

Natural gas extraction from the Marcellus formation in Pennsylvania:  
Environmental impacts and possible policy responses for state parks

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## **Abstract**

State Parks in Pennsylvania are beginning to feel pressure from increasing natural gas exploration activities in the Marcellus Shale formation. Drilling for natural gas has the potential to negatively impact the environment, and may negatively affect Pennsylvania's award winning State Park system. Natural gas drilling operators have years of legal precedent which makes it difficult for the Bureau of State Parks to adequately protect and manage its land. State Parks currently have no legal means to keep drilling from occurring on nearly 233,000 acres of Park land.

After speaking with Bureau of State Parks' Managers, and comparing oil and gas law from Ohio, West Virginia, and Wyoming to those laws found in Pennsylvania, it is clear changes must be made to laws concerning natural gas extraction to adequately protect Pennsylvania's State Parks. Until changes are made on a legal level, Parks must continue to work diligently to forge positive relationships with natural gas companies to insure cooperation between the companies and the Parks. It may also be time for the Department of Conservation and Natural Resources, and especially the Bureau of State Parks, to abandon old management directives and become more proactive in expressing its views on environmental issues involving State Parks.

## Executive Summary

Although Pennsylvania played an important role in gas and oil law formation throughout the country, the state has not updated its laws to reflect the evolution of oil and gas technology, especially considering the current boom in natural gas drilling in the Marcellus shale formation (Bibikos & King, 2009). The Marcellus formation is a natural gas containing layer of shale that extends from the southwestern tip of West Virginia, through eastern Ohio, western and northern Pennsylvania, into southern New York. The large Marcellus reservoir shows potential to produce fortunes for natural gas drillers increasing natural gas interests in Pennsylvania which has prompted fear and skepticism over the safety of drilling operations. Of particular concern is the encroachment of drilling operations on State Park land in Pennsylvania.

State Parks do not own the majority of their land fee simple<sup>1</sup>, which means owning both the surface and subsurface rights (Department of Environmental Protection, 2007). The Department of Conservation and Natural Resources (DCNR) estimates it only owns 20% of its State Park land fee simple (Erdley, 2010). This factor combined with, outdated oil and gas legal statutes and the economic promise of the Marcellus formation, place PA State Parks in a difficult position where they must develop strategies to minimize or avoid possible

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<sup>1</sup> When the subsurface is not owned, surface owners have minimal rights in regards to drilling as found in, *Chartiers Block Coal Co. v. Mellon*, 25 A. 597 (Pa. 1893) “owning mineral rights provides that owner with the right to occupy as much of the surface estate as might be necessary, exercising this right with due regard to the surface estate owner.”

environmental damage, habitat changes, and recreation disturbances, while still adhering to the laws of the State.

To best understand the issues associated with drilling, it is vital to first know what the Marcellus formation is, how drilling is performed, what laws govern split-estate and remediation requirements, and what the risks and rewards are. To discover the best course of action Parks can take to minimize drilling, I conducted interviews with Park managers to determine what methods they have used, or plan to use. I also explored what laws West Virginia, Wyoming, and Ohio have adopted regarding split estates<sup>2</sup>, and remediation<sup>3</sup>, and how those laws, if adopted in PA, may minimize drilling impacts on Parks.

### **The Marcellus Shale Formation**

The Marcellus formation is a natural gas containing shale layers underlying approximately 2/3 of Pennsylvania (Marcellus Shale, 2010). If fully developed the Marcellus shale could prolong the United States' current rate of consumption of natural gas for another 90 to 116 years (Campbell, 2010; Rotman, 2009; Soeder & Kappel, 2009).

The promise of the Marcellus formation has led to a boom for gas drilling companies. Between January 2009 and September 2010, 4,334 Marcellus permits were issued and 1,862 wells were drilled (Department of Environmental

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<sup>2</sup> Split estates refer to properties that have had the surface and subsurface rights separated.

<sup>3</sup> Remediation refers to the rehabilitation of drilling sites after drilling operations have been completed.

Protection, 2010). So far, PA State Parks have avoided drilling encroachment, but since DCNR is not a regulatory body, they currently have no legal means to keep drilling companies from operating within the Park boundaries.

The drilling process involves the construction of access roads and a well pad, and the hauling of heavy equipment, including the drilling rig, pipe casing, and water needed for hydraulic fracturing<sup>4</sup>. Drilling can take several months from start to finish and can disturb 5-15 acres of land (BRSC, n.d.). After completion, the well site is remediated and the drilling equipment is removed.

Concerns involving the safety of Marcellus drilling operations include local infrastructure damage, excessive water usage, water contamination of both drinking wells and rivers, habitat fragmentation, and noise, light, and air pollution issues. In addition, there are also issues with storage and disposal of returned fracturing fluid. This “flowback” can contain dissolved solids, metals, sulfides, radioactive materials such as radium-226, as well as the initial chemicals present in the fluid (Kargbo, Wilhelm, Campbell, 2010; Renner, 2008; Soeder & Kappel, 2009).

Violations associated with the drilling process also pose issues, as these violations are often unpunished. From 1/1/2008 to 1/31/2011 the total number of violations was 2,665 (PA DEP, 2011B). Of these, enforcement action was taken on 620 (PA DEP, 2011B). Trucks associated with drilling were inspected over

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<sup>4</sup> The water needed for the hydraulic fracturing process is taken from local rivers, streams, and municipal sources, and is sometimes trucked onto the well pad where it is stored until it is needed (Soeder & Kappel, 2009).

three three-day periods. During these inspections 2,685 citations were issued, and 665 trucks were taken out of service (PA DEP, 2010 (A,C,D))<sup>5</sup>.

The two main advantages to Marcellus drilling are employment and tax revenue. Employment in core oil and gas industries grew 11% in PA from 2008 to 2010 (Pennsylvania Workforce Development, 2010). Jobs in the core oil and gas industry are expected to continue growing, while at the same time, ancillary and supply chain industries<sup>6</sup> are expecting job growth as well.

### **Laws Regulating Oil and Gas Drilling**

The issues above are addressed by Pennsylvania, Ohio, West Virginia, and Wyoming using varying laws and regulations concerning split-estate rights and protection, and remediation requirements.

*Table ES1. Differences in state regulations regarding oil and gas drilling operations. The states of Ohio, West Virginia, and Pennsylvania were chosen because they are all currently operating in the Marcellus formation, and Wyoming has a more pronounced history of natural gas drilling. Highlighted are the laws of the different states regarding split estates and remediation, and the amount of protection these requirements lend to individuals that do not own their subsurface rights.*

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<sup>5</sup> Trucks were taken out of service for faulty brakes, exterior lighting issues, improper hauling permits, and other violations relating to safety

<sup>6</sup> Ancillary and supply chain industries are those industries that, although are not directly related to Marcellus drilling, provide supplies or services to Marcellus operations. A full list of the ancillary and supply chain industries can be found in appendix D.

State	Remediation Requirements	Split Estate Rights and Protection
<b>Pennsylvania</b>	The well site must be restored within nine months after the completion of drilling. Site restoration involves only the removal of equipment, and not the replanting or regarding of the disturbed area. Other remediation requirements are found in the “Erosion, Sedimentation and Stormwater Control Plan for Oil and Gas Operations” which is issued by the Department of Environmental Protection Bureau of Oil and Gas Management, and must be completed by operators prior to permitting.	Subsurface owners have precedent, and must be allowed access to their minerals regardless of surface ownership. Wells may not be drilled within 200 feet of an existing building, 100 feet from any stream, or 100 feet from any wetland greater than one acre in size.
<b>Ohio</b>	Operations that are carried out in an urbanized area are required to remove equipment, grade or terrace, and plant or sod disturbed land within three months of the start of drilling operations. In all other areas, the operators receive six months to complete the same tasks.	Surface owners in split estate situations have no say in the leasing process. Ohio Administrative Code, chapter 1501: 9-1-05 <i>Safety</i> , regulates that wells may not be placed within 100 feet of a house or public structure (school, store, etc.), within 50 feet of a road, or within 50 feet of railroad tracks.
<b>West Virginia</b>	The WV legislative code (§22-6-30) states that within six months after the completion of the well, the site must be graded or terraced, and seeded or sodded in order to prevent substantial erosion and sedimentation. In addition to these requirements, operators are encouraged to consider the needs of wildlife.	Surface owners are entitled to compensation for damages to surface estate, although mineral rights owners still have the right to access their minerals.
<b>Wyoming</b>	Although remediation practices can be spelled out in the surface use agreement, Wyoming statute requires “the restoring of the surface directly affected by oil and gas operations, as closely as reasonably practicable, to the condition that existed prior to oil and gas operations, or as otherwise agreed to in writing by the oil and gas operator and the surface owner.”	Wyoming law requires a surface use agreement when the land is not owned fee simple. Wyoming Statute 30-5-402: “...the oil and gas operator and the surface owner shall attempt good faith negotiations to reach a surface use agreement for the protection of the surface resources, reclamation activities, timely completion of reclamation of the disturbed areas and payment for damages caused by the oil and gas operations.”

## **Thesis Research Methodology and Results**

In order to manage the impacts drilling may have on state parks, parks must find a way to cooperate with Marcellus drilling companies. The two main types of data used in this analysis are legal data concerning the extraction of natural gas, which were collected from various state sources, and data collected from Park managers through interviews. I interviewed three PA State Park Regional managers to understand how the DCNR is dealing with Marcellus drilling and how the managers feel about the effects of drilling on State Parks. The interviews were carried out via telephone on February 18 and 25 of 2011.

Currently only one Park in western Pennsylvania is being drilled for natural gas in the Marcellus shale. Although the drilling has yet to commence, the final details of the drilling operations are being discussed with the drilling company (Interview, 2011.) Managers' worries include noise and air pollution affecting recreational quality in regards to camping and hiking, scenic and aesthetic changes caused by the drilling equipment, water quality concerns and how accidental spills could affect lake ecosystems and fishing, and habitat fragmentation, which may affect general wildlife health and possibly decrease hunter satisfaction (Interview, 2011).

The main tool that the State Parks use to combat the negative effects of drilling is coordination agreements. These agreements are voluntary to the oil and gas companies, and outline requests by the Park to be compensated for surface

disturbances. So far oil and gas companies involved with conventional drilling on State Park land have been willing to work with the Parks (Interview, 2011).

When asked what the managers would like to see in regards to drilling on Park land, they stated that, although companies have been conscious of the importance of protecting Parks, this sentiment may not last, and a change of legislation could better guarantee protection of Parks surface land (Interview, 2011). These interviews showed that while park managers are concerned with Marcellus drilling operations in state parks, they feel that there is little that they can do given the way that the state government has responded to their concerns.

### **Discussion of Current State of Drilling in PA**

A new political climate in Pennsylvania has led to changes that may diminish DCNR's ability to protect State Parks from drilling. By examining the laws of other states and speaking with current Park managers, reform of the oil and gas law in Pennsylvania is necessary to guarantee protection for Parks. In spite of this, Parks have found ways to protect themselves from gas and oil operations in the past through forging positive relationships with oil and gas companies.

In 2009 the Supreme Court of Pennsylvania ruled that the DCNR and Oil Creek State Park do not have the ability to place additional restrictions on drilling operations set to take place on Park property (Belden & Blake v DCNR, 2009). The case was brought to court when DCNR, asserting that it held an obligation to preserve state parks pursuant to the PA constitution, attempted to impose a

coordination agreement on Belden & Blake Corporation<sup>7</sup>. This case as well as others before it highlights the industries' advantage when dealing with oil and gas law.

Gas companies have noticed the pro-industry environment in PA. Shell Exploration and Production Company (Shell), believes that PA could become the second largest producer of natural gas in the U.S. by 2020. Shell claims that spending from Marcellus operations in 2009 created \$389 million in state and local tax revenue, and added 44,000 new jobs (Blauvelt, 2010). The industry estimates continue to grow showing increasing interest in the Marcellus formation.

### **Policy Recommendations: DCNR and the Public**

The DCNR can help minimize drilling impacts on state park land. By changing its management style, parks could publically voice their opposition to the encroachment of park land by Marcellus operators. Although this solution may not be possible in all instances, it may help limit park land encroachment in some cases.

However, the most important recommendation to minimize drilling impacts on state parks is for the public. It is time that the public takes the initiative to learn about the laws and practices within the State, and to become

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<sup>7</sup> The coordination agreement included terms that would require Belden & Blake to post a \$10,000 performance bond for each well, as well as \$74,885 in stumpage fees (double the fair market value) (Belden & Blake v DCNR, 2009).

informed about the possible negative effects of drilling on state parks. Although media coverage exists on the encroachment of Marcellus drilling onto park land, the message has not been presented in a way that stresses parks inability to legally protect their parks. A push for legal reform and stricter regulations to protect our State Parks is needed, and is the only guarantee our Parks will have for receiving protection. In order to reach this goal, Marcellus opponents need to begin acting on a state-wide level to bring the issue to the proper tier. If the issue of drilling in state parks is to be addressed, the issue needs to be brought to the state legislature and pressure needs to be placed on state representatives and the governor.

## **1.0 Introduction**

Gas and oil drilling has a long history in Pennsylvania beginning with the drilling of the first oil well in the nation in 1859 (Recreational Guide for Oil Creek SP, 2002). Due to this long extractive history, Pennsylvania set the benchmark for gas and oil law that many other states have followed (Bibikos & King, 2009). Despite setting some of the first gas and oil laws in the nation, the PA laws have failed to keep pace with the evolution of the natural gas industry. The last major gas and oil legislation comes from the Oil and Gas Act of 1985, which was revised in 1992 (Oil and Gas Act, 1985). This law summarizes and builds upon the Oil and Gas Conservation Law of 1961. These laws are and troubling because the ability to extract natural gas from the Marcellus formation did not exist when the laws were formed.

The Marcellus formation is a natural gas containing layer of shale that extends from the southwestern tip of West Virginia, through eastern Ohio, western and northern Pennsylvania, into southern New York. Estimates of the natural gas content of the Marcellus formation have placed the recoverable gas amount in the formation at between 60-363 trillion cubic feet (TCF) although some estimates have been as high as 516 TCF (Sodder & Kappel, 2009; Arway, 2010). To put that amount into perspective, the Haynesville Shale in the Gulf Coast contains nearly 250 TCF which is the highest known quantity of natural gas in the United States (Arway, 2010). The Marcellus shale formation's massive

reserve would be a large contribution to the current 23 TCF of natural gas used per year in the United States (Sodder & Kappel, 2009).

