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Overview and Technical Recommendations Concerning the Use of Wastewater Effluent for Hydrofracturing Make-Up Water

(May 16, 2011)

I. Introduction to the Topic

The production of natural gas currently trapped within Marcellus Shale and deeper deposits in New York and elsewhere by hydrofracturing of the formation may become a significant activity in New York in the near future. Hydrofracturing (“fracking”) is a water intensive activity with the fracking of a single well potentially utilizing 5 million gallons of water or more. While in other states initially much, if not all, of this water came from potable water sources and/or from surface or groundwaters, continued use of such large volumes of potable water is not sustainable. Likewise, significant use of surface or groundwater as the primary source of frac water may cause potentially significant environmental or other impacts.

The natural gas drilling industry has recognized these realities and is moving toward re-using most of the recovered frac water (termed “flowback” water). The New York Water Environment Association¹ (“NYWEA”) endorses the concept of recovery and re-use of frac water and encourages the natural gas development industry to continue to research and develop the knowledge and technologies needed to make re-use of significant quantities of flowback water a common practice. Recent articles and announcements by both governmental entities and the Marcellus Shale-related gas development industry indicate that this trend toward increasing re-use of fracking-related flowback water as makeup water for hydrofracturing is being given a high priority. The industry’s stated goal is 100% reuse of this water².

No matter how successful the natural gas development industry is in achieving this goal however, there will continue to be the need for fairly significant volumes of water to blend with the recovered flowback water. This is due both to the fact that a significant portion of frac water is not

¹ The New York Water Environment Association (NYWEA) is a statewide nonprofit organization of approximately 2,500 water and wastewater professionals, environmental engineers and scientists, and water quality management professionals dedicated to protecting and enhancing the waters of New York. NYWEA is primarily an educational organization dedicated to educating not only our members but also those who are charged with setting policy and practices intended to protect the water environment here in New York.

² See, *Sustainable Management of Flowback Water during Hydraulic Fracturing of Marcellus Shale for Natural Gas Production*, DOE/NETL at http://www.netl.doe.gov/technologies/oil-gas/Petroleum/projects/Environmental/Produced_Water/00975_MarcellusFlowback.html.

recovered as flowback³ and because recovered water, even if treated, will often have to be blended with cleaner water to make it suitable for re-use in fracking.⁴

NYSDEC⁵ and others have identified treated wastewater as a possible source of frac make-up water. Recent media reports⁶ on two municipalities who are in discussion with natural gas drillers or development companies concerning selling their treated municipal wastewater effluent, illustrate that use of treated wastewater for this purpose could be a “win-win” situation for both the natural gas industry and municipalities or industries that must treat and dispose of their wastewater. For example, given that much of the New York Marcellus Shale area is located within the Chesapeake Bay watershed, up to 26 municipalities and a few industries will have to invest significant funds over the next 7 years in order to install and operate processes to reduce effluent concentrations of nitrogen and/or phosphorus pursuant to the recently finalized Chesapeake Bay TMDL (Total Maximum Daily Load).⁷ To municipalities such as these, a new source of possible wastewater-related revenue is attractive. Another potential positive benefit of re-use of treated wastewater effluent for use in gas well development, is that using water from this source will reduce the need for water withdrawn from surface waters. In addition to the obvious benefits of reducing surface water withdrawals, is the fact that such reductions should also reduce the potential for gas well development water withdrawals and transport of this water to another location to increase the spread of aquatic invasive species.

The purpose of this paper is to examine technical issues related to the possible re-use of treated wastewater as frac make-up water with respect to environmental and human health.

This paper **does not** address issues related to the impact of fracking water on groundwater or on the treatment of flowback water by municipal wastewater treatment plants (“POTWs”). The former issue is too site-specific to be handled in a single paper, and treatment of flowback water by POTWs is the subject of a companion NYWEA white paper entitled *Evaluating the Acceptability of Gas Well Development and Production-Related Wastewater at New York Wastewater Treatment Plants*. This paper also does not address the issue of transporting treated effluent and safely storing it at a gas well development site prior to its use as a make-up water. This latter issue is addressed in the companion NYWEA White Paper entitled *Protection of Surface Waters Associated with Shale Gas Drilling and Related Support Sites*.

³ Id. Recent estimates are that between 25 and 100% of frac water is recovered. However, not all flowback water will be suitable for re-use. See, *Sustainable Management of Flowback Water during Hydraulic Fracturing of Marcellus Shale for Natural Gas Production*, DOE/NETL at ml

⁴ Id.

⁵ See, *New York Draft Phase I Watershed Implementation Plan, Chesapeake Bay Nitrogen, Phosphorus and Sediment TMDL*, NYSDEC, 9/1/2010 at §II(c) pg 28.

