



MARCELLUS SHALE SAFE DRILLING INITIATIVE STUDY

PART I

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EXECUTIVE SUMMARY

Pursuant to Governor O'Malley's Executive Order 01.01.2011.11, the Marcellus Shale Safe Drilling Initiative Advisory Commission was established to assist State policymakers and regulators in determining whether and how gas production from the Marcellus Shale in Maryland can be accomplished without unacceptable risks of adverse impacts to public health, safety, the environment, and natural resources. This document is the first of three reports, and includes findings and recommendations regarding sources of revenue and standards of liability, in anticipation of gas production from the Marcellus Shale that may occur in Maryland. The Departments and the Advisory Commission have not yet made any determination of whether gas production can be accomplished without unacceptable risks, or how this might be done, and nothing in this report should be interpreted to imply otherwise.

The Executive Order tasks MDE and DNR, in consultation with the Advisory Commission, with conducting a three-part study and reporting findings and recommendations. The completed study will include:

- i. By December 31, 2011, a presentation of findings and related recommendations regarding the desirability of legislation to establish revenue sources, such as a State-level severance tax, and the desirability of legislation to establish standards of liability for damages caused by gas exploration and production;
- ii. By August 1, 2012, recommendations for best practices for all aspects of natural gas exploration and production in the Marcellus Shale in Maryland; and
- iii. No later than August 1, 2014, a final report with findings and recommendations relating to the impact of Marcellus Shale drilling including possible contamination of ground water, handling and disposal of wastewater, environmental and natural resources impacts, impacts to forests and important habitats, greenhouse gas emissions, and economic impact.

This document is Part I of the study, a report on findings and recommendations regarding sources of revenue and standards of liability.

After consultation with the Advisory Commission, the Departments make the following recommendations:

Revenue

A successful cost and revenue structure to offset the costs of State activities will: protect the local economy, social well-being, public infrastructure, and natural environment; internalize the costs attributable to gas exploration and production; and assign responsibility for impacts of industry activities that cannot be attributed to an individual

well site or permittee to the industry operating in Maryland. The Departments make the following recommendations regarding revenue:

- R-1 The General Assembly should impose a fee on gas leases to fund studies of issues set forth in the Executive Order.
- R-2 The General Assembly should enact a State-level severance tax and use it to address impacts of gas exploration and production on the environment and natural resources that are regional and not attributable to specific companies.
- R-3 The severance tax revenue should be deposited into a Marcellus Shale Environmental Fund to be used to fund continuing monitoring and address negative impacts that are not attributable to a specific company or permittee.

Liability

A fair liability system should: promote the goals of environmental sustainability, public health, and equity; and incentivize the prevention of harm. The Departments make the following recommendations regarding liability:

- L-1 The General Assembly should enact a law creating a rebuttable presumption that certain damages occurring close in space and time to exploration and production activities are caused by those activities, and an administrative process for requiring the permittee to remediate the damage, pay compensation, or both.
- L-2 The General Assembly should enact a comprehensive Surface Owners Protection Act.
- L-3 Community impacts should be addressed through mediation or by use of community benefits agreements.
- L-4 The General Assembly should amend the law that limits the amount of a performance by deleting any reference to a dollar amount and directing MDE to determine the proper amount of bond based on a consideration of the likely costs of complying with permit provisions, properly closing the well and performing site reclamation.

The majority of members of the Advisory Commission support these recommendations. A summary of the deliberations of the Advisory Commission can be found in Appendix E.

Section I – Overview

A. Marcellus Shale

Geologists have long known about the gas-bearing underground formation known as the Marcellus Shale, which lies deep beneath portions of the Appalachian Basin, including parts of Western Maryland. Until advances in horizontal drilling and hydraulic fracturing, however, and the combination of these two technologies, few thought that significant amounts of natural gas could be recovered from the Marcellus Shale. Drilling in the Marcellus Shale using horizontal drilling and high-volume hydraulic fracturing began around 2005 in Pennsylvania and has accelerated rapidly.

The production of natural gas has the potential to benefit Maryland and the United States. By tapping domestic sources, it could advance the cause of energy independence for the United States. When burned to produce electricity, natural gas produces lower greenhouse gas emissions than oil and coal, which could help to reduce the impact of energy usage as we transition to more renewable energy sources. The exploration for and production of natural gas could boost economic development in Maryland, particularly in Garrett and Allegany Counties.

As the use of hydraulic fracturing has increased, however, so have concerns about its potential impact on public health, safety, the environment and natural resources. Although accidents are relatively rare, exploration for and production of natural gas from the Marcellus Shale in nearby states have resulted in injuries, well blowouts, releases of fracturing fluids, releases of methane, spills, fires, forest fragmentation, damage to roads, and allegations of contamination of ground water and surface water. Other states have revised or are in the process of reevaluating their regulatory programs for gas production or assessing the environmental impacts of gas development from the Marcellus Shale. A significant amount of research has been completed on hydraulic fracturing and gas production from the Marcellus Shale, but additional research by governmental entities, academic organizations, environmental groups and industry is currently underway focused on drinking water, natural resources, wildlife, community and economic implications, production technologies and best practices.

B. Developments in Maryland

The Maryland Departments of the Environment (MDE) and Natural Resources (DNR) have roles in the evaluation of natural gas projects. Each would be involved in any future permitting decisions for drilling in the Marcellus Shale.

The mission of the Maryland Department of the Environment is to protect and restore the quality of Maryland's air, water, and land resources, while fostering smart growth, economic development, healthy and safe communities, and quality environmental education for the benefit of the environment, public health, and future generations. In addition, MDE is specifically authorized by statute to issue permits for gas exploration and production. The Department of the Environment is required to coordinate with the Department of Natural Resources in its evaluation of the environmental assessment of any proposed oil or gas well.

The Department of Natural Resources leads Maryland in securing a sustainable future for our environment, society, and economy by preserving, protecting, restoring, and enhancing the State's natural resources. In addition, DNR owns or has conservation easements on substantial acreage in the State, including western Maryland.

The Department of the Environment's regulations on oil and gas wells have not been revised since 1993 and thus were written before some of the advances in technology and without the benefit of more recent research. Maryland law allows MDE to place in a permit conditions that the Department deems reasonable and appropriate to assure that the operation shall not only fully comply with the requirements of the law, but also provide for public safety and the protection of the State's natural resources.

Beginning in 2010, applications were filed for permits to produce gas from the Marcellus Shale in Maryland using horizontal drilling and high volume hydraulic fracturing. In the 2011 legislative session, bills were introduced regarding further study and development of regulations before permits could be issued. A bill passed the House that would have funded the study by assessing a fee on those who hold gas leases in Maryland, but it died in the Senate committee at the close of the session. To address the need for information, the Governor issued the Marcellus Shale Safe Drilling Initiative in Executive Order 01.01.2011.11 on June 6, 2011.

C. The Executive Order and the Advisory Commission

Executive Order 01.01.2011.11 directs MDE and DNR to assemble and consult with an Advisory Commission in the study of specific topics related to horizontal drilling and hydraulic fracturing in the Marcellus Shale.¹ The Advisory Commission includes a broad range of stakeholders. Members include elected officials from Allegany and Garrett Counties, two members of the General Assembly, representatives of the scientific community, the gas industry, business, agriculture, environmental organizations, citizens, and a State agency. See Appendix A for a list of Commissioners.

The Executive Order tasks MDE and DNR, in consultation with the Advisory Commission, with conducting a three-part study and reporting findings and

¹ Although the Governor's Executive Order is directed specifically at the Marcellus Shale and hydraulic fracturing, there is a potential for gas extraction from other tight shale gas formations, including the Utica Shale, and by well stimulation techniques other than hydraulic fracturing. The findings and conclusions regarding gas exploration in the Marcellus Shale may also apply to other formations and techniques.

recommendations. The Commission is staffed by DNR and MDE. The completed study will include:

- i. By December 31, 2011, a presentation of findings and related recommendations regarding the desirability of legislation to establish revenue sources, such as a State-level severance tax, and the desirability of legislation to establish standards of liability for damages caused by gas exploration and production;
- ii. By August 1, 2012, recommendations for best practices for all aspects of natural gas exploration and production in the Marcellus Shale in Maryland; and
- iii. No later than August 1, 2014, a final report with findings and recommendations relating to the impact of Marcellus Shale drilling including possible contamination of ground water, handling and disposal of wastewater, environmental and natural resources impacts, impacts to forests and important habitats, greenhouse gas emissions, and economic impact.