The large Marcellus reservoir and the promise of Marcellus fortune has led to thousands of leases signed, permits issued, and wells drilled. Between January 2009 and September 2010, 4,334 Marcellus permits were issued and 1,862 wells were drilled in Pennsylvania (Department of Environmental Protection, 2010). The large expansion of the natural gas interests in Pennsylvania has led to fear and skepticism over the safety of drilling operations. From contaminated wells in Dimock, PA, to heightened total dissolved solids loads in the Monongahela River in Pittsburgh, drilling activity has been suspected for many environmental worries (Vergano, 2010; Federman, 2010; Renner, 2009).

Drilling and its risks are slowly encroaching on State Park land in Pennsylvania. Pennsylvania's state Park system consists of 117 State Parks, 79 of which lie within the Marcellus formation. State Parks own an estimated 20% of their 283,000 acres fee simple<sup>8</sup>. Fee simple ownership means that both the surface and subsurface rights are owned (Department of Environmental Protection, 2007); Parks' lack of fee simple ownership means that they can only prevent drilling on 56,600 acres (Erdley, 2010).

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<sup>8</sup> When the subsurface is not owned, surface owners have minimal rights in regards to drilling as found in, *Chartiers Block Coal Co. v. Mellon*, 25 A. 597 (Pa. 1893) "owning mineral rights provides that owner with the right to occupy as much of the surface estate as might be necessary, exercising this right with due regard to the surface estate owner."

The problems facing State Parks with respect to Marcellus drilling are due to the cumulative effects of State Park formation<sup>9</sup>, outdated oil and gas legal statutes, and the extractive and economic promise of the Marcellus formation. These factors place PA State Parks in a difficult position where they must develop strategies to minimize or avoid possible environmental damage, habitat changes, and recreation disturbances, while still adhering to the laws of the State. In this thesis the options State Parks have to minimize the impacts of Marcellus drilling on State Park land are explored.

In order to determine the best course of action Parks can take to minimize drilling, I reviewed oil and gas law from Ohio, West Virginia, and Wyoming and also conducted interviews with Park managers to determine what methods they have used, or plan to use. These managers were selected due to their Park's vulnerability to Marcellus drilling. The methods given by the Park managers have been examined for effectiveness and their ability to minimize negative impacts of drilling. I then determined if there are any possible legal consequences to their decisions using court cases and past oil and gas drilling law. I also explored what laws West Virginia, Wyoming, and Ohio have adopted regarding split estates<sup>10</sup>, and remediation<sup>11</sup>, and how those laws, if adopted in PA, may minimize drilling impacts on Parks. The final product is a list of options that PA State Parks may

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<sup>9</sup> Purchasing land without subsurface rights, and receiving donated land without subsurface rights.

<sup>10</sup> Split estates refer to properties that have had the surface and subsurface rights separated.

<sup>11</sup> Remediation refers to the rehabilitation of drilling sites after drilling operations have been completed.

use to protect the natural environment within the Parks from the extraction process, and policy recommendations that Parks could utilize.

The results of this study have shown that some state laws are better formulated to protect surface owners than others, and that Pennsylvania lacks legal protection for surface owners. Pennsylvania's lack of protective legislation combined with State Parks lack of fee simple ownership places State Parks in a less than favorable position regarding Marcellus drilling. If Pennsylvania wishes to protect Parks from the possible negative effects of Marcellus drilling, then legislative changes must occur. State Parks managers have been effective at minimizing negative environmental impacts from non-Marcellus operations, but are not sure that the current tactics are sufficient to protect Park land from Marcellus drilling.

Pennsylvania needs to look closely at the current oil and gas law and should consider adding provisions to better protect public land. These changes need to occur before drilling becomes commonplace on State Park property. The Department of Conservation and Natural Resources should continue and perhaps even enhance the availability of Marcellus information for the general public. Although the Department has a wide variety of resources available online, it may be necessary for the Department to abandon its practice of avoiding politically charged issues and issue a formal stance on drilling in order to build public support for legislative change.

Chapter two contains a review of the literature pertaining to Marcellus gas drilling. The first section gives a brief history of the DCNR and State Parks, and outlines the issues that Marcellus drilling presents, and how these issues may affect State Parks. The second section of this chapter clarifies what the Marcellus formation is. Section three explains the drilling process. Section four explores the risks associated with Marcellus gas drilling and how these risks may affect State Parks. The fifth section looks at the regulation involved in Marcellus drilling operations, focusing on violations and enforcements of current regulations. The last section examines the rewards from natural gas extraction from the Marcellus formation in regards to employment and state revenue.

Chapter three looks at legal precedent and laws in PA focusing on mineral rights leasing, royalties, split estate rights and remediation, citing court cases and Pennsylvania Code. This chapter also examines the laws and codes in West Virginia, Ohio, and Wyoming and how they deal with leasing, royalties, split estates and remediation.

Chapter four indicates the tools that may be or have been used to minimize the impact drilling may have on PA State Parks as indicated through interviews with current and past Park managers. In the second section, these options are compared with the split estate and remediation laws and codes of other states to determine if changes to the legal code in Pennsylvania could give managers the tools needed to implement their ideas. This will give an idea of where PA stands as far as the strictness of regulation and what changes might be made. The chapter

also discusses issues involved with data collection and an explanation of the methods used to retrieve the data used in my analysis.

Chapter five discusses the state of the political regime in PA, the legal climate, the state of the natural gas industry and how each of these may affect State Parks. Finally, chapter five reveals the policy recommendations, and what the public and the DCNR should do to protect State Parks. These recommendations will help DCNR and the public not only better understand the issues at hand, but also make decisions on how best to confront these issues.

Chapter six contains the limitations of this study, and lays out recommendations for future work on this subject.

## **2.0 A Review of the Literature Pertaining to Marcellus Shale**

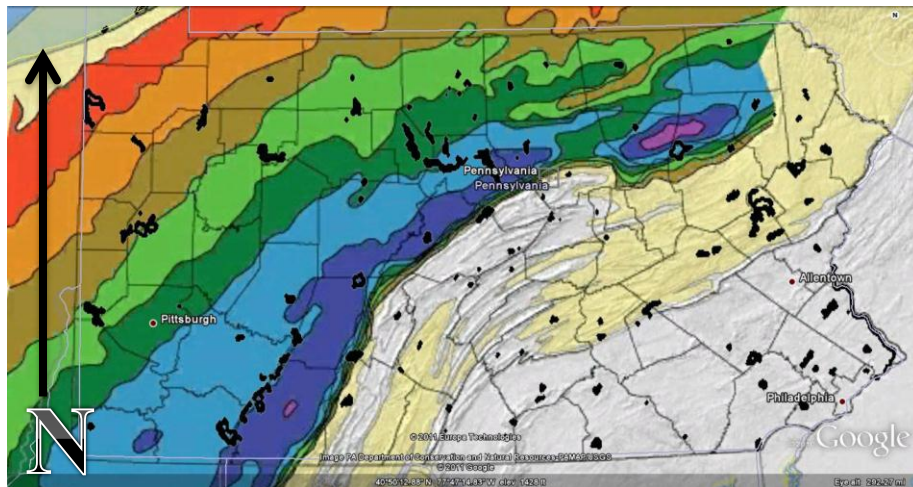
### **2.1 Introduction to the Literature Review**

Pennsylvania has a past marred by environmental degradation. In the late 19<sup>th</sup> century the PA countryside was littered with iron furnaces, sawmills, coal mines, and oil wells (PA Historical & Museum Commission, 2011). Many of the areas hosting these facilities, such as Keystone and Oil Creek State Parks, were damaged environmentally. Oil Creek State Park is the home of Drakes well, the first oil well drilled in the United States. The well was drilled in 1859 and in subsequent years, the land surrounding the well was deforested for timber to build houses, the creek was full of oil, and the air was thick with smoke (A recreational guide for Oil Creek State Park (SP), 2002). Forest fires occurred frequently and destroyed most of the remaining standing forests (A recreational guide for Oil Creek SP, 2002). By 1870 the oil boom was over and the land was abandoned. Keystone State Park had a similar beginning. In 1909 the land was purchased by the Keystone Coal and Coke Company to supply the steel mills in Pittsburgh with coke (A PA Recreational Guide for Keystone SP, 2008). A lake was built to supply water for the coke making process, and remains in the Park today (A PA Recreational Guide for Keystone SP, 2008)<sup>12</sup>.

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<sup>12</sup> Both of these Parks currently have producing conventional natural gas wells within them. Keystone State Park has had good relations with the natural gas companies operating within its borders, while Oil Creek has not, and has actually been taken to court by a drilling company.

Following the establishment of Valley Forge as Pennsylvania's first state Park in 1893, many of these environmentally scarred properties were slowly purchased by the state. For economic and historical reasons<sup>13</sup>, much of this land was purchased without the subsurface rights (Erdley, 2010). By 1930 the state Park system had grown to 13 state Parks and expanded further to 87 Parks by 1970. Currently, the Pennsylvania State Park system consists of 117 Parks covering 291,700 acres (History, 2010). Of these 117 Parks, 79 can be seen as being at risk for Marcellus development due to the location of the Marcellus shale formation (Figure 1).



*Figure 1: State parks in PA situated above the Marcellus formation. The colors in the image show the depth of the Marcellus formation (from the surface to the top of the formation) ranging from 2-3000 feet (red) in the northwest, to over 9,000 feet (purple) in the northeast. The beige areas represent the portion of the formation that is not economically feasible. This map was created using Google earth with State Park data from Pennsylvania State University (<http://www.pasda.psu.edu/>) with an overlay image of the Marcellus formation from <http://www.physorg.com/news205508090.html>.*

<sup>13</sup> Companies that operated on the land prior to selling to State Parks often separated surface and subsurface rights. This allowed companies to maintain control of the valuable minerals beneath the surface so that they could be extracted later. Pennsylvania could then purchase the land at a discount since the economically valuable portion of the land was not included (Erdley, 2010).

The location of many of Pennsylvania's Parks over the Marcellus shale play<sup>14</sup> is further complicated due to the fact that much of the land has been split into surface and subsurface rights. Although the exact figures have not been calculated, due to the high cost of sifting through old deeds (Cleary, 2006; Interview, 2011), the Department of Conservation and Natural Resources estimates it owns only 20% of its State Park land fee simple (Erdley, 2010). This means that 80% or roughly 233,000 acres of State Park land is available for development.

The exploration of the natural gas available in the Marcellus shale formation in the northeastern United States has become an issue for environmentalists, state governments, and the public. The Marcellus play has led to public and political discourse concerning the possible environmental and health effects linked to natural gas drilling, as well as the economic effects of drilling. Marcellus drilling and the issues associated with it are now moving into Pennsylvania's State Parks. In order for PA State Parks to continue to be a haven for recreation and wildlife, Parks must find a way to limit the impact drilling operations may have on Park property.

The first goal of this literature review is to explore what the Marcellus shale play is and what this means for the United States natural gas reserves. The second goal is to explain the drilling process and how it may affect the environment. I will look at water and air quality concerns as well as land use

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<sup>14</sup> A "play" is a high volume natural gas reserve (Weidner, 2008).

changes, and how those may influence State Park resources. I will also show issues with regulating the industry, covering violations of operating permits, and the subsequent citations. The rewards of Marcellus drilling in Pennsylvania will be explored and finally a media analysis of news publications concerning drilling in state parks will be carried out using LexisNexis Academic<sup>15</sup>.

## **2.2 The Marcellus Shale Formation**

The Marcellus shale is an ancient rock formation formed over 350 million years ago containing large quantities of natural gas (Soeder & Kappel, 2009). Fully developed, the Marcellus formation could become the second largest natural gas field in the world after the Pars/Asalouyeh formation shared by Qatar and Iran (Blauvelt, 2010). The Marcellus formation stretches from West Virginia to New York and underlies approximately 2/3 of Pennsylvania (Marcellus Shale, 2010). In 2002 the United States Geological Survey estimated the amount of undiscovered natural gas in the Marcellus formation at 1.9 TCF, and that initial estimate has grown rapidly over the last eight years (Shallenberger, 2009).

Due to increased exploration of the Marcellus formation, current estimates place the amount of economically recoverable natural gas in the Marcellus shale formation at between 219-516 TCF, and technically recoverable natural gas<sup>16</sup> at

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<sup>15</sup> LexisNexis Academic is a search engine designed to aid in the collection of legal, governmental and news publications for research purposes.

<sup>16</sup> Economically recoverable natural gas refers to the amount of gas that can be extracted while avoiding monetary loss. Technically recoverable natural gas refers to the amount of gas that can be extracted given current technology although not all of it makes economic sense. Technically

more than 1,700 TCF. Currently, the United States produces approximately 30 TCF of natural gas per year (Weidner, 2008). If the Marcellus formation is fully developed and added to current production, the United States could continue its consumption rate of 23 TCF per year for 90 to 116 years. If natural gas were used to completely replace coal generated electricity, the Marcellus formation could last 50 years (Kargbo, Wilhelm, Campbell, 2010; Rotman, 2009; Soeder & Kappel, 2009). These forecasts have made the Marcellus formation very attractive to natural gas producers, and have led to a rapidly growing industry.

Deep well drilling techniques borrowed from natural gas companies in Texas helped Range Resources reach the Marcellus formation that lays an average of 5,000-8,000 feet underground (Marcellus Shale, 2010). Range Resources used these technologies to test the most efficient methods to stimulate gas flow. The Barnett formation in Texas is one of the best producing plays in the United States, and is also similar to the Marcellus formation, allowing the methods to be applied to the Marcellus formation (Shallenberger, 2009; National Association of Development Organizations, 2010). Using these technologies borrowed from Texas, in 2003 the first Marcellus wells in Pennsylvania were drilled in Washington County, and began producing gas in 2005 (Shallenberger, 2009). The introduction of Range Resources' techniques into PA allowed for profitable recovery of natural gas from the Marcellus formation creating a new interest in gas drilling in PA.

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recoverable natural gas may become economically recoverable if technology improves or gas prices rise (Naturalgas.org, 2010).

The promise of the Marcellus formation has led to thousands of mineral rights leases<sup>17</sup> signed, thousands of permits issued, and thousands of wells drilled throughout the state. From 2005 to 2009 - 2,100 Marcellus permits were issued by the Pennsylvania Department of Environmental Protection (DEP) (Shallenberger, 2009). By the end of 2008, 195 Marcellus wells were completed, and an additional 499 wells were completed by November, 2009 (Shallenberger, 2009). Between January 2009 and September 2010 - 4,334 Marcellus permits were issued and 1,862 wells were drilled (Department of Environmental Protection, 2010). The 2010 permits issued and wells drilled have already surpassed 2009 levels, showing the continuing increase in the exploration of the Marcellus formation. The numbers of permits that have been issued parallel the acreage of lease agreements natural gas companies have acquired. In 2009 six natural gas companies each held 500,000 acres or more in natural gas leases and another 18 companies held 10,000 or more acres (Shallenberger, 2009).