⁶ *Owego Puts Sale of Wastewater for Fracking on Hold Village will conduct environmental assessment before voting* Broader View Weekly, (December 23, 2010) and *Kane Borough Sewer Authority Making Money From Selling Effluent To Marcellus Shale Driller* March 2010. (http://www.tiogagaslease.org/images/BVW_12_23_10.pdf; <http://marcellusdrilling.com/2010/03/kane-borough-sewer-authority-making-money-from-selling-effluent-to-marcellus-shale-driller/>)

⁷ In October 2010, NYSDEC estimated that the cost of compliance for the 28 New York “Bay Significant” wastewater treatment plants (all but two of which are POTWs) would be ~ \$140 Million if its plan for compliance were adopted. If federal “backstops” are imposed, the cost could be \$1.0 to 1.5 billion. See, http://www.epa.gov/reg3wapd/pdf/pdf_chesbay/pubmtgagendas2010/NYDraftCBayPlan.pdf.

II. Questions Evaluated

This paper focuses on whether there might be constituents in POTW effluent which would:

1. make the effluent unsuitable for use as a frac water,
2. pose a potentially significant incremental increase of risk to the environment, or
3. present a health threat to those working (or living) near where POTW effluent is stored or used as frac make-up water.

III. Assumptions

The evaluation discussed in this paper is based on the following assumptions:

1. Any New York POTW that would be considering providing its treated effluent as make-up water for hydrofracking has installed and is fully meeting at least secondary treatment standards.
2. The regulatory process will be sufficiently robust to insure that during normal (no-accident) operations, frac water does not enter fresh groundwater and that enforceable regulations and permit conditions (such as casing requirements etc.) also minimize the potential for accidental releases to fresh groundwater and the unsaturated zones above fresh groundwater.

IV. Results

A. Quality of Wastewater Needed If Used for Hydrofracking

NYWEA finds that most POTW or other treated wastewater which is being discharged to a *Water of the State* in compliance with a SPDES permit should be of acceptable quality to use as fracking make-up water. The basis of this conclusion is that permit limits and other requirements within the SPDES Permit must be based on the Clean Water Act (CWA)-mandated secondary treatment and minimum removal requirements for municipal wastewater.⁸ For non-municipal wastewater effluents, such as those from industrial or commercial wastewater treatment facilities, numeric effluent limits and other requirements based on the CWA mandated “Best Conventional” or “Best Available” Treatment technology must be met. The existing CWA requirements may be even lower than these “technology-based” requirements, if necessitated by the water quality needs of the current receiving waters. The one exception to this, which is discussed in Section IV(C) below, is for effluent from those wastewater treatment plants whose current SPDES permit does not require disinfection.

For the 26 POTWs within New York’s Southern Tier, and hence close to where hydrofracking may take place in the state, by 2025 (the end of the compliance period for the Chesapeake Bay TMDL imposed additional nutrient removal) the effluent will be of even higher quality by the time nitrogen and/or phosphorus removal capabilities are in place. Other POTWs with Water Quality-based effluent limits already incorporated into their SPDES permits will also have effluent quality that is better than

⁸ See, 40 CFR §133.102. Thirty day averages for BOD₅ and TSS set at 30 mg/L with mandated 85% removal. Required effluent pH between 6 and 9.

secondary. Because the Marcellus Shale natural gas development industry is already using recovered frac water as make-up water, with its much lower water quality, use of cleaner wastewater treatment effluent should be acceptable to most of the industry.

In addition to being of a quality which consistently meets its S/NPDES Permit requirements, the natural gas driller/development entity considering purchasing treated wastewater effluent may place additional quality-related requirements into its water purchase contract. Such additional requirements may reflect the needs of their hydrofracking solutions and/or requirements imposed through their state or local permits or approvals. To the extent reasonably practicable, these requirements should be identified as early in the discussion process as possible in order to allow any additional monitoring or other data collection related to the quality of the wastewater treatment effluent to be initiated.

B. Environmental Protection

Treated wastewater effluent, which is both of a quality to be useful as hydrofracking make-up water and which is free of potentially harmful levels of pathogenic organisms, must also not pose a potentially significant incremental increase of risk to the environment. In support of this goal NYWEA assumes that the drilling of gas wells and the use of hydrofracking solutions will be adequately controlled through the natural gas drilling and recovery permitting and regulatory process. It notes that such things as required specifications for the use of multiple well casings and well joint cement requirements are pivotal in preventing the unintended injection of hydrofracking water into fresh groundwater and to the hydrogeologic layers above and immediately below all freshwater groundwater. Thus, NYWEA concludes that in most instances, the use of treated wastewater effluent which was previously consistently meeting its SPDES discharge requirements as hydrofracking make-up water should not add any incremental risk to fresh (Class GA) groundwater, as long as our stated assumption that the regulatory process will be sufficiently robust to insure that during normal (no-accident) operations, frac water does not enter fresh groundwater and that enforceable regulations and permit conditions (such as casing requirements etc.) also minimize the potential for accidental releases to fresh groundwater and the unsaturated zones above fresh groundwater is met.

The management of treated wastewater effluent above ground, before it is used as hydrofracking make-up water, can pose an environmental threat if not done according to a well thought out and implemented Best Management Plan (BMP). NYWEA notes, however, that the same is true for virtually all of the above ground operations and practices at a natural gas well drilling (or support) site. Hence issues related to the appropriate management of these waters are addressed in the companion BMP-related NYWEA White Paper entitled *Protection of Surface Waters Associated with Shale Gas Drilling and Related Support Sites*.

