COMAR 26.19.01 Oil and Gas Resources
Issue Papers for Stakeholder Input - June 2016

Contents

Introduction 2
Background 2
Standards Maintained from 2015 Proposal 2
Stormwater, storage, and design of the well pad 3
Chemical disclosure 3
Control and reporting of air emissions 4
Management of wastes and wastewater 4
Plugging, abandonment, and bonding 4
How to Provide Feedback 4
Issue 1: Well Construction and Testing 6
Summary of 2015 Proposal 6
Recommended Changes from 2015 Proposal 6
Pilot Holes 7
Casing and cementing 7
Contents of integrity testing plan 8
Downhole safety valve 8
Fill production casing annulus with fluid 8
Issue 2: Comprehensive Development Plans 11
Summary of 2015 Proposal 11
Applicability 11
Contents 11
Review Process 11
Recommended Changes from 2015 Proposal 12
Contents 12
Review Process 12
Issue 3: Environmental Assessment and Baseline Monitoring 16
Summary of 2015 Proposal 16
Environmental assessment 16
Monitoring 16
Recommended Changes from 2015 Proposal 16
Environmental assessment 16
Monitoring of air quality 16
Baseline monitoring of surface and ground water 17
Issue 4: Setbacks and Location Restrictions 20

Summary of 2015 Proposal: 20
Recommended Changes from 2015 Proposal 20
Application of setbacks to infrastructure beyond the well pad 20
Protection of potable water supplies 20
Protection of rivers, streams and wetlands 23
Other Setbacks 25
Appendix A: List of VOCs Measured in 2014-2015 NETL Background Monitoring 34
Appendix B: List of Pollutants Monitored in 2014 at Frostburg Dam Monitoring Station 35

Introduction

Background

In 2011 Executive Order 01.01.2011.11 established the Marcellus Shale Safe Drilling Initiative (the Initiative). The Executive Order created an Advisory Commission 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. In consultation with the Advisory Commission, the Maryland Department of the Environment (the Department) and the Department of Natural Resources (DNR) were charged with reporting on the findings of the Initiative. The 2014 final report of the Initiative recommended best practices and concluded that, with implementation, monitoring and enforcement of those best practices, "the risks of Marcellus Shale development can be managed to an acceptable level."

On January 9, 2015, the Department proposed oil and gas regulations in order to incorporate best practices identified during the Initiative. 42:1 Md. R. 94 — 116. Over 100 people submitted comments on the 2015 proposal. Since the close of the comment period on the 2015 proposal, the Department has been reviewing the 2015 proposal to ensure that it protects public health, safety, the environment, and natural resources while avoiding unnecessary barriers to responsible development of the State's natural gas resources. As part of this effort, the Department has reviewed the public comments received on the 2015 proposal and has met with individual stakeholder groups to obtain additional input.

During the 2015 legislative session, amendments were made to Title 14, Subtitle 1 of the Environment Article, Annotated Code of Maryland, requiring the Department to adopt regulations, on or before October 1, 2016, providing for the hydraulic fracturing of a well for the exploration or production of natural gas. See Md. Code Ann., Envir. § 14-107(b)(2013 Repl. Vol., 2015 Supp.); see also 2015 Md. Laws Chs. 480, 481. The regulations adopted by the Department may not become effective until October 1, 2017; and the Department is prohibited from issuing a permit for the hydraulic fracturing of a well for the exploration or production of natural gas prior to October 1, 2017. Id. at § 14-107 (c), (d).

Standards Maintained from 2015 Proposal

The 2015 proposal was the result of extensive research by the Department and DNR, with input from experts in oil and gas production, geology, natural resources, public health, law, and local issues in Western Maryland. A great deal of work and expertise went into developing the best practices that formed the basis for the 2015 proposal. After reviewing that proposal in light of public comments and feedback received in the intervening

18 months, the Department believes that the 2015 proposal laid a solid foundation for ensuring natural gas production in the Marcellus Shale can occur in a manner that respects Maryland's environment and people. Maryland has also continued to benefit from the ongoing work of other states in the Marcellus Region as they respond to real-world experience in unconventional gas development, including through improvements to their regulatory requirements. As a whole, these examples provide further support for the strong safeguards in the Department's 2015 proposal.

In many areas, the Department has determined that the standards set forth in the 2015 proposal are both reasonable and necessary to provide adequate protection. These provisions will be retained as proposed in 2015. In a few areas, the Department is considering changes that would maintain or improve the level of environmental protection; introduce flexibility where needed; address considerations that were not addressed in the 2015 proposal; and adjust the focus toward preventing problems at the well site through design standards, rather than overreliance on setbacks and location restrictions.

This section describes briefly the major provisions from the 2015 proposal that the Department recommends retaining without substantive changes. The remainder of this document contains four issue papers describing in more detail the Department's current thinking with respect to four key issues from the 2015 proposal in which the Department is considering changes: (1) well construction and testing; (2) comprehensive development plans; (3) environmental assessments and monitoring; and (4) setbacks and location restrictions. Each issue paper includes an overview of the requirements included in the 2015 proposal and the Department's tentative suggestions for revising those requirements.

Stormwater, storage, and design of the well pad

Requirements related to the design, construction, and handling of materials on the well pad can significantly reduce the risk of impacts from accidental surface spills and runoff from the drilling site. The Department recommends maintaining these requirements as proposed in the 2015 proposal, including the following:

- The well pad must be lined with low permeability material and capable of containing the volume of at least the 24-hour, 25-year storm event.
- Only fresh water may be stored in a surface impoundment;
- A surface impoundment used for fresh water must be impermeable, at least 1 foot from the ground water table, and designed to prevent discharges of any kind to waters of the State, including through freeboard of 2 feet at all times and diversion of surface runoff from the impoundment.
- All liquids other than fresh water must be stored in watertight, closed tanks with secondary containment to collect any liquid if leakage should occur.
- Nonliquid chemicals must be stored in a manner that prevents contact with precipitation or other water.
- Stormwater from the pad may not be discharged as long as fuel or chemicals are present on the pad to prevent any inadvertent runoff of fuel or chemicals from the pad.

Chemical disclosure

The Department recommends preserving the 2015 provisions on chemical disclosure to the public. These provisions balance the interests of the public and healthcare professionals in access to information with the interests of the oil and gas industry in protecting intellectual property. An operator would be required to fully disclose to the Department the names and concentrations of chemical constituents in every commercial chemical product to be used on the site, and, for chemicals used in fracturing, the weight of each chemical used. In general, the operator is required to provide this chemical information to FracFocus,[1] members of the public upon request, local emergency response agencies, healthcare professionals, and public health professionals. If an operator attests that the concentration of a chemical in a commercial chemical product or

[1] FracFocus is an online chemical disclosure registry used by operators in multiple states. It allows the public to search for chemical usage information by well location.

fracturing fluid is a trade secret, it must still provide to the public a list of every chemical used, but need not link the chemical to a specific product or reveal the concentration. Healthcare and public health professionals who need trade secret information for medical or public health purposes must be given that information.

Control and reporting of air emissions

The Department recommends retaining the 2015 proposal's provisions to minimize air emissions from drilling sites. These provisions consist of several components, including:

- Implementation of top-down best available technology (BAT) as a condition of the permit, including at a minimum eight listed controls to reduce air emissions;
- Annual reporting of estimated methane emissions from each well pad, and upon notification from the Department that CO_2 equivalent allowances are available, purchasing of allowances to fully offset methane emissions;
- Implementation of a leak detection and repair (LDAR) plan, to include auditing, monitoring, repair of leaking components, and maintenance of LDAR data; and
- Installation and testing of blowout prevention equipment to prevent uncontrolled releases of gas into the air in the event of unexpected pressures (note that while this prevents air emissions, it is also an important safety precaution for people on or near the well pad).

Management of wastes and wastewater

To reduce opportunities for releases and other impacts from drill cuttings, produced water, and flowback, the Department supports the 2015 provisions focused on closed loop management and maximizing recycling of fluids. Drilling fluids and cuttings would be required to be managed on the pad in a closed loop system, and may not be placed in surface impoundments. Flowback and produced water would be managed in a closed loop system of tanks and containers, and must be recycled to the maximum extent practicable; the permit would establish a recycling rate of at least 90 percent. For wastes that must leave the site, wastewater could not be sent to a treatment facility unless the discharge permit for that facility specifically allowed it to accept the wastewater from the operation. Flowback and brine may not be land applied or used for de-icing. Operators must keep records on the quantities and fates of all wastes and wastewater generated on the site, and trucks transporting wastes from the site must keep records to track transport of waste to their destinations.

Plugging, abandonment, and bonding

The Department recommends retaining the standards for plugging and abandoning wells, including deadlines for plugging following discontinuation of production, technical standards for the depth of plugging, marking of plugged wells, and certification of proper plugging to the Department. The operator of each well would be required to post a bond in an amount sufficient to cover the cost of closure, but no less than $50,000, which would not be released until the Department approves that the well was properly plugged and the site reclaimed.

How to Provide Feedback

Written comments on these suggestions will be accepted through July 18, 2016 by e-mail at marcellus.mde@maryland.gov or by mail at:

Maryland Department of the Environment
1800 Washington Boulevard, Suite 610
Baltimore, MD 21230

Based on continuing review and evaluation of the comments received, the Department will propose a revised set of regulations in the *Maryland Register* in advance of the October 1, 2016 promulgation deadline. Following proposal, the Department will provide an additional 30-day written comment period before taking any final action on the regulations.

