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TRANSPORT, STORAGE, AND DISPOSAL OF FRACKING WASTE

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FRACKING IN CT?

According to the state's Comprehensive Energy Strategy, Connecticut's natural gas resources are so minimal that they are highly unlikely to be developed. A recent U.S. Geological Survey study estimated undiscovered natural gas reserves of 3.5 billion cubic feet in the state's Hartford Basin. The Marcellus shale, by comparison, contains an estimated 84 trillion cubic feet of gas. Nevertheless, the state's proximity to Marcellus states like New York and Pennsylvania could make it a potential site for treating and disposing fracking waste if economic and regulatory conditions make it economically feasible.

QUESTIONS

How is the transportation, storage, and disposal of fracking waste regulated? Are there best practices for transporting, storing, and disposing fracking waste? What studies have examined the potential dangers fracking waste poses to the public or ecology?

SUMMARY

The transportation, storage, and disposal of hydraulic fracturing ("fracking") waste are regulated under a variety of federal and state laws. Contaminated water, which is fracking's largest waste product, is typically (1) treated to remove contaminants and discharged into surface waters, (2) recycled for use on other fracking projects, or (3) injected into specialized wells. Treating and discharging fracking wastewater is generally regulated under the federal Clean Water Act, which establishes permitting standards for treatment facilities and water quality standards for the treated water being discharged back into surface waters. Underground injections of fracking wastewater are regulated under the federal Safe Drinking Water Act, which sets permitting requirements for injection wells. Both laws allow federally approved state agencies to administer them. States can also enact their own, more stringent, requirements. Regulating the recycling of fracking wastewater is generally left up to the states.

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Regulating the handling, storing, and transport of fracking wastewater is also generally left to the states. In some states, such as Pennsylvania, the waste is regulated under waste management laws that provide detailed standards for storing and transporting waste and procedures for spills or accidental discharges. Recently enacted regulations in Ohio also require fracking wastewater haulers to install and use electronic transponders to monitor their shipments. Vermont is the only state that has banned the treatment, disposal, or storage of fracking waste, although Connecticut and New Jersey have considered similar bills.

The American Petroleum Institute has published two guidance documents aimed at identifying the industry's best practices used to minimize environmental impacts associated with the acquisition, use, treatment, and disposal of fracking wastewater. These documents contain numerous general recommendations for planning, training, and collaborating with government authorities when dealing with fracking wastes. In addition, State Review of Oil and Natural Gas Environmental Regulations, Inc., (STRONGER) issues guidelines for measuring state regulations and performs voluntary state reviews to evaluate a state's regulations against its guidelines and make recommendations for improvements. STRONGER is a non-profit, multi-stakeholder organization funded by grants from the U.S. Environmental Protection Agency, U.S. Department of Energy, and American Petroleum Institute.

Several studies on the potential dangers related to fracking waste and its disposal (e.g., seismic activity associated with injection wells, elevated radiation levels, and contamination from chemicals added to fracking fluids) have been published in recent years. A listing of some those published by government agencies or peer-reviewed journals is included below. In addition, the U.S. Environmental Protection Agency is expected to issue its study of the potential impacts of fracking on drinking water resources sometime in 2014.

HYDRAULIC FRACTURING ("FRACKING")

Hydraulic fracturing is a technique designed to improve oil and gas production. It involves injecting large volumes of fluids and proppants (small spheroids of solid material) at high pressure into a well to create fractures in the source rock formation and carry the proppants into the fractures to hold them open when production begins. The fracking fluid is typically water-based and contains various chemicals, including bactericides, buffers, stabilizers, fluid-loss additives, and surfactants. These chemicals promote the fracturing operation's effectiveness and prevent damage to the formation. When used in conjunction with horizontal drilling, fracking enables oil and gas producers to extract the resources economically. Without these techniques, the oil and gas do not flow to the well rapidly, and

commercial quantities cannot be produced from shale. Over the past several years, the technique has greatly increased domestic natural gas and oil production by allowing wells to reach previously inaccessible natural resources. For additional information on fracking, see OLR Report 2013-R-0176.

After the well operator has injected the fracking fluid into the well, the pressure is released and a portion of the injected fluid, known as "flowback," returns to the surface over the next few days and weeks. Over a longer period of time, water that was naturally present within the well, known as "produced water," also comes to the surface. Both the flowback and the produced water can contain various contaminants such as salts, organic hydrocarbons (e.g., oil and grease), inorganic and organic additives, and naturally occurring radioactive material, all of which must be managed according to various federal and state regulations.

