Drilling in the Marcellus Shale:

Picture of Marcellus well drill site in Upshur County, WV. Source: West Virginia Surface Owners' Rights Organization (WVSORO).

An Overview of the Process and Issues in West Virginia

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Executive Summary

The Marcellus shale is a rock formation that lies more than a mile beneath the earth's surface through much of the Mid-Atlantic region. The formation contains a significant volume of natural gas trapped inside tiny spaces within the shale that some scientific estimates predict could supply the United States at its current consumption level for more than a decade. New advances in drilling technologies, accompanied by an increased market demand, have made "exploration" of the Marcellus shale highly attractive to the oil and gas industry. The rush to drill is on.

Extracting natural gas from the Marcellus shale involves drilling down to the depth of the formation, using new horizontal drilling technology that "exposes" more of the shale. Once the formation is reached, millions of gallons of water, sand, and an extensive list of man-made chemicals are injected into the well under high pressure in order to fracture the pores of the shale rock and stimulate the gas to flow. This process is known as "hydraulic fracturing." Unfortunately, this process is largely unregulated in West Virginia and the potential for severe impacts to the environment, particularly to surface and groundwater resources has already been demonstrated.

The fracturing process is, by its very nature, highly water intensive. Through the drilling process, each well can require as much as 6 million gallons of water to reach completion. Typically, drilling companies pipe the water they use from nearby rivers and streams, with the potential of "dewatering" small or intermittent streams. Unregulated withdrawal at these volumes can be damaging to the short-term and long-term health of aquatic life, and potentially eliminate valuable sources of drinking water. In West Virginia, there are currently no regulations governing water withdrawals of this type.

There are also numerous opportunities for water quality to be adversely affected during the drilling process. The chemical combinations and concentrations used in the "fracking" process are undisclosed, considered by the industry to be trade secrets. Many of these chemicals are known to be harmful, both to human and animal populations. During the fracturing process, some of the fracking fluids stay underground, but millions of gallons of wastewater come back to the surface and are stored in containment ponds before disposal. Fracking fluids left underground may contaminate groundwater, springs, and private wells. Containment ponds, especially if not properly lined, may leak and contaminate land, groundwater and surface water. In addition, disposal of fracking fluids via any method other than a closed loop recycling system means that many of these chemicals could be accidentally released into the environment through land discharge, surface water discharge, or an underground injection. West Virginia currently has inadequate regulations covering both the containment and disposal of these waste products.

There are many environmental issues surrounding the exploration of the Marcellus shale formation. Current water quality and quantity regulations are insufficient to adequately deal with the potential hazards of this issue.

West Virginia is blessed with some of the most beautiful and pristine waters in the country. Clean water is essential to our lives for drinking, recreation, economic development and ecological balance. We must make sure that our water resources are protected for all uses.

Introduction

As the Federal administration pursues energy independence and discussions of energy availability continue, stateside energy companies are rushing to explore every opportunity they can find to supply the nation's energy demands. Coal, domestic oil, wind and other alternative sources are all being considered, but no source in Appalachia has seen more interest or increased rate of production as natural gas. Although coal has always been the major player, Appalachia also has an abundant supply of natural gas.

Previously, natural gas exploration has been steady and relatively unobtrusive. Vertical wells drilled to tap reservoirs of natural gas leave relatively small footprints and require limited resources and space for drilling equipment. However, advances in drilling techniques have led to a rush to explore the Marcellus shale formation. The reserves held in this formation have the potential to produce enormous amounts of natural gas, but the process to reach them could have enormous impacts on the environment.

The rush to explore this untapped source of energy has taken the mid-Atlantic region by surprise. Drilling in the Marcellus shale, as well as the drilling techniques used to recover natural gas from deep shale formations, is a relatively new concept. A lack of knowledge and information, as well as an inadequate regulatory framework has led to a situation in which regulators and landowners are attempting to catch up with all that is happening. This report seeks to condense much of the information on Marcellus shale drilling that is currently available from a variety of sources.

Geography/Geology

The Marcellus shale formation extends over much of the mid-Atlantic region. Stretching from south-western Virginia to southern New York, and from eastern Ohio to eastern Pennsylvania and West Virginia, the formation covers between 48,000 and 54,000 square miles (31 million acres) and has a thickness ranging from a few feet to 900 feet (*Humphries*) with an average thickness of 100 feet, generally becoming thicker in the east (*National Park Service*). Depth of the Marcellus shale varies; in some places it appears at the surface as it does in Marcellus, NY, for which the formation is named. Most of the formation, however, lies deep under the surface ranging in depth from 4,000 to 8,500 feet (*Abdalla*). Although the Marcellus formation covers only a small percentage of most states, it covers nearly half of Pennsylvania and almost all of West Virginia, with the exception of the eastern panhandle (*Figure 1*).

