

**“Positives, Negatives, Uncertainty, and Opinions
on Hydrofracturing in the Marcellus Shale”**

Mountain Ridge AP Environmental Science

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INTRODUCTION

Good morning. My name is Meghan Coburn. I am speaking today on behalf of Mountain Ridge's 2010-2011 AP Environmental Science classes. Last year's class researched the issue of hydraulic fracturing for approximately four months. The current class has continued to track the issue since September and has spent the past month updating the research and presentation.

Hydraulic fracturing, also known as hydro-fracking or simply "fracking," is the process of using millions of gallons of water mixed with sand and thousands of gallons of varied chemicals to fracture shale rock thousands of feet below the ground. These chemicals and sand particles hold the fractures open, allowing gas to seep back through the drill-hole and to be extracted to the surface. The main issue with the process is the water and the chemicals used. They are essentially the source of most of the controversy. The main benefits are economic growth and cleaner fuel. This process is currently being used in West Virginia and Pennsylvania. However, it has not been permitted in the State of New York or Maryland. These are the primary places where the shale is found.

I will explain the methods used by last year's class to gather information. Then members of the current AP Environmental Science class will continue. Mark Manwani will explain the methods used by this year's class to gather the most recent statistics. Madison Offstein will explain the positive aspects of hydrofracking and how it may benefit our county. Sam Greenawalt and Kyle Harris will explain the negative aspects of hydrofracking. Kiya Wilhelm will cover areas of uncertainty. Georgia Grace Edwards will discuss plans for future research. Finally, Kristie Whiteman will provide an overview of current government positions on hydraulic fracturing.

Last year we collectively read all of the major scientific publications written by the United States Geological Survey, Maryland DNR, U.S Department of Energy, and the Environmental Protection Agency on the impacts of hydrofracturing in our region.

We collectively read all articles published in the Cumberland Times-News in the past four months on this topic. In addition we have read over 50 articles published in newspapers of Pennsylvania and West Virginia.

We attended speeches or presentations from representatives of the following organizations: The George's Creek Watershed Association, the USGS, the Department of Energy, the Western Maryland Resource Conservation and Development Council, Samson Resources, and Texas Keystone Incorporated.

We received and read direct personal correspondence from Commissioner William Valentine, Delegate Wendell Beitzel, Senator George Edwards, and Governor Martin O'Malley.

We visited the Waynesburg, Pennsylvania area. During this trip we viewed 12 hydrofracturing sites first-hand and interviewed 23 local citizens in the Waynesburg, Pennsylvania area.

This effort lead up to a public presentation given to the Allegany County Commissioners at a public meeting in May and a repeat performance at the Frostburg Museum given to the Frostburg Historical Society. The original presentation was reviewed by environmentalists, members of the gas-drilling industry, independent scientists, politicians, and members of the general public. It was praised from all sides for its accuracy and fairness.

Early in January, five members of last year's AP Environmental Science class met with the members of this year's AP Environmental Science class to pass on our knowledge and help them to kick off their own research effort.

The members of this year's AP Environmental Science class have collectively read all the articles published in the Times-News over the past nine months. We have read the most recent documents published by the Maryland Safe Drilling Initiative, the Environmental Protection Agency, the Center for Rural Development in Pennsylvania, and the New York State Department of Environmental Conservation. We viewed an industry-produced film entitled, "Shale Gas and America's Future".

We have met directly with Dan Soeder, hydraulic fracturing expert from the U.S. Department of Energy. We spent an entire day with Johan Schjif of the University of Maryland Center for Environmental Studies, Chesapeake Lab, gathering baseline water quality data on local water supplies.

We directly visited all local sources of Mountain Ridge's drinking water, took water samples, and viewed the nearest potential fracking site, less than one mile northwest of the Piney Run Reservoir.

We have spent the past month discussing, revising, and updating the original presentation produced by last year's AP Environmental Science class.

All facts stated in today's presentation are supported by one or more of the above sources and can be verified by reading our full research paper which includes all citations and a works cited page. This will be available upon request.

