RECOMMENDATIONS FOR AMENDING PENNSYLVANIA'S REGULATORY FRAMEWORK FOR NATURAL GAS DRILLING

Prepared for:
Pennsylvania Marcellus Shale Policy Conference
May 3 & 4, 2010
Pittsburgh, PA

Hosted by:
Pennsylvania Environmental Council
&
Duquesne University

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April 2010

TABLE OF CONTENTS

I. MULTI-STATE/COMMISSION REVIEW.....1
II. SUMMARY OF RECOMMENDATIONS FOR PENNSYLVANIA.....4
III. DETAILED ANALYSIS OF RECOMMENDATIONS FOR PENNSYLVANIA...7
Frack Water Management.....7
Siting Criteria 13
Well Development.....22
Post Development and Long Term Responsibility.....32

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BACKGROUND

Mid-Atlantic States are facing pressure to develop the rich Marcellus Shale gas deposits found beneath their land. Development of this natural gas resource carries with it the potential for substantial environmental and public health impacts. We have reviewed the current and proposed regulatory frameworks for natural gas development for a number of mid-Atlantic states, as well as for Colorado and two mid-Atlantic River Basin Commissions. Based on this research, we make recommendations for Pennsylvania as it amends its laws, regulations and practices to manage the potential issues presented by natural gas development, particularly with respect to hydraulic fracturing ("fracking") in the Marcellus Shale.

This paper represents a summation of information of which we are currently aware and our understanding of that information. We look forward to and welcome additional information, corrections, clarifications and other comments from all of the participants in the upcoming Conference so that we may advance our knowledge and understanding of challenges to be resolved as we move forward in the development if this important resource.

I. MULTI-STATE/COMMISSION REVIEW

Pennsylvania

As the use of fracking technologies and the development of the Marcellus Shale gas progresses in Pennsylvania, the Pennsylvania General Assembly is considering amending the state's Oil and Gas Act. Among other things, the proposed bill, H.B. 2213, if adopted, would provide greater protection for water supplies and require the disclosure of fracking chemicals to the Pennsylvania Department of Environmental Protection ("Pennsylvania DEP").[1] The Pennsylvania DEP is also moving forward with developing new rulemaking for natural gas resource development.[2]

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[1] H.B. 2213, Sess. of 2010 (Pa. 2010).

[2] Erosion and Sediment Control and Stormwater Management, 39 Pa.B. 5131 (proposed Aug. 29, 2009)(to be codified at 25 Pa. Code Ch. 102); Oil and Gas Wells, 39 Pa.B. 838 (proposed Feb. 14, 2009)(to be codified at 25 Pa. Code Ch. 78); Wastewater Treatment Requirements, 39 Pa.B. 6467 (proposed Nov. 7, 2009)(to be codified at 25 Pa.

Susquehanna River Basin Commission

The Susquehanna River Basin Commission ("SRBC"), a federal interstate commission covering much of Pennsylvania and parts of New York and Maryland, has a strong stake in Marcellus Shale gas drilling regulation, as much of the exploitable Shale lies in the basin, especially in New York. Estimates suggest that drilling operations in the Marcellus Shale would use approximately 28 million gallons of fresh surfacewater in the basin per day.[3] The SRBC has issued specific rules for the review and approval of water withdrawals for use in natural gas well development projects. The SRBC has stricter guidelines in some areas, especially regarding water withdrawal, than the regional states do, and Pennsylvania should consider bringing their regulations closer in line to the SRBC's regulations in those areas. This would lead to stricter regulations while at the same time making gas well operators jobs easier by creating consistency in statewide regulation.

Delaware River Basin Commission

The Delaware River Basin Commission ("DRBC"), a federal commission covering parts of Delaware, New Jersey, Pennsylvania, and New York, is also significantly involved with the Marcellus Shale and maintains similar withdrawal and water protection related regulations to the SRBC. However, the DRBC has not yet issued specific rules relating to natural gas development activities, and to date, the DRBC has yet to approve any Marcellus shale development activities within its basin. Per the New York Department of Environmental Conservation's SGEIS (discussed below), any drilling in the Delaware River basin must pass DRBC review of drill site characteristics, fracturing fluid composition, and disposal strategy. Areas where DRBC has expressed concern, per the NY DEC, include reduction of flow in streams and aquifers, discharge of release of pollutants into ground or surface water, and treatment and disposal of hydraulic fracturing fluid.[4] Pennsylvania should consider bringing their regulations in line with some of the better DRBC regulations toward protection of our valued water resources.