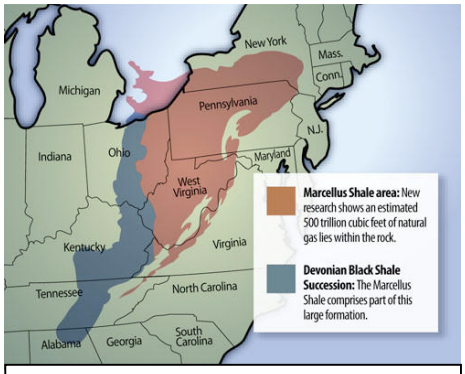

Figure 1: *The Marcellus shale formation is a part of the larger Devonian shale and covers most of West Virginia. (Picture from USGS.)*

The shale was formed during the Devonian geologic period, 350-415 million years ago. During this time much of the eastern United States was partially or entirely underwater, filled with thriving communities of algae, plants and other organisms. As these organisms died they fell to the bottom and were covered by silt, which would eventually become the Marcellus shale formation, and provided the carbon needed to produce hydrocarbons such as methane. As a result, the forming gases exerted pressure

and caused fractures in the shale running in a northeast to southwest direction. Today, the natural gas in the shale exists either as free flowing gas within the natural fractures or locked up in the porous spaces between the shale particles.

Conservative estimates of the natural gas trapped in the Marcellus shale place the volume at around 175 trillion cubic feet. However, some estimate that there may be as much as 516 trillion cubic feet of gas in this shale. It is believed that with current drilling technologies the Marcellus shale could contain as much as 50 trillion cubic feet of recoverable gas. Currently, a total of 30 trillion cubic feet of natural gas is produced in the entire U.S. per year.

THE MARCELLUS DRILLING PROCESS

A. How is it Different?

The potential of the Marcellus shale has been long known by geologists, but until recently there has been no economical way to extract the gas. Unlike other gas fields there are no porous "pockets" of gas in the Marcellus formation allowing easy extraction. Instead, gas particles are dispersed unevenly throughout the entire "tight" formation. Due to the free flowing nature of the gas it can be found in the natural pores and fractures of the shale as well as adhering to organic and mineral partials (USGS).

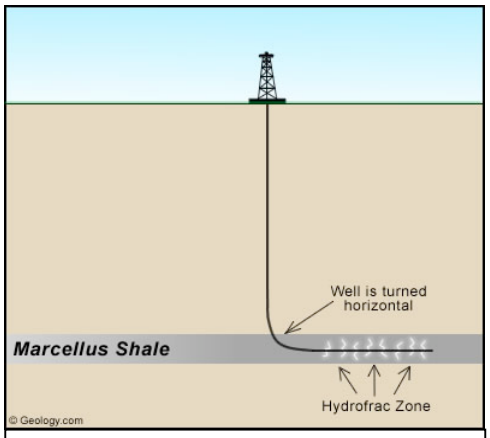

Figure 2: *A well is drilled vertically and then turned 90°. After the lateral section of the well is drilled it is then fracked using water and chemicals to release gas from the shale. (Picture from www.geology.com)*

B. Horizontal Drilling and Hydraulic Fracturing

The most efficient drilling technique in the Marcellus formation is a form of directional drilling known as "horizontal" drilling (Figure 2). Horizontal drilling begins as a typical vertical well, but when the drill reaches the desired strata, approximately 4,000 to 8,000 feet below the surface, it makes a 90° turn so the well can run along the length of a geologic seam instead of bisecting it (*USGS*). As opposed to vertical drilling, horizontal drilling allows for several wells to drilled from the same well pad as radii reducing the need for multiple well pads (*NYSDEC*). The horizontal aspect of the well can reach up to a mile away from the well pad (*USGS*).

During horizontal drilling, a process called hydraulic fracturing (informally known as "hydrofracking" or "fracking") is used to blast apart the shale containing the natural gas particles. There are multiple types of fracking, the most commonly used method is "slickwater fracturing" in which a solution is injected into the formation under high pressure to break up the shale and release the natural gas locked within (*USGS*).

Slickwater fracturing involves the high pressure pumping of a frack solution through the borehole at measured intervals to create fractures in the shale (*USGS*). The

frack solution is comprised of vast quantities of water, sand, and chemicals. In slickwater fracturing the main ingredient is water, followed by a proppant which acts to break and hold apart the fractures. Proppants are usually comprised of sand or synthetic ceramic beads. The chemical additives are a small part of the overall fracturing fluid, however due to the massive amounts of fracking fluid used, they can cause environmentally damaging side effects. Some of the most commonly used chemicals include biocides to stop the growth of microorganisms, sodium chloride to act as a breaker, numerous corrosion inhibitors such as n-dimethyl formamide to prevent the breakdown of drilling equipment, ammonium bisulfate to act as an oxygen scavenger to prevent rust, and friction reducers such as petroleum distillate. Frequently a gelling agent is added to thicken the fluid (*Hydraulic Fracturing Considerations*).