Further, the cessation of the current discharge of this treated wastewater effluent to surface or groundwaters may cause its own negative environmental impact if this discharge makes up a significant part of the stream flow, especially during critical low flow periods.

C. Health and Safety of Workers and Others

Treated wastewater, especially if it has not been disinfected, may contain bacteria and other organisms potentially harmful to human health. While most wastewater discharged to surface waters in New York are required to be disinfected by their SPDES permit, there are some SPDES permit

controlled effluents for which disinfection is not a current requirement. For example, some discharges to smaller “headwater” streams are not required to be disinfected because of a concern that the disinfectant might cause toxicity to sensitive fish or other aquatic species.⁹

In the event that wastewater from a wastewater treatment plant which is not currently being disinfected is being considered for use as hydrofracking make-up water, NYWEA believes that, in most cases, some type of disinfection will be a necessity. Further, while the mechanism to be used for disinfection should be a matter of negotiation between the wastewater treatment plant, the New York State Department of Environmental Conservation (or other involved regulatory agency) and the natural gas developer/driller, NYWEA recommends that serious consideration be given to the use of a non-oxidizing disinfection technique or chemical such as Ultraviolet or Ozonation if any of the treated effluent will continue to be periodically discharged to a low flow receiving water. This will avoid the formation of tri-halomethanes and other disinfection by-products in those receiving waters.

In addition to disinfection, NYWEA also recommends that when treated effluent is to be used for hydrofracking make-up water, its use and safe handling be incorporated into the Employee Safety Training programs which it assumes will be on-going at each of these sites.

V. Summary of Conclusions and Recommendations

1. The existing quality of treated wastewater effluent which is currently consistently meeting its SPDES Permit requirements should be generally sufficient for use as hydrofracking make-up water. Caution will need to be exercised anytime unusual events (excess wet-weather received at the head end of a wastewater treatment plant, upsets within the wastewater treatment system etc.) yields a wastewater effluent that is outside of SPDES permit limits. Perhaps the best way to address this is to make sure the contractual agreements between the wastewater treatment plant and the pre-established “acceptable quality” parameter-specific specifications and narrative requirements address what types of atypical events will trigger a duty to notify the entity purchasing the treated effluent for use as fracking make-up water.

2. Depending on the specifications for a safe and effective hydrofracking fluid, some additional analytical testing and/or treatment may be necessary. It is recommended that additional data needs be identified early in the discussion process between the treated wastewater effluent producer and the natural gas driller/developer.

3. To protect the local environment, proper storage and management of treated wastewater effluent is necessary. The recommendations in the companion NYWEA White Paper entitled *Protection of Surface Waters Associated with Shale Gas Drilling and Related Support Sites* should be considered. These include, but are not limited to:

- New regulations, General Stormwater SPDES permit requirements and/or other enforceable requirements must account for the unique phasing and layout of shale gas

⁹ Even for these discharges, disinfection is being added to many of these permits as a requirement as many of these SPDES permits are being renewed. The newer permits typically have stringent Chlorine/Total Oxidant limits which are met either by using a non-chemical means to disinfect (such as UV disinfection) or through the addition of de-chlorination facilities.

operations. This may be best accomplished by establishing a new Sector within the New York Multi-Sector Industrial Stormwater SPDES Permit, with explicit requirements based on the needs and activities of each phase at the various site and support locations.

- Containment and reduction of potential contaminants at their source should be highlighted as an effective and inexpensive approach for reducing water contamination.
- Monitoring is necessary in order to evaluate the effectiveness of practices and regulations. It is important to monitor the right things at the right times, in the right locations. This is likely best done on a site-by site basis. In the event of a suspected spill or release, use of real-time screening instrumentation (such as Specific Conductivity as an indicator of Total Dissolved Solids) should not only be allowed but actually encouraged.

4. To protect worker health and safety, all treated wastewater effluent should be disinfected prior to it being stored or used at a natural gas drilling/development site. While not a recommendation, consideration should be given to using a non-oxidant based disinfection method if new disinfection methods are needed and the effluent may be periodically discharged to a low-flow surface water.

VI. Other References and Related Resources

[The following information is provided as a resource, it does not indicate a NYWEA position on these proposed DRBC regulations.]

The Delaware River Basin Commission (DRBC) has proposed rules (and apparently has existing rules) giving it approval authority over all make-up water, included treated effluent.¹⁰ Under the proposed rules, if a wastewater has already been approved for discharge into the DRB, then its approval for use as Frac make-up water may be eligible for an “Approval by Rule” (ABR) determination.¹¹ Any additional permits required by the host State and/or the DRBC must be obtained before the wastewater can be re-used. Wastewater which is typically discharged within the DRBC can not (under the proposed rules) be diverted for natural gas drilling related use without DRBC approval.

¹⁰ See, proposed Section 7.4 and Article 2 Section 2.3 of the DRBC Water Code.

¹¹ See proposed 7.4(d)(2)