Issue 1: Well Construction and Testing

Summary of 2015 Proposal:

COMAR 26.19.01.22, .36, .38-.41

The 2015 proposal incorporated best practices related to drilling, casing, cementing, integrity testing, and monitoring of wells. The proposed regulations generally adopted the best practices identified by the University of Maryland Center for Environmental Science (UMCES) in its 2013 Best Practices Report.[2] These practices were based on industry guidance documents and regulatory requirements in other states. Key requirements include:

- Notification of the Department prior to the start of drilling;
- Sampling and logging during drilling, including to determine the depth of freshwater zones;
- Drilling of one pilot hole for each well pad where directional drilling will be used;
- Submission of a drilling, casing and cementing plan that provides for zonal isolation;
- Compliance with minimum standards for casing and cementing, including installation and cementing of surface casing to at least 100 feet below the lowest freshwater;
- Compliance with minimum casing specifications, including the requirement for steel alloy casing with a minimum internal yield pressure rating designed to withstand at least 1.2 times the maximum pressure to which the casing may be subjected;
- Submission of a plan for integrity testing and pressure testing of the cased hole, including segmented radial cement bond logging (SRCBL);
- Certification of the integrity of cement and casing, including isolation of fluid-bearing formations, prior to the start of hydraulic fracturing;
- Use of a tiltmeter or microseismic survey to determine the extent, geometry, and location of fracturing for the first well hydraulically fractured on each pad;
- Installation and testing of blowout prevention with two or more redundant mechanisms; and
- Periodic integrity testing during the life of the well.

Recommended Changes from 2015 Proposal

The Department considers best practices for well planning, construction, and testing to be among the most important provisions in the regulations. Proper construction ensures the integrity of the well and the isolation and protection of the fluid-bearing zones through which the well passes. Specifically, casing prevents leakage of gas from inside the well, and proper cementing prevents the creation of channels through which methane from outside the well can migrate upward to fresh water aquifers. While setbacks may delay or lessen the impacts of methane migration, best practices that ensure the integrity of the well prevent problems before they occur. In addition to largely preserving the safeguards proposed in 2015, the Department suggests several improvements to better ensure well integrity, consistent with industry best practices.

[2] [2] Eshleman, Keith and Andrew Elmore, University of Maryland Center for Environmental Science Appalachian Laboratory, "Recommended Best Practices for Marcellus Shale Gas Development in Maryland." February 18, 2013, http://www.mde.state.md.us/programs/Land/mining/marcellus/Documents/Eshleman_Elmore_Final_BMP_Report_22113_Red.pdf

Pilot Holes

Recommendation: Rather than always requiring a pilot hole to be drilled for each well pad prior to directional drilling, the Department suggests a case-by-case approach. For each well pad on which directional drilling will be used, the operator must either drill a pilot hole or submit for approval an explanation of how the operator will determine the geologic and hydrogeologic nature of the well pad site and identify geologic features, underground voids, gas- or water-bearing formations, geologic faults, and the lowest freshwater aquifer. In some cases, the operator may have adequate information from other sources, such as the geological investigation required for the comprehensive development plan and from nearby well pads, confirmed by logging of each section of the well as it is drilled, such that a pilot hole is not necessary for every well pad. In these cases, the risk of opening another channel through which methane could migrate may outweigh the benefit of the pilot hole.

Casing and cementing

The 2015 proposal required an applicant's casing plan to contain, at a minimum, certain standards for conductor, surface, intermediate, and production casing. Conductor casing is shallow casing used primarily to keep unconsolidated surface sediment from collapsing during drilling.[3] Surface casing extends below the freshwater zone to protect and isolate fresh water. Only air or fresh water based drilling fluid may be used through this zone. Because of the depth of the Marcellus Shale, an intermediate casing is used to provide well control and stability and to isolate shallower gas-bearing formations. Finally, the production casing isolates the producing zone and contains the production tubing through which gas is brought to the surface. The Department suggests the following to ensure that minimum casing standards adequately protect groundwater. (See Figures 1 and 2 for a depiction of the 2015 proposal and the adjustments recommended below.)

Run all casing strings to the surface

Recommendation: The Department suggests clarifying that all casing strings must be run to the surface. The 2015 proposal was unclear and may have been interpreted to allow these casings to terminate at the bottom of the preceding casing. (For example, proposed COMAR 26.19.01.38E(3) stated: "The intermediate casing shall be installed and cemented from its greatest depth to the bottom of the surface casing.") This clarification ensures that freshwater will be protected by at least three layers of casing, and that the production casing will provide a direct and controlled conduit from the target formation all the way to the surface.

Additional casing layer and protection of underground sources of drinking water

Recommendation: A casing and cementing plan should ensure isolation of fresh water that provides drinking water for many residents in Western Maryland. However, deeper aquifers that do not qualify as "fresh water" may still warrant isolation and protection as possible future sources of drinking water. The federal definition of underground sources of drinking water (USDW), for example, includes an aquifer that contains a sufficient quantity of water to supply a public water system and contains less than 10,000 mg/L of total dissolved solids. 40 CFR §144.3. In comparison, the 2015 proposal's definition includes only water containing less than or equal to 1,000 mg/L of total dissolved solids.

The Department recommends an additional casing layer that would provide an extra layer of casing to isolate the ground water that is actually used as drinking water in the surrounding area. In this scenario, an additional "drinking water casing" would extend to at least 100 feet below the depth of the deepest private drinking water well in the surrounding area, including, at minimum, the area within 2,500 feet from the vertical wellbore. The second casing layer, the surface casing, would extend to 100 feet below the lowest USDW or the lowest coal seam through which the well passes, whichever is deeper. The third layer, the intermediate casing,

[3] API HF 1 (1st Ed. October 2009), http://www.shalegas.energy.gov/resources/HF1.pdf

would extend to the depth needed to provide for well control, down-hole stability, safety, and separation of flow zones. The fourth layer would be the production casing.

Based on conversations with the Pennsylvania Department of Environmental Protection, a similar approach using an additional layer of casing is often used in the Southwestern portion of Pennsylvania, which is closer in proximity and geology to Western Maryland. In these wells, separate strings of casing are used to isolate drinking water and workable coal, in addition to the typical intermediate and production casings. Like Southwestern Pennsylvania, significant portions of Garrett and Allegany Counties have coal seams through which gas wells may be drilled.

Cement the intermediate casing to the surface

Recommendation: The 2015 proposal required the intermediate casing to be cemented from its greatest depth to the bottom of the surface casing. The intermediate casing should instead be cemented to the surface to secure the space between the surface and intermediate casings all the way to the surface. This is a requirement in both Pennsylvania and West Virginia. 25 Pa. Code § 78.83c(3); 35 West Virginia CSR § 8-9.2.

Contents of integrity testing plan

Recommendation: The 2015 proposal requires a permit applicant to submit a plan for integrity and pressure testing of a cased hole, to include SRCBL and other methods, such as omnidirectional cement bond logging and neutron logging. The Department recommends adding more specific language stating that the plan must include testing at the following points during drilling and operation of the well.

- **Casing shoe testing for "drinking water," surface, and intermediate casings.** A casing shoe test is conducted following the placement and cementing of each of the drinking water, surface, and intermediate casings. After the casing is set and cemented, a short portion of the next segment is drilled and pressure-tested. This practice is used to test the strength of the casing shoe and formation below it and to ensure there are no flow paths above the casing shoe.

- **Production casing and production tubing integrity test.** After the production casing is run and cemented and the production tubing is placed, the annulus between the production casing and tubing must be tested to 1.2 times the maximum internal pressure to which the annulus may be subjected.

- **Periodic integrity testing during life of well.** Integrity testing during the life of the well should occur no less frequently than every 5 years.

- **Integrity testing following shut-in.** Integrity testing should be performed prior to restart of a well after a shut-in period greater than 1 year.

Downhole safety valve

Recommendation: The Department proposes to require the well to be equipped with a downhole safety valve in the production string. If a loss of pressure occurs to the well, the device would close and shut off the flow of gas. This would prevent uncontrolled release of gas in the event of a failure at the wellhead. The downhole safety valve should be required to be tested prior to putting the well into production.

Fill production casing annulus with fluid

Recommendation: The Department suggests requiring the annulus between the production tubing and the production casing to be filled with a sufficient quantity of fluid to kill the well and prevent any gas outside the production tubing from flowing out of the well bore. This practice also allows for ongoing monitoring of the fluid level, which serves as an integrity test.