Approximately 700,000 acres of Pennsylvania's state forests were under gas leases as of January 2010 (History of Gas Exploration, 2010), showing that Pennsylvania's state owned land is not immune to the pressure of Marcellus drilling. Although Marcellus drilling is new, non-Marcellus drilling operations have been a part of state owned land since the first gas and oil lease in PA state forests in 1947 (History of Gas Exploration, 2010). So far, Pennsylvania's state

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<sup>17</sup> The Commonwealth of Pennsylvania does not maintain records of leases of surface and subsurface land; this information is held at the county level (DEP, 2007). Permits will not be issued unless a lease agreement has been signed or the subsurface rights are owned by the drilling company, so there are at least as many leases as there are permits (Weidner, 2008).

Parks have avoided this encroachment; as it is their management directive to not lease land for drilling activities, they have not allowed drilling on the land that is owned fee simple (State Park Management Plan, 2010). State Parks mission and management directives are now being challenged as natural gas companies are obtaining subsurface lease agreements that lie under state Parks. Since DCNR is not a regulatory body, they currently have no legal means to keep drilling companies from operating within the Park boundaries<sup>18</sup>.

### **2.3 Marcellus Drilling Process**

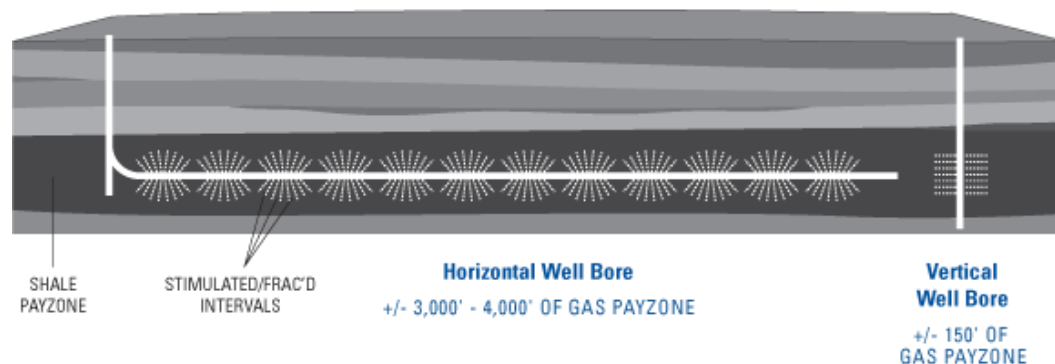
Drilling in the Marcellus formation involves two main steps. The first step in the drilling process is to find the area where the formation is likely to have the highest volume of natural gas, and the second step is drilling into the formation and recovering natural gas. In order to find the best formations for drilling, companies carry out seismic surveys. There are two different types of seismic survey. The first type of survey is called a vibroseis survey. This type of survey uses a large weight mounted to a truck that strikes the road surface at constant intervals (DCNR Bureau of Forestry, 2010). This survey method supplies the drillers with a two-dimensional picture of the subsurface that can be used when choosing a well pad. The other method is called a dynamite survey. This survey is completed by digging 20 foot deep holes throughout the survey area and setting one to two pound charges in each hole. After the holes are covered, the charges detonate and

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<sup>18</sup> These legal issues including a court case brought upon DCNR highlighting the lack of power behind State Parks will be covered in chapter three.

the subsurface characteristics are recorded in three-dimensions by geophones positioned along the survey area (DCNR Bureau of Forestry, 2010).

After the seismic survey is completed the drilling process may begin. First access roads are built and the well pad is prepared for the drilling equipment. Then the drilling rig is erected on the well pad and the drilling process begins. The drill bit travels thousands of feet vertically, and before the Marcellus layer is reached, the drill bit begins turning horizontally. Horizontal drilling allows the well to contact more of the natural gas containing formation and can produce more gas with fewer wells than conventional (vertical) wells (see figure 2) (Energy Information Association, 1993). The point at which the drilling begins to turn horizontally is called the kickoff point (Energy Information Association, 1993). The drilling then continues horizontally through the formation for up to a mile.



*Figure 2. This image shows the footage of the gas containing shale that can be accessed by each drilling technique. Source: Blue Flame Energy Corporation at [http://www.blueflameenergy.com/ops\\_horizontal-drilling.html](http://www.blueflameenergy.com/ops_horizontal-drilling.html)*

As the well is drilled, metal pipe or casing is inserted into the well. The casing size, as well as the number of casings varies with the depth of the well.

Each casing is cemented into place, which also seals the pipe (see appendix F for casing diagram). When the well bore has been completed to its final length, the rig is removed and the next step of the drilling process can begin.

In order to extract the maximum amount of gas from the Marcellus formation, companies use a technology called hydraulic fracturing (fracing). This method involves the use of two to ten million gallons of water, mixed with chemicals and sand<sup>19</sup>, that will be pumped into the well in order to fracture the shale layers releasing the natural gas held inside (Kargbo, Wilhelm, Campbell, 2010; NADO, 2010). The pipe is perforated and the fracing fluid is pumped under high pressure into the surrounding shale to increase the size and number of fissures.

After the fracturing process is completed the gas flows from the fractures and out of the well. A portion of the fracturing fluid is also returned to the surface. This flowback water can contain natural toxins, heavy metals, and radioactive material, as well as the initial chemicals that were present in the fracturing fluid. This waste water is often stored in water impoundments built on site and held until it can be taken for treatment at approved waste water treatment plants (PA DEP, 2011A).

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<sup>19</sup> Many different chemicals are used in fracing fluid and perform different functions (URS Corp., 2009). A list of chemicals used in this process can be found in appendix A. These chemicals are used to change the properties of the natural gas to make it easier to recover. The sand functions as a type of placeholder to keep the fractures open so that the gas can flow freely.

## **2.4 Environmental and Health & Safety Concerns of Marcellus Drilling**

The Marcellus shale presents a new and unique form of energy that requires the use of techniques that have not previously existed in PA. These new techniques have led to concerns involving the safety of Marcellus drilling operations. These concerns include local infrastructure damage, excessive water usage, water contamination of both wells and rivers, habitat fragmentation, and noise, light, and air pollution issues. Each of these risks will be discussed and the impacts they may have on Pennsylvania's State Parks will be shown.

### *2.4.1 Local Transportation Infrastructure*

Large amounts of heavy equipment must be moved to the drilling site to begin the drilling process, and during the drilling process, truckloads of water travel to and from the well site. This heavy equipment is often more than what the local roads were built to handle and may cause road damage (NADO, 2010). This could present an issue for State Parks as many of its roads are not fit to hold the massive weight of Marcellus equipment. Many local governments have expressed concerns over diminished road surface quality citing the danger of damaged roads (Wilber, 2010). In addition to road damage, increased traffic due to the hauling of equipment could place Park visitors at risk. Many of the roads are small and do not allow much room for two normal vehicles to pass one another. When oversized trucks are added to this mix, it may create a dangerous situation.

The Pennsylvania Department of Transportation has been attempting to correct issues related to equipment transportation for Marcellus wells. In order for drilling companies to be allowed to exceed the weight limit, they must post bond on the road. The bond is then used to help municipalities repair damaged roads (NADO, 2010). Although this funds road repairs for municipalities, roads are often left unrepaired until drilling operations are completed. This leaves dangerous driving conditions that can persist even after hauling operations are completed.

#### *2.4.2 Excessive Water Usage*

The water needed for the hydraulic fracturing process is taken from local rivers, streams, and municipal sources, and is sometimes trucked onto the well pad where it is stored until it is needed (Soeder & Kappel, 2009)<sup>20</sup>. Smaller creeks and streams may not be able to accommodate these large withdraws of water, and the flora and fauna of these ecosystems may be at risk (Kargbo, Wilhelm, Campbell, 2010). The large water withdraws could also cause problems during times of drought, during low flow seasons, or in areas that are already water stressed (Kargbo, Wilhelm, Campbell, 2010).

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<sup>20</sup> Water withdrawal permits need to be acquired by the DEP prior to withdrawing water. The requested location of the point of withdrawal and the water source must be provided by the operator and approved by the DEP.

These large water withdrawals could impact the ecosystems of PA State Park's many lakes<sup>21</sup>. Of the 117 State Parks in PA, 56 of them have recreational lakes (History, 2010). Large water withdrawals from smaller lakes could cause temperature shifts leading to fish kills. Increased occurrences of fish kills could affect the Parks visitation rates, as well as the recreational experience that PA State Parks pride themselves on. Water withdrawal is not the only water related concern. Chemicals added to the hydraulic fracturing fluid prior to the fracing process, as well as naturally occurring toxins<sup>22</sup> within the shale formation are also worrisome.

#### *2.4.3 Water Contamination*

Although chemical additives commonly account for about 0.5% of fracing fluid, the large quantity of water used implies that there may still be 15,000-50,000 gallons of chemicals used (Soeder &Kappel, 2009). The chemicals added to fracing fluid include acids, biocides, and surfactants intended to aid the flow of natural gas by increasing the size of the fissures. These chemicals also alter the viscosity of the gas, and eliminate bacteria that may produce bi-products that would contaminate the natural gas (Kargbo, Wilhelm, Campbell, 2010; Soeder & Kappel, 2009). Although the exact combinations used by each drilling company

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<sup>21</sup> Currently the DCNR is not allowed to sell, transport, or supply water from these lakes, but legislation change could make these transactions possible (Interview, 2011).

<sup>22</sup> Naturally occurring toxins include arsenic, chromium, barium, and mercury, as well as naturally occurring radioactive materials (Kargbo, Wilhelm & Campbell, 2010; URS Corp., 2009). These toxic materials are brought up during the drilling process. Natural salts are also brought to the surface carried by the fracing fluid that can damage water and vegetation if released into the environment (Shallenberger, 2009).

are considered proprietary and are not public information, most companies use some combination of the chemicals listed by the Pennsylvania DEP<sup>23</sup> (Soeder & Kappel, 2009).

These chemicals could have negative environmental and health affects if they were to enter water supplies. According to the Endocrine Disruption Exchange (2009), “94% of fracking chemicals analyzed can cause skin, eye and respiratory harm, 93% can harm the gastrointestinal system and 83% have brain and nervous system effects.” Over 20% of the chemicals that could be analyzed are known endocrine disruptors (PA Land Trust Association, 2010). These chemicals could be released due to blowouts, accidental spills, improper well casing, or improper impoundment of waste water. Between January 1<sup>st</sup>, 2008 and August 20<sup>th</sup>, 2010, a total of 1,614 violations were issued to Marcellus drillers by the PA Department of Environmental Protection, 600 of which related to these exact worries (PA Land Trust Association, 2010). Nearly 35% of these violations were levied against only five companies<sup>24</sup> (PA Land Trust Association, 2010).

Cabot Oil & Gas Corp. is among those on the list and amassed an average of 1.2 violations per well. This corporation has also just settled a lengthy legal battle in Dimock, Pennsylvania where they were blamed for drilling operations that supposedly contaminated of 18 drinking water wells with methane (Federman, 2010; Campbell, 2011). The legal battle was prompted by the

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<sup>23</sup> The Department of Environmental Protection’s list of chemicals can be found in appendix B.

<sup>24</sup> A list of these companies and the number of violations can be found in appendix C.

explosion of a drinking water well in January 2009<sup>25</sup>. Cabot Oil & Gas also received a \$56,650 fine for fracturing fluid spills amounting to more than 8,000 gallons, and causing a fish die-off in a nearby creek. The PADEP fined Cabot an additional \$120,000 relating to the water well contaminations and ordered them to provide temporary water supplies for the families utilizing the affected drinking water wells (Federman, 2010). These occurrences have led the Environmental Protection Agency to consider Dimock as a case study location for the possible effects of Marcellus drilling (Campbell, 2011).

In addition to accidental spills and contamination due to improper well construction, there are also issues with storage and disposal of returned fracturing fluid. After the hydraulic fracturing process is completed, a percentage of the fracturing fluid returns to the surface. This “flowback” can contain dissolved solids, metals, sulfides, radioactive materials such as radium-226, as well as the initial chemicals present in the fluid (Kargbo, Wilhelm, Campbell, 2010; Renner, 2008; Soeder & Kappel, 2009). The waste water can be stored onsite in waste water impoundments to be reused during later fracturing, trucked away to treatment plants, or left to evaporate which leaves the dissolved solids behind to be handled as dry waste (Kargbo, Wilhelm, Campbell, 2010). The failure of these impoundments due to either human error or natural events could damage surface

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<sup>25</sup> Cabot’s drilling was accused of releasing methane into two drinking water wells, leading to explosions at the wellheads. The explosions were thought to be caused by sparks from the pumps used to draw well water from the ground. In addition, others joined the lawsuit claiming water contamination from heavy metals and a total of 8,000 gallons of fracturing fluid spills in the area. (Lustgarten, 2009).

and ground water resources<sup>26</sup>. In the PA State Park system, these events could damage sensitive habitat within the Parks and could keep DCNR from following its departmental mandate to protect Parks clean water, clean air, recreation, and habitat for current and future generations (Issues Threats and Oppurtunities, n.d.). Accidental spills are not the only concern associated with wastewater, as the different chemicals contained in the flowback can make treatment of Marcellus waste water difficult.

Even though the DEP must approve waste water treatment plants before they can accept flowback from Marcellus wells, the water is sometimes inadequately treated (Kargbo, Wilhelm, Campbell, 2010; Colleran, 2010). The Monongahela River in Pittsburgh has experienced this issue as total dissolved solids as well as salt levels reached extremely high levels in 2008 (Vergano, 2010). These high levels were thought to be due to improper waste water treatment of drilling wastewater (Kargbo, Wilhelm, Campbell, 2010). Wastewater releases due to accidents or improper drill site management could affect the natural environment contained within State Park boundaries, but wastewater is not the only issue of concern for State Parks.

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<sup>26</sup> Although a large accident has not occurred, there have been complaints and settlements throughout PA in regards to odors and spills at impoundment sites (Legere, 2010 A). Failure of waste impoundments do happen as was seen in 2008 with the failure and subsequent flooding of a coal ash impoundment at the Kingston Fossil Plant in Tennessee.