REGULATING FRACKING WASTE

Because federal regulations prohibit the discharge of shale gas wastewater directly from a production site into surface waters, fracking well operators in the northeast generally have three options for managing their contaminated fracking wastewater: (1) having the water treated to remove the contaminants then discharged into surface water; (2) recycling the water within their fracking operations; or (3) disposing of the water, typically through underground injection into specialized wells. In 2011, roughly 60% of the wastewater from shale gas production in Pennsylvania was treated and discharged, 30% was recycled for fracking use, and 10% was injected into disposal wells (National Resources Defense Council (NRDC), *In Fracking's Wake: New Rules are Needed to Protect Our Health and Environment from Contaminated Wastewater*, May 2012, p. 4). Each option falls under different federal and state regulatory umbrellas.

Treatment and Discharge

Prohibited from discharging wastewater directly to surface waters, many fracking well operators send their wastewater to treatment facilities authorized to treat and discharge fracking wastewater under the federal Clean Water Act's National Pollutant Discharge Elimination System (NPDES). These facilities include publicly owned treatment works (POTWs) that are typically state or municipal water or sewage treatment plants, and centralized waste treatment facilities (CWTs) that are privately owned plants designed to treat industrial wastewater.

The NPDES program requires all facilities that discharge pollutants to surface waters to obtain a permit from federal Environmental Protection Agency (EPA) or the designated state agency (typically the state agency responsible for

environmental protection). Permits can be tailored to individual facilities or cover multiple facilities within a specific geographic region. They have (1) technology-based conditions, which generally apply to all permitted treatment facilities, and (2) water quality conditions which can be unique to each facility and tailored to local conditions found in the surface water that receives the treated wastewater (NRDC p. 71).

To obtain a permit, producers must complete an application that, among other things, describes (1) the waste that will be discharged, (2) where the discharge will take place, and (3) the method of treatment. Once the state or EPA has issued a permit, producers must report any discharges, including the amount of each pollutant specified in the permit, to the permitting authority at least once per year. EPA has issued regulations establishing Effluent Limitations Guidelines for some onshore oil and gas extraction including shale gas (U.S. Government Accountability Office (GAO), *Energy-Water Nexus: Information on the Quantity, Quality, and Management of Water Produced during Oil and Gas Production*, GAO-12-156, Jan. 2012, p. 27).

The permits must require POTWs to provide "adequate notice" to the EPA and the state permitting authority, if applicable, when the POTW intends to accept new or additional pollutants or waste streams. This allows the permitting authority to determine if the POTW's permit needs to be modified to address the possible effects of the new discharge. Thus, POTWs that want to start treating fracking wastewater must collect information from the fracking well operator on the quality and quantity of wastewater, assess the potential impact of that wastewater on the POTW's discharges, and report this information to the EPA or the state (NRDC p. 72).

Permits for POTWs and CWTs must also include any requirements necessary to meet local water quality standards. The EPA and delegated states develop standards for each body of water by identifying the water's intended uses (e.g., fishing, swimming, or drinking) and then setting water quality criteria necessary to protect these uses. The criteria are generally numeric limitations on pollutants in a particular water body that are adequate to support the water body's designated uses. The EPA has published recommended national water quality criteria as guidance for delegated states. These recommendations include criteria for some pollutants that could be found in fracking wastewater, such as chloride, oil and grease, suspended solids, and nitrates (NRDC p. 73).

States can also establish discharge requirements that are stricter than federal requirements. In 2010, the Pennsylvania Department of Environmental Protection (PADEP), which administers the NPDES program in the state, issued regulations requiring, among other things, NPDES permits for facilities discharging industrial waste to comply with both EPA promulgated effluent limitation guidelines and the state's own industrial waste discharge standards. The state's regulations require each natural gas operator to implement a wastewater source reduction strategy identifying the methods and procedures it will use to maximize recycling and reuse of wastewater. They also prohibit "new and expanding" discharges of shale gas wastewater unless the discharge is authorized by a state-issued permit, which can only be issued for CWTs. POTWs can discharge shale gas wastewater only if it has been treated at a CWT first (NRDC p. 74). The state's regulations also provide stricter limits on certain contaminants contained in the wastewater discharged from CWTs, including limits on monthly averages of total dissolved solids and chlorides. They establish stricter water quality standards for several contaminates potentially found in shale gas wastewater, such as alkalinity, ammonia nitrogen, chloride, nitrate, sulfate, and total dissolved solids (NRDC p. 75).