Figure 1: Casing and Cementing - 2015 Proposal

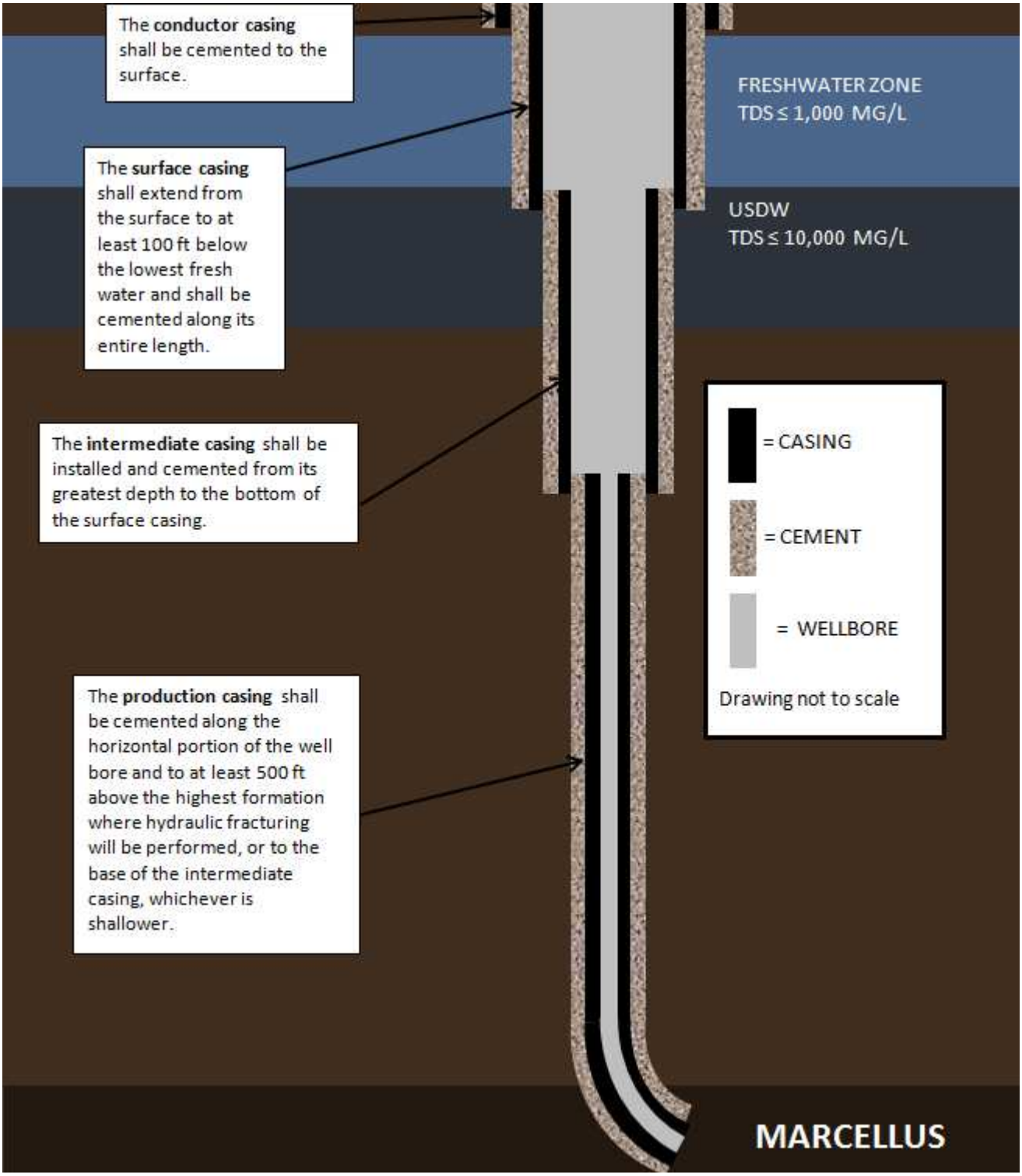
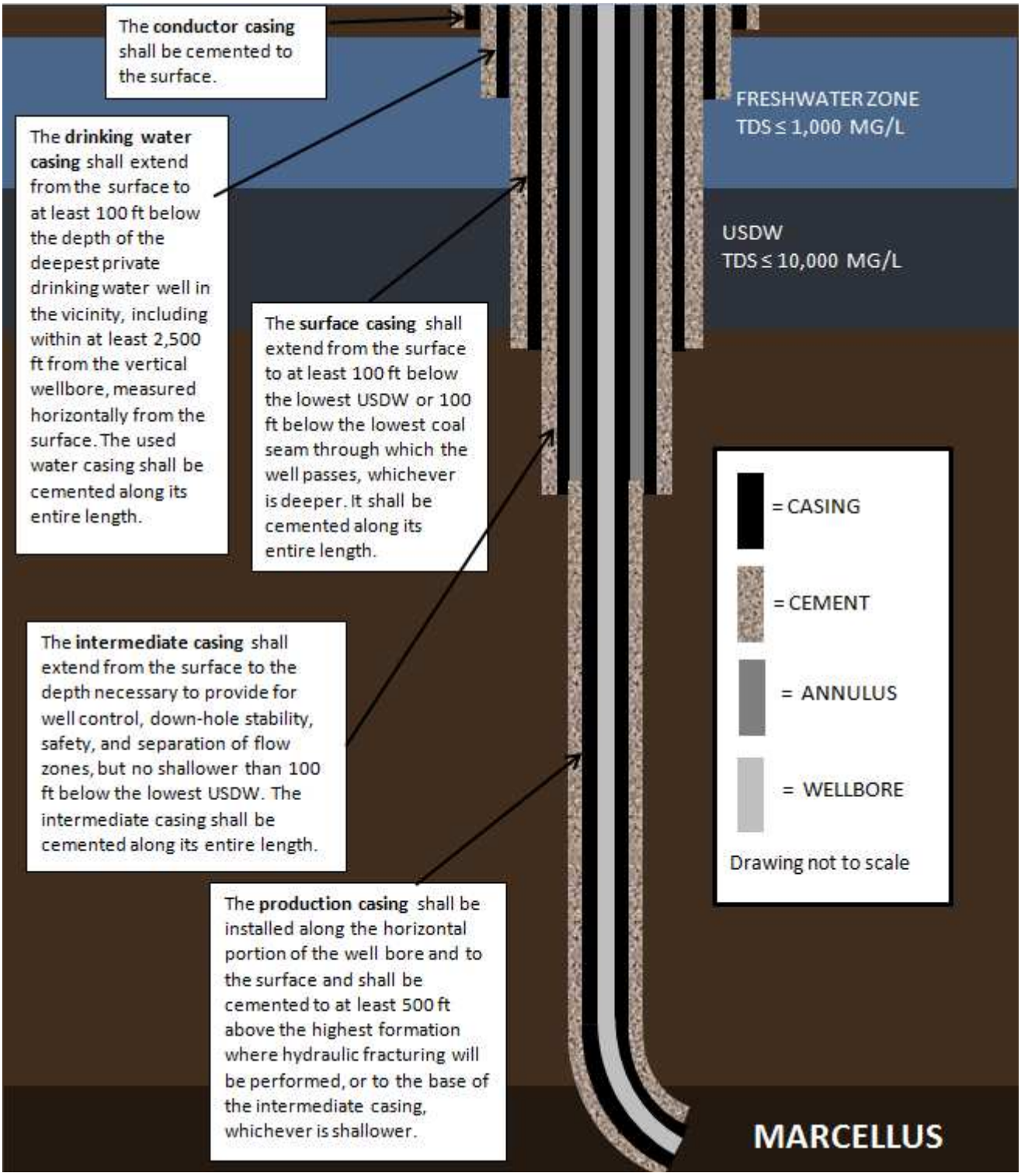


Figure 2: Casing and Cementing – 2016 Recommended Casing



Issue 2: Comprehensive Development Plans

Summary of 2015 Proposal

COMAR 26.19.01.11 and .12

A Comprehensive Development Plan (CDP) is a roadmap that lays out an operator's intended gas development over the next several years. The CDP proposes locations of wells and other infrastructure, taking into account environmental and other constraints. In its Best Practices Report, UMCES recommended that Maryland regulations include a voluntary CDP incentivized by lower permit fees or bond requirements. UMCES noted that by planning and considering constraints at the landscape level and with stakeholder feedback, development can be channeled to areas with a comparatively lower impact on the environment and surrounding communities. In its 2015 proposal, the Department adopted UMCES' recommendation and went a step further, making the CDP mandatory and laying out an extensive process of stakeholder review.

Applicability

The CDP would be a prerequisite to submission of an application for a drilling and operating permit for wells using any of the following techniques: directional drilling; multi-well pads; acid stimulation, except of a storage well; and high-volume hydraulic fracturing. A person may drill up to one wildcat well every 2.5 miles without first completing a CDP. The CDP may be completed by each operator separately, or may be completed by multiple operators to cover development within a given area.

Contents

The CDP would include geological and location data for the applicant's planned development over at least the succeeding 5 years. The CDP would be completed using a "CDP planning guide and State-provided toolbox," which would include some of the geospatial data needed to comply with location restrictions and setbacks. The applicant would need to provide any other data needed to complete the CDP. The CDP must include:

- The locations of all planned wells, well pads, gathering and transmission lines, compressor stations, separator facilities, access roads, and supporting infrastructure;
- Survey data and field notes from a geological survey of the CDP area;
- Proposed travel routes within Maryland for transport of equipment and materials to and from the well pad;
- A water acquisition plan; and
- The sequence of well drilling, which must locate the first well pads in areas removed from natural resources.

Review Process

The review process for the CDP would consist of several phases. First, the draft CDP would be reviewed preliminarily by the Department and State and local agencies responsible for public health, natural resources, and roads. The applicant would revise the CDP in accordance with preliminary comments and re-submit it to the Department. The Department would notify the Department of Natural Resources (DNR) and DNR would convene a stakeholder group to discuss the CDP. Following the stakeholder group's review, the CDP applicant would hold a public meeting on the CDP and accept public comments. The applicant would then submit the CDP, with any needed revisions, to DNR. DNR would conduct a review of the CDP and transmit it to the Department with advice on whether the CDP meets regulatory requirements and meets the following criteria:

- Avoids, to the extent possible, adverse site-specific and cumulative impacts to public health, the environment, the economy, and the people of Maryland;
- Minimizes adverse impacts that cannot be avoided; and
- Mitigates any remaining impacts.

Finally, the Department would review the CDP and approve or disapprove it. Figure 3 depicts the steps of the review process in detail.