#### *2.4.4 Habitat Alterations*

The average land disturbance for a vertical Marcellus well is anywhere from three to five acres while multidirectional horizontal drilling pads may utilize 15 acres of land (BRSC, n.d.). These earth disturbances as well as those associated with the construction of access roads can cause fragmentation, loss of important wildlife habitat, may alter the composition of plant and animal species over time, and may also create opportunities for invasive species (Issues Threats and Opportunities, n.d.; Managing the Impacts, 2010). Although Pennsylvania assesses sites for rare and endangered species prior to issuing a drilling permit, declining migratory bird species' habitats may still be affected (Issues Threats and Opportunities, n.d.). These effects can complicate DCNR's ability to properly manage its forests and wildlife (Managing the Impacts, 2010).

#### *2.4.5 Light, Noise, and Air Pollution*

In addition to the effects Marcellus drilling may have on water and animal habitats, it also creates light, noise, and air pollution. Marcellus drilling rigs are well lit and often operate 24 hours a day (NADO, 2010). Light and noise pollution may affect wildlife cycles and could also take away from people's enjoyment of nature. Noise pollution may be caused by equipment such as bulldozers, heavy trucks, and the drilling process. Noise can also be produced by flaring and

pressure releases. Some studies show that well sites can be as loud as 100 decibels and can be heard from up to three miles away<sup>27</sup>(NADO, 2010).

Air pollution is also a concern. Flaring and other operations associated with the drilling process can cause decreased air quality in the vicinity of Marcellus wells. As an example, a study conducted in Dish, Texas, found that air quality had decreased in the vicinity of a gas field containing 11 natural gas wells (NADO, 2010). The study found elevated levels of carcinogens and neurotoxins, including benzene, in the vicinity of this gas field (Burnett, 2009). Many residents in the area attribute respiratory difficulties and health issues with the drilling activities (Burnett, 2009).

## **2.5 Violations and Enforcements**

The PA Department of Environmental Protection (PADEP), and other departments address health and safety concerns through issuing permits pertaining to drilling operations to drilling companies. These permits cover operating procedures including erosion and sedimentation control, water withdrawal, and wastewater disposal. In addition, the PA Department of Transportation issues permits to operators hauling overweight equipment, referring to equipment that is over the stated road weight limit. By failing to meet the guidelines laid out during

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<sup>27</sup> According to the National Center for Chronic Disease Prevention and Health Promotion, “Noise-induced hearing loss can result from a one-time exposure to a very loud sound (at or above 120 dBA), blast, impulse, or by listening to loud sounds (at or above 85 dBA) over an extended period.”

the permitting phase, companies may be subjected to fines levied by these departments.

Between 1/1/2008 and 8/20/2010 Marcellus drillers received 1,614 violations<sup>28</sup> (PA Land Trust, 2010). From 1/1/2008 to 1/31/2011 the total number of violations was 2,665 (PA DEP, 2011B). These violations were accrued from 3,123 inspections, which is a rate of 0.85 violations per inspection. Of these 2,665 violations, enforcement action was taken on 620 (PA DEP, 2011B). This shows an enforcement rate of about 23%. Over the same period of time, 5,383 violations were recorded for non-Marcellus oil and gas wells from 3,221 inspections (1.7 violations per inspection) (PA DEP, 2011B). Of these, 1,465 enforcement actions were taken displaying an enforcement rate of about 28%. These figures express a lack of enforcement on the part of the DEP, but these are not the only violations that Marcellus drillers experienced during this time frame.

On three separate three-day operations, the DEP in conjunction with the PA State Police, inspected 3,447 trucks, mostly associated with hauling wastewater for Marcellus operations. Of these inspections, 2,685 citations were issued, and 665 trucks were taken out of service (PA DEP, 2010 (A, C, D))<sup>29</sup>. In addition, 161 drivers were taken out of service (PA DEP, 2010 (A, C, D)). The

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<sup>28</sup> The four most common activities warranting violations were discharge of industrial waste (155), improper construction of wastewater impoundments (162), faulty pollution prevention (212), and improper development or implementation of erosion & sediment plans (299) (PA Land Trust, 2010).

<sup>29</sup> Trucks were taken out of service for faulty brakes, exterior lighting issues, improper hauling permits, and other violations relating to safety.

truck out-of-service rate for Marcellus haulers is about 40% which is well above the national average for all trucking operations at 23%-30% (PA DEP, 2010 (B)).

## **2.6 Rewards from Marcellus Drilling**

Although the risks may seem to be overwhelming, there are many possible advantages that may come from this new interest in the Marcellus play. The two main advantages to Marcellus drilling are employment and tax revenue.

Employment in core oil and gas industries grew 11% in PA from 2008 to 2010 (Pennsylvania Workforce Development, 2010), which represents an increase of the workforce in the industries directly related to oil and gas extraction of about 1,100 new employees. This increase in the oil and gas sector is made all the more impressive considering 186,000 jobs were lost across all of PA during this same timeframe representing a decrease of about 3.2% (Pennsylvania Workforce Development, 2010).

Jobs in the core oil and gas industry are expected to continue growing, while at the same time, ancillary and supply chain industries<sup>30</sup> are expecting job growth as well. The Center for Workforce Information and Analysis identifies 21 ancillary and supply chain industries related to Marcellus drilling (Pennsylvania Workforce Development, 2010). From July, 2009 to July, 2010, the number of job postings online for ancillary and supply chain industries grew 27.7% from 1,321

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<sup>30</sup> Ancillary and supply chain industries are those industries that, although are not directly related to Marcellus drilling, provide supplies or services to Marcellus operations. A full list of the ancillary and supply chain industries can be found in appendix D.

to 1,687. This shows an increase in demand for laborers in these industries (Pennsylvania Workforce Development, 2010).

The issues expressed above make the risks and rewards of Marcellus drilling apparent. These issues are seen in every state where oil and gas drilling occurs, whether the drilling is focused on the Marcellus formation, Barnett shale, or any other gas containing formation. The issues are addressed by each state using laws and regulations and these laws and regulations vary by state. While the laws and regulations are important, public knowledge is also important.

## **2.7 Media Analysis**

Using LexisNexis Academic, I completed 12 searches for news on drilling in state parks looking at news from the last five years. Searches were restricted to news media that are distributed in Pennsylvania, and used three different search terms; “Marcellus,” “drilling,” and “gas,” that would be contained in the headline of the publication. The results indicate a lack of media coverage on Marcellus drilling in state parks.

Table 1 shows the results of a search for newspaper articles that contain information about drilling operations in Pennsylvania’s state parks. The first three rows show the results of searches using Marcellus, drilling, and gas in the headline and searching for state parks anywhere in the article.

*Table 1. Newspaper articles showing recent news on drilling in state parks. The “headline” column refers to the keyword that was searched, restricting it to the headline of the news article. “Anywhere” refers to searching for the keyword anywhere in the document. “Articles” refers to the number of articles that were returned after searching using the keywords in the columns before, and “Papers” shows the number of different newspapers where the articles were found. An “X” in the anywhere column denotes that state parks was searched for in the headline and not anywhere in the document. The data was collected and counted using search results from LexisNexis Academic.*

<b>Headline</b>	<b>Anywhere</b>	<b>Articles</b>	<b>Papers</b>
Marcellus	State Parks	59	13
Drilling	State Parks	73	16
Gas	State Parks	169	27
Marcellus/ SP'S	X	21	6
Drilling/ SP'S	X	26	9
Gas/ SP'S	X	49	10

When searching for these, gas in the headline returned the most results at 169 articles in 27 newspapers. Although these results may seem sufficient, on closer inspection, the majority of the articles merely mentioned state parks, and parks were not the main focus of the article.

In the next three rows, “state parks” was moved to the headline section along with Marcellus, drilling, and gas. There is a substantial drop in the number of articles returned. Gas and state parks was again the largest returning category with 49 articles from 10 newspapers. Then the search was expanded to cover all news (news transcripts, blogs, press releases and newswires) (Table 2).

*Table 2. News on Marcellus drilling in state parks in PA. The “headline” column refers to the keyword that was searched, restricting it to the headline of the news article. “Anywhere” refers to searching for the keyword anywhere in the document. An “X” in the anywhere column denotes that state parks was searched for in the headline and not anywhere in the document. “All news” refers to the number of news reports including blogs, newswires, transcripts, and newspapers. “Publications” refers to the number of publications the results were contained in. The data was collected and counted using search results from LexisNexis Academic.*

<b>Headline</b>	<b>Anywhere</b>	<b>All News</b>	<b>Publications</b>
Marcellus	State Parks	99	29
Drilling	State Parks	143	32
Gas	State Parks	298	58
Marcellus/ SP'S	X	28	9
Drilling/ SP'S	X	53	19
Gas/ SP'S	X	81	20

Although the number of articles increased when expanding the search to all news sources, the coverage of Marcellus operations in state parks is still lacking. These articles much like those located in Table 1, mostly mention state parks in passing, and do not touch on the core issues and reasons behind drilling on state park property. This media analysis shows that the public does not have a sufficient resource to gain adequate information concerning drilling in state parks.

Once these initial searches were completed, I decided to search for Marcellus, drilling, and gas without state parks attached. In each instance, all news and newspapers only, and for Marcellus, drilling, and gas in the headline, each search returned with more than 3,000 results. This points out that, although there is a sufficient amount of information on drilling in general, there is a gap in information pertaining to state parks.

In addition to the lack of articles concerning Marcellus drilling in state parks, there is also a lack of information within the articles. Although the articles mention that parks have little legal protection due to the separation of surface and mineral rights, and that this is thought to be due to the manner in which the land was acquired, there is no explanation of what this lack of protection entails. None of the articles cover the actual laws, or the history of the laws that affect the parks or what can be done to correct them. The articles usually mention that parks may be at risk of drilling because of the lack of fee simple ownership, but there needs to be more in-depth coverage of the issues.

### **3.0 Laws Regulating Oil and Gas Drilling**

This section will cover the laws that govern oil and gas drilling in Pennsylvania, Ohio, West Virginia, and Wyoming, and will specifically cover mineral rights leasing, royalties, split estate rights and protection, and remediation requirements. By exploring the manner in which these issues are dealt with in different states, I will show which laws are best suited to protect state Parks in PA. These laws will be instrumental in determining how Pennsylvania can update current laws to better address the issues facing state Parks.

#### **3.1 Pennsylvania Law**

Following the completion of the first oil well drilled in PA in 1859, the state laid the framework for oil and gas law for the entire nation (Bibikos & King, 2009). A brief summary of PA's oil and gas law will show the strong and weak points of the legal framework of Pennsylvania. Leasing, surface owner and subsurface owner rights, and general well placement and remediation laws are three important components of gas and oil operations.

##### *3.1.1 Mineral Rights Leasing in PA*

Leasing is the first step in natural gas extraction. As reported by Weidner (2008), gas companies must obtain a lease of subsurface rights in order to commence drilling operations. The gas companies must also acquire enough land to commence horizontal drilling operations, as it is illegal to drill under property

where the subsurface rights are not leased to the company (Weidner, 2008). Gas companies often lease land to form a unit<sup>31</sup>, which is a combination of different properties that share common boundaries (Weidner, 2008). The formation of units gives the gas companies the acreage they need to drill efficiently. Each property in the unit may have a different lease agreement. The lessor determines the length of the lease, as well as the amount per acre that will be paid for leasing the land<sup>32</sup>. A delay rental payment may also be included in the lease agreement where the lessee will provide an annual payment for the leased land until a well is drilled. Although there is no going rate for rental payments, payments can range from \$10 to over \$10,000 per acre (Weidner, 2008; NADO, 2010). These rental payments are paid to the lessor and are above and beyond the royalties that are mandated by law (Weidner, 2008).

### *3.1.2 Gas Royalties in PA*

Legally, gas companies must pay a minimum royalty of 12.5% of the value of oil or gas produced (PA Ch.58 P.S. §33 and §34). When drawing from a unit, the 12.5% royalty is split between the different lessors based on the acreage of each property (Weidner, 2008). While drafting the lease agreement, landowners can negotiate royalties higher than the 12.5% minimum. DCNR, for example, requires at least 18% royalties before leasing state forest land for drilling (DCNR Bureau

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<sup>31</sup> This process is called pooling, and is used by oil and gas companies to consolidate leases so that multiple properties can be accessed from the same well pad (Xander, 2009).

<sup>32</sup> This is called a rental payment, it is a onetime payment per acre to lease the land (Xander, 2009).

of Forestry, 2010). These royalties are paid only to the owner of the subsurface rights.

### *3.1.3 Split Estate Rights and Protection in PA*

In Pennsylvania subsurface (mineral) and surface rights can be two separate entities. If the surface is owned without the mineral rights, the surface owner has very little protection from drilling operations. The gas company would enter a lease with the mineral rights owner, and the mineral rights owner would reap the benefits of royalties and lease payments. Surface owners must allow mineral rights owners to extract their minerals, even if extraction involves “altering, or temporarily occupying parts of the real estate” (Swarthmore College Environmental Studies, 2010; *Belden Blake v. DCNR*, 2009). This puts PA State Parks at risk since the majority of its property is not owned fee simple.

This idea that the mineral rights owners have the right to access their claim began during the coal era in Pennsylvania in the 1800’s. In 1854 the Supreme Court of Pennsylvania ruled in *Turner v. Reynolds*, 23 Pa. 199, 206 that “One who has the exclusive right to mine coal upon a tract of land has the right of possession even as against the owner of the soil, so far as it is necessary to carry on mining operations.” This early ruling is echoed in 1893 when the court ruled in *Chartiers Block Coal Co. v. Mellon*, 25 A. 597 that “owning mineral rights provides that owner with the right to occupy as much of the surface estate as might be necessary, exercising this right with due regard to the surface estate

owner.” These early rulings have not only stood the test of time, but have also been imposed on oil and gas drilling, and have been cited in oil and gas rulings as recently as 2006 (*Belden Blake v. DCNR*, 2009).

#### *3.1.4 Remediation in PA*

Even though the Parks may not have the explicit ability to negotiate lease agreements, due to their lack of subsurface ownership, there are some laws in place to protect water supplies, historical sites, and land use. The Oil and Gas Act of 1985 provides minimum requirements that gas and oil companies must follow in regards to well placement, well site reclamation, and water supply protection. According to the law wells may not be drilled within 200 feet of an existing building, 100 feet from any stream, or 100 feet from any wetland greater than one acre in size (§601.205 (a, b)). In addition to these regulations, the DEP shall “consider the impact of the proposed well on public resources to include, but not limited to,” Parks, forests, gamelands and wildlife areas, national natural historic landmarks, national or state historic scenic rivers, historical sites, and habitats of rare and endangered species of flora and fauna (§601.205(c)). Although these regulations help protect the most sensitive areas, and help protect PA State Park’s exceptional value areas, not all areas contained in State Parks fall into this category, and the DEP shall “consider the impact,” not prohibit the impact.