Pursuant to the Executive Order, the Marcellus Shale Safe Drilling Initiative Advisory Commission is to assist State policymakers and regulators in determining whether and how gas production from the Marcellus Shale in Maryland can be accomplished without unacceptable risks of adverse impacts to public health, safety, the environment, and natural resources. This document is Part I of the study, a report on findings and recommendations regarding sources of revenue and standards of liability, in anticipation of gas production from the Marcellus Shale that may occur in Maryland. The Departments and the Advisory Commission have not yet made any determination of whether gas production can be accomplished without unacceptable risks, or how this might be done, and nothing in this report should be interpreted to imply otherwise.

D. The Work of the Advisory Commission

The governor announced the membership of the Advisory Commission in July, 2011, and the Commission has on four occasions: August 4, October 7, November 15 and December 12, 2011. Meetings were held in Western Maryland.

Resources were provided to the Commission through MDE's web page, and included articles from scientific journals, government publications, industry standards and guidelines, and publications and reports by non-governmental organizations. These included the New York State Department of Environmental Conservation, Supplemental Generic Environmental Impact Statement on the Oil, Gas and Solution Mining Regulatory Program (Revised Draft 2011), the Pennsylvania Governor's Marcellus Shale Advisory Commission Report (2011), and The Secretary of Energy Advisory Board (SEAB) Shale Gas Production Subcommittee: Ninety-Day Report (August 11, 2011). The Secretary of MDE provided an initial briefing on Marcellus Shale issues, and staff prepared briefing memoranda on revenue and liability issues. Members of the public

submitted comments to the Commission. Lastly, the Commissioners themselves, a well-informed and diverse assemblage, shared information and brought their expertise to bear.

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Section II – Revenue

A. Introduction

The Executive Order requires the Departments to report on the desirability of establishing:

- one or more sources of revenue, such as a State level severance tax or other assessment, to fund
- State activities relating to hydraulic fracturing - including impact assessments, research, broad area monitoring, and remediation where no liable entity can be identified.

This section of the report addresses the items in reverse order. To identify State impacts, the Departments examined a wide variety of sources describing potential environmental and natural resource damages from Marcellus Shale drilling and related operations. In considering sources of revenue, the Departments investigated Maryland’s general taxing practices; taxes specific to gas production; permit fees; and a fee for State activities relating to hydraulic fracturing that must be completed before drilling starts, such as collecting baseline resource data. Using information developed by the United States Geological Survey, the Departments have also preliminarily developed a rough estimate of the amount of potential revenue from the Marcellus Shale play in Maryland. The Departments’ findings and a recommended cost and revenue structure are presented below.

B. Maryland Activities Relating to Hydraulic Fracturing

The impacts of gas production by hydraulic fracturing (fracking²) occur both on and off the permitted site. In order to assess these impacts, the following information and actions are required: pre-drilling on-site data, regional background data, and monitoring and enforcement, at the pre-drilling, drilling, fracking, and production, and post-production stages.

Impacts Associated with a Specific Well or Site

On-site impacts are the immediate actual and potential impacts from the drilling operation.

² Although the more correct spelling is “fracing” the alternate spelling “fracking” has become common and is used herein.

Pre-Drilling

The permit applicant is required to provide pre-operational data for the site and its immediate environs, which will be needed so that, if impacts occur, they can be identified and addressed. The applicant is responsible for providing this information at its own expense. The expense to the Departments will include the cost of reviewing the data presented by the permit applicant.

Drilling, Fracking, Production and Post-Production

The permittee will be required to comply with regulations and permit provisions and to monitor, report and correct impacts associated with the drilling, fracking, production and post- Activities typically required in other jurisdictions with an active shale gas development industry may include:

- Site-specific surface and ground water monitoring
- On-site presence of a State or State-certified inspector during drilling and fracking, paid for by the permittee, either through permit fees or directly
- Construction of new roads and pipelines in accordance with regulations and permit conditions
- Periodic testing of nearby public and private water wells
- Recordkeeping and reporting to document that all wastes, including flow-back, are properly transported, treated, and disposed of
- Repair of public facilities (roads, road signs, etc.) damaged by vehicles traveling to or from the drilling site
- Remediation of site-related surface or ground water contamination
- Remediation of site-related natural resource damages, short-term and long-term
- Proper plugging/sealing of well if it is not going into production or after production
- Removal of temporary facilities and equipment and partial reclamation of the site
- Full reclamation of the site

The permittee will be responsible for performing these actions at its own expense.

The State could incur expenses for additional activities, such as:

- Increased presence of the Maryland State Police Commercial Vehicle Enforcement Division to monitor and enforce compliance with trucking regulations

Non-Site Specific (General or Regional) Impacts

Gas exploration and production may have impacts that extend beyond the site. In order to assess these impacts, the Departments first must develop pre-drilling baseline data so that, if impacts can be minimized or, if they occur, be identified and addressed.

Pre-Drilling

Baseline studies would include:

- Regional water quantity;
- Regional water quality;
- Specific stream data; and
- Mapping data

Determining existing water quality and quantity within the area of Western Maryland underlain by the Marcellus Shale before gas extraction from the formation begins is critical. Data produced from future monitoring of streams and wells in the region will be compared to the baseline data to identify impacts that may be associated with gas development activities including drilling, hydraulic fracturing, trucking, etc. Baseline ground water and stream data for at least two years is needed to capture the variability caused by different weather and seasonal events.

Other non-site specific baseline data are also needed. The first is development of best practices for all aspects of gas production and exploration in the Marcellus Shale. The second is a study to predict the impacts, both positive and negative, of gas exploration and production in the Marcellus Shale on the economy and the community. Data should be assembled on housing, transportation, recreation/tourism, local land use patterns, rural character, habitat, and wildlife. The study should identify ways to maximize the positive impacts and avoid or minimize negative impacts on the economy and community.

A description of existing baseline data and additional information required is attached as Appendix B. The estimated cost of collecting and obtaining additional baseline information -- \$1.5 million -- is summarized in Appendix C.

Drilling, Fracking, Production and Post-Production

There may be impacts on natural resources and the environment from gas development and production that cannot be attributed to a specific permittee or party. Impacts may occur on the State and local level. The State could incur expenses for additional activities, such as:

- Increased presence of the Maryland State Police Commercial Vehicle Enforcement Division to monitor and enforce compliance with trucking regulations
- Regional surface and ground water monitoring

- Investigating incidents of environmental impact or damage to determine cause and whether it can be attributed to a particular well site or permittee (who can then be billed)
- Mitigation/remediation of contamination from drilling mud, drill cuttings, fracking fluid, gas, etc.
- Mitigation/remediation of any damages or impact on public water supplies
- Mitigation/remediation of natural resource damages – both short term and long term
- Restoration of natural resources and ecological resources and services
- Response to seepages of gas or fluid that appear to have a connection to gas well activity
- Review of newly available technologies and management practices to determine if Maryland should require them as Best Practices.

The probability of occurrence of a significant adverse environmental impact on important resources is unknown; hydraulic fracturing in the Mid-Atlantic region is a relatively new phenomenon. However, such impacts, should they occur, will be expensive to address. If, hypothetically, the drinking water source of a community of 400 households (1,000 persons) should become contaminated with high levels of dissolved solids, providing clean drinking water to the community could easily cost on the order of \$10 million. The basis for this estimated cost is described in Appendix D.

The local governments could incur expenses for additional activities, such as:

- Increased local law enforcement (both traffic and crime)
- Increased local emergency services (fire and rescue first responders)
- Increased demand for health services
- Public education specific to the shale gas industry
- Other demands for social services
- Repair of local roads
- Maintenance and improvement of community social wellbeing
- Improvement of other economic sectors in preparation for the end of the "gas boom" and economic adjustment assistance
- Creation of public amenities for tourism and other sectors to improve the "post gas boom" local economy

C. Sources of Revenue

The Departments identified five potential sources of revenue³ that may be used to offset the costs and impacts of Marcellus Shale gas production.

Real property taxes are assessed against the value of the property. The Maryland statute regarding property taxes provides: "If minerals and mineral rights are owned separately

³ The State could anticipate that gas exploration and production could also result in some additional income from income tax, sales tax, and fuel taxes.

from the land in which they are located, the supervisor may assess the minerals and mineral rights separately from the land.” Md. Tax-Property Code Ann. § 8-229. According to State Department of Assessment and Taxation, this provision has not been used, mainly because it is so difficult to estimate the value of mineral rights when the minerals are still in the ground.