Over the course of this research, our understanding of hydrofracturing and its potential positive and negative impacts upon our county has deepened and evolved. I feel that we are well-qualified to share data and our opinions with you on this topic.

POSITIVES

Marcellus shale is a domestic natural gas source which is cleaner burning than coal and oil. Hydraulic fracturing for Marcellus shale has many positive aspects. For example, if this gas is taxed and the money stays in the local economy, county infrastructure such as schools, hospitals and roads could be greatly improved. Jobs will be created to support the industry both directly and indirectly. Property and rental value will increase tremendously. Farmers will be paid for leases on their land and royalties if gas is extracted.

A notable and upfront positive effect of drilling for the Marcellus shale will be the job increase in our struggling economy. In the city of Clearfield, Pennsylvania, unemployment rate dropped from 10.1% in December 2010 to 9 % in February 2011 after shale drilling was started in the area. (Frank, 2011) This occurred during a time that unemployment was rising in most of the nation. Traveling drilling crews have already been established and most workers come from other states. Yet, over time, as local people receive training, more and more of them may be employed. In the immediate term, hundreds of local truckers are needed to transport the millions of gallons of water and chemicals, making up 10% of the jobs in the Marcellus shale industry. (The Tribune-Democrat, 2011) People will be needed to work at hotels and restaurants that the workers visit while they are drilling in the area. In addition, local businesses will gain patrons from the hundreds employed on fracking sites. This may allow local businesses to expand or hire more employees.

If there is a tax on extracted gas, tax revenue can be used to fund school and hospital needs. It can also be used to hire more firemen, ambulance crews, and police officers to serve the community and handle the population and traffic increase. Revenue will additionally be used to repair the roads from the damages caused by tractor trailers.

A small percentage of the population will benefit from the gas if they own land that has the gas underneath it. One farmer mentioned in a Waynesburg interview received a \$250,000 signing bonus and now makes \$15,000/month in royalties on the gas produced. This is a little above average, but it represents the economic potential of this resource. Another financial benefit is that owners of rental properties will be able to increase rates, due to increased demand for housing.

Compared to traditional vertical drilling, modern hydraulic fracturing uses a horizontal drilling technique. This allows each drill site to have multiple gas extraction wells, each extending horizontally for 5,000 or more feet in several different directions. This minimizes habitat destruction and maximizes gas output for each site.

Beyond the economic boost, there is an important environmental benefit as well. Natural gas is more efficient and cleaner burning than coal. When burned, natural gas releases 58% less CO₂ than coal and 33% less CO₂ than oil. (Miller, 2004) We already have a large part of the infrastructure in place to distribute the industry-estimated 400 trillion cubic feet of gas throughout the country, minimizing the cost of an infrastructure conversion for only the Marcellus shale. If we converted all of our electricity production to natural gas, we would have enough to power the entire country for 33 years. Under a more reasonable usage estimate of 25% of the nation's energy, this supply will last 132 years. (Soeder, 2011) Using Marcellus gas in cars rather than gasoline could be cheaper than foreign oil. The Marcellus Shale contains enough gas to replace all oil imports for an estimated 54 years. Cars and buses can be cheaply converted to run on natural gas. Pennsylvania is already making an effort to convert public buses and fleet cars to natural gas, proposing that 25% of bus purchases by mass transit agencies be natural gas fueled by 2015 and 75% by 2026. (Mellot, 2011)

While popular distrust of this new industry exists, Dan Soeder a leading expert on Marcellus Shale, and geologist for the Department of Energy, states that only an estimated 0.5% of recorded drill sites result in newsworthy spills. This means that only 1 in 200 wells in Pennsylvania and West Virginia experience major contamination events. Seeing as Maryland plans to proceed with more caution than its predecessors, the likelihood of spills will only decline. (Soeder, 2012)

A final piece of supporting evidence in favor of hydraulic fracturing comes from the Center for Rural Pennsylvania. This group monitored water quality in 233 wells. All wells involved in the study were within 5,000 feet of a Marcellus Shale fracturing site. Comparative analysis of pre-fracturing and post-fracturing water wells shows no significant changes in levels of key indicator chemicals used in hydraulic fracturing, or in levels of methane. Only one of 233 wells showed an increase in bromide concentrations. However these levels declined and returned to normal levels within one month. (Center for Rural Pennsylvania, 2011)

Even more gas is held in the Utica Shale, a similar untapped natural gas deposit below the Marcellus. The combination of Utica and Marcellus both have the ability to supply large amounts of energy to our country for over a century, making it important to consider the positive effects these sources will have before we come to a decision.