In addition to regulating where wells can be placed, the Oil and Gas Act of 1985 also lays out the minimum restoration requirements. The Oil & Gas Act

section 601.206 (a,b) requires that the well site must be restored within nine months after the completion of drilling, but site restoration involves only the removal of equipment, and not the replanting or regarding of the disturbed area.

Although not contained in the Oil and Gas Act itself, restoration of the site and replanting requirements are contained in the “Erosion, Sedimentation and Stormwater Control Plan for Oil and Gas Operations” which is issued by the Department of Environmental Protection Bureau of Oil and Gas Management, and must be completed by operators prior to permitting (PA DEP, 2009). This document requires oil and gas operators to follow best management practices. If the disturbed land is within a special protection watershed the remediation plan must show that “all construction and post construction discharges will not degrade the physical, chemical or biological characteristics of the surface waters.” In addition to the above requirements it also stipulates that the permanent erosion protection must involve a minimum of 70% vegetative cover of perennial vegetation over the entire disturbed area (PA DEP, 2009). The document recommends cool or warm season grasses to perform this function, and gives no consideration to the prior flora (PA DEP, 2009).

The legal framework in which gas and oil extraction has evolved in PA tends to favor mineral extraction over environmental protection. This places State Parks in a particularly difficult position as it does not own the rights to the subsurface, and therefore does not have legal say in drilling operations, as long as gas companies follow the laws regulating drilling operations mentioned above.

### **3.2 West Virginia Oil and Gas Law**

Oil and gas extraction in West Virginia (WV) has been occurring as long as, if not longer than in Pennsylvania. In the early 1800's, oil was inadvertently struck by salt miners operating in the Kanawha Valley in western West Virginia (West Virginia Geological and Economic Survey, 2004). At this time the oil was seen as a nuisance and was often dumped into local rivers. The uses and value of oil and gas were not realized until years later when drillers began using the petroleum to power lamps for workshops and factories (WVGES, 2004). By 1906 WV was the leader in the United States in oil and gas production (WVGES, 2004).

#### *3.2.1 Mineral Rights Leasing in WV*

Leasing in West Virginia is much like that of Pennsylvania. A delayed rental payment is often offered which supplies the mineral rights lessor a payment, often per acre, for every year of the lease until the well is drilled and royalties begin. In addition or in lieu of the first years delayed rental payment, companies may incorporate a bonus payment (Xander, 2009). A bonus payment is a one-time payment that is also often on a per acre basis (Xander, 2009). As of 2009, these lease payments have been as high as \$1,000 per acre, but may reach levels seen in Pennsylvania (Xander, 2009).

Land that is leased by a drilling operator is often pooled to form a unit. Unlike PA, the Oil and Gas Conservation Commission<sup>33</sup> can force pooling when disputes arise between lessors and lessees, and can even force pooling of lands not covered under lease with the operator (Xander, 2009). The OGCC also regulates the drilling of deep wells, approves drilling permits, determines the optimum spacing of wells, pools the interests of royalty owners and operators of a drilling unit. The OGCC aims to foster, encourage and promote exploration for oil and gas resources, prohibit waste of oil and gas resources, encourage the maximum recovery of oil and gas, and protect and enforce the correlative rights of operators and royalty owners in a pool of oil or gas to assure and equitable share of production (The State of West Virginia, 2010). The act of forced pooling creates the environment necessary to most efficiently recover gas while minimizing surface impacts that may occur from additional drilling if forced pooling was not practiced<sup>34</sup> (Legere, 2010). In addition, forced pooling keeps landowners from stalling drilling operations<sup>35</sup> (Legere, 2010).

### *3.2.2 Gas Royalties in WV*

Unlike Pennsylvania, West Virginia does not have a minimum royalty mandated by law. However, historically royalties have been 12.5% which is the same as the

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<sup>33</sup> The OGCC functions much like the PA DEP as they are the regulatory agency for oil and gas drilling in WV.

<sup>34</sup> Surface impacts can be reduced when a property owner between two leased lands is forced to pool. One horizontal well can then be drilled across the three properties and access the gas that may have taken two wells otherwise.

<sup>35</sup> Forced pooling legislation is being discussed in Pennsylvania although it has not yet passed (Legere, 2010).

minimum royalty in Pennsylvania (Xander, 2009). The main difference between PA and WV in regards to royalties is that WV has a severance tax<sup>36</sup> (unlike PA), and gas operators can deduct severance taxes and other fees prior to paying royalties. This means that higher royalties may not equal higher payments, if taxes and fees are deducted prior to payment. These issues are worked out in the lease agreement (Xander, 2009). As is the case with PA, the royalties are paid to lessor of the subsurface (Xander, 2009).

### *3.2.3 Split Estate Rights and Protection in WV*

Surface and subsurface rights can be separated in West Virginia much like in Pennsylvania. In WV however, surface owners receive more protection when the subsurface is not owned. West Virginia Code §22-7-3 states that surface owners are entitled to compensation for:

“(1) Lost income or expenses incurred as a result of being unable to dedicate land actually occupied by the driller's operation or to which access is prevented by such drilling operation to the uses to which it was dedicated prior to commencement of the activity for which a permit was obtained measured from the date the operator enters upon the land until the date reclamation is completed, (2) the market value of crops destroyed, damaged or prevented from reaching market, (3) any damage to a water supply in use prior to the commencement of the permitted activity, (4) the cost of repair of personal property up to the value of replacement by personal property of like age, wear and quality, and (5) the diminution in value, if any, of the surface lands and other property after completion of the surface disturbance done pursuant to the

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<sup>36</sup> A severance tax is a tax placed on the extraction of a natural resource (§11-13A-2 West Virginia Code). The current severance tax rate for natural gas in WV is 5% of the total market value of gas extracted (§11-13A-5a(a) WV Code).

activity for which the permit was issued determined according to the actual use made thereof by the surface owner immediately prior to the commencement of the permitted activity.”

This language expressly shows West Virginia’s concern over the rights of the surface owners. In §22-7-1 of the West Virginia Code, the Legislature explains that these provisions are necessary because surface rights may have been severed at a time preceding current drilling technologies, so that a landowner may have separated the subsurface from the surface without knowing the extent of land use that is now common.

#### *3.2.4 Remediation in WV*

Not unlike Pennsylvania, West Virginia requires operators to submit a sedimentation and erosion plan in conjunction with their application for a well permit. The plan details how the operator intends to minimize erosion and sedimentation, and also contains the operator’s remediation plan (§22-6-6(d) WV Code).

The remediation guidelines are spelled out within the WV legislative code (§22-6-30). This is unlike Pennsylvania, in that PA relies on the Erosion, Sedimentation and Stormwater Control Plan for Oil and Gas Operations to spell out remediation requirements, which is a DEP document, and not law. In the WV Code §22-6-30, within six months after the completion of the well, the site must be graded or terraced, and seeded or sodded in order to prevent substantial erosion

and sedimentation<sup>37</sup>. In addition to these requirements, operators are encouraged to consider the needs of wildlife, which is not mentioned in the PA document (West Virginia Division of Environmental Protection, 1993). The Department of Natural Resources and the Department of Energy document, *Managing Gas and Oil Well Sites for Wildlife* (1986), shows different planting methods that should be considered depending on the natural environment disrupted during drilling. The guide gives examples of plant species that provide food and shelter for wildlife, and what types of ecosystem each scheme can be incorporated into (WV DNR & DOE, 1986).

### **3.3 Ohio Oil and Gas Law**

Ohio's history of oil and gas extraction is as extensive as that in Pennsylvania. The first commercial well was drilled in Ohio in 1860 (Ohio Department of Natural Resources, n.d.C). Although one might not think of Ohio as an oil and gas intensive state, it should be noted that it is ranked fourth in the United States in terms of the number of oil and gas wells<sup>38</sup>. Despite this, Bibikos and King (2009) assert that Ohio oil and gas law is largely undeveloped compared to West Virginia and Pennsylvania.

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<sup>37</sup> Like Pennsylvania, more detail can be found in a manual separate from the law. In West Virginia specifications for erosion and sedimentation control and remediation can be found in the *West Virginia erosion and sediment control field manual* (West Virginia Division of Environmental Protection, 1993).

<sup>38</sup> Ohio ranked fourth behind Texas, Oklahoma, and Pennsylvania and has drilled 274,733 wells since 1860 (OH DNR, n.d.C).

### *3.3.1 Mineral Rights Leasing in OH*

Mineral rights leasing in Ohio is conducted in the same manner as West Virginia and Pennsylvania. Subsurface owners are contacted by a landman<sup>39</sup> or an oil and gas company. The lease is then negotiated to determine bonus and delay rental amounts and also royalty payments. It is also common practice in Ohio that the landowner where the well is located receives free gas (Ohio Department of Natural Resources, n.d.B). Ohio also practices mandatory pooling<sup>40</sup> much like West Virginia (OH DNR, n.d.A).

### *3.3.2 Gas Royalties in OH*

Royalties in Ohio are commonly 12.5% (OH DNR, n.d.B), although there is no law specifying a minimum royalty payment. Royalty payments are divided among the subsurface owners in each unit based on the amount of land each owns (OH DNR, n.d.B). As with West Virginia, Ohio has a severance tax that may affect the amount of royalties that may be paid. Unlike West Virginia, Ohio's severance tax is based on a per unit basis. The severance tax in Ohio is 2.5 cents per thousand cubic feet of natural gas (Chapter 5749.02 OH Code).

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<sup>39</sup> A landman is an often independent lessor who leases subsurface rights and then transfers the leases to oil and gas companies for a profit (Ohio Department of Natural Resources, n.d.B)

<sup>40</sup> Historically only 2% of drilling operations have requested mandatory pooling (Ohio Department of Natural Resources, n.d.A).

### *3.3.3 Split Estate Rights and Protection in OH*

In the case of mineral severance, the mineral rights owner has precedent over the surface owner (OH DNR, n.d.A). Surface owners are not involved in the leasing process. Ohio law does have some regulations, like Pennsylvania, that can protect surface owners' property. Ohio Administrative Code, chapter 1501: 9-1-05 *Safety*, regulates that wells may not be placed within 100 feet of a house or public structure (school, store, etc.), within 50 feet of a road, or within 50 feet of railroad tracks. These laws lend some protection to surface rights owners.

### *3.3.4 Remediation in OH*

Ohio retains two different sets of requirements for remediation. One set of rules is intended for urban drilling operations<sup>41</sup> and the other for non-urban operations. Operations that are carried out in an urbanized area are required to remove equipment, grade or terrace, and plant or sod disturbed land within three months of the start of drilling operations. In all other areas, the operators receive six months to complete the same tasks. In addition, those same time frames are used to remediate sites after final plugging of the wells. Neither Pennsylvania, nor West Virginia has separate regulations regarding the location of wells in urban or non-urban areas.

Ohio also has a document that is to be used by oil and gas operators in order to choose the correct remediation action. The document gives

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<sup>41</sup> Urban operations are classified as those that fall within a municipal corporation (borough) or township with a population of more than 5000 people (Chapter 1509.01 OH Code).

recommendations of different seed mixtures for use in different parts of Ohio (OH DNR, 2005). The document also briefly mentions the idea of replanting disturbed areas with wildlife in mind, and gives contact information for the Ohio Department of Forestry where companies may be eligible to receive tree packets at low cost (OH DNR, 2005). Helping companies realize the importance of remediating for wildlife and the habitats that may be altered by drilling, as well as giving companies sources to utilize, is a progressive step towards proper remediation.

### **3.4 Wyoming Oil and Gas Law**

Wyoming entered the oil and gas arena in 1885, with the drilling of the State's first oil well (Roberts, n.d.). In these early years oil was used as a lubricant in wagon and train axels. Kerosene, an oil byproduct also became an important substitute for whale oil in lighting applications (Roberts, n.d.). As oil production dwindled, natural gas exploration increased. In 2009, 1,713 natural gas wells were drilled (Petroleum Association of Wyoming, 2009). Wyoming was ranked second in the nation for natural gas production in 2009 producing 2.5 TCF of natural gas (PAW, 2009).

#### *3.4.1 Mineral Rights Leasing in WY*

After searches of the Wyoming Department of Environmental Quality, Wyoming Oil and Gas Conservation Commission, the University of Wyoming, Wyoming

Office of State Lands and Investments, and various online mineral rights forums in Wyoming, reliable data relating to the likely amounts a private mineral rights owner could expect in per acre lease fees could not be located. The state leasing of lands through the Bureau of Land Management did give some values however. In 2009, a bimonthly oil and gas lease auction returned lease rates ranging from \$2.00-\$240.00 per acre<sup>42</sup> (Bureau of Land Management, 2009). During the auction the State offered nearly 43,000 acres of land for lease (BLM, 2009).

### *3.4.2 Gas Royalties in WY*

Gas royalties in Wyoming serve the same function as the states previously mentioned, and are meant to give the owner of the subsurface a share of the value of their minerals (Montana Department of Natural Resources and Conservation, 2005). There is no state minimum on royalty payments as there is in Pennsylvania; Wyoming instead follows WV and OH relying on historical precedent leading to average royalty rates of 1/8<sup>th</sup>, or 12.5%. Wyoming initially auctions state land at a 1/6<sup>th</sup> royalty rate. If the land is not receiving bids, the rate is lowered to a 1/8<sup>th</sup> royalty rate, although the majority of the land offered is leased at the 1/6<sup>th</sup> royalty rate<sup>43</sup> (MT DNRC, 2005).

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<sup>42</sup> \$2.00 is the federally mandated minimum for leasing (BLM, 2009).

<sup>43</sup> Four auctions conducted in 2005 showed a 96% lease rate at a 1/6<sup>th</sup> royalty rate which represented 576 leases (MT DNRC, 2005).

### 3.4.3 *Split Estate Rights and Protection in WY*

Wyoming, unlike the other states mentioned above, has a progressive split estates law. Wyoming Statute 30-5-402:

“...the oil and gas operator and the surface owner shall attempt good faith negotiations to reach a surface use agreement for the protection of the surface resources, reclamation activities, timely completion of reclamation of the disturbed areas and payment for damages caused by the oil and gas operations.”