Code Ch. 95); Oil and Gas Wells, 40 Pa.B. 623 (Advance Notice of Proposed Rulemaking issued January 30, 2010)(to be codified at 25 Pa. Code Ch. 78).

[3] New York State Department of Environmental Conservation, Draft Supplemental Generic Environmental Impact Statement on the Oil, Gas and Solution Mining Regulatory Program, §2.4.7.2 (2009) [hereinafter Draft SGEIS]. http://www.dec.ny.gov/energy/58440.html (Viewed: April, 2010).

[4] Draft SGEIS, *supra* note 3, at §2.4.7.1.

New York

It is important to note for regulatory review purposes, that much of the core Marcellus Shale acreage in New York is found within the Susquehanna and Delaware River Basins[5]. Also, much of New York City's drinking water supply is derived via aquifer system from the Catskill region, which is within the Delaware River Basin.[6]

Unseen elsewhere, New York has decided to place a moratorium on Shale gas development until it can fully study and address the industry development practices and potential environmental impacts, including public health and safety issues. New York's Department of Environmental Conservation ("New York DEC") has initiated such a study and has since issued a draft Supplemental Generic Environmental Impact Statement ("SGEIS") (authority for which is discussed below in 'Siting Criteria') setting forth new proposed permit standards and guidelines which the industry would be required to meet in order to develop Shale gas within the State.[7] The SGEIS was recently open for public comment, thus creating large debate throughout the State and bringing awareness of the industry practices to its citizens. Currently, the New York DEC is reviewing the public comments for consideration toward further revisions to the proposed SGEIS.[8] An example of one of the comments; following the results of its own impact study the New York City DEP has issued a statement calling for the prohibition of drilling for Marcellus Shale gas within its public water supply region.[9]

West Virginia

As in Pennsylvania, shale gas development and the use of fracking has spread through West Virginia before the state's regulatory framework could be revised to supervise and direct the voluminous development. The West Virginia Department of Environmental Protection

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[5] DRBC, Natural Gas Drilling in the Delaware River Basin. a*vailable at*: http://www.state.nj.us/drbc/naturalgas.htm (Viewed: April, 2010).

[6] NYC DEP, New York City's Water Supply Map. a*vailable at*: http://www.nyc.gov/html/dep/html/drinking_water/wsmaps_wide.shtml (Viewed: April, 2010).

[7] New York State Department of Environmental Conservation, Draft Supplemental Generic Environmental Impact Statement on the Oil, Gas and Solution Mining Regulatory Program, §6.1.1 (2009) [hereinafter Draft SGEIS]. http://www.dec.ny.gov/energy/58440.html (Viewed: April, 2010).

[8] Id.

[9] NYC DEP, Dec. 23, 2009, Department of Environmental Protection Calls for Prohibition on Drilling in the New York City Watershed. *available at*: http://www.nyc.gov/html/dep/html/press_releases/09-15pr.shtml (Viewed: April, 2010).

("West Virginia DEP") has proposed some updates to its oil and gas regulations,[10] with a particular focus on pits and impoundments used in oil and gas operations toward furthering environmental protection efforts.

Colorado

Colorado, having a history of mass resource extraction, and site of the Gothic Shale and others, is another important state to consider. The Colorado Oil and Gas Conservation Commission (Colorado Commission) has some strong regulations that Mid-Atlantic states should consider adopting, especially in the areas of permitting, siting, remediation and bonds. However, because Colorado is an arid western state that requires strict water regulations and relies heavily on aquifers, some of the considerations the Commission has to deal with do not arise in the Mid-Atlantic. Conversely, Colorado mostly does not have to deal with several issues (such as withdrawn water transport) that Mid-Atlantic States do. In the spring of 2009, the Commission adopted new regulations regarding chemicals used at wellsites and public water supply protection.[11] Colorado has also given its Department of Public Health and Environment a say in Commission decisions that concern public health.[12] Additionally, Colorado has included the Department of Public Health and Environment and the Division of Wildlife in the gas well permitting process.[13]