Personal property taxes may be assessed against the value of the property. Personal property is exempt from State property tax. Md. Tax-Property Code Ann., §§ 7-301. However, local jurisdictions may impose a tax on personal property. Md. Tax-Property Code Ann., §§ 6-202 and 6-203. If natural gas were considered a mineral or earthen material, the machinery and equipment used to extract it would be considered manufacturing property subject to taxation. Md. Tax-Property Code Ann. § 1-101 (r); Md. Tax-Property Code Ann., § 7-225. At this time, neither Allegany nor Garrett Counties taxes manufacturing property, although such taxation is authorized by State law.

Other states assess personal property taxes on the value of equipment or other assets used to produce oil or gas, ranging from 2% in Alaska, 6.2% in Wyoming, and 27% in New Mexico.

A severance tax is a tax imposed on the value of natural resources such as coal, oil or gas extracted from the earth. Severance taxes are determined after completion of drilling when the gas is extracted and can be measured, and the taxes are assessed and paid after the gas is extracted. Generally, a severance tax is based on the value of the gas extracted at the wellhead, the volume or weight when it is extracted, or a combination of the two.

Maryland and Pennsylvania are the only gas-producing states in the Mid-Atlantic area that do not have some form of state-level severance tax. Most states apply a statewide tax while some authorize counties to impose the tax. The formulas for calculating severance taxes vary considerably across the states in both the basis for calculation and the amount of the taxes. There are many exceptions (deductions and credits) that factor into the final tax rate and usually lower the tax payment made to the state.⁴ Revenue from a state severance tax is usually placed in the general funds of the State. Tax rates from selected states are listed below:

Alaska	25% of net value at production
Kansas	8% of gross value
Texas	7.5% of market value at well
Oklahoma	7% of average monthly price
Wyoming	6% of gross value, including royalties
West Virginia	5% of gross value

Attempts have been made to determine the effect of a severance tax on an oil and gas company’s decision about where to devote its efforts and on the economy of the jurisdiction imposing the tax. Some studies analyzed historic data and some used models to simulate different scenarios.

⁴ State and local taxes are generally deductible from federal corporate income tax returns.

Headwaters Economics, an independent, nonprofit research group, conducted a detailed study comparing data about taxing and spending policies from Colorado, Montana, New Mexico, Utah and Wyoming.⁵ A major conclusion of the study is that “States can increase effective tax rates and realize higher revenue from energy development with little risk of affecting the local energy economy.”⁶ The study found no evidence to suggest that different tax rates led to more or less energy investment, citing the example of Montana – which cut tax rates to stimulate drilling but experienced less energy development than Wyoming, which did not cut tax rates.

Another study of Wyoming used a model to simulate the effect of raising severance taxes.⁷ The study found raising the severance tax does little to affect production, so that tax collections increase. However, the authors noted that their simulations showed that a tax increase slows down drilling in the early years of the program and shifts it to the future compared to a scenario of no tax increase.⁸

Looking specifically at Pennsylvania, another study⁹ concluded that a severance tax would have potentially small negative effects on some economic metrics,¹⁰ but that these would probably be more than offset by the positive effects of state and local government spending made possible by the severance tax.

Thus it is difficult to predict whether the imposition or increase of a severance tax in Maryland would affect gas exploration and production activity. A severance tax is just one factor among many that influence a company’s decision about where to devote its efforts. The total tax burden is a more relevant figure than any one tax, and other factors may be more important, such as gas price, labor costs, and access to pipelines.

Garrett County levies a tax of 5.5 % on the wholesale market value of gas produced from wells in Garrett County. Ten-elevenths of the money received is distributed to the County, and one-eleventh to the municipalities in the County, on a per capita basis. Public Local Laws of Garrett County, Sections 51.01 through 51.07.

Allegany County levies a 7% tax on the wholesale market value of natural gas produced in Allegany County. Chapter 394, Allegany County Code. It is likely that a bill to

⁵ Headwaters Economics, *Energy Revenue in the Intermountain West: State and Local Government Taxes and Royalties from Oil, Natural Gas, and Coal*, October, 2008. (http://headwaterseconomics.org/pubs/energy/HeadwatersEconomics_EnergyRevenue.pdf).

⁶ *Id.* at 3.

⁷ Kuncce, M. *et al.*, *State Taxation, Exploration, and Production in the U.S. Oil Industry*, 43 *Journal of Regional Science* 749-770 (2003).

⁸ *Id.* at 759. Several Commissioners have suggested that Maryland should ramp up drilling activity slowly in the early years.

⁹ Baker, R. M. and Passmore, D. L., *Benchmarks for Assessing the Potential Impact of a Natural Gas Severance Tax on the Pennsylvania Economy* at 15 (September 13, 2010). Available at SSRN: <http://ssrn.com/abstract=1667022>.

¹⁰ Total employment, private nonfarm employment, gross state product, real disposable personal income and population. *Id.* at 15.

change Allegany's severance law to match Garrett's will be introduced in the 2012 General Assembly.

A permit fee is a fee assessed to defray the costs of regulatory review and enforcement. In Maryland, a person must obtain a permit from MDE's Minerals, Oil, and Gas Division before drilling a well for the exploration, production, or underground storage of gas or oil in Maryland. MDE is required to set and collect permit and production fees related to oil and gas well drilling. Fees must be set at a rate necessary to cover all costs incurred by the State to (1) review, inspect, and evaluate monitoring data, applications, licenses, permits, and other reports; (2) perform and oversee assessments, investigations, and research; (3) conduct permitting, inspection, and compliance activities; and (4) develop and implement regulations to address the risks to public safety, human health, and the environment from oil and gas well drilling and development.

Unlike most taxes, permit fees generate revenue in advance of the actual gas production; however, the fees would be assessed only against those who apply for permits.

A study fee is a fee that may be imposed on an industry to enable regulators to collect baseline data and other information prior to allowing a regulated activity. In 2011, the Maryland General Assembly considered House Bill 852 (HB 852) that would have imposed a fee prior to the extraction of any gas. Under HB852, certain persons with gas interests in Garrett and Allegany Counties would have been required to pay a fee of \$10 per acre per year for two years to Maryland's Oil and Gas Fund. The purposes for which the fee would have been used included studies of most of the issues mentioned in the Executive Order, including installation of well and stream gages for baseline ground and surface water monitoring and studies of best practices for gas exploration and production.

D. Projected Amount of Revenue

The U.S. Geological Survey (USGS) recently completed a reassessment of the undiscovered oil and gas potential of the Marcellus Shale within the Appalachian Basin Province of the eastern United States. The assessment is based on the geologic elements of the formation's total petroleum system, including its characteristics as a petroleum source rock as well as a reservoir rock.¹¹ The USGS did the reassessment to take into account newer drilling and completion technologies and additional, timely production data available for Marcellus wells. Using the USGS percentages of the resource within each state,¹² Maryland is estimated to have the following amounts of technically recoverable natural gas at 95%, 50% and 5% confidence levels.

¹¹ Coleman, J.L., *et al.*, *Assessment of Undiscovered Oil and Gas Resources of the Devonian Marcellus Shale of the Appalachian Basin Province*, 2011: U.S. Geological Survey Fact Sheet 2011-3092, 2 p., available at <http://pubs.usgs.gov/fs/2011/3092/>.

¹² Coleman, J.L., *et al.*, *USGS Re-Assessment of the Undiscovered, Technically Recoverable Oil and Gas Resources of the Marcellus Shale, Appalachian Basin, USA*. PowerPoint presentation, MD-DE-DC Water Science Center, U.S. Geological Survey, Baltimore, MD. 21 Oct. 2011.

Estimated Marcellus Shale Gas Resource in Maryland			
	F95 - Min	F50	F5 - Max
Natural Gas (billion cubic feet)	711	1,302	2,383

The new USGS estimate of the volume of recoverable gas is lower than some other estimates.¹³

A large amount of uncertainty still exists in estimates of the amount of gas recoverable from the formation, and the future price of natural gas. Using the USGS estimates and assuming a constant price of \$3.93 per million cubic feet,¹⁴ each 1% of severance tax on Marcellus Shale gas is estimated to result in revenues ranging between \$27.9 million and \$93.7 million during the lifetime of the gas extraction. Assuming a 50 year lifetime of the Marcellus play in Maryland, the average annual receipts per 1% of severance tax range from \$559K to \$1.9M; at a 50% confidence level, \$1M.