Recommended Changes from 2015 Proposal

The Department proposes to retain the mandatory CDP for the activities listed in the 2015 proposal. The CDP provides an important opportunity to plan for the various aspects of shale gas development in advance and at a broad level. It ensures that the applicant has considered ahead of time how development can be carried out without excessive disturbance of natural resources and surrounding communities. It also provides the Department and other State and local agencies an opportunity to plan for the number and location of wells to be developed over the next 5 years, allowing for more effective oversight and better customer service. The Department considers the primary purpose of the CDP to be as a planning tool rather than a mechanism for determining compliance. As part of each permit application under a CDP, the applicant will provide an in-depth plan for construction and operation of the well. This information, along with the environmental assessment, will allow the Department to make an informed regulatory determination of whether the well would pose a substantial threat to public safety or a risk of significant adverse environmental impact, including to populations in the surrounding communities. If it would, the Department would be required to deny the permit.

As proposed in 2015, the procedures for CDP review would have resulted in excessive delays. The complete process would likely take well over 7 months, exclusive of any judicial review. This process would be in addition to public participation on each permit application under the CDP. The Department therefore considered alternatives to simplify the review process for the CDP. The process should focus on the opportunity for broad public and agency feedback rather than on a limited stakeholder group. The CDP-applicant should still be required to demonstrate that a CDP has been completed and undergone public participation prior to review of a permit application.

Contents

Recommendation: The contents of the CDP would be similar to those required in the 2015 proposal, except the regulations would clarify that the CDP is not required to address development of infrastructure to be operated by other entities, such as transmission lines and compressor stations.

Rather than requiring the State to develop and update a planning toolbox and requiring each applicant to use that toolbox in the development of the CDP, the applicant would be responsible for obtaining the geospatial and geological data necessary to create the CDP, but may draw on existing data sources, including State-provided data if available and sufficiently recent. This adjustment would clarify the fact that while a significant portion of the necessary data can be found through publicly available sources such as Maryland's iMap portal, the applicant is ultimately responsible for ensuring that the CDP is based on accurate, complete data, and providing any data that may not be available through existing sources.

Review Process

Recommendation: The Department is suggesting a more simplified process for review of the CDP. The revised procedures would preserve the value of the CDP as a planning tool for the applicant, the Department, and local jurisdictions and allow for an iterative public input process, without causing unnecessary delay or redundancy. This suggestion is in keeping with the Departments' 2014 Best Practices Report published as part of the

Initiative, which expressed the intent to structure the CDP requirement so that obtaining a CDP is not unduly burdensome to the applicant.[4]

The simplified process would require the applicant to publish the draft CDP and accept comments from the public, the Department, and other State and local agencies. The applicant would be required to post each comment received on its website. The applicant would also present the draft CDP at a public meeting in the county in which development would take place. Following the public comment period, the applicant would be required to consider the comments received and may make changes to the CDP in response to those comments. The final CDP must be maintained on the applicant's website in a publicly accessible form. When the applicant applies for the first drilling and operating permit under the CDP, the final CDP must also be submitted to the Department, with a description of the applicant's public participation process and a synopsis of the comments received. The Department will not begin reviewing a drilling and operating permit application for which a CDP is required unless the applicant has submitted the final CDP and accompanying information. See Figure 4 for a detailed description of the suggested review process.

In the 2015 proposal, DNR would make a recommendation on whether to approve or deny a CDP based on whether the CDP adequately avoids, minimizes, and mitigates site-specific and cumulative adverse impacts. The Department would then make a final decision on whether to approve or deny a CDP. In the current proposal, there would be no separate approval of a CDP, nor would DNR be tasked with evaluating whether the CDP avoids, minimizes, and mitigates adverse impacts. For the new proposal, the Department's permit review would ultimately determine whether and under what conditions each well can be constructed and operated in a manner protective of public health, the environment, and surrounding populations. Because the CDP is a more high-level plan with less detailed information than the individual permit applications, the Department does not believe it is ideal to make a determination at the planning stage as to whether an operator's proposed development adequately avoids, minimizes, and mitigates adverse impacts. However, the Department still believes there is value in the applicant considering these goals as part of its planning process. The Department therefore suggests requiring the applicant to consider the following planning principles in the development of the CDP:

- Compliance with the setbacks and location restrictions in the regulations;
- Avoidance, to the extent possible, of adverse impacts of the overall plan of development on public health, the environment, the economy, and the people of Maryland;
- Minimization of impacts that cannot be avoided, and mitigation of any remaining impacts.

As part of the review for each permit application, the Department would be required to evaluate the application and deny a permit if it determines the proposed activities would pose a substantial threat to public safety or a risk of significant adverse environmental impact.

As in the 2015 proposal, the CDP must include development planned for at least the succeeding 5 years, but the CDP would remain in effect for up to 10 years after it is finalized by the applicant. If significant changes to the CDP are needed, such as adding a well pad, or at the end of the 10-year period, the applicant must revise the CDP and undergo public participation on the revised CDP.

[4] Maryland Department of the Environment and Maryland Department of Natural Resources, Marcellus Shale Safe Drilling Initiative Study: Interim Final Best Practices (2014), http://mde.maryland.gov/programs/Land/mining/marcellus/Documents/7.10_Version_Final_BP_Report.pdf

Figure 3: 2015 Proposed CDP Review Process

1. Submit draft CDP to the Department.

The applicant submits a draft CDP to the Department. The Department forwards the draft to local agencies responsible for land use, roads, and environmental protection.

2. Receive preliminary comment by agencies.

The agencies comment to the Department, and the Department provides the comments to the applicant within 45 days after receipt of the CDP by the Department.

3. Submit revised draft CDP to Department.

The applicant makes any necessary revisions in response to preliminary comments and re-submits the CDP to the Department.

4. Participate in DNR-led stakeholder group.

The Department notifies DNR, which convenes a stakeholder group. Stakeholders meet with a facilitator and discuss the CDP. They complete their discussion within 60 days after the Department's receipt of the CDP.

5. Hold a public meeting.

The applicant presents the CDP at a public meeting. Public comments are accepted on the CDP for an additional 5 days after the public meeting.

6. Submit CDP to DNR.

The applicant may revise the CDP before submitting the final version to DNR.

7. DNR review and advice.

DNR reviews the CDP and within 30 days transmits it to the Department with written advice on whether the CDP conforms to the location restrictions under the regulations and, to the maximum extent possible, avoids the adverse impacts to public health, the environment, the economy, and the people of Maryland, minimizes unavoidable impacts, and mitigates remaining impacts.

8. Department review and decision.

The Department reviews the CDP and within 30 days of receipt must approve, disapprove, or partially approve the CDP.

Figure 4: 2016 Suggested CDP Review Process

Issue 3: Environmental Assessment and Baseline Monitoring

Summary of 2015 Proposal

COMAR 26.19.01.17 and .49

Environmental assessment

The statute requires an applicant to submit an environmental assessment (EA) with each application for a drilling and operating permit. The purpose of the EA is to assist the Department in evaluating the application. The Department must coordinate with DNR to review the EA. Environment Article, § 14-104(b), Annotated Code of Maryland.

Existing regulations do not define EA, but in the past the Department has provided guidance on topics that must be considered in the EA, including an evaluation of site conditions, historical landmarks, endangered species, streams and water bodies, noise, air quality, transportation, and public health and safety. The 2015 proposal further defined an EA to include a discussion and evaluation of the possible ecological, aesthetic, historic, cultural, economic, social, or health impacts of the planned drilling and operating. It specified that the Department, in consultation with DNR, would develop guidance for completing the EA.

Monitoring

The 2015 proposal required an applicant for a drilling and operating permit to drill a new well to submit 2 years of baseline monitoring data with the permit application. The baseline monitoring was required to include the surface water, ground water, and air in the vicinity of the well pad. Baseline monitoring would be conducted in accordance with guidance developed by the Department, in consultation with DNR. The baseline monitoring guidance would include sampling design, monitoring protocols, quality assurance and quality control criteria, and specifications for analysis and data submission. Ongoing monitoring during the periods of drilling, hydraulic fracturing and production as specified in the drilling and operating permit was also a requirement. The Department and DNR would jointly develop protocols for ongoing monitoring and assessment for air and water quality, terrestrial and aquatic living resources, invasive species, geophysical assessments and any additional information as required by the Department.

Recommended Changes from 2015 Proposal

Environmental assessment

Recommendation: No changes are proposed to the EA requirement, which is an existing statutory requirement. The Department would build on its existing EA guidance to assist applicants in preparing the EA.

Monitoring of air quality

The Department is considering not requiring each applicant to conduct before and after air quality monitoring. The current Maryland moratorium on hydraulic fracturing provided an opportunity for Maryland to partner with the National Energy Technology Laboratory (NETL), prior to the commencement of the natural gas exploration, to monitor air quality in the general area where future natural gas exploration may occur in order to establish background concentrations of pollutants associated with natural gas exploration.

NETL conducted background monitoring approximately two miles southeast of Oakland during two separate periods: May-August 2014 and November 2014-February 2015. NETL used a mobile laboratory to measure concentrations of ozone, oxides of nitrogen, nitrogen dioxide, fine and coarse particulate matter, greenhouse gases (methane and carbon dioxide), hazardous air pollutants and other non-methane volatile organic

compounds (VOCs). A meteorological station to measure meteorological parameters was also a part of the monitoring effort. A list of the VOCs that were monitored is in Appendix A.

The Department maintains a mountaintop monitoring station at the Frostburg Dam. The station routinely measures for ozone, fine particulate matter, sulfur dioxide, carbon dioxide and oxides of nitrogen. In addition to this routine monitoring, monitoring for additional pollutants was conducted for 58 ozone precursor compounds, such as benzene, toluene, propane and ethylbenzene, and 44 TO-15 compounds, such as butadiene, styrene, methylene chloride and chloroform. A list of the specific pollutants associated with the two sampling groups is in Appendix B. Sample collection began on January 11, 2014 and continued until November 19, 2014. Methane data was collected at the Frostburg Dam station beginning in the fall of 2013. There were 238 days of valid data collected for methane.