NEGATIVES

Drilling for Marcellus Shale in Allegany County may seem like a great opportunity that many look forward to, but there are many flaws with this potentially great energy source. I will speak only of proven and documented problems.

First, there is the issue with water consumption. In the drilling process, there are approximately four million gallons of water used to retrieve the gas. This water comes from local streams and rivers and is used until the job is completed. While some say that this amount of water is relatively small compared to average municipal water use, (Beitzel, 2011) it should be noted that this is a consumptive water loss, meaning that unlike water from the shower or dishwasher, most of this water is not returned to the water cycle. Instead most of this water remains deep in the ground for many years. (Soeder, 2011) Proper regulations must be enforced to ensure that the demand is not so high as to debilitate local waterways.

Water is not the only ingredient in the drilling process. The second concern is the many chemicals that are needed to effectively retrieve the gas and to hold the cracks in the earth open. These “proppant” chemicals include kerosene, benzene, hydrochloric acid, other carcinogens, neurotoxins, and a host of other dangerous substances. For each drilling project, more than fifteen thousand gallons of these harmful chemicals are used. (DNR, 2010) Large trucks transport these concentrated chemicals to the drilling site and then mix the chemicals with water. This is a very risky procedure because if there should be a spill, even a small scale spill, the great concentration of the chemicals would have devastating effects on the environment and on human health. Small spills of 10-100 gallons are a common occurrence. While each spill may be “small”, the cumulative impact of these spills from many sites is much larger and could have potential unknown consequences and effects. (Soeder, 2011)

Another problem with drilling deals with how wastewater is handled and treated. This “produced water”, in many cases, sits in man-made ponds. This poses a risk to humans (due to potential leaks) and wildlife that may wander to these exposed chemical pools. When this wastewater returns to the earth’s surface it contains uranium, radon, and the other fracking chemicals mentioned earlier. Current municipal wastewater treatment facilities are not designed to handle such chemicals and proper treatment is extremely expensive, not to mention that very few facilities exist for this process. Our state plans to require disposal at proper treatment facilities, but because of the high expense for proper treatment, violations will occur. Such infractions have already been witnessed in Pennsylvania. (Silver, 2011) Furthermore, injection of wastewater fluids into deep-injection wells 20,000 feet below Earth’s surface has been linked with small earthquakes in Ohio and Arkansas. (Soeder, 2012)

For each Marcellus Shale drilling well, 250 tons of drill cuttings are collected. While drilling down to the shale, the drill bit grinds up bits of material that gets carried upwards to the surface. The biggest concern about the drill cuttings is the fact they contain harmful amounts of radioactivity. Thus far, drill cuttings have either been buried on the fracking site or transported to nearby municipal landfills. (Soeder, 2012) Neither of these disposal methods is acceptable or safe.

One of the concerns given the most media attention is methane seeping up from wells and into aquifers. While many of the claims regarding flammability of water have yet to be substantiated, a study published in April by the National Academies of the Sciences by Duke University indicates that drinking water wells within a one-kilometer radius of a drilling site have a 17 times higher concentration of methane than wells outside of a one-kilometer radius.

(Osborne, 2011) However, a lack of baseline data makes this study difficult to interpret.