Recycling

In recent years, some shale gas producers have begun reusing flowback and produced water for fracking additional wells. The water is typically treated first, either on-site or off-site, and then mixed with fresh water if salt concentrations remain high. In Pennsylvania, the practice has become more common since the state made its surface discharge standards more stringent, which made treatment and discharges comparatively more expensive (GAO 12-156, p. 20).

Fracking wastewater that is managed or treated solely to be reused for fracking is not subject to federal regulation (NRDC 7). Thus, recycling fracking wastewater for future fracking is regulated at the state level. Some states, such as Oklahoma, have regulations for the temporary storage of hydraulic fracturing fluids on drilling sites that prescribe standards for the construction, operation, location, and maintenance of noncommercial ponds used to temporarily store flowback water. In addition, some states, such as Louisiana, Pennsylvania, Texas, and Wyoming, require producers to disclose the chemical composition of their hydraulic fracturing fluids (GAO 12-156, pp. 28-29).

Underground Injection

If fracking wastewater is not treated and discharged or reused in future fracking operations, it can be disposed in specialized injection wells. These injection wells are particularly suitable in areas with porous sedimentary rock, such as in the mid-

continent and Great Plains, but conditions are less favorable along the Atlantic Coast, in New England, and in the Appalachian Mountains. In 2011 there were eight injection wells licensed in Pennsylvania, but applications for more wells were pending (NRDC p. 18). Due to the relatively low number of wells, many Pennsylvania producers who dispose their wastewater through underground injection generally transport it to authorized injection wells in Ohio or West Virginia, which can significantly increase the cost (GAO 12-156, p. 17). Ohio, which has over 170 licensed injection wells, has also recently increased fees for accepting out-of-state waste (J.A. Veil, Argonne National Laboratory, *Water Management Technologies Used by Marcellus Shale Gas Producers*, prepared for U.S. Dept. of Energy, Office of Fossil Energy, National Energy Technology Laboratory, July 2010, p. 15).

The federal Safe Drinking Water Act regulates underground wastewater injection through the Underground Injection Control (UIC) program, which sets standards for safe wastewater injection practices. All underground injections, except for fracking itself, must be authorized by the program. As with the Clean Water Act, EPA implements the UIC program unless a state has been given authority to administer it. In the Marcellus region, Maryland, Ohio, and West Virginia administer the UIC program, but EPA administers it directly in New York, Pennsylvania, and Virginia (NRDC pp. 77-78).

Under the UIC program, injection well operators typically must apply for a permit to drill an injection well and supply information, including the location and depth of the proposed well. After receiving a permit, the operators must observe, record, and report the injection pressure, flow rate, and cumulative volume each month. Operators must also conduct mechanical integrity tests on the wells at least once every five years (GAO-12-156, p. 26). UIC permits can be issued for one of five classes of wells, with each class subject to different requirements. Because EPA does not consider fracking wastewater as "hazardous," it does not have to be injected into Class I wells, which are subject to the most stringent requirements. The wastewater can instead be injected into Class II wells for fluids associated with oil and gas production (NRDC p. 77).

Before authorizing a Class II well, EPA or the authorizing state agency must consider the (1) location of existing wells and other geographical features in the area, (2) well operator's proposed operating date, (3) injection fluid's characteristics, (4) injection zone's geological characteristics, (5) proposed well's construction details, and (6) operator's demonstration of mechanical integrity. Class II wells must inject into an underground formation that is separated by a fault- and fracture-free zone from any underground source of drinking water. The

wells must be cased and cemented to prevent fluids moving into or between underground drinking water sources. Once operating, the well's injection pressure cannot exceed a predetermined maximum and operators must maintain the well's mechanical integrity or cease injection (NRDC p. 78).

While there may be individual variations, states with Class II UIC wells also generally have requirements for casing and cementing, operating pressures, mechanical integrity testing, well plugging, and the monitoring and reporting of certain information. In 2012, the Ohio Department of Natural Resources placed a moratorium on injections into Class II wells in the Youngstown area after finding a "compelling argument" that injections in the wells had caused a series of earthquakes in 2011 and 2012 (U.S. Government Accountability Office, *Unconventional Oil and Gas Development: Key Environmental and Public Health Requirements*, GAO-12-874, Sept. 2012, p. 59). In response, the state imposed new regulations on Class II wells that, among other things, (1) prohibit any new wells from being drilled into a Precambrian basement rock formation, (2) require well operators to submit extensive geological data before drilling, and (3) require using pressure and volume monitoring devices with automatic shut-off switches and electric data recorders (http://www.ohiodnr.com/home_page/NewsReleases/tabid/18276/EntryId/2711/Ohios-New-Rules-for-Brine-Disposal-Among-Nations-Toughest.aspx).