II. SUMMARY OF RECOMMENDATIONS FOR PENNSYLVANIA

In order to minimize the risks presented by fracking, strong controls are needed on the fluids involved in the process. The best way to do this, while increasing uniformity throughout the state, is for the Pennsylvania DEP to adopt the SRBC's regulations on water withdrawal. The most important of these include requiring operators to create long-term plans for affected water sources, then issuing rules based on the plan, requiring passby flows, and giving other uses priority in drought situations. Pennsylvania should also follow New York's lead which provides its DEC the right to enter and inspect any facility containing water withdrawal equipment. To properly incentivize well operators to protect Pennsylvania's water resources, the General

[10] Oil and Gas Wells and Other Wells, W.Va. (proposed)(to be codified at W. VA. CODE § 35-4).
[11] Draft SGEIS, *supra* note 3, at §5.18.
[12] H.B. 07-1341, 2007 Legis. Sess. (Colo. 2007).
[13] Colorado Oil and Gas Conservation Commission, Rules of Practice and Procedure, Rule 306. Consultation. Available at: http://cogcc.state.co.us/

Assembly should adopt the proposed amendment to the Pennsylvania Oil and Gas Act, which would broaden the presumption of liability on well operators for damage to water resources near drilling operations. Furthermore, Pennsylvania should require that well operators test nearby water resources before, during, and after drilling operations and that they adequately case and cement all wellbores to protect water supplies. The DEP should also publish and publicize a detailed list of chemical additives used in frackwater, including site-specific details on the concentrations and chemical formulas of each chemical used. Finally, Pennsylvania should consider setting aside special areas where fracking cannot occur or can only occur if additional strict requirements are met.

Pennsylvania should expand the criteria that are considered to determine where natural gas well sites may be drilled. Certain factors, such as whether the site is within a floodplain, should be explicitly added to the criteria considered. Other factors, such as geology and topography are already included in the factors to be considered, but only in a vague way that should be better defined. If promulgated, proposed amendments for erosion and sediment control regulations would somewhat expand and clarify the role of geologic considerations. Additionally, Pennsylvania ought to implement a program to consider cumulative region-wide impacts of multiple drill sites and institute a spacing requirement between wells to prevent overly dense development. With respect to the siting of wells, Pennsylvania should also seriously study the option of implementing forced pooling regulations that would apply to drilling in the Marcellus shale.

There are several devices available to Pennsylvania to improve well development practices in aid of environmental protection and public health. Of particular relevance to drilling in the Marcellus shale, Pennsylvania should require mapping of non-vertical wellbores, especially in relation to nearby bodies of surface and groundwater and follow Colorado's lead in instituting additional requirements for enhanced recovery wells. The DEP should continue to encourage the recycling of flowback water where appropriate and should consider adopting specific provisions for the storage and transport of flowback water, distinct from the rules for produced water. For all natural gas drilling sites, the Pennsylvania DEP should promulgate proposed regulations that would require riparian buffer zones and the planning and implementing of measures to manage stormwater runoff. The DEP should also identify sensitive areas where drilling will be allowed to occur and issue regulations that require additional safeguards for

developing wells in those areas. Finally, the DEP should enhance its efforts to reduce the negative impacts on communities posed by natural gas drilling. For example, the DEP could institute stronger statewide controls on visual, noise and light emissions and it could develop best management practices toward reduced air emissions from gas processing, compression, and transportation equipment.

Pennsylvania needs to ensure that produced water does not cause environmental damage or become a nuisance to the surrounding community. The best way to accomplish this goal is to ban long term storage of produced water on-site, unless it will be used for future operations. Pennsylvania should also require frequent inspections of storage containers, either by the operators or by the DEP. Pennsylvania should continue to encourage operators to reuse as much produced water as possible. When an operator disposes of produced water, it should have to obtain a National Pollutant Discharge Elimination System permit, or a stricter state equivalent, no matter the disposal method. Pennsylvania should adopt the proposed changes to Chapter 95 (Title 25) of the Pennsylvania Code, banning new discharges directly into Pennsylvania waters and creating high standards for current discharges and land application. Pennsylvania should also follow New York's lead and ban road spreading of Marcellus Shale wastewater. Any waste removed from a site should have detailed, independent lab testing before it is moved, allowing the DEP as well as local stakeholders to know what to monitor in their water.

Pennsylvania has thorough requirements for site remediation, but there is still room for improvement. Pennsylvania should implement monitoring requirements, similar to that of Colorado, for well sites after drilling is complete, which should include frequent sampling of soil and groundwater for a period after remediation. Pennsylvania should also follow Colorado's lead in requiring consultation with landowners before remediation begins. Pennsylvania should also implement proposed changes to its plugging requirements and consider requiring that a DEP employee observe the plugging.