	F95 - Min	F50	F5 - Max
Total Play Value Over 50 Years	\$ 2,794,325,499	\$ 5,115,416,118	\$ 9,365,344,842
Total Receipts Over 50 Years per 1% of Severance Tax	\$ 27,943,255	\$ 51,154,161	\$ 93,653,448
Average Annual Receipts per 1% of Severance Tax	\$ 558,865	\$ 1,023,083	\$ 1,873,069

The actual annual severance tax receipts would depend on the pace of drilling and the production curve of the wells. The total amount will be realized only if all the technically recoverable gas is produced and sold. Some portion of that gas will not be recovered in practice.¹⁵

E. Recommendations

A successful cost and revenue structure to offset the costs of State activities will satisfy the following three objectives:

- The local economy, social wellbeing, public infrastructure, and natural environment (including natural resources and the ecological functions of healthy ecosystems) will be protected during gas well drilling and

¹³ For example, the USGS minimum is less than half, and the maximum is less than 20%, of the volume estimated by a representative of Sampson Resources and used as a basis for calculations by an extension agent. UMD Extension Agent, Estimated Marcellus Shale Natural Gas Value, http://www.mde.state.md.us/programs/Land/mining/marcellus/Documents/Economic_Value_Estimates.pdf.

¹⁴ This is the same price for wellhead natural gas used by the extension agent.

¹⁵ Some gas may be inaccessible for a variety of reasons, such as the unwillingness of an owner to lease mineral rights.

production, and maintained or restored to the same or better condition when the drilling and production cease.

- Each permittee will be responsible for all activities and costs related to the well site and all impacts attributable to its activities. Where possible, the costs should be internalized and paid directly by the permittee.
- As part of internalizing the costs of all impacts of Marcellus Shale drilling, permittees should collectively be responsible for impacts of industry activities that cannot be attributed to an individual well site or permittee.

The two identified sets of impacts to State resources are (a) costs associated with a specific well or site, and (b) costs of non-site specific (regional or general) impacts. Here are potential funding mechanisms for each set of costs that could satisfy the foregoing objectives.

Costs Association with a Specific Well or Site

At the pre-drilling phase, the applicant would bear the cost of collecting and presenting the data required by the State for permit review, such as an Environmental Assessment and site-specific surface and ground water information. State costs for review will be included in the drilling permit fee.

During drilling, fracking,¹⁶ and production, on-site costs would be the responsibility of the permittee, and permit conditions will require monitoring, reporting, and correction of associated impacts. State activities relating to inspections and compliance will be funded by permit fees. Permit provisions might require:

- Site-specific surface and ground water monitoring
- On-site presence of a State or State-approved inspector during drilling and fracking site operations
- Collection and reporting of specific data during drilling, *e.g.*, geophysical logs, and collection of drill cuttings
- Periodic testing of nearby public and private water wells
- Recordkeeping and reporting to document that all wastes, including flow-back, are properly transported, treated, and disposed of
- Repair of public facilities (roads, road signs, etc.) damaged by vehicles traveling to or from the drilling site.
- Remediation of site-related surface or ground water contamination
- Remediation of site-related natural resource damages, both short-term and long-term

The Department of the Environment currently requires the applicant for a permit to provide a performance bond, the release of which is conditioned on compliance with the

¹⁶ Fracking includes re-fracking, should it occur.

law, regulations, permit, and orders of the Department, including those relating to reclamation of the site. By statute, the bond cannot exceed \$100,000 per well, or \$500,000 as a blanket bond for all of the applicant's wells.

Non-Site Specific (General or Regional) Impacts

In order to conduct post-drilling general or regional impact assessments, the Departments require general or regional baseline data, including ground water and surface water information. Subject to approval by the General Assembly, the Departments should collect a Marcellus Shale study fee on a per-acre basis from owners who, after January 1, 2007, acquired a gas interest in real property in Allegany or Garrett Counties for the purpose of drilling for natural gas. It is estimated that gas interests on 120,000 acres of land have been acquired in Garrett County for this purpose. At an estimated study cost of \$1,538,320, the study fee on a per-acre basis is \$6.41 per acre per year for two years, or \$8.41 for the first year and \$4.32 for the second year. If leases have been signed for land in Allegany County, the per-acre cost might be lower.

The fee could be used to fund the studies of the various issues set out in the Executive Order, including installation of well and stream gages for baseline ground and surface water monitoring and studies of best practices for gas exploration and production.

For State general or regional impacts occurring during or after drilling and fracking, subject to approval by the General Assembly, the State should establish a Marcellus Shale Environmental Fund paid for by a severance tax assessed on the industry.¹⁷ The severance tax is the best source of revenue for the Fund because it is connected directly to the activity of Marcellus Shale gas production. Models of a fund of this kind include MDE's Acid Mine Drainage and Treatment Fund established in § 15-1103 of the Environment Article used for reclamation of abandoned mines for which there is no continuing reclamation responsibility on any party and Trust Funds established in other states such as New Mexico and Colorado. The amount of percentage of the severance tax levied should consider:

- The range and potential magnitude of environmental and natural resource damage, including a margin of safety;
- The amount of potentially available revenue; and
- Whether pre-existing (non-Marcellus Shale) wells should be exempt.

Garrett County has already established a severance tax, as has Allegany County. Severance taxes based on production value are likely to be volatile and unpredictable. Local governments will rightly be cautious about incorporating these funds into their budgets, and avoid using them to fund continuing governmental services. The local jurisdictions should be free to decide how they will use severance tax revenue, but it

¹⁷ The severance tax could be structured to advance other public interests. For example, a tax credit could be granted for every full time job filled by a Maryland resident.

would be prudent to deposit the revenue into a special fund directed toward programs and services that build the counties' human and physical capital, aid other sectors of the economy that may have been adversely impacted by gas development, and encourage diversification of their economies. This would address the local impacts and prepare for the day when the gas resources are depleted or exhausted and the industry no longer contributes substantially to the local economy.

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Section III – Liability

A. Introduction

Executive Order 01.01.2011.11 directs the Departments to investigate the desirability of legislation that would define standards of liability for gas exploration and production. In consultation with the Advisory Commission, the Departments examined the current liability structure in Maryland, problems and gaps in this structure, and a range of responses available to the legislature or Administration. To guide the analysis, several goals were identified:

- To support a healthy, sustainable economy and environment;
- To the extent that adverse impacts cannot be eliminated, ensure that those who suffer negative impacts are appropriately compensated and damage is mitigated;
- To craft solutions that incentivize prevention of harm and foster prompt remediation; and
- To choose solutions that are fair to all parties.

B. The Current Liability Structure in Maryland

The only statutory authority directly addressing liability for gas well operators is within a subtitle of the Natural Resources Code that deals with oil and gas leases on State-owned land. The relevant section states that “[a]ny person who drills for oil or gas on the lands or in the waters of the State is strictly liable for any damages that occur in exploration, drilling, or producing operations or in the plugging of the person's oil or gas wells, including liability to the State for any environmental damage.” Md. Nat. Res. Code Ann. § 5-1703. While the section specifically mentions liability to the State, the scope or applicability of the section has not been tested.

There are also statutory requirements that oil and gas permittees must post a performance bond and maintain liability insurance. Under current law, the Department may not require a bond in excess of \$100,000 per well, or \$500,000 as a blanket bond for all wells of a permittee. The bond is released only after MDE determines that the well has been properly plugged, the site reclaimed, required records submitted, and obligations under the statute, regulations, and permit fulfilled.

The statute requires liability insurance coverage of at least \$300,000 per person and \$500,000 per occurrence or accident. This insurance must cover injury to persons or property damage caused by drilling, production, or plugging. MDE's regulations expand the requirement of liability insurance coverage to \$1,000,000 per person and \$5,000,000 per occurrence or accident, but do not otherwise address liability. The regulations allow an applicant to self-insure if it meets certain criteria. COMAR 26.19.01.06 C(4)

Many states recognize the common law¹⁸ rule that mineral rights are considered the dominant estate, meaning those rights are considered legally superior to, and take precedence over, the rights of the surface owner. Even in those states, however, mineral owners are not free completely to disregard the rights of surface owners and must limit their interference to what is reasonably necessary to develop the mineral estate. The rule reflects a judgment that it is in the public interest that natural resources, such as minerals, not be wasted. It appears that Maryland courts have not explicitly decided whether the common law rule applies in Maryland, but the Maryland legislature has both recognized the economic importance of oil and gas production, and indicated that the environmental cost of extracting oil and gas could, in certain circumstances, justify prohibition of oil and gas exploration and production. Env. Code Ann. § 14-101 provides:

The General Assembly finds and declares that the production and development of oil and gas resources is important to the economic well-being of the State and the nation. The drilling and production of oil and gas should be conducted in a manner that will minimize their effects on the surrounding environment. Furthermore, proper evaluation of a project and the use of the most environmentally sound drilling and production methods are necessary to prevent adverse environmental consequences that would be detrimental to the general welfare, health, safety, and property interests of the citizens of the State. In addition, there are certain circumstances where oil and gas exploration or production should be prohibited, such as when these operations will have a significant adverse effect on the environment. The General Assembly finds that the conduct of exploration or production of oil and gas resources under this subtitle will allow the safe utilization of the State's natural resources and will provide for the protection of the State's environment.