C. Reclamation

Although the ideal of the reclamation process is to return the site back to suitability for pre-drilling uses, the reclamation of well sites often falls short of this target. Many sites use retention ponds to hold the millions of gallons of wastewater produced by the drilling. After the water is treated and disposed of, pit liners, if used, are folded up and buried at the site leaving a potentially hazardous waste on the property. Furthermore, to prevent erosion and sedimentation, vegetation must be restored to the site. During the site prepping process, trees and topsoil are removed from the site to level the area for the drill pad and equipment. When finished, the topsoil frequently is not reused for the site (it may have even been hauled off to sell for additional profit), leaving soils unsuitable for vegetative growth. Additionally, trees and natural grasses require loose, aerated soil. The typical drilling pad and equipment can weigh 60 tons which causes soils to compact resulting in unsuitable condition for immediate reclamation of native vegetation. As a result, bio-engineered vegetation, such as grasses that are more tolerant of post site conditions, is often substituted for native species.

II. ENVIRONMENTAL CONCERNS

A. Water Quantity

Due to the enormous amounts of water needed for the hydraulic fracturing process, water quantity and availability have become issues across the Marcellus shale region. The fracking process can use up to 3.5 million gallons of water for some of the longer horizontal wells (*National Park Service*) and up to 6 million gallons per well if the well is re-fracked (*Sumi*) after production levels drop off. This amount of water is often drawn from local water sources such as nearby rivers, lakes, and reservoirs. Currently, West Virginia has no regulations limiting the location from which water is withdrawn or how much water is withdrawn for oil and gas operations. Existing water withdrawal regulations in West Virginia essentially apply only to very large industrial users and drinking water withdrawals.

Lack of regulation leaves drilling companies to follow the state's Best Management Practices or BMP's. The BMP's for water withdrawal normally require that

users should follow the "7Q10" Rule: users cannot withdraw more water than would leave the stream at its lowest estimated flow expected to occur once in ten years for aa period of seven consecutive days. While this is often adequate for large bodies of water, it is extremely critical for the smaller rivers and streams that are common across West Virginia. Any activity that withdraws water, including withdrawals for drilling, should maintain adequate flows for downstream uses (aquatic life included). Without adequate regulation and information provided to drillers, we are relying on an honor system for withdrawals.

For this reason, state regulators have urged companies to do the following: only draw water from larger water bodies; store water for use on sites not near larger water bodies; or recycle the water for use at other fracking sites creating a closed system. These practices would be ideal for more responsible water use, but there is currently no regulatory structure to support this.

B. Water Quality

Water quality is also a major concern associated with oil and gas drilling. Hydraulic fracturing, as the name implies, is a water intensive practice. Millions of gallons of slurry consisting of water, sand, and chemicals may be used to release gas within the formation.

The chemicals added to the water and sand "slurry" used in the hydrofracking process can pose a threat to water quality. Although the chemicals only make up about 1% of the fracking fluid injected into the wells, because of the large volumes, thousands of gallons of potentially harmful chemicals are being used. If one million gallons of fracking fluid are used to frack a well, at 1% of total volume, 10,000 gallons of added chemicals are included into the slurry mix.

What makes these chemicals even more dangerous is the fact that many of the chemicals and their concentrations are unknown. Companies producing the chemicals used are not required to report the content of their fracking fluids and formulas are considered proprietary information vital to the company's success. There are 435 known chemical products used in the oil and gas industry. Many of these products contain chemicals that are extremely harmful to humans even in small concentrations. A 2002 Environmental Protection Agency (EPA) report cited that many fluids used in the fracturing process contained chemicals and concentrations that well exceeded drinking water standards (*WORC*). Accidents have been reported from well sites in which workers came in direct contact with some of the chemicals used in the fracking fluid. Reports of severe nausea, respiratory irritation, kidney, liver, and heart damage, and chemical burns and rashes are common symptoms among victims.

Figure 3: *Saline crust forms around the edge of a lined pit used to hold and treat flow back water from hydrofracked well. Also, the far end of the pit does not seem to be lined above the water level.*

C. Disposal of the Fluids: Threats to Surface Water

Proper disposal of the huge volumes of wastewater produced by Marcellus shale drilling operations is one of the most critical environmental problem facing the drilling industry and state regulators.