Transporting and Storing

Regardless of whether a fracking operator chooses to treat, recycle, or dispose of its fracking waste, it will most likely have to temporarily store the waste or transport it to another facility for treatment. Because oil and gas wastes are not considered "hazardous" under the federal Resource Conservation and Recovery Act, state regulations generally govern the handling, storage, and transport of shale gas wastewater prior to its ultimate disposal (U.S. Dept. of Energy, Office of Fossil Energy, National Energy Technology Laboratory, *State Oil and Natural Gas Regulations Designed to Protect Water Resources*, May 2009, pp. 32-33).

In Pennsylvania, wastewater from industrial operations is classified as nonhazardous and must be managed in accordance with the state's Solid Waste Management Act. The act generally requires anyone who stores, processes, transports, or disposes of nonhazardous waste to comply with all PADEP waste management regulations. It also prohibits them from endangering public health or the environment and from causing a public nuisance. The state's regulations provide detailed standards for the storage and transportation of waste. If a spill or accidental discharge occurs during transport, the transporter must notify PADEP

and take immediate steps to contain and clean up the spill (NRDC, p. 81). In 2011, Pennsylvania's legislature also considered, but did not enact on, a bill to require any vehicle carrying fracking wastewater to have a notification placard on the outside of the vehicle.

Several states have set requirements for storing produced water, drill cuttings, and other waste substances. For example, North Dakota allows temporary use of lined pits to retain solids or fluids generated during well completion, but requires them to be removed within 72 hours after operations end. Pennsylvania requires certain types of pits to be lined and sets permeability, strength, and thickness standards for the linings. Colorado and Wyoming require storage tanks to be used under certain circumstances and other states set construction requirements for storage tanks (GAO 12-874, p. 58). Ohio's new regulations also require fracking waste water haulers to install electronic transponders to monitor all shipments (http://www.ohiodnr.com/home_page/NewsReleases/tabid/18276/EntryId/2711/Ohios-New-Rules-for-Brine-Disposal-Among-Nations-Toughest.aspx).

Fracking Waste Bans

Other states have enacted or considered laws to ban storing or processing fracking waste outright. In 2012, Vermont enacted a law that prohibits fracking in the state and bars anyone from collecting, storing, or treating fracking wastewater or discharging any fracking waste into the state's pollution abatement facilities. New Jersey's legislature also passed a bill in 2012 to prohibit the treatment, discharge, disposal, or storage of fracking wastewater, wastewater solids, sludge, drill cuttings or other byproducts. Governor Christie, however, vetoed the bill because it may have violated the U.S. Constitution's commerce clause, which limits the states' ability to regulate interstate commerce. The New Jersey legislature did not override the veto. In the 2013 legislative session, the Connecticut General Assembly considered, but did not pass, a similar ban (HB 5335) and moratorium (HB 6533).

For additional information on recently enacted or proposed state regulations on fracking, see http://www.ncsl.org/documents/energy/NaturalGasDevLeg313.pdf.

BEST PRACTICES

API Guidance Documents

The American Petroleum Institute (API) has published two guidance documents, "Water Management Associated with Hydraulic Fracturing," (API Guidance Document HF2, June 2010) and "Practices for Mitigating Surface Impacts Associated with Hydraulic Fracturing," (API Guidance Document HF3, January 2011) that aim to identify and describe many of the current industry best practices used

to minimize the environmental impacts associated with the acquisition, use, treatment, and disposal of water and other fluids associated with fracking. Among other things, the documents recommend that well operators:

1. engage local water planning agencies when developing their fracking programs and consider a broad spectrum of competing water requirements and constraints, including flowback water treatment and disposal options and the potential for water recycling;

2. review and evaluate regional practices regarding waste management and disposal, including the preferred disposition method, treatment capabilities, and permit requirements for proposed treatment facilities or disposal wells;

3. assess requirements and constraints associated with fluid transport and consider alternative strategies to minimize its expense and potential environmental or social impacts;

4. develop and implement a detailed fluid transport strategy and work collaboratively with local law enforcement, community leaders, and area residents to enhance safety and reduce potential impacts;

5. prioritize potential opportunities to reuse flowback and produced water prior to treatment for surface discharge or injection disposal, including selecting fracking fluid additives with environmentally benign constituents that do not impede water treatment initiatives;

6. require all responsible personnel involved in the post-fracking activities to be trained in the transportation and handling of fluids, chemicals, and other materials associated with the process;

7. disclose proprietary fracking fluid formulations when requested by designated state agency representatives and health professionals in emergencies or when they demonstrate a need to know such information;

8. design and construct surface impoundments for storing fracking fluids so that they prevent infiltration of fluids into the subsurface; and

9. have spill prevention, response, and cleanup procedures in place before initiating activities that have potential for a spill.