The Department is of the opinion that the NETL monitoring effort and the Department's monitoring at the Frostburg Dam adequately characterizes background levels in the area.

NETL has agreed to return to Maryland to conduct additional monitoring when gas development takes place to determine whether there is any change in ambient concentrations during a typical operation. This follows the approach of several other states and the EPA, where studies were undertaken near well pads or compressor stations during times of active hydraulic fracturing. During some of those studies, hydrogen sulfide and carbonyls were measured in addition to some or all or the pollutants mentioned earlier. NETL has requested funds to purchase equipment to measure hydrogen sulfide, which would allow them to add that pollutant to their monitoring program. As for carbonyls, NETL would be able to collect samples for the Department using equipment supplied by the Department with analysis of those samples conducted by an EPA contract lab or another state lab that provides that analytical service. The Department believes this overall effort by NETL is sufficient to characterize air quality impacts associated with gas exploration and production.

As an added measure, the Department is also pursuing amending its air toxics regulations to require equipment associated with hydraulic fracturing operations to undergo a review to determine if any emissions after applying required pollution controls will have an adverse impact on public health using the public health protection screening criteria used for stationary equipment (COMAR 26.11.15). Such equipment is currently exempt from such a review.

Recommendation: The Department recommends the following to address air monitoring:

- Remove the requirement to perform baseline and ongoing air quality monitoring at each well pad, and instead use data from NETL's regional air monitoring efforts and the Department's Frostburg Dam monitoring station to characterize air quality before and after gas development takes place in Western Maryland; and
- Pursue amending existing air toxics regulations to require an evaluation of whether air emissions from gas wells would have an adverse impact on public health.

Baseline monitoring of surface and ground water

Baseline monitoring prior to site preparation or drilling activities is important to allow for the later detection of any environmental impacts from drilling and operating activities. Particularly for water quality, baseline monitoring is useful for both the regulator and the operator. Information on any existing contamination would be important for an operator to rebut the statutory presumption that contamination of a water supply within 2,500 feet from the vertical wellbore and within 1 year from the certain gas exploration and production activities was caused by those activities. Environment Article, § 14-110.1. Baseline monitoring is also used to create the EA required as part of the permit application.

The 2015 proposal adopted the recommendations from the UMCES report for 2 years of baseline monitoring. During the comment period on the 2015 proposal, the Department received comments stating that the 2-year monitoring period prior to submission of a permit application would produce unnecessary and excessive delay and discourage gas development. This is compounded by the fact that baseline monitoring must be conducted specific to the vicinity of each well pad so that a one-time regional monitoring program, such as for the area covered by each CDP, would not necessarily suffice.

The moratorium on hydraulic fracturing has given the State time to collect background water quality data. Since June 2011, monitoring has been conducted at 12 sites in Garrett County to determine baseline (range of values/health) conditions in select streams and rivers in advance of Marcellus Shale natural gas development. Information collected from these streams includes continuous conductivity and temperature data, overall stream health based on the biological communities (fish and benthic macroinvertebrates), physical habitat, and a suite of water quality parameters. In 2012, the State collaborated with watershed associations, Trout Unlimited, colleges and citizens in western Maryland to form the Marcellus Shale Stream Monitoring Coalition. The primary goal of the Coalition is to collect water quality and biological data from streams and rivers in Garrett County to help characterize baseline stream conditions and supplement the State's monitoring in the Marcellus Shale region. Currently there are 60 volunteers participating in this monitoring program, in which data are being collected from an additional 70 streams.

A review of other Department regulatory programs indicates that the 2015 proposal exceeded the typical duration for baseline monitoring prior to permit issuance. For coal mining permits, the Department requires 6 months of baseline water monitoring data to be submitted with the application. For municipal, rubble, and industrial landfills, the Department requires at least four samples from each proposed monitoring well prior to permit issuance. There is no specific requirement on the timing of the four samples, but the Solid Waste Program recommends quarterly samples for four quarters, or 1 year of sampling. The Solid Waste Program considers this sufficient because quarterly sampling accounts for seasonal variation and allows adequate time for the disturbed sediment in the water to settle out before sampling again.

Ohio and West Virginia both require at least one-time sampling of water supplies in the area surrounding the proposed well. In Ohio, an application to drill a well in an urbanized area must be accompanied by testing results from private drinking water wells within 1,500 feet of the wellhead for a horizontal well, and 300 feet for a vertical well. ORC §1509.06 (a)(8)(b)—(c). Agency guidance specifies the parameters to be tested, but does not require multi-year or multi-season sampling for each well. Ohio does not require baseline monitoring of surface water. In West Virginia, an applicant for a horizontal well must sample any water well or developed spring located within 1,500 feet of the proposed gas well, if requested by the surface owner or water purveyor. If not requested, the applicant must sample at least one water well within 1,500 feet, or if no well can be found within 1,500 feet, within 2,000 feet. West Virginia CSR §35-8-15. Pennsylvania, like Maryland, has a presumption of causation for contamination of a water supply within 2,500 feet of an unconventional gas well. If an operator would like to preserve its defense that contamination of a public or private water supply pre-dated the operator's activities, it must conduct a pre-drilling or pre-alteration survey of the water supply. The regulations do not require multi-year or multi-season sampling, nor do they require baseline monitoring aside from pre-drilling surveys for the purpose of liability protection. 25 Pa. Code § 78.52.

Recommendation: The Department recommends requiring 1 year of baseline monitoring data for surface and ground water. Since the baseline monitoring data would be used in developing the EA, and the EA is used in evaluating the permit application, the full year of baseline monitoring must be complete prior to completion of the permit application. However, since the drilling and operating permit application contains other complex components, the Department will consider allowing the permit application to be submitted in two phases. The Department may accept and begin conducting a preliminary review of the phase one application, which would

contain the plan for construction and operation of the well, including the casing and cementing plan and methane leak detection and repair plan. The phase two application would contain the baseline monitoring data and the EA. Following submission of the phase two application, the Department would conduct a final review and make a determination on permit issuance.

The Department would develop the monitoring protocol for baseline monitoring, which should list the minimum parameters for monitoring and the extent of the area to be sampled. The monitoring protocol should include testing of private drinking water wells within the presumptive impact area, if authorized by the owners of those wells. Note that the presumption of causation under §14-110.1 of the Environment Article does not apply if the applicant has requested permission of the property owner to sample the well and permission was denied.

Issue 4: Setbacks and Location Restrictions

Summary of 2015 Proposal:

COMAR 26.19.01.18

The 2015 proposal contained a list of setbacks and location restrictions. Some of these were based on recommendations of the UMCES report, while others went beyond the UMCES recommendations. The Department recommends retaining many of the setbacks and location restrictions proposed in 2015, but several changes are being recommended below. Table 1 provides a comparison of the UMCES recommendations, the requirements in the 2015 proposal, and the Department's recommended revisions to the 2015 proposal.

Recommended Changes from 2015 Proposal

Application of setbacks to infrastructure beyond the well pad

The 2015 proposal went beyond the UMCES recommendations and existing Maryland oil and gas regulations to apply certain setbacks to gas development activities located off the well pad that result in permanent surface alteration. This included permanent roads, compressor stations, separator facilities, and other permanent infrastructure. The setbacks and location restrictions for this potentially off-well pad infrastructure would have applied to land sloped more than 15 percent, drinking water reservoirs, aquatic habitat, special conservation areas, cultural or historical sites, public lands, caves, limestone outcrops, occupied buildings, wellhead protection areas, private drinking water wells, and springs used as drinking water.

While specific setbacks are discussed below, a preliminary issue is whether these setbacks should apply from the limit of disturbance of the well pad only or also from roads and other infrastructure not otherwise regulated under the oil and gas statute and regulations. Construction of roads and buildings have generally similar impacts whether related to gas development or not. Construction activities are subject to erosion and sediment control planning to address the impacts created when significant areas of earth are disturbed. These requirements are enforced at the local level and specific requirements vary by jurisdiction. For example, some local governments have buffers from streams for these activities, including Garrett (50 feet) and Allegany (25 feet) Counties. A statewide buffer of 25 feet applies to wetlands, and a buffer of 100 feet applies from Wetlands of Special State Concern. Aside from impacts on water resources, the potential impacts of roads and other facilities would be related to air emissions from traffic and aesthetic and noise issues. Traffic, noise, and aesthetic issues are typically the province of local governments, and may be addressed through zoning and land use restrictions. The Department recognizes, however, that most areas of Garrett County are currently unzoned.

Recommendation: In general, the Department recommends applying setbacks and location restrictions to the limit of disturbance of the well pad. Offsite development of gathering lines, compressor stations and other infrastructure will be regulated by the federal, State and local laws and regulations pertinent to these activities. For streams and wetlands, the Department is proposing revised buffers for onsite access roads (discussed further below).

Protection of potable water supplies

The Department considered several factors in determining proposed setbacks from sources of potable water supplies during the planning, design, construction and operations of shale gas drilling. These include:

protection of public health; principles and practices of source water protection; the characteristics of the hydrogeology and topography of Western Maryland (such as the presence of caves and karst geology); and the investments made by government and citizens in the development of public and private water supplies. Approaches taken by other states in which shale gas drilling is being done were also considered.