It has been estimated that between 20-40% of fracking fluid stays down hole, either in the producing formation or in the well bore, leaving 60-80% to return to the surface as "flow back" (*Humphries*). However, in West Virginia,producers and state regulators claim that only 30% of this fluid returns as flow back, while as much as 70% remains down hole.

Whatever the exact percentage of frack fluid that is returned as flow back, it is a substantial volume and must be disposed of properly. This flow back mixture contains the water, sand, and chemicals injected into the well, as well as water, salt, sediment, trace metals, and traces of radioactive materials found in the formations being drilled through. Because of the high concentrations of chlorides found in flow back water, it is frequently referred to simply as "brine water."

Flow back is stored either in holding tanks or retention ponds (pits) and must be removed from the site. From an environmental standpoint, retaining flow back in holding tanks is the preferred storage method as it offers the opportunity to create a closed system. However, holding flow back in open pits is more economical for the driller and thus the more common practice. In 2010 the West Virginia Department of Environmental Protection (DEP) and the state legislature adopted rules that essentially require the use of impermeable synthetic liners for all oil and gas pits and impoundments.

Once collected and contained, this flow back fluid must be disposed of. Currently there are three legally allowed methods for disposing of flow back fluids in West Virginia.

For conventional, small volume vertical wells the most commonly used method of disposal is "land application." In the 1980's the EPA approved a "General Permit" for the land application of pit water for oil and gas wells in West Virginia. This program eliminates the need for individual NPDES permits for each well. The land application procedure involves treating the wastewater on site in the drilling pit by adding chemicals to precipitate or crystallize solids, lower pH, and neutralize some of the toxins within the water. Treated wastewater is then sprayed over vegetated land away from water sources and allowed to be filtered "naturally" by the surface soils. This method has been utilized for traditional gas wells without large-scale environmental damage. However, the larger volumes and particular chemical makeup and concentrations of non-conventional Marcellus shale flow back fluids do not meet the WV DEP requirements for this form of disposal.

The second method of disposal is to pump flow back wastewater from Marcellus wells into underground injection wells. Under the EPA's Underground Injection Control (UIC) Program, the designation of Class II disposal wells is reserved for fluids produced from oil and gas operations. In this type of injection well, waste fluids are injected back into the same or similar formations as the ones from which they were produced. Although this type of retention disposal method has potential environmental consequences, it is currently the preferred method of disposal by many state regulatory agencies and the EPA because it, in theory, prevents contamination of surface waters. However, West Virginia currently has an insufficient number of permitted commercial disposal wells to

handle the disposal of the large volumes of flow back fluids from Marcellus wells. In addition, inadequate study has been conducted on potential impacts to groundwater sources from the underground injection of waste.

The third method of disposal is to haul the wastewater to an approved industrial wastewater treatment plant, or, in some states, to a municipal wastewater treatment facility, where the water is treated and then discharged to surface waters. Under Section 303 of the Clean Water Act, the party ultimately disposing of the wastewater and discharging to surface water is responsible for obeying the state and federal regulations pertaining to water quality standards of the receiving water body into which they discharge.

In 2009, two municipal wastewater treatment facilities in West Virginia began accepting oil and gas flow back fluids for treatment. However, because of the high concentrations of chlorides and other total dissolved solids contained in the fluid, the WV DEP is now prohibiting this practice.

In West Virginia there are few industrial wastewater treatment facilities with sufficient capacity for treating the large volumes of flow back fluid being produced by the Marcellus shale play. As a result wastewater must be held in holding tanks and treated in portions to accommodate the facility's relatively low treatment capacity. In addition, very few treatment facilities are equipped to treat the type of waste (high concentrations of salts and total dissolved solids) produced by Marcellus shale drilling.

In response to the shortage of suitable wastewater treatment facilities, one industry-backed company has designed and constructed its own treatment facility. The operation is known as AOP Clearwater and is located in Fairmont, WV. In 2009 the facility obtained the necessary permits from the WV DEP and began treating oil field wastewater in early 2010. However, the AOP operation has "subscribed" its full capacity to just one of the drilling companies operating in the Marcellus play.

An additional option to industry for dealing with this wastewater stream is recycling. This has become a common industry practice in shale plays in other parts of the country, perhaps because there are more treatment facilities available. Without treatment, the water is unusable to the industry. The AOP plant in Fairmont in fact sells back all the water it treats to the oil and gas operator for re-use.

The fact remains that until more legally authorized treatment facilities are created, the huge volumes of wastewater produced by Marcellus shale drilling operations remain a serious threat to West Virginia rivers and streams.