STRONGER

The State Review of Oil and Natural Gas Environmental Regulations, Inc. (STRONGER) is a nonprofit, multi-stakeholder organization that issues guidelines for states regulating oil and gas exploration and production (E&P) wastes. The organization is funded by grants from the EPA, U.S. Department of Energy, and

API. The guidelines are developed by state, environmental, and industry stakeholders and are used to measure the successes of states' regulations and offer recommendations for improvement.

Among other things, the 2013 guidelines recommend:

1. authorizing an appropriate state agency to require training for truck drivers that commercially transport E&P wastes to a commercial disposal facility, including proper record keeping and emergency response and notification procedures and

2. implementing a waste tracking system that documents the movement of wastes from their original site to their final disposition.

STRONGER is currently developing additional guidelines specific to fracking-related issues.

States can voluntarily agree to be reviewed by STRONGER teams composed of stakeholders from the oil and gas industry, state environmental regulatory programs, and members of the environmental/public interest communities. For example, Pennsylvania underwent a review in 2010 and a follow-up review in 2013.

STUDIES ON PONTENTIAL DANGERS

Numerous studies examining the potential dangers of fracking waste have been published. While our office is not authorized or qualified to evaluate their accuracy, the following is a sample of recent studies that have been published by government agencies or peer-reviewed journals:

- Brian D. Lutz, et al., "Generation, Transport, and Disposal of Wastewater Associated with Marcellus Shale Gas Development," *Water Resources Research*, Feb. 8, 2013 (http://onlinelibrary.wiley.com/doi/10.1002/wrcr.20096/abstract).

- National Research Council, *Induced Seismicity Potential in Energy Technologies*, 2013 (http://www.nap.edu/catalog.php?record_id=13355).

- Ohio Department of Natural Resources, *Preliminary Report on the Northstar 1 Class II Injection Well and the Seismic Events in the Youngstown, Ohio, Area*, March 2012 (http://www.oilandgaslawreport.com/files/2013/04/ODNR-UIC-Report.pdf).

- E.L. Rowan, et al., *Radium Content of Oil- and Gas-field Produced Waters in the Northern Appalachian Basin: Summary and Discussion of Data*, U.S. Geological Survey Scientific Investigations Report 2011–5135, 2011 (http://pubs.usgs.gov/sir/2011/5135/).

- Charles Schmidt, "Estimating Wastewater Impacts from Fracking," *Environmental Health Perspectives*, April 2013 (http://ehp.niehs.nih.gov/121-a117/).

- U.S. Environmental Protection Agency, *Study of the Potential Impacts of Hydraulic Fracturing on Drinking Water Resources: Progress Report*, December 2012 (http://www2.epa.gov/hfstudy/study-potential-impacts-hydraulic-fracturing-drinking-water-resources-progress-report-0). (Final report anticipated for 2014.)

- U.S. House of Representatives, Committee on Energy and Commerce, Minority Staff, *Chemicals Used in Hydraulic Fracturing*, April 2011 (http://democrats.energycommerce.house.gov/sites/default/files/documents/Hydraulic-Fracturing-Chemicals-2011-4-18.pdf).

- Nathaniel R. Warner, et al., "Impacts of Shale Gas Wastewater Disposal on Water Quality in Western Pennsylvania" *Environmental Science & Technology*, Oct. 2, 2013 (http://pubs.acs.org/doi/abs/10.1021/es402165b).

In addition, FracFocus maintains a national hydraulic fracturing chemical registry that 10 states, including Pennsylvania, use for chemical disclosures required by state law. Managed by the Ground Water Protection Council and Interstate Oil and Gas Compact Commission, FracFocus does not provide a scientific analysis of risks associated with hydraulic fracturing, however numerous studies of the various chemical additives disclosed on the site have been performed in other contexts.

HYPERLINKS

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Connecticut General Assembly, HB 6533 (2013), *An Act Concerning Hydraulic Fracturing Waste*, http://www.cga.ct.gov/asp/cgabillstatus/cgabillstatus.asp?selBillType=Bill&bill_num=6533&which_year=2013&SUBMIT1.x=0&SUBMIT1.y=0, last visited January 13, 2014.

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