Public water supply systems

The Savage, Piney Creek and Broadford reservoirs serve a combined population of approximately 20,400 people in Garrett and Allegany Counties. This does not include the very large population of the Washington metropolitan area who use the water stored behind the Savage River Dam to augment water supplies during low flow periods. Significant financial investments have been made by federal, State and local agencies in these reservoirs. Protection of the reservoir watersheds, in the context of State regulation of the oil and gas industry, will help to prevent the degradation of raw water quality in these sources of supply.

Source water protection is a basic tenet of the federal Safe Drinking Water Act. The prevention of contamination is imperative to protect public health and public investments in water supply infrastructure, and is more cost-effective than spill response and remediation. Source water protection of public water supply systems applies to surface water (reservoirs, intakes on flowing streams and rivers and springs) and to groundwater systems.

Source water assessment reports have been prepared for dozens of publicly and privately owned water systems that serve towns, unincorporated areas, schools, nursing homes and businesses in Garrett and Allegany Counties. These reports identify the land area, land uses and practices that may influence the quality of the water produced and used by people. The presence of existing industrial uses in source water zones which predate the assessments must be managed. It is reasonable, however, to discourage or prohibit new industrial uses, such as shale gas well pads, in source water protection areas. While land use is the responsibility of local governments, State government is the delegated authority to implement the Safe Drinking Water Act in Maryland, so it is reasonable that prohibition of new shale gas well pads in certain areas be implemented at the State level as part of the overall regulation of this activity.

While source water assessments were completed for all sources that were in use in 2003, source water assessments have not been completed for all new sources that have come on line in Garrett and Allegany Counties since 2003. Not all water suppliers have gone on to develop and implement source water protection plans. While the 2015 proposal contained a 1,000 foot setback from a wellhead protection area (which is a source water protection area for a groundwater source), it did not contain any setback from a public water supply well for which a source water protection area is not defined, nor did it provide any setback from a public surface water intake, such as Friendsville's surface water intake on the Youghiogheny River.

Maryland protects its water bodies for aquatic life and public health through the establishment of water quality standards. The standards consist of use designations, water quality criteria and anti-degradation. These parameters can be found in State regulation at COMAR 26.08.02. Each water body in Maryland is assigned a use class. The use class is a grouping or set of designated uses that apply to a water body which individually may or may not be supported now, but should be attainable. In Western Maryland, the following use classes may be found:

Use Class I: Water Contact Recreation, and Protection of Nontidal Warmwater Aquatic Life
Use Class I-P: Water Contact Recreation, Protection of Aquatic Life, and Public Water Supply
Use Class III: Nontidal Cold Water
Use Class III-P: Nontidal Cold Water and Public Water Supply

Use Class IV: Recreational Trout Waters
Use Class IV-P: Recreational Trout Waters and Public Water Supply

In addition, Western Maryland has numerous streams classified as High Quality Waters, meaning they have chemical or biological characteristics that are significantly better than the minimum water quality requirements. This is the anti-degradation component of water quality standards. All Tier II designations in Maryland are based on having healthy biological communities of fish and aquatic insects. These streams support the robust recreational activities that attract tourists to the area.

Pennsylvania statute requires a distance of 1,000 ft between the vertical wellbore and a public water well, surface water intake, reservoir or other water supply extraction point. The water purveyor may waive this distance. Even if it does not, a variance will be granted where the setback would deny the operator the right to produce the gas and the operator submits a plan with additional measures and conditions to protect safety, affected persons, and property. Pennsylvania is in the process of modifying its regulations to require additional coordination with public resource agencies and additional consideration during permit application review. This additional review and coordination process would address areas within zones 1 or 2 of an approved wellhead protection area and within 1,000 feet of a water well, surface water intake, reservoir or other water supply extraction point used by a water purveyor.

Recommendation: In order to more broadly protect both surface and groundwater sources, the Department recommends prohibiting the location of a well pad and associated on-site construction and operation, defined as the edge of well pad disturbance, within:

1. An arc of 2,000 feet parallel to and above the surface water intake of a public drinking water supply;
2. The watersheds of the Broadford, Savage and Piney Creek reservoirs;
3. The outside border of a delineated source water protection area for groundwater sources;
4. 1,000 feet from a public water supply well for which a source water protection area has not been delineated; and
5. An arc of 2,000 feet parallel to a line of equal elevation and above a public water supply spring for which a source water protection area has not been delineated.

Private water supplies

There are many individual water wells within the Marcellus Shale play in Maryland. In addition, some residents and businesses rely at least partially on springs, although these sources are highly subject to contamination from surface activities and discouraged from use for human consumption. Property owners have the right to expect protection of their private water supplies.

The UMCES report recommended a setback of 500 feet from private drinking water wells. This was extended to 2,000 feet in the 2015 proposal. Pennsylvania State statute requires a setback of 500 feet between the vertical well bore and a private drinking water well. This distance may be waived by the owner of the well. While the Department agrees that a setback from private drinking water wells is advisable to provide a safeguard in the event of methane migration or surface spill, the Department does not believe that setbacks are the most effective protection against these problems. While setbacks may delay or lessen the chance of impacts from a defect in casing or cementing or an uncontrolled surface spill, strong well construction and pad containment provisions can in many instances prevent these problems from ever occurring. In Issue 1: Well Construction and Testing, above, the Department is recommending several changes to strengthen the casing and cementing requirements and ensure that casing and cementing are properly tested to identify any problems early. For surface spills, the 2015 proposal contained protective safeguards, which the Department

recommends maintaining. These include the requirement for a lined, low-permeability pad, capable of containing the volume of the 24-hour, 25-year storm event. Chemicals must be stored in watertight, closed tanks with secondary containment to prevent releases in the event that a tank leaks. The Department believes that these preventative measures, along with the improvements suggested for well casing and cementing, allow for a reduction in the setback from private water wells to 1,000 feet, while maintaining protection of private water supplies.

Recommendation: The Department recommends prohibiting the location of a well pad and associated on-site construction and operation, defined as the edge of drill pad disturbance, within:

1. 1,000 feet of a private water supply well; and
2. An arc of 2,000 feet parallel to a line of equal elevation and above a private spring used for drinking water.

Protection of rivers, streams and wetlands

In determining proposed buffers from streams and wetlands associated with the planning, design, construction and operation of shale gas drilling, the Department has considered several factors, reflecting the input of natural resource managers and scientific literature. These include: the nature and quality of streams and wetlands in Western Maryland, existing scientific literature, economic value of these resources for recreational and other activities, and approaches taken by other states.

There is a significant amount of literature evaluating the need for and size of riparian buffers for stream health and biotic diversity. Buffer width recommendations vary depending on the management purpose, whether shading for stream aquatic health or use of stream corridors by animals. The UMCES report recommended a 300 foot buffer from the edge of an aquatic resource (floodplains, wetlands, seeps, vernal pools, streams, or other surface water bodies) to the edge of disturbance of the well pad.

In the past, Pennsylvania has imposed a 100 foot setback between the edge of disturbance of the well site and a solid blue lined stream, spring or body of water as identified on the most current 7 1/2 minute topographic quadrangle map of the United States Geological Survey (300 feet from the well itself). A 100 foot setback applied between the edge of disturbance of the well site and a wetland greater than 1 acre in size (300 feet from the well itself). These setbacks for unconventional wells were struck down under the State constitution following a statute change in 2012 that instituted mandatory waiver provisions. Pennsylvania is now proposing regulations that would reinstitute these location provisions and add new ones related to public parks, landmarks, and other cultural resources. However, rather than imposing specific setbacks, the new regulations would require additional information and review where drilling activity would be within certain distances of these resources. West Virginia imposes a 100 foot buffer for some streams and a 300 foot buffer for trout streams.

In Maryland, there are existing setbacks or buffers that prohibit land disturbance for construction and development within certain distances from water resources. There is a 100 foot setback from streams and wetlands in the Chesapeake and Coastal Bays Critical Areas. Most Maryland counties also have nontidal stream buffers, which range from 25 feet to 100 feet, with additional buffer width in areas of steep slopes in some counties. Maryland law regarding construction in waterways and the 100-year floodplain currently contains no stream buffer provisions. There is a 25 foot buffer from the upland boundary of nontidal wetlands and a 100 foot buffer around Wetlands of Special State Concern. Wetlands of Special State Concern are listed in Maryland regulation (COMAR 26.23.06). In addition to the presence of Wetlands of Special State Concern, the nontidal wetland buffer may also be expanded to 100 feet where there are adjacent steep slopes, highly erodible soils, or Outstanding National Resource Waters.

The Department proposes to maintain protective setbacks for the development of both well pads and private roads built to access well drilling sites. The UMCES Report recommended a 300 foot setback from aquatic resources. Setbacks of 100 to 300 feet are more in line with the requirements of surrounding states than the 450 foot setback proposed in the 2015 proposal. The State has a robust wetlands and waterways permitting program that the Department believes will be protective of water resources given these setbacks. The State also has a sediment and erosion control regulation and manual that provides guidance for site development that is protective of water resources. It will be critical, however, to ensure that site development for shale gas drilling includes careful sediment and erosion control plan design that is consistent with state regulatory requirements, and that these plans are implemented in the field with adequate oversight, inspection and maintenance of sediment controls.