D. Threats to Groundwater

While there is a clear potential to affect groundwater with any drilling procedure, there is little research to date on the effect of Marcellus drilling on surrounding groundwater resources. Groundwater contamination may occur slowly and is difficult to trace. Fractures created by the fracking process typically extend up to a couple hundred feet, however, fractures have been known to run as long as several thousand feet. These long fractures can serve as a fairway for fracking fluids to enter other formations. If these formations are water bearing they may lead to larger aquifers. There is clearly a need for systematic testing and monitoring of water quality in all groundwater surrounding

Marcellus sites. The interconnected nature of underground water systems, particularly in West Virginia, points to the need for caution and care of this resource.

Reported water quality issues surrounding gas exploration in the Marcellus shale have made big news in recent years. In the summer of 2008, after municipal wastewater treatment facilities had been overburdened by the recent influx of water produced from drilling resulting in high levels of total dissolved solids in the Monongahela River system, the Pennsylvania Department of Environmental Protection ordered that those facilities greatly reduce the amounts of flow back water they were accepting for treatment. Several incidents of residential water well contamination have been reported in the press, linked to oil/gas drilling and the hydraulic fracturing process, both in the Marcellus and other western shales such as the Barnett. Residents living near Marcellus wells have reported odd colored and foul tasting and smelling water, and reportedly became ill after drinking water that did not visually appear to be contaminated. Others have claimed that the water coming out of faucets can be ignited due to the presence of natural gas carried by the water. Farmers have claimed that vegetation and animal life around ponds near or down slope from gas well sites have died.

III. ADDITIONAL CONCERNS

A. Environmental and Human Health Concerns

Low concentrations of radioactive materials, known as "naturally occurring radioactive materials" (NORMs), may also be found in drill cuttings and flow back water produced from the Marcellus shale. The Marcellus formation, compared to other rock formations, is considered to have relatively high radioactivity (*Sumi*). Common radioactive materials found in the Marcellus shale include: uranium, thorium, and various isotopes of their byproducts - radium. NORMs are often found not only in deep shales, but also shallower rock layers drilled through to get to the shale. NORMs can be brought to the surface in water that was present in radioactive formations or in the form of radon gas mixed in with the natural gas. Historically houses sitting over Marcellus shale have higher occurrences of radon, a common radioactive gas formed from the decay of radium, in their basements.

Air pollution, although minimal on a site by site basis, may be significant if a region has a particularly dense well spacing. The emissions of nitrogen oxides (NOx) are of particular concern. NOx is emitted mainly by pipeline compression stations and, to a lesser degree, drilling equipment, and is also released from drilled formations (*National Park Service*). Eastern regions are beginning to adopt stricter ozone standards and in rural areas additional emissions may make compliance difficult. Also, Eastern regions are known for many ozone sensitive plants, thus additional NOx may cause changes in native vegetation (*National Park Service*).

New well sites have enormous transportation needs. Fleets of 35-45 large trucks carrying heavy drilling equipment, water, and other necessities normally travel to and from the well site throughout the duration of the drilling and completion process, which can last up to three weeks or more. Small rural roads may not be able to support the size of individual trucks and need to be widened. Additionally, dirt roads that are not properly

cared for will be prone to excessive dust and erosion. Noise pollution from traffic and running equipment will also be an issue.

Lastly, the creation of well sites, new roads, and pipelines will fragment wildlife habitat. Forested areas are crucial corridors for the movement and migration of wildlife throughout their home range. Areas with particularly dense well spacing may experience a decrease in wildlife populations.

B. Concerns for Landowners

Drilling a Marcellus shale gas well is a major industrial activity that has a huge impact on the land it occupies. This is a particular problem for landowners in West Virginia where historically the ownership of the minerals under the land has been "severed" from the ownership of the surface of the land. Also, in West Virginia, as in most states, the "mineral estate" has dominance over the "surface estate." Basically, that means that the mineral owner has the right to do on the land whatever is "convenient and necessary" to produce those minerals.

The result is that in West Virginia many landowners do not own their mineral rightsand are at a huge disadvantage when they receive a notice that a company is going to drill a well on their land.

But surface owners DO have rights in West Virginia.

Landowners should find out whether or not they own their mineral rights and then learn what their legal rights are as property owners when dealing with drilling issues. For example, different lease types entail different rights to the property. Landowners should become familiar with these differences and learn what rights are involved with each.

Whether a landowner owns the mineral rights to their property or not, the best advice when entering into a contract with a company is to be knowledgeable. Getting professional legal help is always good advice. Knowing ahead of time what can and cannot be negotiated or changed can save a lot of time, money, and conflict. Also, lawyers can assist in negotiating agreements with a drilling company's land agents, and can provide important understanding and clarification of the particulars of a lease agreement.