Maryland recognizes several common law tort claims that may potentially be used by persons who believe they have been damaged by Marcellus Shale gas production:

1. Trespass

A person who owns land generally has the right to exclude others from the land. If someone intentionally or negligently enters onto that land (either on the surface or subsurface) without authority, he or she has committed trespass. The essential element of trespass is the entry, regardless of whether harm has occurred, although the existence of harm will affect the award of damages. The "entry" need not be by a

¹⁸ Common law is the system of law based on custom and judicial precedent rather than laws enacted by a legislature.

person; in some circumstances the movement of pollutants onto property could be a trespass.

2. Negligence

A person can be liable if he or she negligently causes harm to another.¹⁹

3. Private Nuisance

If a person intentionally causes unreasonable, substantial interference with another person's right to use and enjoy his or her land, he or she can be liable for nuisance. A court might order the person to stop the interference, award money damages, or both. Nuisance is different from trespass in that there is no physical entry onto land.

4. Strict Liability and Liability for Abnormally Dangerous Activity

Strict liability means liability without fault. The basis for strict liability is the creation of an undue risk of harm to other members of the community, regardless of how much care was exercised in undertaking an abnormally dangerous activity (ADA). In the absence of a statutory definition of ADA, the issue of whether an activity is an ADA is a fact-intensive inquiry involving the consideration of multiple factors, including whether the activity is inappropriate to the place where it is carried on and the value of the activity to the community. The person seeking damages under strict liability must still prove the cause and effect between the action and the harm.

C. Criticisms of the Current Liability Structure

The current liability structure has been criticized on several grounds. Parties most likely to be injured by gas well drilling and operation are the surface landowner, neighboring property owners, or members of the general public near the drilling site. A dispute between such an individual and an oil and gas company is a classic example of asymmetry of resources. The company is likely to be prepared to defend a suit because it has experience with such litigation and ample resources to engage counsel and experts. Individuals, on the other hand, have probably not been involved in similar cases, and would be at a disadvantage in hiring lawyers and experts. Individuals with valid claims who do bring challenges can anticipate considerable expense and may have to wait for the appeals process to be exhausted before receiving any compensation for their damages.

Second, any legal theory currently available will probably require the individual to produce evidence on complex and cutting edge issues of engineering, geology and hydrogeology. Opposing experts may draw opposite conclusions from the same facts, especially where scientific understanding is incomplete.

Third, there are few meaningful remedies for those who do not own their mineral rights, but are nevertheless injured in some way by the activities. People who own mineral and surface rights can negotiate for some protection when contracting for the sale or lease of those rights to another party. A contract or lease may incorporate protections against

¹⁹ If a person has a duty to act in a certain way, *e.g.*, to exercise reasonable care, and fails to do so, and that failure causes damage that is natural, probable, proximate, and not too remote, the person may be liable for the damage. A familiar example would be an automobile accident caused by momentary inattention.

damage or include provisions for compensation. For example, the location for an access road could be specified to avoid cropland, or payment for crop damage could be stipulated. However, some surface owners never owned mineral rights in their land because those rights were reserved or transferred to someone else before the surface owner acquired the property. There is no way for these individuals to obtain any contractual protection.²⁰

Lastly, there are few meaningful remedies for neighboring residents, landowners, or businesses whose lands are not directly involved in drilling, but who may incur damage. As described above, a patchwork of common law tort claims provides the main source of remedies for these injured parties. Availability of a remedy differs depending on the situation and even when an injury seems to fall within one of the recognized torts, certain elements may be difficult for the injured party to prove under the circumstances.

D. Recommendations

Enact a Statute Creating a Presumption of Causation

Maryland could create a statutory presumption that certain types of damage were caused by the drilling activity or operation of the gas well if the damage occurred close in time and place to the gas operations. The presumption should be limited to the sorts of damage that logically could be associated with the activity. The Departments recommend that such a statute be enacted.

Maryland already has a similar law that could serve as a model. It applies to surface mines, such as sand and gravel mines, within karst terrain. Mine owners must obtain an MDE water appropriation permit in order to dewater the pit. When issuing the permit, MDE establishes a zone of dewatering influence around the surface mine. If drinking water wells in the zone of influence fail because of declining ground water levels, or the surface suddenly subsides within that area, the permittee must replace the water supply or compensate the landowner for the other damage. Md. Env. Code Ann. §§ 15-812, 15-813. The presumption is rebuttable; that is, if the mine operator can prove by clear and convincing evidence that its operations were not the cause of the damage, it can prevail and avoid liability. Essentially, the burden is shifted to the operator, so that it must prove its actions were *not* the cause of damage, rather than the individual needing to prove that its actions were the cause.

In the context of gas well drilling in the Marcellus Shale, a similar law could be enacted that would require MDE to establish, a “presumptive impact area” surrounding gas wells in Garrett and Allegany Counties.²¹ Determining the area would be more complex than

²⁰ The Departments acknowledge that responsible companies routinely work with surface owners, regardless of lease or contractual provisions, to minimize interference with the rights of the surface owner. In addition, companies will sometimes agree to accommodate the surface owner in order to avoid a challenge to the permit.

²¹ It is preferable to set the distance on a site-by-site basis or by regulation, rather than in a statute, because a regulation would be easier to amend if new information became available to justify a different distance.

in the dewatering example, where pump tests can verify the connection between the dewatering, the water table, and individual wells. At this time, any choice of area should be based on our current understanding of impact zones, but with the expectation that experience may justify a change. The authors of a September 2010 report of a Pennsylvania study assert that 3,000 feet is a more reasonable distance than 1,000 feet.²² The distances are measured from the vertical borehole.²³

MDE would also be responsible for designating the types of damage that the gas well could cause within the presumptive impact area. For example, the presumption might be applied to pollution of well water and damage to structures caused by vibration.

Finally, MDE would identify a reasonable time period within which the damage would be presumed to have been caused by the activity. The Pennsylvania study largely focused on potential changes within a short time period (usually less than six months) after fracking occurred.²⁴ The entire study lasted just two years. The authors suggest that more detailed, longer-term studies are needed to provide a more thorough examination of potential problems related to fracking, and to investigate changes that might occur over longer time periods.²⁵ If the time period is long, there is more of a chance that other events or factors could cause the damage. One year or more from completion of hydraulic fracturing may be appropriate.

A program would be established by which MDE would oversee the remediation or compensation of affected property owners. As under the dewatering law, the permittee would be able to rebut the presumption by proving its activities were not the proximate cause of the damage. After the time period under the law passes, an allegedly injured party would not be without a remedy, but he or she would have to prove causation rather than take advantage of the presumption.

Such a law would provide an incentive to the driller to test drinking water wells to document pre-existing problems before undertaking any site activities. If a landowner refused to allow the driller to test his or her water, the landowner would not be able to take advantage of the law.

Enact a Surface Owners Protection Act

Maryland could enact a law specifically for the protection of surface owners on whose, or under whose, land exploration or production activities occur. These laws have already been enacted in over a dozen states. The Departments recommend that such a law be adopted in Maryland.

²² Boyer, E.W., *et al.*, *The Impact of Marcellus Gas Drilling on Rural Drinking Water Supplies*” (October 2011) at 21, http://www.rural.palegislature.us/documents/reports/Marcellus_and_drinking_water_2011_rev.pdf.

²³ The interface between the vertical borehole and the drinking water aquifer is the most likely point of contamination. Because of the depth of the horizontal borehole, contamination of drinking water aquifers is less likely to occur and the pathway and presumptive impact area more difficult to predict.

²⁴ Boyer, E.W. *et al.*, *op. cit.* at 4.

²⁵ *Id.* at 21.

