wastewater and cuttings are being dealt with in PA, and I have outlined some considerations relative to the use of POTWs in NY. However, it is clear that POTWs are not being extensively used in PA, and that their use in NY entails a variety of concerns. So, what is the available POTW capacity in NY, and will POTWs matter?

According to the SGEIS [App 22; 6.1.8.1] the DEC performed a basic analysis to determine the potential available capacity for POTWs to accept high-volume hydraulic fracturing wastewater. The analysis assumed that treatment facilities are willing to accept wastewater; that POTWs are equipped to treat this wastewater; that industry is willing to adhere to rules applicable to public treatment facilities; and that receiving water has assimilative capacity to accept additional TDS loadings. Given all these assumptions, the analysis still finds that there is questionable available capacity for POTWs in New York State to accept high-volume hydraulic fracturing wastewater.

WRI has also performed an analysis of the capacity of POTWs to treat wastewater in the Susquehanna River basin of NY, again assuming that facilities have the ability and inclination to do so. Results of our analysis support the idea that capacity is limited due to a combination of public infrastructure size and regulatory constraints such as those proposed in the SGEIS. In reality, there are additional reasons to think that POTWs will not be extensively utilized in NY. For example, no POTW in New York State currently has TDS-specific treatment technologies.

These analyses, together with evidence from PA suggesting that industrial treatment facilities have far greater ability and capacity to treat waste streams, lead me to conclude that POTWs will not offer an acceptable solution for industry within the regulations NY is likely to adopt. Encouraging establishment of purpose-built industrial treatment facilities has several key advantages over using POTWs:

- Technology - purpose-built industrial facilities are better suited to treating complex wastewaters, and thus less likely to encounter problems meeting effluent water quality standards
- Capacity - compared with POTWs, fewer industrial facilities provide equivalent treatment capacity, an important consideration in the face of collective wastewater treatment needs that could quickly outpace regional infrastructure
- Oversight - assuring compliance of a small number of industrial facilities is likely to present a significantly smaller regulatory burden than assuring compliance of many POTWs
- Planning & finance - private facilities may be built at a pace and scale concurrent with industry needs, and may have more flexibility than public entities in choosing business models that accommodate the volatile nature of extractive development

Conclusions

1. Due to a combination of evolving regulation, expanded industrial treatment infrastructure, and advancements in treatment technologies, a large majority of shale gas wastewater in PA is being handled by private industrial treatment facilities, with an increasing model of reuse. Solid cuttings from PA development are almost exclusively sent to landfills in both PA and NY.

2. Treatment of most shale gas wastewaters is not appropriate at POTWs utilizing biological processes (almost every POTW in NY). That being said, these wastewaters are treatable, but only under carefully controlled circumstances, using appropriate technology, with well-trained professionals and adequate regulatory personnel. This likely means sophisticated physical/chemical processes with some form of thermal distillation technology or its equivalent.

3. POTW treatment capacity in NY is limited, even under the most permissive policy scenarios. Given the relatively stringent regulations NY is likely to adopt, use of POTWs would not represent a viable treatment/disposal option for the shale gas industry. Private facilities, purposefully designed and located within areas of significant shale gas development, could treat wastewater without putting public facilities and taxpayers at risk.

Lastly, I would like to offer a general comment in support of gathering as much data on these important issues as possible in the event that development moves forward in NY. In the SGEIS, the DEC proposes many new measures and data collection requirements, but it is not clear who will organize and analyze this data, to what extent it will be public, and how it will feed back into policy and management decisions in the future. I would urge the state to be diligent in its approach to data collection, analysis, and presentation in the upcoming years so that all stakeholders have access to good information, and so NY can critically evaluate its approach to complex development issues.

Sources referenced:

Evaluating the Acceptability of Gas Well Development and Production-Related Wastewater at New York Wastewater Treatment Plants (2011). New York Water Environment Association
<http://nywea.org/gac/HFSC/EvaluatingAcceptability.pdf>

- Discusses challenges facing wastewater treatment plants in NY and provides recommendations for plant operators and policy makers