It is also important to know what's happening on neighboring properties, both private and public, as both are being targeted for drilling. Banding together with neighboring landowners can also help level the playing field when dealing with a drilling company, particularly one that always insists it has the upper hand.

Communication with the company is essential to help avoid misunderstandings and make sure everything is done properly. Good communication allows landowners to take part and have input in what is happening on their land. One option is to help organize and attend a non-biased community information session where the landowner is able to talk with neighbors, drillers and legal assistants all at once. It's an ideal way to gain knowledge not only on leasing issues, but all aspects of Marcellus drilling operations.

It is through communication that landowners have the best chance of protecting themselves from damages or unwanted activities that may take place due to drilling on their land. Often, drillers will agree to preventive measures to limit unwanted damages and alterations to land's surface. For example: landowners can ask that well equipment be

fenced off to prevent harm to children and livestock; farmers can negotiate well placement to protect a nearby stream they are using for irrigation or livestock; drillers can be asked to not remove the topsoil from the site and replace it during the reclamation process.

Finally, since many damages to land and water sources can take years to occur after drilling, it is important to know the condition of those resources before the drilling company comes on the land. Prior to drilling, tests should be done by a reputable environmental consultant on all surface and groundwater sources on the property, and also on soils near the well site. Additionally, basements should be tested for contaminates and radon. These tests will create a base line of data in case anything should happen as a result of the drilling.

We encourage landowners to consult the web site of the WV Surface Owners' Rights Organization, www.wvsoro.org, which is an excellent source for additional information.

IV. THE REGULATORY ENVIRONMENT

In the United States the responsibility for regulation of the oil and gas industry has largely been delegated to the individual oil and gas producing states. In addition, specific federal administrations, with the support of the U.S. Congress, have granted exemptions to the oil and gas industry from several major environmental laws. The result has been weakened federal laws, a patchwork of differing state laws and regulatory programs, and little oversight by the federal government.

A. Federal Regulations

The petroleum industry, and all its various industry associations, has historically been one of the most powerful lobbying groups in Washington, D.C. This has resulted in an overall lack of federal environmental legislation regulating the oil and gas industry. But it's even worse than that: the industry is so overwhelmingly powerful that it has succeeded in getting Congress to specifically exempt it from important provisions of federal environmental law.

For example, the oil and gas industry enjoys an exemption granted by Congress from the Resource Conservation and Recovery Act (RCRA). This statute gives the EPA the authority to control hazardous wastes from "cradle to grave" including the generation, transportation, treatment, storage, and disposal of hazardous waste (*USEPA*). Essentially, this exemption precludes all fluids used by industry for oil and gas drilling exemption from being regulated as hazardous wastes.

As a more recent example, in the "Energy Policy Act of 2005" Congress granted the industry numerous adjustments to and exemptions from federal laws. These changes have weakened the previous safeguards against water pollution from oil and gas exploration contained in three of the major pieces of federal environmental law that protect our waters in the United States:

The first of these 2005 changes totally exempted oil and gas field activities from the storm water runoff provisions of the federal Clean Water Act. However, at least one federal court has thrown out this exemption, but the case is still under litigation.

Secondly, the 2005 Energy Policy Act contained three weakening provisions to the federal Safe Drinking Water Act (SDWA): it completely exempted hydraulic fracturing procedures from SDWA regulation; it allowed for the voluntary cessation of the use of diesel fuel in fracking fluid instead of banning it; and it exempted flow back water from regulation if disposed via underground injection wells unless it contained diesel fuel (*Kosnik*).

Thirdly, the 2005 Energy Policy Act gave the industry an exemption from the environmental assessment requirements of the National Environmental Policy Act (NEPA). The NEPA requires an environmental assessment to be conducted before any major projects on federal public lands are undertaken that could possibly impact the environment and also provides an opportunity for public interaction though a comment process. Instead, the 2005 Energy Policy Act, however, granted various oil and gas industry operations a created a "categorical exclusion" under the Interior and Agricultural Departments (*Kosnik*). Granting this "categorical exclusion" means that less strict assessments are now required for oil and gas operations on federal lands, reduces the opportunity for public involvement though the NEPA process, and shifts the burden of proof for the need for additional analysis of these projects from the agency to the public (*Kosnik*).

Finally, although not changed by the 2005 Energy Policy Act, the lack of regulations requiring industries to report the use of hazardous chemicals and identify concentrations of frack fluid additives was highlighted earlier in this report. Under the Toxic Release Inventory provisions of the Emergency Planning and Community Right-to-Know Act, agencies falling under certain criteria are required to report the use of toxic chemicals. Even though Marcellus shale drilling and other oil and gas operations generally meet one or more of the criteria requiring other agencies to report harmful chemical use, the EPA has chosen to exempt the industry from this burden. Chemicals used in the fracturing process can remain undisclosed even when taken to underground injection sites or waste water treatment facilities for disposal.