The provisions of Surface Owners Protection Acts (SOPA) vary from state to state. Commonly, however, a method of identifying all persons having surface rights is identified. Before performing any work on the site, the permit applicant gives notice to surface owners; the notice must sufficiently disclose the plan of work and operations to enable the surface owners to evaluate the effect of drilling operations on the surface owner's use of the property. The notice must include an offer to discuss with the surface owners all surface activities and the placement of roads, pipelines, points of entry and the like, as well as a method of placing a monetary value on any damages due to the activity such as destruction of crops, lost timber, and diminution in property value. If the parties reach agreement on these issues, the terms are recorded in a legally enforceable document. States take differing approaches in the event agreement is not reached. Some SOPAs require one party or the other to bring a court action; others allow the driller to enter after posting bond for possible future damage; and some allow mediation or arbitration. It is essential that there be time limits on negotiations, and that the consequences of failure to agree are clear.

SOPA should apply to all leases entered into after the effective date of the statute, unless there is disclosure of those rights and an explicit written waiver by the lessor. Laws designed to protect consumers could provide a model. See, *e.g.*, Md. Real Property Code Ann. § 10-603 (relating to the new home warranty security plan).

Enact a Law to Protect Residents, Landowners, and Business Owners Other than Surface Owners

This option would address the problems of residents, landowners, or business owners who might be adversely impacted by exploration or production but who are not covered under a Surface Owners Protection Act. The law could provide that a permittee would be strictly liable to the resident, landowner, or business for damage caused by the activity as long as the party can show that the damage was caused by the permittee's on-site or off-site activities. The injured party would have to file a civil suit but would not need to show that there was any intent, negligence or fault on the part of the permittee. This is what is meant by "strict liability" and is appropriate where the activity is abnormally dangerous.

The justification for applying such a strict liability standard to gas exploration and production is not clear. Also, there are other legitimate business activities that have the potential to have an adverse impact on the community; any move to impose strict liability should take this into account. At this time, the Departments do not recommend that Maryland designate, as a matter of law, that Marcellus Shale drilling and fracking be considered abnormally dangerous activities subject to strict liability. In any particular situation, the injured party would be free to bring a claim under a theory of strict liability, but the court would make a factual determination, based on several factors, whether drilling and fracking are abnormally dangerous.

Approach Community Impacts through Mediation or a Community Benefits Agreement

There may be instances where particular members of the community would be disproportionately affected by a proposed activity; for example, a home may be located very close to the only access road to a proposed drill site. Although responsible companies are often willing to address the concerns of such individuals, some members of the community may not feel equipped to discuss matters with a permit applicant. Mediation or another form of alternative dispute resolution (ADR) could facilitate this process. Local government could play an important role in reaching out to community members and providing ADR services. ADR can also be used to address perceived damage after it occurs, as an alternative to litigation.

Where the impacts are community-wide, a different approach may be appropriate. Community Benefits Agreements (CBAs) are legally binding, enforceable agreements between a developer and a community coalition. They allow community groups to press for community benefits that are tailored to their particular needs, and to enforce developers' promises. Each CBA is unique. Some communities are interested in deriving benefit from of the development activity, such as local hiring preferences, or new green space, recreation facilities, and parks. Communities can also negotiate to mitigate adverse impacts, such as vehicle traffic, noise or dust, with controls that are above minimum legal requirements.

The Departments recommend that a process for mediation and the negotiation of Community Benefits Agreements be established.

Increase Financial Assurance Requirements to Cover Additional Foreseeable Types of Damages

Bonds and insurance are a form of financial assurance; that is, they guarantee that some funds will be available to pay for work if the permittee fails to perform, and that some money will be available to pay for damages for which the permittee may be liable. Currently, bonds for oil and gas wells are limited in amount and address only compliance with laws, permits, and site reclamation. The Departments do not have enough experience with Marcellus wells to know whether the amount is adequate. The comprehensive general liability (CGL) insurance requirements currently require coverage of damages for injury to persons or property. CGL policies generally exclude coverage for pollution damage, which can be covered by other forms of insurance, such as Environmental Impairment Liability insurance. Increasing the amount of financial assurance would not change the liability standard, but it would help assure that money will be available to perform work the permittee fails to do, or to pay damages once liability is established.

Insurance issues are complex. The Departments do not have sufficient information at this time to make a recommendation regarding insurance. Because the law sets a minimum amount of liability insurance, MDE could change the insurance requirement through regulatory action in the future if it becomes apparent that more insurance is needed.

The Departments recommend that the General Assembly amend the law that limits the amount of a performance bond by deleting reference to a dollar amount and directing MDE to determine the proper amount of bond based on a consideration of the likely costs of complying with permit provisions, properly closing the well and performing site reclamation.

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Section V – Conclusions

Executive Order 01.01.2011.11 tasks the Departments of Natural Resources and the Environment MDE and DNR, in consultation with the Advisory Commission, to conduct a three-part study and reporting findings and recommendations. The first part of the study relates to revenue and liability. The Departments developed three recommendations regarding revenue (R) and four recommendations regarding standards of liability (L). They are:

- R-1 The General Assembly should impose a fee on gas leases to fund studies of issues set forth in the Executive Order.
- R-2 The General Assembly should enact a State-level severance tax and use it to address impacts of gas exploration and production on the environment and natural resources that are regional and not attributable to specific companies.
- R-3 The severance tax revenue should be deposited into a Marcellus Shale Environmental Fund to be used to fund continuing monitoring and address negative impacts that are not attributable to a specific company or permittee.
- L-1 The General Assembly should enact a law creating a rebuttable presumption that certain damages occurring close in space and time to exploration and production activities are caused by those activities, and an administrative process for requiring the permittee to remediate the damage, pay compensation, or both.
- L-2 The General Assembly should enact a comprehensive Surface Owners Protection Act.
- L-3 Community impacts should be addressed through mediation or by use of community benefits agreements.
- L-4 The General Assembly should amend the law that limits the amount of a performance by deleting any reference to a dollar amount and directing MDE to determine the proper amount of bond based on a consideration of the likely costs of complying with permit provisions, properly closing the well and performing site reclamation.

The majority of members of the Advisory Commission support these recommendations. A summary of the deliberations of the Advisory Commission can be found in Appendix E.

APPENDIX A – MEMBERS OF THE COMMISSION

Chair

David A. Vanko, Ph.D., *a geologist and Dean of The Jess and Mildred Fisher College of Science and Mathematics at Towson University*

Commissioners

Senator George Edwards

Delegate Heather Mizeur

James Raley, *Garrett County Commissioner*

William Valentine, *Allegany County Commissioner*

Peggy Jamison, *Mayor of Oakland*

Shawn Bender, *division manager at the Beitzel Corporation and president of the Garrett County Farm Bureau*

Steven M. Bunker, *director of Conservation Programs, Maryland Office of the Nature Conservancy*

John Fritts, *president of the Savage River Watershed Association and director of development for the Federation of American Scientists*

Jeffrey Kupfer, *senior advisor, Chevron Government Affairs*

Dominick E. Murray, *deputy secretary of the Maryland Department of Business and Economic Development*

Paul Roberts, *a Garrett County resident and co-owner of Deep Creek Cellars winery*

Nick Weber, *chair of the Mid-Atlantic Council of Trout Unlimited*

Harry Weiss, Esq., *partner at Ballard Spahr*

APPENDIX B – BASELINE DATA

Marcellus Shale Baseline Studies

Introduction

Determining existing water quality and quantity within the area of Western Maryland underlain by the Marcellus Shale is critical for establishing baseline data prior to gas well development. Data produced from future monitoring of streams and wells in the region will be compared to the baseline data to identify impacts that may be associated with gas development activities including drilling, hydraulic fracturing, trucking, etc. Collection of baseline ground water and stream data for at least two years is necessary to fully understand the magnitude of variations caused by different weather and seasonal events.

Garrett County is expected to see more Marcellus Shale gas development than Allegany County. Not only is the land area underlain by the Marcellus Shale greater in Garrett County than in Allegany County, but Garrett County is located over the Interior Marcellus Assessment Unit, which is thought to be more productive than the Foldbelt Marcellus Assessment Unit that underlies Allegany County. Due to the significant potential for high production levels, large numbers of wells and risks associated with trucking activities, Garrett County will be the focus of baseline studies in the immediate future. Baseline studies will not be initiated in Allegany County until such time as number of gas leases increases, indicating a greater potential for drilling. That study, if and when it occurs, will be funded from severance tax revenues.