This statute gives surface owners bargaining power with the oil and gas companies in regards to the use of their land. In addition to the right to negotiate a surface agreement, the Wyoming Title 30 Statute also requires oil and gas operators to compensate surface owners for damage caused to the land. Wyoming Statute 30-5-405 further protects surface owners' rights to compensation by stipulating that the right to receive compensation for surface damages cannot be separated from the land surface<sup>44</sup>.

### 3.4.4 *Remediation in WY*

The definition of reclamation<sup>45</sup> in W.S. 30-5-401 is: “...the restoring of the surface directly affected by oil and gas operations, as closely as reasonably practicable, to the condition that existed prior to oil and gas operations, or as otherwise agreed to in writing by the oil and gas operator and the surface owner.”

This strong definition inherently implies that remediation should consider the state of the local environment prior to land disturbances due to drilling. In

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<sup>44</sup> A landowner cannot sign away their right to compensation.

<sup>45</sup> Remediation and reclamation can be used interchangeably.

addition, the surface owner agreement would allow the surface owner the ability to negotiate remediation.

### **3.5 Gas and Oil Law Summary**

After examining the laws and regulations of the different states, it is clear that there is a range of regulations. Some state's regulations can be seen as more protective than others. The point of summarizing the laws from different states is to show what types of laws may be applicable to PA, and which of these laws if introduced would help protect State Parks.

## **4.0 Methodology and Results**

The methods section will describe what types of information were used, and how the information was obtained for the analysis. I will also discuss issues associated with the collection of legal data for the different states, as well as how the interviews were performed.

The results will include a best case scenario for the reform of Pennsylvania's legal code using examples of oil and gas law from OH, WV, and WY based on how well the laws for remediation, split estates, leasing, and royalties address Park managers concerns over drilling. In addition, other DCNR solutions as mentioned by the managers will be examined for their effectiveness.

### **4.1 Methods for Analysis**

Parks are facing pressures from natural gas companies due to the increasing exploration of the Marcellus shale formation. The current laws associated with gas drilling in Pennsylvania are lacking in their ability to protect surface owners, which leave State Parks in a vulnerable position. Parks must find a way to deal with Marcellus drilling companies in order to minimize the possible negative effects of drilling on the ecological and recreational aspects of the Park environments.

#### *4.1.1 Legal Data Collection Process and Challenges*

The two main types of data used in this analysis are legal data concerning the extraction of natural gas, which were collected from various state sources, and data collected from Park managers through interviews. When collecting legal data different states have oil and gas information on a variety of websites.

Pennsylvania's oil and gas information can be found on the DEP and DCNR websites. These websites link to all relevant documents. Pennsylvania State University and the PA Code websites also contain leasing and remediation information and are connected to the DEP and DCNR websites. The main issue with collecting data came when I was searching for the remediation information. The laws and codes cite one another without giving a description of what was meant by remediation. Only after searching the permitting requirements did I find the document that contained the remediation guide<sup>46</sup>.

West Virginia was a bit more difficult. The oil and gas information I was looking for was contained in three different government websites, the WV DEP, WV GES, and the West Virginia legislature, and the mineral rights leasing information was found on two non-government websites<sup>47</sup>. The government sites were well constructed, although there was less linkage between the different sites. Remediation information was readily available as it was written into the WV code.

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<sup>46</sup> This guide is the sediment and erosion control plan for oil and gas drilling operators. Although the information is needed for permitting, it is not the same as having remediation information written into law.

<sup>47</sup> One site was run by an oil and gas company and the other was a news website.

Ohio's information was all connected to the Ohio DNR website. This made the data collection a bit easier, although navigating the websites was difficult. PA and WV offered full legislative code that was easily navigable, whereas Ohio relied on summery legal information<sup>48</sup>. When I finally found the full legislative code, it was hard to navigate. The mineral rights leasing information was difficult to come by as the state websites did not have any figures on the amounts that were likely to be offered.

Wyoming was the most difficult state to obtain information from. The government websites had no information on the history of oil and gas drilling in the state. The information was obtained from the University of Wyoming and was written by a history professor with a Ph.D. in Environmental History. I could not find any information on government or private websites about the amount one might expect to receive from a lease agreement. Royalty rates for Wyoming were found in a publication authored by the Montana DNRC. The Bureau of Land Management had information on leasing of state lands, but no information for what private landowners could expect. There are also more departments responsible for oil and gas operations in Wyoming including, the Wyoming Oil and Gas Conservation Commission, the BLM, the Wyoming legislature and the Wyoming Department of Environmental Quality. These departments do not seem to work well together as there is no cohesive oil and gas information center.

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<sup>48</sup> I believe this is due to the fact that Senate Bill 165 concerning drilling passed in June of 2010 and the State wants to make this information readily available.

#### *4.1.2 Interview Data Collection Process and Challenges*

In addition to gathering public information on oil and gas operations, I interviewed three PA State Park Regional managers to understand how the DCNR is dealing with Marcellus drilling and how the managers feel about the effects of drilling on State Parks. The interviews were carried out via telephone on February 18 and 25 of 2011. The interviewees were asked a series of questions (appendix E) and their answers were recorded. Following the initial questioning, general dialogue continued and revealed information that the original questions did not cover. This method of data collection revealed itself to be beneficial to my research because the conversation flowed to topics that I had overlooked when generating my questions, and that the managers found important.

Difficulties arose using the interview method during the planning phase and while recording the data. DCNR managers are very busy during the month of February planning programs and maintenance schedules for the upcoming season. This made finding times to conduct the interviews difficult. In addition, the current political climate in Pennsylvania following the election of a new Governor placed the DCNR in a precarious position that made the managers cautious when answering the questions. A new DCNR secretary, Richard Allen, was appointed on March 24<sup>th</sup>, 2011, but there is still little guidance for state park managers on the strategies the Parks will be pursuing in the upcoming years concerning

Marcellus drilling. The managers had to be careful to keep the mission of State Parks in mind when answering the interview questions<sup>49</sup>.

## **4.2 Results**

The results section covers the legal issues surrounding Pennsylvania oil and gas law and highlights the most progressive laws from other states. By looking at these different laws, I hope to show the type of legislative change that would help the DCNR protect its land. The review of the literature focusing on legal strengths and weaknesses helps one see that there are issues with Marcellus drilling, but what do managers in the State Park system think about Marcellus exploration?

First, interviews with DCNR managers answered some important questions concerning drilling on Park property. How do DCNR managers feel about the risks associated with Marcellus, and how are they trying to minimize these drilling risks? What actions are the State Parks taking to minimize drilling impacts on the environment within the Parks, and how effective are these actions? The answers to these questions help show difficulties the DCNR faces concerning Marcellus drilling.

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<sup>49</sup> “The primary purpose of Pennsylvania State Parks is to provide opportunities for enjoying healthful outdoor recreation and serve as outdoor classrooms for environmental education. In meeting these purposes, the conservation of the natural, scenic, aesthetic, and historical values of Parks should be given first consideration. Stewardship responsibilities should be carried out in a way that protects the natural outdoor experience for the enjoyment of current and future generations” (PA DCNR, n.d.).

#### *4.2.1 Interview Results: Parks Stance on Marcellus Drilling*

First, it is important to understand that the DCNR consists of seven different bureaus<sup>50</sup>. Of these, State Parks, and State Forests are the two that are currently facing pressure from Marcellus drilling. State Forests have a history of oil and gas extraction, and actively lease state owned land for gas and oil exploration (Interview, 2011). The money earned from leases on state forest land are placed in the “Oil and gas lease fund,” which is used to acquire new Park and Forest land, maintain the Parks and forestry infrastructure, and contribute to conservation programming within DCNR (Interview, 2011). Although this money is supposed to go to conservation programs, from 2008-2010, \$203 million was transferred from the oil and gas lease fund to balance the state budget (PA Environmental Digest, 2010). The proposed 2010-2011 budget shows an additional \$180 million diversion of oil and gas fund money to balance the State’s general fund. This shows that although DCNR’s focus is on conservation, and that a funding source was created using money gained through drilling operations, the State legislature can and has used this money for purposes other than conservation.

Although the Bureau of Forestry (State Forests) actively leases land, the Bureau of State Parks does not (Interview, 2011). The managers were asked what they thought of drilling on Park land in regards to environmental damage. The managers explained that everything within the Park involving land change is first

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<sup>50</sup> The DCNR consists of the Bureau of State Parks, Forestry, Topographic and Geologic Survey, Recreation and Conservation, Facility Design and Construction, Conservation Science, and Human Resources (PA DCNR, n.d.).

considered environmental damage (Interview, 2011). The reasoning behind this statement is that Parks are charged with protecting their environmental resource for the enjoyment of future generations, and any land change within the Parks may alter the land in ways that are not fully understood at the time. This is not to say that Parks do not allow land changing activities on Park land, only that first they must view the possible negative effects in order to determine the costs and benefits of the proposed land change. The land changes can include the creation of trails, extension of camping operations, and even mowing<sup>51</sup>. These land changes are different from drilling in that the individual Park has the ultimate decision on whether or not the land change occurs. With Marcellus drilling, this decision is not the Bureau of State Parks to make.

Currently only one Park in western Pennsylvania is being drilled for natural gas in the Marcellus shale. Although the drilling has yet to commence, the final details of the drilling operations are being discussed with the drilling company (Interview, 2011). The fact that there have been no Marcellus wells placed on State Park land to date, leaves unanswered questions on the full effects drilling will have. The manager's concerns echo the concerns listed in the literature review above. Worries include noise and air pollution affecting recreational quality in regards to camping and hiking; scenic and aesthetic changes caused by the drilling equipment; water quality concerns and how

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<sup>51</sup> Reducing mowing activities was a management directive over the 2009-2010 season in order to reduce operation costs and improve edge habitat in underutilized areas of the Parks (Interview, 2011).

accidental spills could affect lake ecosystems and fishing; and fragmentation which may affect general wildlife health and decrease hunter satisfaction (Interview, 2011).

The Bureau of State Parks has created tools to help managers deal with oil and gas drilling. The main tool that the State Parks use to combat the negative effects of drilling is coordination agreements. These agreements are voluntary to the oil and gas companies, and outline requests by the Park to be compensated for surface disturbances. The compensation offered in the coordination agreements is placed into the oil and gas fund. The Park managers interviewed would all like to see some of the money obtained through the coordination agreements to remain within the affected Park (Interview, 2011). So far oil and gas companies involved with conventional drilling on State Park land have been willing to work with the Parks. Among issues specific to certain Parks, companies generally pay double stumpage for timber, allow Parks to negotiate well placement and access road construction, and some companies have even given Parks royalties (Interview, 2011). The Park managers feel that oil and gas companies are not bullying the DCNR<sup>52</sup> because the concessions given by the oil and gas companies help build public relations and minimize public resistance. But will extending these coordination agreements to Marcellus drilling be enough?

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<sup>52</sup> The oil and gas companies have been receptive to Parks' recommendations and although the law regarding surface and subsurface rights gives the companies the ability to drill without signing coordination agreements, the agreements have become standard practice for gas and oil drilling on Park land (Belden Blake v. DCNR, 2009; Interview, 2011). There is no guarantee that the industry will be receptive to coordination agreements in Marcellus operations, and the lack of Marcellus operations in parks does not allow conjecture either way.

When asked what the managers would like to see in regards to drilling on parkland, they stated that, although companies have been conscious of the importance of protecting Parks, this sentiment may not last, and a change of legislation could better guarantee protection of Parks surface land (Interview, 2011). A legislative change that would mandate oil and gas companies to obtain surface use agreements would guarantee Parks the ability to “have a seat at the table” during negotiations (Interview, 2011).

These interviews showed that while park managers are concerned with Marcellus drilling operations in state parks, they feel that there is little that they can do given the way that the state government has responded to their concerns. The managers have little freedom to publically speak out against drilling operations without the risk of harming their career. The Bureau of State Parks is at the mercy of the government. What the governor and the legislature decides is what parks eventually have to follow.

#### *4.2.2 Results of Legal Comparisons*

After comparing the legal statutes concerning leasing, royalties, split estates, and remediation of Ohio, West Virginia, Wyoming, and Pennsylvania, Pennsylvania’s laws are generally weaker. The following paragraphs will look at the strong and weak drilling regulations of Pennsylvania using the other states as points of comparison.

Mineral rights leasing is similar in the four states, although Pennsylvania is more stringent in that it does not have a mandatory pooling mandate as Ohio and West Virginia have. This allows fee simple landowners in PA the ability to refuse access to their subsurface minerals. In addition, PA is seeing very high per acre rental payments. This has been used to the advantage of DCNR when leasing State Forest land for natural gas exploration. The high rental payments have allowed the DCNR to acquire millions of dollars for the oil and gas lease fund, which is then used for conservation initiatives within the Department.

Pennsylvania also has progressive legislation regarding royalty payments. Of the states that were examined, PA is the only state that has a minimum royalty law. This law requires that drillers pay surface owners 12.5% of the value of the natural gas that is removed from their property. Although there is a legal minimum, drilling companies do not always demand the minimum and it is possible to negotiate for higher rates. For example, DCNR requires 18% when leasing State Forest land. The minimum royalty regulation benefits private lessors by mandating a minimum amount companies can pay (DCNR Forestry, 2010).

The above regulations deal predominantly with transactions involving fee simple land ownership, and although they are important to the DCNR Bureau of Forestry, split estate and remediation laws are the most contentious for the Bureau of State Parks. The laws concerning split estates and remediation in Pennsylvania are not as strict as those from WV and WY.

Split estate laws are weakest in Pennsylvania and Ohio. In both states, subsurface owners have the right to extract the minerals utilizing an amount of the surface that is reasonable, based on industry best management practices. In both states, mineral rights owners have years of legal precedent giving them the right to access their minerals, even when working on split estate land. Other states have instituted laws that protect surface owners whose rights may have been severed from the subsurface before they acquired the land. West Virginia has addressed this issue by mandating that companies must reimburse surface owners for damage to the property, loss of property value, and for any lost income or expenses incurred due to the occupation of the land by the gas company. In Pennsylvania surface owners are reimbursed for damage to water supplies, but the law does not mention compensation for land alterations. The strongest split estate laws come from Wyoming, where companies are required to attempt good faith negotiations with surface owners. If this fails, both the gas company and surface owners hold the right to contract an arbitrator who can mediate between the two parties until a surface use agreement is formed (WY Title 30-5-402).