However, largely in response to concerns about the recent boom in activity from the various industry shale "plays" across the country (including the Marcellus), both the EPA and members of Congress are taking a new look at the adequacy of federal oil and gas environmental regulations.

In early 2010 The U.S. Environmental Protection Agency (EPA) announced that it will conduct a comprehensive research study to investigate the potential adverse impact that hydraulic fracturing may have on water quality and public health. That process is currently underway and has included a series of public meetings and a public comment period.

B. State and Commission Regulations

States bordering West Virginia have already experienced the exploration of the Marcellus layer, and as a result have been examining and enacting legislation to specifically deal with some of the issues mentioned above. Because these legislative

responses are constantly evolving, the brief outlines below represent the situation at the time of printing and changes may have occurred since then. These summaries are intended to provide a picture of the regulatory environment, not a complete citation of all pertinent regulations.

Pennsylvania Regulation

Pennsylvania legislature amended the Oil and Gas Act in March 2010 effectively creating the first Marcellus shale regulatory legislation in the state. Senate Bill 297 requires Marcellus shale drillers to submit semi-annual reports to the DEP. The reports must include status of the well and the production from the preceding six months.

Previously the DEP was required to keep operator reports confidential for five years, now the reports will be available after only six months. The data reported may be used for enforcement.

Pennsylvania is currently considering additional changes to their oil and gas regulatory program.

New York Regulation

As a result of overwhelming concern about the safety of New York City's drinking water sources, the State of New York has recently passed bill S8129B suspending all new hydraulic fracturing permits until May 15, 2011. Suspension of hydraulic fracturing in the Marcellus shale would allow for proper review of new permits and analysis of habitat destruction, road usage, groundwater contamination, and other hazards would be thoroughly reviewed.

Regional Commission Regulations

Geologic formations and watersheds rarely follow political boundaries such as state lines. This creates additional complications when the regulation of gas drilling is determined on a state-by-state basis. While most states have control over regulation of oil and gas drilling within their borders, under the regulations of the Clean Water Act, in issues of water quality, downstream states must be taken into consideration. This becomes an issue when an upstream state has weaker standards than its downstream neighbors.

One example of this cross border regulatory issue was seen in the debate between West Virginia and Pennsylvania over water quality at the border. West Virginia currently has no water quality standards regulating Total Dissolved Solids (TDS). TDS standards control the acceptable amounts of dissolved solids such as chlorides, bromides, sulfates, and like minerals contained in waters. Pennsylvania maintains a TDS standard of 500 ppm or 500 mL/L for drinking water at intakes. EPA recommends a TDS standard of 250 ppm. In fall of 2008 and again of 2009, water flowing from West Virginia into Pennsylvania was measured at or above 500 ppm crossing the WV/PA state line. Some samples were tested as high has 1200 ppm in the fall of 2008.

Some watersheds within the Marcellus shale region have regulations focused on a more comprehensive understanding of shared water resources. Gas wells drilled within the Susquehanna River and Delaware River watersheds are required to report water withdrawals and usage even if not required by state issued permits. Water withdrawals in

the Susquehanna and Delaware watersheds are regulated by the Susquehanna River Basin Commission (SRBC) and the Delaware River Basin Commission (DRBC) respectively. The DRBC requires all water-related projects using over 100,000 gal/day on average, over a 30-day period to be approved or "docketed" by the Commission (*Abdalla*). Also, projects involving the underground injection or surface discharge of pollutants must obtain Commission approval (*Abdalla*). Similar regulations are used within the Susquehanna watershed by the SRBC. The PA DEP requires approval of company activities by the respective commission before issuing a drilling permit.

However, there is no such commission regulating water withdrawals in Marcellus areas of West Virginia and southwestern Pennsylvania, located in the Ohio River watershed. The Ohio River Valley Sanitation Commission (ORSANCO) regulates *water quality* within the Ohio watershed but does not regulate *water quantity*. In addition, ORSANCO tends to issue regulations pertaining to the mainstem Ohio and not the entire watershed. When issues arose in both the Susquehanna and Delaware watersheds regarding Marcellus shale drilling, the commissions were a key component in swiftly establishing regulations preventing both degraded water quality from pollution *and* withdrawals affecting water quantity. Therefore, a commission overseeing water quality and quantity issues throughout the entire Ohio watershed may help by not only to protecting water resources being used, but also limiting further inter-state water conflicts.