Accidents and miscalculations happen as well. All of the citizens in the town of Carmichael were ordered by the Pennsylvania Department of Environmental Protection to boil their water. This was a result of complications with fracking flowback fluid in their municipal water supply. Seven families in Bradford County were ordered to evacuate and drink bottled water after a blowout occurred on April 19th. (Tribune, 2011) Of 8000 total wells fracked in the Mid-Eastern States, there have been over 40 newsworthy contamination events already between Pennsylvania and West Virginia. (Soeder, 2012) These 40 are only those that have gained media attention; it is possible that other lesser contamination events have gone unnoticed. Even where there are no proven cases of contamination, anxiety about the health of drinking water is widespread.

After drinking water, the most common concern mentioned by citizens of Waynesburg was the increase in truck traffic. In a count taken by environmental science students in the spring of 2011 while sitting along Main Street in Waynesburg, approximately 50 18-wheelers passed in a one hour period. This poses a safety risk to pedestrians and smaller vehicles. There is no pre-fracking data for comparison, but citizens indicate that few, if any, 18-wheelers passed through their town in the years before fracking. Large trucks cause significant wear on roads not designed for such traffic. While fracking companies do pay to replace roads that lead directly to their sites, they do not repair roads that are further away.

Another concern mentioned by several individuals interviewed was unwelcomed increases in their property taxes. Rates for rentals have increased on long-term renters, forcing some to move to other areas. These are some of the indirect and unfortunate financial consequences of hydrofracturing.

A social impact that was uncovered during the trip to Waynesburg was that fracking in the area led to an increase in crime. A police officer is quoted as saying, "Because so many of the workers are brought in from Texas and other Western states and many of them are in their 20's and 30's without families, there has been an increase in bar fights, alcohol abuse, and illegal drug trafficking." Data from the Greene County District Attorney's Office supports this claim by showing a 16% increase in overall crime from 2005 to 2010. This crime increase exceeds the rate which would be expected due to the coinciding population growth. Yet, it is acknowledged that more data from other fracking and non-fracking counties would be needed to solidly support a connection between fracking and crime.

Returning to environmental concerns, methane is actually 25 times more potent as a greenhouse gas compared to carbon dioxide. About 2 to 6% of methane gas leaks from pipelines when being transported, which only contributes to global climate change. (Living on Earth, 2011) The time period it resides in the atmosphere is about 12 years. So, it can be argued that even though burning natural gas emits less carbon dioxide than both oil and coal, the methane release could potentially have a more detrimental immediate effect on climate change. Furthermore, development of the U.S. infrastructure is not keeping up with the amount of gas produced. Therefore, the Marcellus output is not replacing oil or coal usage domestically, but excess is instead being shipped overseas. This provides no global climate change prevention benefit. To this point, drilling for Marcellus gas is only delaying the necessary and ultimate shift to clean renewable energy sources.

While drilling for gas in the Marcellus Shale may bring economic growth to our area, a host of other problems may accompany it.

UNCERTAINTY

There is a lot of uncertainty surrounding the specifics of Marcellus Shale fracking. Although the basics are known, many details have either been overlooked or have not yet been researched by any scientific organization.

What happens to the remaining three million gallons of frack fluid that is not retrieved? Does it stay underground? If it does stay underground, for how long? What new chemicals are produced when fracking chemicals react with deep rock? Will it resurface at a later date far into the future? Most prevalent on citizens' minds, does any of this seep into aquifers and other drinking water sources? The answer to all of these questions is, "no one is sure yet". While some studies are beginning to emerge, neither the EPA, DNR, USGS, nor any other scientific organization has conclusive answers yet .

It seems that the Maryland legislature is poised to require full-disclosure of all fracking chemicals used in order to earn a permit and this is a step in the right direction. Yet, of the chemicals that are commonly used, what are the health impacts of continued low-level consumption over many years? What is the health impact when hundreds of wells, using millions of gallons of fracturing fluids, are all in one county for 20, 50, or 100 years? How long do the permanent drilling pipes last before corrosion, weathering, and other effects cause them to crack? Will they last 50, 100, 200 years, or more? If these pipes eventually do crack open, what will the consequences be? Similarly, what is the impact of hundreds of wells upon air quality and human health?