The last legal issue affecting State Parks is remediation law. Not only are Pennsylvania's remediation laws lacking, but all of the depth of existing regulation is found in permitting documents from sedimentation and erosion control plans, which are issued by the Department of Environmental Protection (DEP) and are not actually written into the code. In addition, the remediation requirements in PA do not urge operators to consider the natural habitats that

existed prior to drilling operations and instead lay out generic remediation guidelines to be used in all drilling operations. In this case PA can take advice from Ohio, West Virginia and Wyoming. Ohio lays out separate remediation timelines for drilling operations occurring in urban and non-urban areas. This idea of differentiating between different environments could be adapted to Pennsylvania by setting stricter regulations on drilling operations involving state owned land. West Virginia could be emulated as they suggest that operators consider re-planting for wildlife habitat. Wyoming could be used as the model legislation for its requiring surface lease agreements, which would give the Parks the legal right to negotiate remediation efforts.

The laws in Pennsylvania leave room for improvement, especially in relation to remediation and split estates. By adopting some of the regulations found in West Virginia, Ohio, and Wyoming, Pennsylvania would be able to better protect state parks from the negative effects of natural gas drilling operations. Changing these laws could also allow state parks to obtain some monetary benefit, which could help with conservation funding and park maintenance.

## **5.0 Discussion and Policy Recommendations**

Currently Parks are facing increased pressure from drilling operations due to increased exploration of the Marcellus shale formation. In addition, the new political climate in Pennsylvania has led to changes that may diminish DCNR's ability to protect State Parks from drilling. By examining the laws of other states and speaking with current Park managers, reform of the oil and gas law in Pennsylvania is necessary to guarantee protection for Parks. In spite of this, Parks have found ways to protect themselves from gas and oil operations in the past through forging positive relationships with oil and gas companies. Next, the difficulties of working in the current political, legal and industrial climates facing the DCNR are discussed, and recommendations to the Department and the public on what can be done to help protect Pennsylvania's State Parks are formulated.

### **5.1 Political Climate**

The current political regime seems to favor drilling operations. Legislative changes have become less likely following the change in government that occurred over the last election. Since Governor Tom Corbett has taken office in 2010, Parks have seen changes in the State's policies towards oil and gas drilling operations. Governor Corbett has rescinded a policy initiated under former Governor Ed Rendell that required DCNR to perform an environmental review of drilling proposals that involved State Park land (Hopey, 2011). The policy also stated that if a voluntary agreement could not be made between the DCNR and the

oil and gas company, the DEP had to take the DCNR's findings into account when issuing the permits (Hopey, 2011). In addition, Gov. Corbett has expressed interest in lifting a moratorium that was placed on leasing additional State Forest land (Hopey, 2011). These changes show a shift in the legislature towards a pro industry stance and may decrease Parks ability to negotiate with oil and gas companies.

These changes in governance affect State Parks directly as the secretary of the DCNR is an appointed position. On March 24, 2011, Richard Allen was nominated by Governor Corbett. The appointment of a new secretary places Park managers in a "hold pattern" as the secretary has the responsibility of shaping the Parks' formal positions on activities affecting the state park system. One worry that the managers have had is that they currently don't know where the DCNR is heading due to this lack of direction from the secretary (Interview, 2011). They feel that not having a known voice at the higher level of government may diminish the Department's bargaining ability in regards to drilling operations.

The steps that Governor Corbett has taken to loosen restrictions that were initiated by the former Governor have lessened State Parks ability to be involved in the permitting process. Gov. Corbett received over \$344 thousand in campaign contributions (opposed to challenger Dan Onorato's \$45,000) from the natural gas industry over a 97-day period (Associated Press, 2010). In addition, Gov. Corbett opposes a severance tax on natural gas that could contribute money for

conservation initiatives (AP, 2010). These changes in the position of the state government may accelerate the industry's infiltration of the State Park system.

## 5.2 Legal Climate

The Pennsylvania constitution, Article one section 27 states that:

“The people have a right to clean air, pure water, and to the preservation of the natural, scenic, historic and esthetic values of the environment. Pennsylvania's public natural resources are the common property of all the people, including generations yet to come. As trustee of these resources, the Commonwealth shall conserve and maintain them for the benefit of all the people.”

This article shows that in 1972 when the article was adopted Pennsylvania's legislatures were conscious of the importance of public land and the environment for peoples' health and enjoyment. Legal precedent throughout the years in Pennsylvania has strayed from this right given in the constitution. Courts have ruled in cases such as *Belden and Blake v. DCNR*, that the Department does not have the ability to place additional regulations on oil and gas operations simply because they are charged with the management of public land.

In 2009 the Supreme Court of Pennsylvania ruled that the DCNR and Oil Creek State Park do not have the ability to place additional restrictions on drilling operations set to take place on Park property (*Belden & Blake v DCNR*, 2009). The case was brought to court when DCNR, asserting that it held an obligation to preserve state parks pursuant to the PA constitution, attempted to impose a

coordination agreement on Belden & Blake Corporation<sup>53</sup>. These agreements have historically been agreed to by natural gas companies wishing to develop their mineral rights interests below State Park land. Although DCNR cited cases pertaining to the public trust doctrine<sup>54</sup>, the court ruled that Belden & Blake had fulfilled its legal obligations, and that a subsurface owner's rights cannot be diminished because the surface comes to be owned by the government (Belden & Blake v DCNR, 2009). The majority continued that the DCNR could, however, restrict activities on State Park land if just compensation is given to the mineral rights owners.

The legal climate that has developed from Pennsylvania's extractive history has contributed to the issues facing Parks. The Belden & Blake case continues Pennsylvania's historic precedent favoring extractive practices. In order to protect state parks from natural gas development in the future, the PA legislature may have to revisit the constitution, and clarify what the language requires of the state.

### **5.3 Industrial Climate**

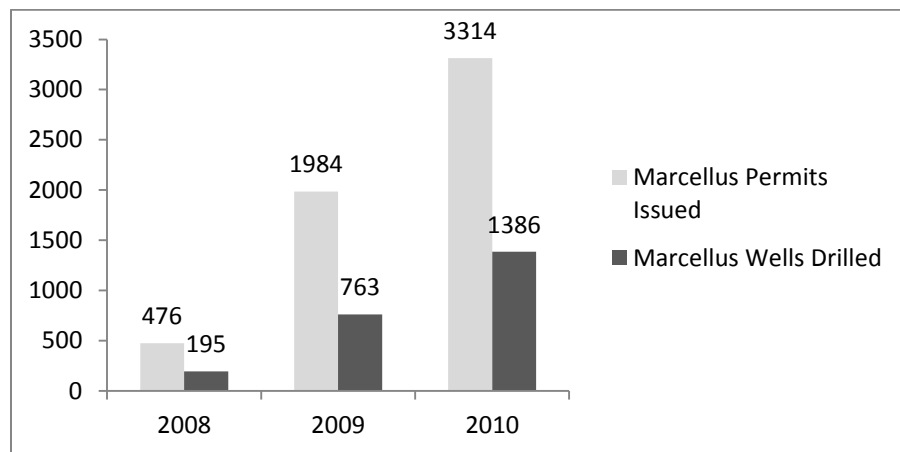
The natural gas industry in Pennsylvania is expanding rapidly. From 2008 – 2010 the number of permits issued has increased almost seven-fold. During the same

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<sup>53</sup> The coordination agreement included terms that would require Belden & Blake to post a \$10,000 performance bond for each well, as well as \$74,885 in stumpage fees (double the fair market value) (Belden & Blake v DCNR, 2009).

<sup>54</sup> The public trust doctrine is a legal idea adopted from Roman and English law that recognizes and attempts to protect public utilization of publicly owned land. The laws initially revolved around water bodies to be used for navigation and fishing, but since, have been adopted to scenic beauty and aesthetics like those found in parks (Sax, 1970).

time frame the number of wells drilled has increased seven-fold. Permits issued have increased from 476-3,314 while wells drilled has increased from 195-1,386 (DEP, 2011) (See figure 3).



*Figure 3: Marcellus Activity in Pennsylvania*

*Source:*

<http://www.dep.state.pa.us/dep/deputate/minres/oilgas/2010PermitDrilledmaps.htm>

This graph shows the number of permits issued in blue and the number of wells drilled in red from 2008 to 2010.

The industry would like to see this trend continue. Shell Exploration and Production Company (Shell), believes that PA could become the second largest producer of natural gas in the U.S. by 2020, and if fully developed, the Marcellus formation could become the second largest natural gas producing formation in the world (Blauvelt, 2010). Shell claims that spending from Marcellus operations in 2009 created \$389 million in state and local tax revenue, and added 44,000 new jobs (Blauvelt, 2010). The industry also claims that each Marcellus well generates \$6.2 million in economic impact, whereas each non-Marcellus well generates only \$1.7 million (Blauvelt, 2010). Gas company spending plans suggest over 2,200

wells could be drilled in 2011 and investment will increase from \$8.8 billion in 2010 to \$11 billion in 2011 (Blauvelt, 2010).

The industry estimates continue to grow showing increasing interest in the Marcellus formation. The industry estimates 3,500 wells could be drilled in 2020 and Pennsylvania's production in 2015 could be greater than Wyoming's production from 2008<sup>55</sup> (Blauvelt, 2010). These trends expressed by the industry show that Marcellus drilling is going to continue to increase in the foreseeable future.

#### **5.4 Policy Recommendations: DCNR and the Public**

The DCNR's mission is to protect the land for current and future generations, and the pressures from Marcellus drilling in conjunction with PA laws are making this mission difficult. In addition, the DCNR is an apolitical<sup>56</sup> entity (Interview, 2011). The apolitical nature of DCNR is needed to be able to work under different political regimes. It also allows the Department to disseminate non-biased information regarding drilling operations which can be seen in the DCNR's wide range of information on Marcellus drilling that is available on its website.

One constraint arising from the apolitical stance of DCNR is that DCNR employees will not use their environmental and personal contacts to organize a movement to pressure the legislature. In spite of this, environmental groups and

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<sup>55</sup> PA could be producing over 7 billion cubic feet by 2015.

<sup>56</sup> Definition: Apolitical- having no interest in politics, or not concerned with politics.

friends groups<sup>57</sup> often fight for what they believe is best for the DCNR (Interview, 2011). Although these groups do not currently lobby the state government on the protection of all parks in PA, they are active in utilizing their local representatives when their park is being affected by state or DCNR decisions. If these groups were to become organized throughout the state, they could represent a strong coalition to help change regulations at the state level.

The DCNR can also help minimize drilling impacts on State Park land. By changing its management style, parks could publically voice their opposition to the encroachment of Park land by Marcellus operators. The parks could help organize friends groups across the state parks to form a cohesive group that could be used to pressure the state government to change regulations that leave parks at risk. In addition, parks could be looking at other ways to limit intrusion.

If parks were to change their management style and lease some land that is owned fee simple, gas companies may be able to locate their rigs off of state park property and reach their mineral rights within the park utilizing horizontal drilling. The reasoning behind this is that in cases where the parks may own small tracts of fee simple land separating private land and Park land, natural gas companies would not be allowed to drill under the fee simple land. Thus, if parks leased that fee simple tract, the gas companies may be able to avoid placing the drilling equipment on Park land, and could place it outside the park. Although this

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<sup>57</sup> Friends groups are groups that are formed by the community to help parks maintain operations through free labor and fund raising. These groups are formed around individual parks (i.e. Friends of Moraine State Park etc.).

solution may not be possible in all instances, and it is unknown how many of these scenarios exist, the idea could help limit Park land encroachment in some cases, and is worth discussing.

The most important recommendation to minimize drilling impacts on state parks is for the public. It is time that the public takes the initiative to learn about the laws and practices within the State, and to become informed about the possible negative effects of drilling on state parks. Pennsylvania has more readily available information on Marcellus drilling than Ohio, West Virginia, and Wyoming, and this resource has not been taken advantage of. The PA DEP website gives access to much more non-biased information than the other states researched in this thesis. Based on personal relationships I have in PA, it is clear that many Pennsylvanians are unaware of the lack of legal protection our Parks have. Although media coverage exists on the encroachment of Marcellus drilling onto Park land, the message has not been presented in a way that stresses Parks inability to legally protect the land.

A push for legal reform and stricter regulations to protect our State Parks is needed, and is the only guarantee our Parks will have for receiving protection. In order to reach this goal, Marcellus opponents need to begin acting on a state-wide level to bring the issue to the proper tier. If the issue of drilling in state parks is to be addressed, the issue needs to be brought to the state legislature and pressure needs to be placed on state representatives and the governor.

In order to organize this movement, change agents<sup>58</sup> active in local Marcellus opposition groups should become familiar with the laws and regulations that affect State Parks. By framing the dangers of Marcellus drilling within the context of State Parks, these change agents will be able to reach a broader spectrum of people. Currently, those that are in favor of drilling are focused on the economic and financial benefits drilling operations lend to private property owners. When the scope of the argument is extended to State Parks, these monetary benefits are stripped away, as Parks are not benefitting financially from these operations. This fact may help unite the more than one million people who visit State Parks annually.

In addition, although drilling is a current issue and one that needs to be addressed, it is important to think about the future. The impacts drilling may have on wildlife, water, and public health, are issues that are still not completely understood. In addition, the construction of compressor stations and the installation of transmission lines have been overlooked. These activities may damage the environment in much the same way as drilling. These issues will also have to be explored in relation to State Parks. State Parks currently do not allow right-of-ways on Park land. Transmission lines needed to remove natural gas from Marcellus wells will need to be built, and Parks will have a new set of issues to consider. Future research should focus on the legal aspects of transmission and eminent domain, and how these issues may affect the PA State Park System.

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<sup>58</sup> A change agent is a person who can incite change through the organization of people who hold similar views, and who can also repackage ideas and convince people to try or adopt them.