C. West Virginia Regulations

Both Randy Huffman, Cabinet Secretary of the West Virginia Department of Environmental Protection, and James Martin, Chief of DEP's Office of Oil and Gas, have publicly stated on several occasions this past year that the agency was not prepared to handle the Marcellus shale drilling boom.

Even West Virginia regulators realize the state is currently lacking the breadth of regulations, as well as the staff and resources necessary to adequately deal with issues surrounding Marcellus shale drilling - particularly those relating to water.

The agency is now trying to fill some of the regulatory gaps.

During the 2010 Legislature, the DEP proposed (and the Legislature passed) changes to the agency's Oil and Gas Well Drilling Rule that begin to address Marcellus shale drilling issues. The rule provides construction standards for large volume pits and impoundments. Amendments adopted make it highly unlikely that drillers will *NOT* use impermeable synthetic pit liners.

And in April of 2010 the agency began a comprehensive review of the entire oil and gas regulatory program, with the goal of developing legislation for the 2011 Legislature to fill more of the regulatory gaps. This review is continuing at this time, with DEP still meeting with the various stakeholder groups.

West Virginia Rivers Coalition is participating in this review, and is encouraging DEP to adopt a wide variety of programmatic changes that will better protect the state's water resources.

V. CONCLUSION

Advances in drilling have allowed energy companies to explore new sources of energy to help the U.S. become more energy independent. Natural gas is a relatively clean source of fossil fuel energy and has many benefits over coal and oil. However, the extraction of natural gas should not come at the price of clean water. It is clear that current regulations, particularly in West Virginia, are outdated and fall short of protecting fresh water resources.

New regulations must be enacted in order to better control the activities of the companies operating within this sector. The primary concern should always be the prevention of pollution entering our rivers, streams and groundwater. Wastewater from Marcellus wells contains high concentrations of naturally occurring pollutants brought up from the drilling process as well as an extensive list of added chemicals. Use and disposal of fracking fluids as well as water withdrawals should be better regulated and closely monitored. It is important to protect not only the water that we use in West Virginia, but also the water that we share with other states.

West Virginia is blessed with some of the most beautiful and pristine waters in the country. Clean water is essential to our lives for drinking, food, recreation, and ecological balance. However, it is also essential for drilling and other industries. We must take actions to ensure that our water resources are protected for all uses.

References Cited

Abdalla, Charles W., Drohan, Joy R. Marcellus Education Fact Sheet. Penn State College of Agricultural Sciences and Penn State Agricultural Research and Cooperative Extension. pp. 11.

Arthur, Daniel J., P.E., Bohm, Brian, P.G., Layne, Mark, Ph.D.,P.E. Hydraulic Fracturing Considerations for Natural Gas Wells of the Marcellus Shale. The Ground Water Protection Council. pp. 10-11. September, 21-24 2008.

Humphries, Marc. Memorandum - Marcellus Shale Gas Development: Royalty Rates, Surface Owner Protection, and Water Issues. Congressional Research Service. pp. 19. October, 14 2008.

Kosnik, Renee Lewis. The Oil and Gas Industry's Exclusions and Exemptions to Major Environmental Statues. Oil and Gas Accountability Project (OGAP), Earthworks. pp. 20. October 2007.

McMahon, David. Information about Oil and Gas Leasing for Surface Owners Who Also Own Their Mineral Rights. WV Surface Owners Rights Organization. pp. 28. May, 16 2008.

Moss, Kerry. Potential Development of the Natural Gas Resources in the Marcellus Shale. National Park Service, US Department of the Interior. pp. 22. December 2008.

New York Department of Environmental Conservation (NYDEC). "Gas Well Drilling in the Marcellus Shale". http://www.dec.ny.gov/energy/46288.html. Accessed 7/9/2010.

Soeder, Daniel J., Kappel, Willliam M. Water Resources and Natural Gas Production from the Marcellus Shale. USGS. May 2009.

Sumi, Lisa. Shale Gas: Focus on the Marcellus Shale. Oil and Gas Accountability Project/Earthworks. pp. 21. May 2008.

US Environmental Protection Agency (EPA). Exemption of Oil and Gas Exploration and Production Wastes from Federal Hazardous Waste Regulations. http://www.epa.gov/waste/nonhaz/industrial/special/oil/oil-gas.pdf. Accessed 2/8/10.

US Environmental Protection Agency (USEPA). "Summary of the Resource Conservation and Recovery Act". http://www.epa.gov/lawsregs/laws/rcra.html. Accessed 2/8/10.

Western Organization of Resource Councils (WORC). "Hydraulic Fracturing Fact Sheet". July 2009. http://www.worc.org/userfiles/file/HyrdraulicFracturing.pdf. Accessed 11/5/09.