An EPA Draft Study, released three months ago, indicates that fracking caused significant contamination of drinking water wells in Pavillion, Wyoming. However, this study has fallen under much criticism and scrutiny. What can we learn from Pavillion, Wyoming? Are the results reliable? If not, what really did happen in Pavillion? What can we in Maryland learn from the confusion caused at this fracking and testing site? (EPA-Pavillion, 2011)

Somerset County currently has about 50 fracked sites. It is known that Garrett County will produce more gas than Allegany County. How many fracking sites will be developed in Allegany County? One source suggests that Garrett may have 1500 wells and Allegany will eventually have 200 wells. (Soeder, 2012) Are these predictions accurate? When will we see the first fracking site in Allegany County? How much gas really is in our nation's Marcellus Shale? Some estimates are as high as 400 trillion cubic feet. Other estimates are as low as 200 trillion cubic feet. Which estimate is correct? Only time will tell.

Another method of hydrofracturing has been introduced: carbon dioxide fracking. It is cleaner, uses less toxic chemicals, and can be a good method for sequestering carbon dioxide from local power plants. In Canada it has been shown to produce four times more gas than traditional methods. To date, it has not been successfully used in this region. Can carbon dioxide fracking be effectively used in Maryland? If so, should we wait for this method to be perfected? (Michael, 2001)

Answers to many of the questions may be favorable for industry. If so, we should proceed. If not, we should improve the process. The fact is, we need answers before we can move forward.

With so many unknowns, it is clear why there is so much debate over proper legislation to protect the health of citizens and the environment. Are laws too strict or not strict enough? Nobody knows because the basic scientific questions have not yet been answered. Until answers to the above questions are found, the consequences of Marcellus Shale drilling will remain a mystery and legislation will be guesswork.

FUTURE RESEARCH

To resolve much of the uncertainty mentioned above, a major research effort has been initiated by the EPA. As the “Draft Plan to Study the Potential Impacts of Hydraulic Fracturing on Drinking Water Resources” indicates, the EPA is working hard to resolve many of the questions raised earlier. The scope of the proposed research includes the full life cycle of water in hydraulic fracturing, from water acquisition through the mixing of chemicals and actual fracturing to the post-fracturing stage, including the management of flow back and produced water and its ultimate treatment and/or disposal. (EPA, 2011) They will include studies of areas that already have reports of contamination as well as before-and-after studies where fracking has not yet begun but will start soon. One such “before-and-after” site is near Washington, Pennsylvania where data will be collected on air quality, soil gas, avian populations, groundwater and stream health, and endangered species before and after fracking. Tracer studies are also being done to precisely follow the pathway of fracking fluids. Scientists from the USGS, US Fish and Wildlife Service, US Department of Energy, the Army Corps of Engineers, and many other research organizations will be participating. An interim progress report will be published in 2012. The complete EPA Report is slated for 2014. (EPA, 2011)

In addition, the Department of Energy is conducting a risk assessment study to determine the statistical likelihood of specific types of accidents, the probability of contamination events, the seriousness of the effects on nearby communities, and the estimated costs of mitigation and cleanup. This information will be released within the next few years. (Soeder, 2012)

There are also environmental studies to be completed in Maryland so that citizens and government officials can learn as much as possible and make informed decisions. Such studies include baseline analysis of water quality. This testing is necessary to determine whether hydraulic fracturing is harming water and soil in surrounding areas, or if the conditions were pre-existing. According to Maryland’s Marcellus Shale Safe Drilling Initiative Study, which was released in December 2011, Garrett County will be the sole “focus of baseline studies in the immediate future.” The DNR plans to “recruit, train, and equip teams of local volunteers to collect baseline conductivity, pH, water temperature, and possibly other data at additional stream locations.” Gauges will also test trace metals, salts, methane, radioactivity, and invertebrates. (Maryland, 2011)