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## Appendices

### A. Hydraulic Fracturing Fluid Additives and Purpose

Additive Type	Description of Purpose	Examples of Chemicals <sup>1</sup>
Proppants	"Props" open fractures and allows gas / fluids to flow more freely to the well bore	Sand [Sintered bauxite; zirconium oxide; ceramic beads]
Acid	Cleans up perforation intervals of cement and drilling mud prior to fracturing fluid injection, and provides accessible path to formation	Hydrochloric acid (HCl, 3% to 28%)
Breaker	Reduces the viscosity of the fluid in order to release proppant into fractures and enhance the recovery of the fracturing fluid	Peroxydisulfates
Bactericide / Biocide	Inhibits growth of organisms that could produce gases (particularly hydrogen sulfide) that could contaminate methane gas. Also prevents the growth of bacteria which can reduce the ability of the fluid to carry proppant into the fractures	Gluteraldehyde; 2-Bromo-2-nitro-1,2-propanediol
Clay Stabilizer / Control	Prevents swelling and migration of formation clays which could block pore spaces thereby reducing permeability	Salts (e.g., tetramethyl ammonium chloride) [Potassium chloride (KCl)]
Corrosion Inhibitor	Reduces rust formation on steel tubing, well casings, tools, and tanks (used only in fracturing fluids that contain acid)	Methanol
Crosslinker	The fluid viscosity is increased using phosphate esters combined with metals. The metals are referred to as crosslinking agents. The increased fracturing fluid viscosity allows the fluid to carry more proppant into the fractures.	Potassium hydroxide
Friction Reducer	Allows fracturing fluids to be injected at optimum rates and pressures by minimizing friction	Sodium acrylate-acrylamide copolymer; polyacrylamide (PAM)
Gelling Agent	Increases fracturing fluid viscosity, allowing the fluid to carry more proppant into the fractures	Guar gum
Iron Control	Prevents the precipitation of metal oxides which could plug off the formation	Citric acid; thioglycolic acid
Scale Inhibitor	Prevents the precipitation of carbonates and sulfates (calcium carbonate, calcium sulfate, barium sulfate) which could plug off the formation	Ammonium chloride; ethylene glycol; polyacrylate
Surfactant	Reduces fracturing fluid surface tension thereby aiding fluid recovery	Methanol; isopropanol

Table obtained from page 2-2 from: URS Corporation. (2009, September 16). *Water-related issues associated with gas production in the Marcellus shale* (Contract Number No. 10666).

Retrieved from:<http://www.nyserda.org/publications/01%20Report%20Cover%20and%20Chapter%201-%20Alpha%202009-09-23.pdf>

## B. Hydraulic Fracturing Chemical List

Chemicals Used by Hydraulic Fracturing Companies in Pennsylvania  
For Surface and Hydraulic Fracturing Activities  
Prepared by the Department of Environmental Protection  
Bureau of Oil and Gas Management  
Compiled from Material Safety Data Sheets obtained from Industry

1,2,4-Trimethylbenzene	Glycol Ethers (includes 2BE)
1,3,5 Trimethylbenzene	Guar gum
2,2-Dibromo-3-Nitrilopropionamide	Hemicellulase Enzyme
2,2-Dibromo-3-Nitrilopropionamide	Hydrochloric Acid
2-butoxyethanol	Hydrotreated light distillate
2-Ethylhexanol	Hydrotreated Light Distilled
2-methyl-4-isothiazolin-3-one	Iron Oxide
5-chloro-2-methyl-4-isothiazotin-3-one	Isopropanol
Acetic Acid	Isopropyl Alcohol
Acetic Anhydride	Kerosine
Acie Pensurf	Magnesium Nitrate
Alcohol Ethoxylated	Mesh Sand (Crystalline Silica)
Aliphatic Acid	Methanol
Aliphatic Alcohol Polyglycol Ether	Mineral Spirits
Aluminum Oxide	Monoethanolamine
Ammonia Bifluoride	Naphthalene
Ammonia Bisulfite	Nitrilotriacetamide
Ammonium chloride	Oil Mist
Ammonium Salt	Petroleum Distillate Blend
Ammonia Persulfate	Petroleum Distillates
Aromatic Hydrocarbon	Petroleum Naphtha
Aromatic Ketones	Polyethoxylated Alkanol (1)
Boric Acid	Polyethoxylated Alkanol (2)
Boric Oxide	Polyethylene Glycol Mixture
Butan-1-01	Polysaccharide
Citric Acid	Potassium Carbonate
Crystalline Silica: Cristobalite	Potassium Chloride
Crystalline Silica: Quartz	Potassium Hydroxide
Dazomet	Prop-2-yn-1-01
Diatomaceous Earth	Propan-2-01
Diesel (use discontinued)	Propargyl Alcohol
Diethylbenzene	Propylene
Doclecybenzene Sulfonic Acid	Sodium Ash
E B Butyl Cellosolve	Sodium Bicarbonate
Ethane-1,2-diol	Sodium Chloride
Ethoxlated Alcohol	Sodium Hydroxide
Ethoxylated Alcohol	Sucrose
Ethoxylated Octylphenol	Tetramethylammonium Chloride
Ethylbenzene	Titanium Oxide
Ethylene Glycol	Toluene
Ethylhexanol	Xylene
Ferrous Sulfate Heptahydrate	
Formaldehyde	
Glutaraldehyde	

Table obtained from: The Department of Environmental Protection retrieved from [http://www.dep.state.pa.us/dep/deputate/minres/oilgas/new\\_forms/marcellus/Reports/Frac%20list%206-30-2010.pdf](http://www.dep.state.pa.us/dep/deputate/minres/oilgas/new_forms/marcellus/Reports/Frac%20list%206-30-2010.pdf) on 2/17/2011.

## C. Companies and Violations

### Corporations with the Most Violations in PA (1/1/08-8/20/10)

Company Name	Total	# Wells
Chesapeake Appalachia LLC	149	190
Chief Oil & Gas LLC	110	63
East Resources MGT LLC	106	26
Talisman Energy USA Inc	104	181
Cabot Oil & Gas Corp	93	75
PA Gen Energy CO LLC	46	34
Seneca Resources Corp	42	45
Atlas Resources LLC	40	153
Ultra Resources INC	39	37
Range Resources Appalachia	32	240
Williams Production Appalachia	32	7
JW Operating CO	29	5
EOG Resources Inc	28	69
Anadarko E&P CO LP	25	75
XTO Energy INC	25	19
Citrus Energy Corp	18	2
Energy Corp of Amer	16	11
Southwestern Energy Prod CO	15	16
Phillips Exploration INC	10	9
EQT Production CO	9	45
Stone Energy Corp	9	5
Guardian Exploration LLC	7	1
Exco Resources PA INC	6	12
MDS Energy LTD	6	3
Novus Operating LLC	6	6
Penn Virginia Oil & Gas Corp	6	1

### Number of Average Violations per Well Drilled

Company Name	Avg#
Citrus Energy Corp	9.0
Guardian Exploration LLC	7.0
Penn Virginia Oil & Gas Corp	6.0
JW Operating CO	5.8
Samson Res CO	5.0
Williams Production Appalachia	4.6
East Resources MGT LLC	4.1
Anschutz Exploration CORP	2.0
Antero Resources Apalachian	2.0
Carrizo Oil & Gas Inc	2.0
MDS Energy LTD	2.0
Stone Energy Corp	1.8
Chief Oil & Gas LLC	1.7
Tanglewood Expl LLC	1.7
Energy Corp of AMER	1.5
PA Gen Energy CO LLC	1.4
Bumett Oil CO INC	1.3
XTO Energy INC	1.3
Cabot Oil & Gas CORP	1.2
Phillips Exploration INC	1.1
Ultra Resources INC	1.1
Baker Gas Inc	1.0
Interstate Gas MKT INC	1.0
Novus Operation LLC	1.0
Southwestern Energy Prod CO	0.9
Seneca Resources Corp	0.9

*These numbers are based on the subset of 1056 violations identified as most likely to harm the environment.*

This table was obtained from Pennsylvania Land Trust Association. (2010, September 1). *Marcellus Shale drillers in Pennsylvania amass 1614 violations since 2008*. Retrieved from Pennsylvania Land Trust Association website: <http://conserveland.org/violationsrpt>

## D. Marcellus Ancillary Industries

Ancillary & Supply-Chain Industries			
NAICS	Description	2010 Establishments	2010 Jobs
221112	Fossil Fuel Electric Power Generation	64	4,042
221210	Natural Gas Distribution	145	3,696
221310	Water Supply & Irrigation Systems	106	1,728
221320	Sewage Treatment Facilities	40	212
237110	Water & Sewer Line & Related Structures Construction	378	6,309
238912	Nonresidential Site Preparation Contractors	634	9,198
325120	Industrial Gas Manufacturing	32	1,275
331111	Iron & Steel Mills	56	11,110
331210	Iron & Steel Pipe & Tube Manufacturing from Purchased Steel	42	3,790
333131	Mining Machinery & Equipment Manufacturing	23	3,229
333132	Oil & Gas Field Machinery & Equipment Manufacturing	8	353
484220	Specialized Freight Trucking, Local	1,040	9,723
484230	Specialized Freight Trucking, Long-Distance	272	3,439
531190	Lessors of Other Real Estate Property	242	779
532412	Construction, Mining & Forestry Machinery & Equipment Rental & Leasing	114	2,173
541330	Engineering Services	2,432	34,120
541360	Geophysical Surveying & Mapping Services	55	229
541380	Testing Laboratories	396	6,649
541620	Environmental Consulting Services	478	2,951
562910	Remediation Services	230	2,584
811310	Commercial & Industrial Machinery & Equipment Repair & Maintenance	1,029	8,034
<b>Totals</b>		<b>7,812</b>	<b>115,625</b>

This figure was obtained from Pennsylvania Workforce Development. (2010, December). *Marcellus shale industry snapshot update* [Publications Spotlight]. Retrieved January 6, 2010, from [http://www.paworkforce.state.pa.us/portal/server.pt/community/pa\\_workforce\\_development/12865](http://www.paworkforce.state.pa.us/portal/server.pt/community/pa_workforce_development/12865).

NAICS refers to the North American Industry Classification System used by the Bureau of Labor Statistics to categorize different industries.

### **E. Interview Questions**

- 1.) Has your Park had natural gas or oil drilling before 2008?
- 2.) What are some of the pros and cons that drilling activities have had at your Park, or at other Parks in region 2?
- 3.) What percentage of subsurface rights does your Park own?
- 4.) Have there been any companies interested in drilling or seismic mapping at your Park?
- 5.) Have the companies that have contacted you, or are planning drill on State Park property worked well with the Park as far as conservation and general environmental protection?
- 6.) As Park manager, do you have any environmental or management concerns over Marcellus shale drilling?
- 7.) If your Park has already had drilling in the past, either oil or natural gas, is there any thing that makes Marcellus different from these activities and how so?
- 8.) What options do you have as Park manager when dealing with Marcellus companies that wish to drill?
- 9.) Do you think something needs to be done to protect state Parks from Marcellus drilling, and if so what are some options?
- 10.) Do you think that the Bureau of State Parks needs to be concerned with Marcellus drilling, and why or why not?

## F. Well Casing Diagram

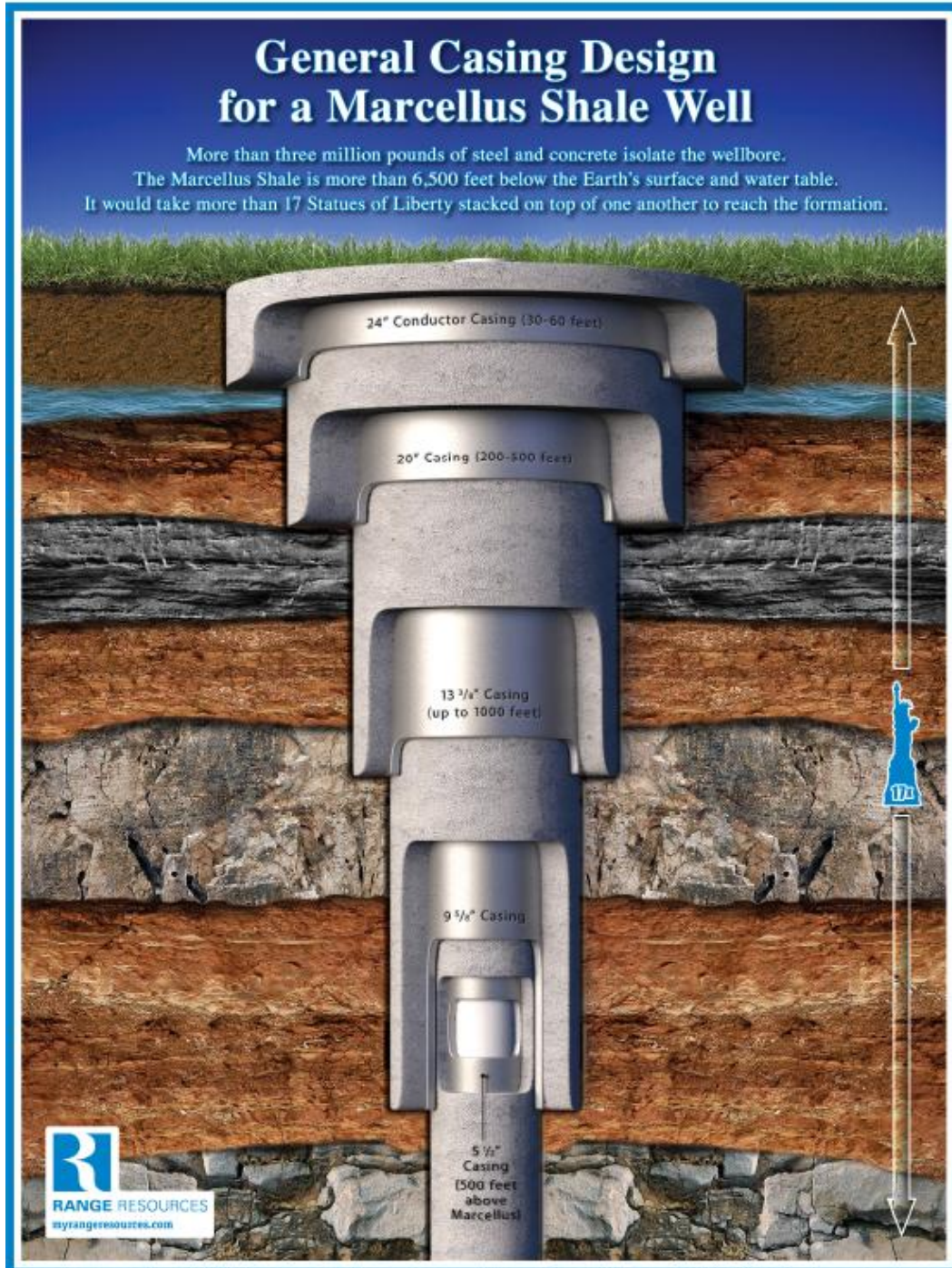


Image obtained from Range Resources website:

[http://www.myrangeresources.com/Drilling/learn\\_drilling.aspx](http://www.myrangeresources.com/Drilling/learn_drilling.aspx)