Regional Water Quantity

Understanding the dynamics of ground water use and recharge is important for protecting both the quantity and quality of drinking water supplies in the region. Data are also needed to understand the influence of drought and the seasonal impacts of ground water withdrawal on the water resource and on the health of stream biota.

In Garrett and Allegany Counties, ground water exists in fractured rock aquifers. Surface water and ground water are important and interconnected water sources in such areas. Streamflow characteristics vary in response to different land use, geology, topography, soil, and other factors. Water availability depends upon the size of fractures as well as the interconnections between fractures. Water in this region moves down through the soil and decomposed rock and along joints, faults, and fractures in the underlying rock. Surface contamination can easily reach ground water.

The Maryland Department of the Environment is directed by statute to manage both the quality and quantity of water for public supplies, propagation of wildlife, fish and aquatic life, and domestic, agricultural, industrial, recreational, and other legitimate beneficial uses. Currently, requests for water appropriation permits are evaluated one permit request

at a time, and it is difficult to assess cumulative effects of multiple withdrawals on a watershed. The Advisory Committee on the Management and Protection of the State's Water Resources (the Wolman Committee) studied water supply State-wide, and made detailed recommendations for actions to obtain needed data. The Committee recommended drilling additional monitoring wells in fractured rock areas like Garrett and Allegany Counties and adding gages on associated streams to inform State decisions on how much water can be withdrawn from wells and streams without causing adverse impacts to the resource or other users.

There are currently three monitoring wells in the Marcellus play area of Garrett County and one in the Marcellus play area of Allegany County. One of the wells in Garrett County is measured only twice a year so is not suitable for tracking water level changes related to precipitation.

Regional Water Quality

To establish baseline conditions for regional water quantity, the State will drill six deep and six co-located (nested) shallow wells to monitor water levels and hydrologic conditions monthly at depths that are utilized by domestic and local municipal water supplies. The State will also establish or reactivate six stream gages at sites within the Marcellus development region. The United States Geological Survey (USGS) has thirteen gages that measure stream depth and flow in Garrett County and eight in Allegany County. Data from those gages will be included in the baseline analysis.

The existing water monitoring wells in Garrett and Allegany Counties are monitored for ground water levels only, not for water quality. The State will begin monitoring those and the newly drilled wells for water quality parameters such as trace metals, salts, methane, radioactivity, groundwater invertebrates, etc. The State will also establish real-time water quality monitoring of temperature and conductivity at four new stream gage sites and will periodically sample the surface water for other selected constituents.

Most of the existing USGS stream gages measure only stream depth and flow. The very limited data on water quality parameters that is available from the USGS will be included in the baseline analysis.

Specific Stream Data

Sampling of surface streams and the living organisms in them is key to establishing a baseline against which to assess the potential impacts of increased gas drilling, hydraulic fracturing, and production activity. DNR has identified a total of 652 stream reaches in Garrett County. Existing biological sampling programs have sampled 64 of those reaches, or about 10%, since 2007.

In 2011 DNR deployed twelve continuously-recording data loggers in Garrett County streams that are located down slope from potential Maryland or West Virginia gas drilling sites. The data loggers measure temperature and conductivity every hour.

Conductivity is a good surrogate parameter for detecting discharges of salts and other dissolved substances that could find their way into streams and rivers from gas well activities. While the twelve data loggers are located throughout Garrett County, they are not sufficient to provide baseline stream data.

Because the estimated gas resource, leasing activity and immediate interest in drilling are all higher in Garrett County than in Allegany County, the Departments believe it is reasonable to focus initial background monitoring and baseline studies on the potential gas play area in Garrett County.

About one-third (231/652) of the stream reaches in Garrett County are currently associated with parcels that have been leased for gas well activity. The Departments believe that through careful prioritization and in conjunction with the existing twelve data loggers, a sample of 50 of those stream reaches will be sufficient to establish baseline conditions. Criteria for selection of the stream reaches to be monitored will include areas associated with the highest density of leases, areas where the percentage of stream reaches already sampled is lowest, areas where the numbers of imperiled aquatic species are highest, and areas where the earliest drilling is expected to occur.

Each of the 50 stream reaches will be sampled by DNR during at least two consecutive years to give an adequate picture of seasonal and annual variations in those streams. The baseline monitoring will collect data on continuous conductivity and temperature, specific water quality parameters determined via laboratory analysis, and assessment of biological communities and physical habitat conditions. In 2012 DNR will also begin conducting biological sampling at the twelve data logger sites. Collectively, the existing 12 data loggers and the 50 additional stream reach monitoring sites will encompass over 25% of the stream reaches in Garrett County associated with parcels that have been leased for gas well activity.

To supplement the 50 thoroughly sampled locations, DNR plans to recruit, train, and equip teams of local volunteers to collect baseline conductivity, pH, water temperature, and possibly other data at additional stream locations.

Mapping and Survey Data

In order to assess potential future impacts to State resource and recreational lands as required by the Executive Order, the Departments are working to identify, locate and map severed mineral rights under State lands in Garrett County. Until the advent of Marcellus Shale drilling, it has not been necessary to map contiguous parcels owned by the Department or to locate severed mineral interests. The following land units with associated acreages are potentially impacted.

Land Unit	Acres
Savage River State Forest	54,324
Potomac State Forest	10,079
Garrett State Forest	7,639
Youghiogheny Natural Resource Management Area	3,993
Deep Creek Lake State Park	1,818
Mt. Nebo Wildlife Management Area	1,854

The work includes reviewing deeds, identifying mineral interests, and locating monuments referenced in the deeds with known monuments surveyed and mapped by DNR on the ground. In some cases, however, DNR does not have sufficient information to locate individual parcel. . Survey work in the field will be required to complete the mapping task and establish a complete baseline for assessing and mitigating potential impacts to State lands.

Study of Best Management Practices

Under Governor O'Malley's Executive Order 01.01.2011.11, the Maryland Departments of Natural Resources (DNR) and the Environment (MDE), in consultation with the Advisory Commission, are to report no later than August 1, 2012, on best practices for all aspects of gas exploration and production in the Marcellus shale in Maryland. These activities will range from site preparation activities through final closure, including drilling, hydraulic fracturing, handling of water, wastewater and chemicals, and installation of gathering lines and pipelines. The Departments are unable to accomplish this task with their existing staff and resources. A Request for Proposals for technical assistance in Best Management Practices for Marcellus Shale gas development is being prepared by MDE. The successful bidder will (1) provide information on best practices identified by other states, the industry, the federal government, and other sources, (2) suggest a suite of best practices that will provide the maximum protection of public health, safety, the environment and natural resources in Maryland, and (3) provide a draft of regulations to require best practices.

Economic and Resource Impact Study

An economic and resource impact study is needed to quantify the impacts, both positive and negative, of increased gas drilling, hydraulic fracturing, and production on other sectors of the economy including housing, transportation, food supply, and recreation/tourism. The study should identify ways to avoid or minimize adverse impacts on scenic landscapes, local land use patterns, rural character, forest habitat fragmentation, wildlife and other natural values that provide the basis for the recreation and tourism sectors of the region's economy. The Departments expect to contract through the Department of Business and Economic Development and/or the University of Maryland to conduct of this study.

APPENDIX C – COST OF COLLECTING BASELINE DATA

Marcellus Shale Baseline Study Costs	Year 1	Year 2	Basis of Calculation
Regional Groundwater			
Well and stream gage construction, monitoring equipment	\$265,000		Drilling 6 deep and 6 co-located (nested) shallow wells, purchasing 6 stream gages
Water sampling, equipment maintenance	\$70,000	\$70,000	Estimated annual cost of acquiring and analyzing monitoring data
Geologist	\$75,000	\$75,000	1 dedicated FTE geologist
Specific Stream Data	\$410,000	\$338,320	Estimated \$8050 per site x 50 sites = \$402,500/yr plus \$8,400/yr to recruit, train, equip volunteer teams; less equipment purchase in year 2
Survey Data	\$35,000		Yearlong effort by contractual employee
Economic and Resource Impact Study	\$65,000	\$35,000	Estimated cost of contract
Study of Best Management Practices	\$100,000		Estimated cost of contract
Totals	\$1,020,000	\$518,320	