Additionally, the Governor’s Executive Order tasks MDE and DNR, in consultation with an Advisory Commission, composed of a variety of citizens, with conducting a three-part study and reporting findings and recommendations. The first part was completed in December of 2011. It included a presentation of findings and related recommendations regarding the desirability of legislation to establish revenue sources and also standards of liability for damages caused by gas exploration and production. By August of 2012, recommendations will be made for the best practices for all aspects of natural gas exploration and production. By August of 2014, a final report will include findings and recommendations relating to the impact of drilling including possible contamination of ground water, handling and disposal of waste water, environmental and natural resources impacts to forests, greenhouse gas emissions, and economic impact. Maryland is taking a cautious approach to hydraulic fracturing and does not plan to begin fracking until after August of 2014. (Maryland, 2011)

Due to economic constraints baseline sampling sites in Allegany County will not be included in the State funded research set. In the mean time, Frostburg’s municipal water supply currently has the potential to be affected by a proposed fracking site less than one mile northwest

of its reservoir in Pennsylvania. To make up for the lack of baseline testing in our county, we, the AP Environmental Science students of Mountain Ridge High School, have decided to take the initiative and conduct baseline testing at five locations that could potentially be affected by this fracking site. We have already tested for total dissolved solids, water temperature, pH, turbidity, barium, bromide, and strontium at the following locations: Piney Run Tributary, Piney Run Dam, Savage River Aquifer, and the Water Treatment Plant. We plan to continue to sample at these sites once each month for the next several years, establishing a range of natural variability, enabling us to determine if any abnormal values are detected after fracking begins. We are being assisted on this project by a scientist at the University of Maryland Center for Environmental Studies, Chesapeake Lab.

OUR ELECTED OFFICIALS

In both our local and state government, there is quite a lot of controversy over the topic of drilling in the Marcellus Shale. Some officials want to start drilling now, while others want to observe the experiences of other states and then take measures to improve drilling methods in Maryland.

The County Commissioners of Garrett and Allegany Counties want to see fracking start as soon as possible. They are quoted in a recent letter to the Governor encouraging “the Advisory Commission to expedite their review”. (Commissioners, 2011) Senator Edwards and Delegate Beitzel share their pro-fracking perspective. They would like to boost the local economy as soon as possible.

Yet, Governor O’Malley has held firm on his moratorium and is not the only one with this opinion. U.S. Senator Ben Cardin and U.S. Senator Barbara Mikulski support O’Malley’s moratorium and encourage more research. This will improve safety of the fracking methods to avoid spills, leaks, and other damaging accidents.

President Barack Obama has taken a “middle-of-the-road” approach. He supports drilling in the Marcellus Shale, but “will take every possible action to safely develop this energy”.

The weighing of the pros and cons has divided many on the issue of Marcellus Shale drilling. Pennsylvania and West Virginia have been fracking for over two years, while New York and Maryland have each maintained a moratorium.

In a poll taken for the Maryland Petroleum Council, 74% of respondents “favored the development of natural gas resources in Western Maryland”. (Maryland Petroleum, 2011) Yet, the question asked made no mention of hydraulic fracturing. A Cumberland Times-News poll taken in January concluded that 66% of their readers opposed hydraulic fracturing. (Goldsworthy, 2011) It appears that the wording of the questions, the level of information provided to participants, and the demographics of the population polled all play a part in the results. This has been a difficult issue for gauging public opinion.

CONCLUSION

Now that you have learned about the positives, negatives, and areas of uncertainty regarding hydraulic fracturing for the Marcellus shale gas, we would like to hear your opinion. The following survey will ask about issues such as: When should fracking begin in Allegany county? If a tax is put on extracted gas where should the money go? What are your major

concerns about fracking? Which benefits of fracking excite you most?... along with other key issues. Please answer these questions with your honest opinion.

A final survey item asks if you are willing to have your anonymous survey included in a compiled report that will be sent to Governor O'Malley, our County Commissioners, and others in the decision making process. We will not refer to "Mountain Ridge" in our data report, but will simply refer to this population as a "group of citizens". We hope that you will allow us to include your survey results so that our elected officials can have a more informed sense of public opinion.

Before distributing the surveys, we are willing to answer any questions that you may have on this topic and welcome any feedback.

We thank you for listening. We hope that this presentation has been informative. Thank you for enriching our learning experience.

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