For well pads, the Department recommends revised setbacks. The identification and protection of the water resources on a drilling site will be determined through the normal Federal/State Joint Permit Application process where a proposed drilling operation may impact regulated waters of the State and waters of the United States. The U.S. Army Corps of Engineers and the Department review and issue permits and authorizations for activities that will impact water resources. For example, if the federal/State regulatory agencies take jurisdiction over springs, seeps, wetlands and streams (perennial or intermittent) on a site, the setback (100 or 300 feet) will apply based on the State's water use designations and antidegradation regulations (COMAR 26.08.02). The Department proposes a 100 foot setback from Use I streams (suitable for water contact recreation, and protection of nontidal warm water aquatic life) to the edge of disturbance for well pads. The Department proposes a 300 foot setback for Use I-P, Use III (streams with naturally reproducing populations of trout), Use III-P (all uses identified for Class III waters and use as a public water supply), and Use IV-P (Recreational Trout Waters and Public Water Supply) streams. The Department also proposes a 300 foot setback from Tier II waters, which possess an existing quality that is better than the water quality standards established for them. The water use designations of specific water bodies and Tier II water segments may also be found in COMAR 26.08.02.

In addition to showing these buffers on plans submitted to the Department, the buffers should be shown on sediment and erosion control plans, which will be approved by the appropriate local Soil Conservation District. It should be noted that any impacts to streams, wetlands or other water resources are subject to regulation under federal and State permit processes.

For roads, the Department proposes a more flexible approach instead of imposing hard setbacks. The design and construction of access roads on well drilling sites should consider proximity to nearby water resources. Maintaining setbacks from streams and wetlands helps to ensure maintenance of vegetation, which provides critical shading, keeps sediments out of the resources, and maintains wildlife corridors. The Department recommends revised buffers between access roads and streams (100 feet), wetlands (25 feet), and 100-year floodplains (25 feet), but the Department will consider a variance for the construction of an access road if the applicable buffer would deny reasonable access to a proposed drilling site. Where an access road must be constructed within the buffer area in order to provide reasonable access, any impacts to the water resource and aquatic habitat must be minimized.

Recommendations:

The Department recommends the following setbacks between **well pads** and streams and wetlands:

1. 100 foot setback measured horizontally from the edge of well pad disturbance for Use I streams;
2. 300 foot setback measured horizontally from the edge of well pad disturbance for Use I-P, III, III-P, IV-P, and Tier II water segments;

3. 25 foot setback measured horizontally from the edge of well pad disturbance to wetlands that are not Wetlands of Special State Concern (existing buffer requirement in Nontidal Wetlands statute); and
4. 100 foot setback measured horizontally from the edge of well pad disturbance to Wetlands of Special State Concern, or where there are adjacent steep slopes, highly erodible soils or Outstanding National Resource Waters (existing buffer requirement in Nontidal Wetlands statute).

The Department recommends the following for **access roads** located near rivers and wetlands:

5. Where feasible, access roads shall be designed to remain 100 feet measured horizontally from any identified stream and a minimum of 25 feet from any nontidal wetland or floodplain;
6. Where there is no feasible design to maintain the above buffers in the opinion of the Department, roads shall be designed and constructed to minimize impacts to the stream and adjacent aquatic habitat.

Other Setbacks

Caves and karst topography

The 2015 proposal included setbacks of 1,000 feet from known caves and 750 feet from the downdip side of limestone outcrops. The Department's primary concerns with impacts to caves would be from surface spills, and from the difficulties of cementing if an underground void is encountered. Surface spills are addressed with the requirements for the well pad and storage of liquids on site, including lined pads and secondary containment, but the Department believes that setbacks are necessary to ensure that underground voids are avoided. In addition to reducing the setback from known caves from 1,000 to 750 feet, the Department believes that caves and limestone outcrops should be better defined to clarify which features are subject to the setbacks.

Recommendation: The Department recommends prohibiting the location of a well pad and associated on-site construction and operation, defined as the edge of well pad disturbance, within:

1. 750 feet of a known cave, as shown in Franz, R. and Slifer, D. Maryland Geologic Survey Education Series No. 3, *Caves of Maryland* (1971) or discovered through geologic surveys and environmental assessments; and
2. 750 feet from the downdip side of a limestone outcrop, as shown on Brezinski, D.K. and Conkwright, R.D, *The Geologic Map of Garrett, Allegany and Western Washington Counties in Maryland* (2013) or discovered through geologic surveys and environmental assessments.

Sloped land

The 2015 proposal prohibited location of the well pad on land sloped greater than 15 percent, before grading. A significant portion of the land in Maryland's Marcellus Shale region is sloped greater than 15 percent. While the UMCES report did note that highly sloped land presents greater challenges and that operators typically avoid slopes greater than 15 percent, that report did not include a prohibition on location in these highly sloped areas as one of the best practices recommendations.

Recommendation: The Department recommends a more flexible approach to sloped land. Instead of a blanket prohibition, the Department would be authorized to evaluate proposals for location on land sloped greater than 15 percent. The Department may impose additional requirements as permit conditions or prohibit the location altogether, if determined to be necessary to avoid excessive disturbance of highly sloped land.

Property line

Section 14-112 of the Environment Article establishes a setback of 1,000 feet between the well and the property boundary, *except* where there is agreement by the owners of the oil and gas on the adjacent lands. Even without agreement by adjacent mineral owners, the Department may allow a closer location on property on which it is impossible to comply with the setback. In this case, notification and opportunity for objection must be provided to surrounding land, lease, and royalty owners. Existing regulations also include an exemption where there is written agreement by landowners and royalty owners on the adjacent property. COMAR 26.19.01.09C. The 2015 proposal included a setback of 1,000 feet between the limit of disturbance of the well pad and the property line, with no provision for a waiver by adjacent property owners.

Recommendation: The Department suggests retaining the 1,000 foot setback between the limit of disturbance of the well pad and the property line. However, this requirement should be waived where the adjacent surface and mineral owners have agreed to the waiver in writing and the Department determines the waiver does not pose significant risk of adverse impacts to adjacent properties.

Cultural or historical sites and special conservation areas

The 2015 proposal adopted the UMCES recommendation for a setback of 300 feet between the edge of the well pad disturbance and cultural and historical sites, State and federal parks, trails, wildlife management areas, scenic and wild rivers, and scenic byways. A setback of 600 feet from special conservation areas was also adopted from the UMCES report. However, the 2015 proposal applied these setbacks not just to the well pad, but to other activities causing permanent surface alteration.

Recommendation: Because the nature of cultural or historical sites and any potential for impacts from a well vary significantly, the Department recommends a more flexible approach to protecting cultural and historical sites. Rather than a 300 foot setback, the Department recommends an individualized review of potential impacts to cultural or historical sites as part of the permit application process. Upon receipt of each permit application, if any cultural or historical sites are identified in the environmental assessment, the Department will transmit the application to relevant agencies for comment, including DNR and the Maryland Historical Trust. Based on these agencies' comments, if any, the Department may include additional permit conditions or determine that the proposed location would impermissibly result in adverse impacts to cultural or historical resources. This is the process currently followed for other types of mining permits. A similar process would be followed for special conservation areas, with DNR providing input on any potential impacts and the need for additional permit conditions to protect these areas.

Abandoned oil or gas wells

The 2015 proposal established a 1,320 foot setback from abandoned or active oil or gas wells, unless the applicant provides evidence satisfactory to the Department that its plan for well completions will control pressure and fluid movement within the target geological formation so these changes do not adversely interact with the abandoned or active well. The applicant is required, in its permit application, to indicate any abandoned or active wells within 2,640 feet of the proposed well location, based on the best available information.

Recommendation: The Department believes it is beneficial to identify and encourage the proper plugging of historic gas wells. The Department therefore proposes to maintain the 1,320 foot setback, but make the following adjustments:

1. The permit application regulation should be revised to specify that the best available information that must be consulted in order to identify abandoned wells should include a review of historical sources and any available databases, and if not available for that area, a survey of the surface owners within the area of review.

2. The setback provision should be revised slightly to state that the Department may issue a permit to drill a well within the 1,320 foot setback from an abandoned well if the operator first properly plugs the abandoned well. If the Department determines it is necessary, it also reserves the right to require an applicant to plug additional abandoned wells identified within the 2,640 foot area of review prior to commencement of drilling.

Table 1: Recommended Revisions to Setbacks and Location Restrictions

Setback/Location Restriction	Eshleman & Elmore 2013		2015 Proposal		Recommended Change from 2015 Proposal
	Restriction	**Applies to**	**Restriction**	**Applies to**	
Waters or tributaries of the Chesapeake Bay	Prohibited	Location of drilling	Prohibited	Location of drilling	No change (Note: required by statute; Md. Code Ann., Env. §14-107).
Critical Area	Prohibited	Location of drilling	Prohibited without written approval from the Critical Area Commission	Location of drilling	No change (Note: required by statute; Md. Code Ann., Env. §14-107).
Property line	**1,000** foot setback, with waiver if necessary due to site constraints	Borehole	**1,000** foot setback, with no waiver provision	Limit of disturbance of the well pad	Keep 1,000 foot setback, but add a waiver provision where agreed to in writing by adjacent surface and mineral owners, subject to Department approval (Note: required by statute; Md. Code Ann., Env. §14-112).
Land sloped greater than 15 percent, before grading	None (discussed p. 1-16, but not included as a recommendation)	None	Prohibited	Limit of disturbance of well pad and other gas development activities resulting in permanent surface alteration	Remove blanket prohibition; if land is sloped greater than 15 percent, the Department may impose additional conditions or prohibit the location if it determines the disturbance would be excessive.
Public surface water sources	**2,000** foot setback from public surface water intakes	Borehole*	Prohibited within the watersheds of the following drinking water reservoirs: Broadford Lake, Piney Reservoir, Savage Reservoir	Limit of disturbance of well pad and other gas development activities resulting in permanent surface alteration	Keep prohibition on location within the watersheds of the Broadford, Savage and Piney Creek reservoirs. Add a setback of an arc of 2,000 feet parallel to and above the surface water intake of a public drinking water supply. Apply these restrictions only to the