APPENDIX D – REMEDIATION COST ESTIMATES

Cost Estimates for Providing Drinking Water to a Community

The probability of occurrence of a significant adverse environmental impact on important resources is unknown; hydraulic fracturing in the Mid-Atlantic region is a relatively new phenomenon. However, such impacts, should they occur, will be expensive to address. Consider a hypothetical example: contamination by dissolved metals of a drinking water aquifer used by a community of 1,000 people in 400 homes, with an average daily demand of 100,000 gallons per day. Two options, one for a community was served by a public water system and one for a community with individual wells, with cost estimates, are described below:

- Option I: If the community was served by a public water system whose wells have become contaminated, the system could install a reverse osmosis treatment system
- Estimated Capital Cost = \$5,000,000 (including required pre-treatment)
 - Additional Operation and Maintenance (O&M) Cost = \$300,000 per year
 - Present Value of O&M (at 4% for 20 years) = $300,000 \times 13.5903 = \$4,077,090$
 - **Total Estimated Cost is approximately \$9,077,000**
- Option II: If the community was served by individual wells which became contaminated, but a public system (assumed for purposes of the hypothetical to be 4 miles away) with sufficient quantities of clean water is available, water could be provided by that system
- Force Main Estimated Cost = $21,120 \text{ LF} \times \$100 \text{ per LF} = \$2,112,000$
 - Pumping Station = \$1,000,000
 - Storage tank and distribution system = \$3,000,000
 - Estimated Capital Cost = \$6,112,000
 - Additional O&M Cost = \$300,000
 - Present Value of O&M = \$4,077,090
 - **Total Estimated Cost is approximately \$10,190,000**

APPENDIX E – CONSULTATION WITH THE ADVISORY COMMISSION

The purpose of the Marcellus Shale Safe Drilling Initiative Advisory Commission is to assist State policymakers and regulators in determining whether and how gas production from the Marcellus Shale (and, presumably, similar gas-bearing formations) can be carried out in Maryland without unacceptably and negatively impacting public health, safety, the environment and natural resources. The Advisory Commission's role, therefore, is to serve as a body with which representatives of the Department of Natural Resources and of the Department of the Environment may consult during their (DNR and MDE) preparation of and production of the three reports called for in Executive Order 01.01.2011.11. The Advisory Commission helps identify and discusses issues surrounding shale gas development. It conducts its affairs openly and transparently and actively seeks and considers public commentary. Public comments are received through the Advisory Commission's web site and at Commission meetings.

Advisory Commission members include representatives from local and State government, the gas industry, environmental organizations, businesses, private citizens and landowners, a geology professor, and an environmental lawyer. The members have different perspectives and opinions, as well as a range of expertise and, consequently, achieving unanimity on all the issues discussed is difficult. This section of the report explains which recommendations enjoy broad support, which recommendations elicit a significant difference of opinion, and, finally, a number of other issues that were brought up in Advisory Commission meetings that are not part of the recommendations but that, nevertheless, are worthy of mentioning.

From its inception, members of the Advisory Commission have agreed that if shale gas production is to proceed in Maryland, it needs to be done "right." However, the definition of "right" varies to some extent among the Commissioners. All agree that safety is of paramount importance.

The Departments' recommendations were presented to the Commission at the meeting on November 15 and further discussed during a meeting on December 12, 2011. With respect to the findings and recommendations in the current report:

1. Commissioners largely agree that the pre-drilling costs of required data collection associated with a specific well or site should be the burden of the permit applicant.
2. During drilling, fracking and production at a specific site, certain costs as listed in the report are the responsibility of the permittee.
3. Commissioners agree that an applicant for a permit should provide a performance bond. The current statutes dictate a bond that cannot exceed \$100,000 per well,

or \$500,000 as a blanket bond for all of an applicant's wells. Some Commissioners expressed the opinion that these ceilings are too low. The Commissioners generally agree that the amount of the bond should be adequate to allow the State to complete the permittee's obligations if it fails to perform. The Commissioners suggested that the Departments should review the bonding requirements of other states.

4. In the case of possible non-site specific impacts, the report argues for the need for baseline data relating to ground water and surface water conditions, and possibly to regional air quality. To fund such baseline studies before any shale gas development activities, the Departments suggest a Marcellus Shale study fee. Commissioners expressed both positive and negative views on the proposed study fee. Those in favor noted that Maryland is in a unique position to obtain environmental information before any shale gas development takes place, for comparison to data obtained during and after drilling, fracking and production. This would make it possible to observe changes in environmental indicators that might be due to the development activities. Currently, DNR has no resources to conduct these studies without a new revenue stream. Advocates of the study fee argue that the data will be needed in the event drilling is ultimately permitted, and that establishing the baseline now would actually facilitate permitting in the future.

Those opposed to the study fee argue that there is no precedent for billing industry before they have an opportunity to commence development activities. They think that the current regulations in place that apply to coal mining and to obtaining water appropriations are sufficient to regulate the gas industry. In their view, skipping a Marcellus Shale study would accelerate the shale gas development.

5. Commissioners generally agree that a statewide severance tax needs to be assessed, the proceeds of which could be devoted largely to address general or regional impacts that are not easily attributable to a single company or a single well site. The report recommends the establishment of a Marcellus Shale Environmental Fund for this purpose.

Commissioners differ on the amount of the severance tax that should be enacted. The statewide severance tax will be in addition to the county severance taxes already in place. There is general agreement that the county tax should be controlled by the county as they see fit (the report recommends that counties direct much of the tax revenue to "programs and services that build the counties' human and physical capital, aid other sectors of the economy that may have been adversely impacted by gas development, and encourage diversification of their economies"). There is also general agreement that the statewide tax should be used primarily for Marcellus impacts.

6. Commissioners generally agree that a statute creating a presumption of causation should be enacted. Three parameters that need to be determined are (a) what kinds of damages are included, (b) within what time period should the presumption be in effect, and (c) within what distance of the wellhead should the presumption apply. Commissioners agree that pollution of well water and surface

water should be covered, although some disagree that damage to structures by vibrations caused by exploration seismic activity need to be included. A one-year time frame was generally thought to be adequate, although some Commissioners think a longer period would be better. A distance of 3000 feet from the wellhead was most often mentioned in Commission discussions.

Commissioners have asked the Departments to collect comparable information from neighboring states on what parameters they apply to the presumption of causation (i.e., kinds of damages covered, length of time and distance within which the presumption applies).

7. Commissioners agreed that a Surface Owners Protection Act is advisable. Surface owners who do not own or control the mineral rights beneath their land need some form of protection from significant negative impacts that drilling and fracking might have on their land.
8. Commissioners are in favor of a mediation approach to addressing incidents where shale development activities are having negative community-wide impacts.

The Advisory Commission identified a number of additional issues that it feels should be answered or considered. Among them are the following:

1. There are many issues surrounding the topic of leases. There is an apparent need for public education and/or consumer protection so that citizens are not lured into signing unfavorable leases. One Commissioner questioned whether any states regulate or license the “landmen” who offer leases. The question of whether leases could by law have to contain standard language was asked.
2. Another issue related to leases is how they are frequently bought and sold on a secondary market in a way that largely avoids having to pay Maryland tax. If the State could tax these sales, a new revenue source would be created.
3. Should Maryland establish a minimum royalty that all lessors should receive? Some states have a minimum royalty, and the Advisory Commission has asked the Departments to explore which states do so and at what level.
4. Realtors have concerns about property values and their fluctuations depending on whether mineral rights beneath a property or a nearby property have been leased. One realtor group contacted the Advisory Commission and requested consideration of a Maryland Gas Lease Registry, which could assist realtors in helping their clients. Commissioners noted that such a registry could also collect registration fees, providing another possible revenue source.
5. Commissioners discussed whether gas development could take place on State lands. In particular, there is a significant portion of State-owned land in Western Maryland where the State does not own the mineral rights. If the State is obligated to provide reasonable access for the mineral rights owner, what types of access and activities are reasonable on these lands that are used by the public?
6. One perceived problem of shale gas development in other states is a large influx of out-of-state workers. Some Commissioners would prefer that drilling and gas companies train and hire local workers to the maximum extent possible. One way

to incentivize this would be to build in a reward for doing so, possibly in the form of a severance tax deduction.

7. Some Commissioners suggest that careful control of the rate of permitting, if and when it begins to take place, will be one way to “keep a handle” on shale gas development and its possible impacts. There may be a potential for as many as 2200 wells in Garrett and Allegany Counties combined. By pacing the issuance of permits, the intensity of the activity, and presumably the impact, could be reduced.
8. Finally, the Advisory Commission largely agrees that environmental monitoring and strict regulatory enforcement are critical, because “it costs much more to clean up a spill than to prevent a spill.”

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