Bringing science to energy policy

Date: 5/30/2019

Subject: Response to Questions from Representative Matt Cartwright (D-PA)

From: Dominic DiGiulio Ph.D.
PSE Healthy Energy, Oakland, CA

To: Alan S. Lowenthal, Chair
Subcommittee on Energy and Mineral Resources
U.S. House of Representatives

Chairman Lowenthal:

On May 16, 2019, I testified before the Committee on Natural Resources, Subcommittee on Energy and Mineral Resources at a hearing titled, "Oil and Gas Development: Impacts of Water Pollution Above and Below Ground." Following this hearing, Representative Matt Cartwright (D-PA) submitted the following question.

Question:

In your study of oil and gas practices in Pennsylvania, you found that 35% of wastewater could not be tracked, largely because of the RCRA exemption.

a. What are the implications of this volume of 'missing' waste?

b. What are the potential consequences if a portion of that missing wastewater made its way into our public water sources?

Response:

Oil and gas wastewater (produced water) in Pennsylvania is hypersaline (often more than 5X saltier than seawater) and contains toxic metals, organic compounds, and radionuclides necessitating careful management practices. Pennsylvania is unique among oil and gas producing states in that it has few Class II Underground Injection Control (UIC) wells – the primary method of disposal of produced water throughout the United States. Scientists at our non-profit energy science and policy research institute, PSE Healthy Energy and University of California, Berkeley recently published a paper (Hill et al. 2019) examining management practices of produced water in Pennsylvania.

In 2006, prior to scaled commencement of high volume hydraulic fracturing of the Marcellus Shale, approximately 4.9 million barrels (~0.2 billion gallons) of produced water was generated in Pennsylvania of which 80% of this volume was discharged to surface water through centralized waste treatment facilities (CWTFs), on-site discharge using National Pollutant Discharge Elimination System (NPDES) permits, and Publicly Owned Treatment Works (POTWs).

High-volume hydraulic fracturing of the Marcellus Shale formation in Pennsylvania began to be scaled in 2008 after which the generation of produced water steadily increased. In 2017, approximately 57.5

million barrels (2.4 billion gallons) of produced water was generated in Pennsylvania – more than an order of magnitude (~12X) increase. Initially, much of the increased produced water was discharged to CWTFs and POTWs.

CWTFs, POTWs and facilities with National Pollutant Discharge Elimination System (NPDES) permits provide only partial treatment prior to discharge to surface water. Field studies on wastewater treatment of produced water in Pennsylvania have indicated exceedance of maximum contaminant levels and incomplete removal of organic compounds prior to discharge to surface water. Of considerable concern is the buildup of persistent, bioaccumulative, and carcinogenic radium in sediment collected downstream of effluent outfalls in Pennsylvania. Soluble salts containing chloride and bromide generally pass through POTWs without treatment. This resulted in high concentrations of chloride and bromide in the Monongahela and other rivers in Pennsylvania causing concern about the generation of carcinogenic chlorinated and bromated disinfection byproducts during downstream drinking water treatment for public water supply.

The State of Pennsylvania eventually restricted the discharge of produced water sourced from Marcellus and Utica Shale hydraulic fracturing operations to POTWs thereby encouraging the reuse and recycling of produced water for hydraulic fracturing. In many ways, Pennsylvania appears to be a success story demonstrating that the oil and gas industry can quickly and effectively improve management practices for produced water when forced to do so. In 2017, 56% and 52% of produced water from conventional and unconventional (shale) oil and gas production was reused, respectively. Perhaps most impressive was that reported discharge of produced water to surface water was down to 19% for conventional oil and gas wells and down to 0.1% for unconventional gas wells.

A potential problem with this success story is that intermediary facilities, for example, “residual waste processing facilities” and “residual waste transfer facilities” have formed throughout Pennsylvania to accept produced water. In 2017, these intermediary facilities accepted nearly half (43%) of produced water from unconventional gas production. The State of Pennsylvania only requires tracking of produced water to the first receiving facility. Hence, produced water from these facilities could be sent to CWTFs or POTWs without being properly tracked. It is possible for non-governmental organizations such as PSE Healthy Energy to search reports submitted to the Pennsylvania Department of Environmental Protection on facilities permitted under NPDES and at CWTFs to discern ultimate endpoints for reuse or disposal. However, this activity is time consuming, expensive, and should routinely be performed by State personnel and made electronically available. The lack of “cradle to grave” tracking of produced water is common throughout the United States and would not be allowable if produced water was regulated under Subtitle C of the Resource Conservation and Recovery Act.

Hence, the implication of this missing waste is that some portion of it could end up in surface water without being tracked. The primary consequence of this lack of tracking is potential impact to aquatic ecosystems from compounds passing through CWTFs and POTWs and to human health via increased generation of carcinogenic disinfection byproducts in public drinking water. Contact to radionuclides may occur during dredging or by ingestion of fish in contact with radionuclides in sediment.

Reference

Hill L.L., Czolowski E.D., DiGiulio D.C., Shonkoff S.B.C. 2019. Temporal and spatial trends of conventional and unconventional oil and gas waste management in Pennsylvania, 1991–2017. *Science of the Total Environment* 674, 623-636.