					limit of disturbance of the well pad.
Aquatic habitat	**300** foot setback	Limit of disturbance of well pad	**450** foot setback	Limit of disturbance of well pad and other gas development activities resulting in permanent surface alteration	**100** foot setback to Use I streams **300** foot setback from Use I-P, III, III-P, IV, IV-P, and Tier II water segments **100** foot setback from Wetlands of Special State Concern, or where there are adjacent steep slopes, highly erodible soils, or Outstanding National Resource Waters (existing buffer requirement in nontidal wetlands statute) **25** foot setback from other wetlands (existing buffer requirement in nontidal wetlands statute) All of the above setbacks should apply to the edge of disturbance of the well pad. Apply the following to access roads to the well site: Include buffers of 25 feet for wetlands and floodplains and 100 feet for streams, where feasible. Where there is no feasible design to maintain the buffers in the opinion of the Department, roads must be

					designed and constructed to minimize impact to the stream and adjacent aquatic habitat.
Special conservation areas	**600** foot setback	Limit of disturbance of well pad	**600** foot setback	Limit of disturbance of well pad and other gas development activities resulting in permanent surface alteration	Remove blanket setback. If any special conservation areas are identified in the environmental assessment, the permit application will be forwarded to DNR, with opportunity for additional comments and permit conditions if necessary to protect the resource.
Cultural or historical sites, State or federal parks, trails, wildlife management areas, wild and scenic rivers, and scenic byways	**300** foot setback	Limit of disturbance of well pad	**300** foot setback	Limit of disturbance of well pad and other gas development activities resulting in permanent surface alteration	Remove blanket setback. If any of the listed cultural or historical areas are identified in the environmental assessment, the permit application will be forwarded to the relevant agency (DNR, Maryland Historical Trust, etc.), with opportunity for additional comments and permit conditions if necessary to protect the resource.
Public lands owned or managed by DNR	None	None	Prohibited without approval of DNR	Limit of disturbance of well pad and other gas development activities resulting in permanent surface alteration	No change
Known caves	**1,000** foot setback	Borehole	**1,000** foot setback	Limit of disturbance of well pad and other gas development activities resulting in permanent surface alteration	Reduce setback to 750 feet. Apply only to the limit of disturbance of the well pad.

Limestone outcrop	**1,000** foot setback	Borehole	**750** foot setback from the downdip side	Limit of disturbance of well pad and other gas development activities resulting in permanent surface alteration	Keep 750 foot setback. Apply only to the limit of disturbance of the well pad.
Occupied buildings	**1, 000** foot setback from any occupied building	Borehole and compressor stations	**1,000** foot setback from occupied building, school, or church	Limit of disturbance of well pad and other gas development activities resulting in permanent surface alteration	Keep 1,000 foot setback, but apply only to the limit of disturbance of the well pad.
Public drinking water wells	**2,000** foot setback from a public groundwater well	Borehole	**1,000** foot setback from the boundary of a wellhead protection area	Limit of disturbance of well pad and other gas development activities resulting in permanent surface alteration	For a public water supply well for which a source water protection area has been delineated, prohibit within the outside border of the source water protection area. For a public water supply well for which a source water protection area has not been delineated, add a setback of 1,000 feet. These restrictions should apply only to the limit of disturbance of the well pad.
Private drinking water well	**500** foot setback	Borehole*	**2,000** foot setback	Limit of disturbance of well pad and other gas development activities resulting in permanent surface alteration	Reduce the setback to 1,000 feet and apply only to the limit of disturbance of the well pad.
Discharge of a spring used as the source of	None	None	Prohibited within an area defined as all lands at an elevation equal to or greater	Limit of disturbance of well pad and other gas development activities	Prohibit within an arc of 2,000 feet parallel to and above a private spring or public water

domestic drinking water by the resident of the property on which the spring is located			than the discharge, not to exceed **2,500 feet**, unless the Department approves an alternative based on the delineation of recharge area of the spring	resulting in permanent surface alteration	supply spring for which a source water protection area has not been delineated. Apply only to the limit of disturbance of the well pad.
Abandoned or active oil or gas well	**1,320** foot setback	Vertical or horizontal segment of the well	**1,320** foot setback, unless the applicant provides evidence satisfactory to the Department that its plan for well completions operations will control pressure and fluid movement within the target geological formation so these changes to not adversely interact with the abandoned or active well	Vertical or horizontal segment of the well	No change to setback. Clarify that the Department may allow location within the 1,320 foot setback area if the operator first properly plugs the well. If the Department determines it is necessary, it may require an applicant to plug additional abandoned wells identified on the permit application within 2,640 feet prior to commencement of drilling.
Existing gas well in the same oil or gas reservoir	None	None	**2,000** foot setback, except for wells with horizontal segments drilled from vertical boreholes on a common well pad and unless the Department is provided with credible geologic evidence of reservoir separation to warrant granting a spacing exception	Location of drilling	No change
Existing oil well in the same oil or gas reservoir	None	None	**1,320** foot setback, except for wells with horizontal segments drilled from vertical boreholes on a common well pad and unless the Department is provided with credible	Location of drilling	No change

			geologic evidence of reservoir separation to warrant granting a spacing exception		

* The Eshleman and Elmore report contains conflicting recommendations for the setback from private groundwater wells and public groundwater wells or surface water intakes; on p. 1-12, the setback is from the wellbore, whereas on p.4-32, the setback is "measured from the well pad, not from the individual wellbores." Because the Departments' Best Practices Report assumed the Eshleman and Elmore report applied these setbacks from the wellbore, that information is used here.

Appendix A: List of VOCs Measured in 2014-2015 NETL Background Monitoring

Acetylene	Trans-2-pentene	Methylcyclohexane
n-Butane	Propane	Methylcyclopentane
1-Butene	Propylene	2-Methylheptane
Cis-2-butene	Benzene	3-Methylheptane
Trans-2-butene	Cyclohexane	2-Methylhexane
Cyclopentane	n-Decane	3-Methylhexane
2,2-Dimethylbutane	m-Diethylbenzene	n-Nonane
2,3-Dimethylbutane	p-Diethylbenzene	n-Propylbenzene
Ethane	2,3-Dimethylpentane	Styrene
Ethylene	2,4-Dimethylpentane	Toluene
1-Hexane	n-Dodecane	1,2,3-Trimethylbenzene
Isobutane	Ethyl Benzene	1,2,4-Trimethylbenzene
Isopentant	o-Ethyltoluene	1,3,5-Trimethylbenzene
Isoprene	m-Ethyltoluene	2,2,4-Trimethylpentane
n-Pentane	p-Ethyltoluene	2,3,4-Trimethylpentane
1-Pentane	n-Heptane	n-Undecane
2-Methylpentane	n-Hexane	o-Xylene
3-Methylpentane	Isopropylbenzene	m-Xylene
Cis-2-pentene	n-Octane	p-Xylene

Appendix B: List of Pollutants Monitored in 2014 at Frostburg Dam Monitoring Station

Constituent Group	Frostburg Dam (Piney Run) Constituents in the Constituent Group
Air Toxics	Dichlorodifluoromethane, Chloromethane, 1 ,2-Dichloro-l, 1 ,2,2,tetrafluorolethane, Chloroethene, 1,3Butadiene,Trichlorofluoromethane, Acrolein, Acetone, Methylene Chloride, 1,1,2-Trichloro-I ,2,2trifluoroethane,2-methoxy-2-methyl-Propane, Hexane, Chloroform, Tetrahydrofuran, 1,2-Dichloroethane, I, I, I-Trichloroethane, Benzene, Carbon tetrachloride, Cyclohexane, 1,2Dichloropropane, Trichloroethene, Heptane, Cis-I ,3-Dichloro-I-Propene, Trans-1 ,3-Dichloro-1Propene,Toluene, 1 ,2-Dibromoethane, Tetrachloroethylene, Chlorobenzene, Ethylbenzene, m & pXylene, Styrene, 1,1,2,2-Tetrachloroethane, o-Xylene, 1-Ethyl-4-Methylbenzene, 1,3,5Trimethylbenzene, 1,2,4-Trimethylbenzene, I A-Dichlorobenzene
PAMS VOCs	Acetone, Ethane, Acetylene, Propane, 2,2-dimethylbutane, Benzene, i-Butane, n-Butane, i-Pentane, n-Pentane, 2,2,4-trimethylpentane, i-Propyl benzene, n-hexane, 2-methylpentane, 2,3-dimethylbutane, Cyclopentane, Ethylbenzene, n-Propylbenzene, 3-methylpentane, Toluene, Styrene, n-Heptane, 2-methylhexane, 2,4-dimethylpentane, 2,3,4trimethylpentane, o-Xylene, 3-methylhexane, 2,3-dimethylpentane, Formaldehyde, n-Octane, 2-methylheptane, Cyclohexane, 3-methylheptane, n-Nonane, m&p-Xylenes, MethyJcyclohexane, MethyJcyclopentane, n-Decane, n-Undecane, Acetaldehyde, 1,2,3-Tlimethylbenzene, 1,2,4-Tlimethylbenzene, 3-methyl-l-butene, I-Butene, Propene, I-Penteoe, 1 ,3,5-Trimethylbenzene, 2-methyl-I-pentene, 2-methyl-2-butene, c-2-hexene, c-2-pentene, c-2-Butene, Cyclopentene, 4-methyl-I-pentene, t-2-hexene, t-2-Butene, -t-1:Pentene, Isoprene