Finally, Pennsylvania should increase its bond requirements for Marcellus Shale wells, which are currently significantly lower than other states. A proposed bill, Pennsylvania House Bill 2213, would raise single bonds significantly, and eliminate blanket bonds for Marcellus Shale wells. The General Assembly should adopt this bill, or take other action to raise bond requirements for Marcellus Shale wells. Pennsylvania should also consider requiring minimum liability insurance levels for operators drilling in the Marcellus Shale.

III. DETAILED ANALYSIS OF RECOMMENDATIONS FOR PENNSYLVANIA

FRACK WATER MANAGEMENT

Water Withdrawal

Limits on Withdrawal

Pennsylvania has minimal regulation on water withdrawal in place. DEP guidelines require that operators who take water from a freshwater stream take care not to damage the stream or to cause flooding, erosion, or any damage to life in the stream.[14] The Pennsylvania regulatory code requires only the registration of major operators and/or large scale water withdrawals. If an operator withdraws an average of over 10,000 gallons per day in a 30-day period from a single watershed (or through another contractor withdraws over 100,000 gallons on average or 10,000 gallons if withdrawing from a critical water planning area), then the operator must register the withdrawal with the Pennsylvania DEP.[15] However, this registration does not appear to include any monitoring or other requirements. The registration is only removed from the record if the operator's water withdrawal falls below the minimum threshold. It is not a permit system.

Pennsylvania is already considering an improvement to its water withdrawal regulations. A proposed bill would create a presumption that a well operator is responsible for the diminution of a water supply that is within 2,500 feet of an oil or gas well (currently the regulation only covers wells within 1,000 feet).[16] Pennsylvania could go further and give its DEP the same rights as held by the New York DEC. These include the right to enter and inspect any facility containing water withdrawal equipment, the right to access actual records of withdrawal, the right to inspect any equipment, practice or method used for withdrawal, and the right to verify the amount of water actually being withdrawn. [17]

Pennsylvania could also aim for uniformity of withdrawal regulations within its borders by adopting the stricter SRBC and DRBC standards for withdrawal. The SRBC requires

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[14] Bureau of Oil and Gas Management, Pa. Dep't of Envtl. Prot., Oil and Gas Operators Manual, Oil and Gas Management Practices, Document No. 550-0300-001, Chapter 4 at 72 (2001) [hereinafter Manual Chapter 4].
[15] 25 Pa. Code § 100.201(3-5) (2010).
[16] H.B. 2213, Sess. of 2010, § 208(c) (Pa. 2010).
[17] N.Y. Comp. Codes R. & Regs. tit. 6, § 675.13 (2006).

operators to create a comprehensive long-term plan for affected water sources that includes consideration of stream and aquifer depletion and effects on wildlife. The SRBC then issues rules based on this plan. [18] Both the SRBC and DRBC have strict monitoring and reporting requirements for water withdrawal. The SRBC requires, with certain exceptions for small withdrawals and areas where they have proven to be unnecessary, passby flows be provided as mitigation for water withdrawals.[19] In drought situations, the SRBC and DRBC disfavor withdrawals by oil and gas well operators, with the DRBC stating that industry would get last priority in a stricter allocation system during those times. [20]

New York has proposed using a different system, the Natural Flow Regime, to prevent stream depletion. This method requires the establishment of a passby flow calculated as the greater of 30% of Average Daily Flows and 30% of Average Monthly Flows.[21] This system builds in seasonal adjustment to the passby flows, ensuring that streams are maintained as close to possible to their natural state while minimizing complex calculations. However, this method is unfeasible in areas that lack requisite hydrologic data to determine seasonal flows. For more information and a detailed description of how the Natural Flow Regime can be implemented, see Section 7.1.1.4 of New York's draft SGEIS, beginning on page 7-18.

Source to Site and Transport

Pennsylvania's water transport regulations cover only pipeline transport and storage using dams. These guidelines, focusing mostly on installation of pipes, serve to protect local vegetation as well as water sources. The Pennsylvania DEP requires operators to install waterbars before the pipeline crosses any streams or wetlands and require minimizing disturbance of the area through which the pipeline runs. [22] Any large dams built to store freshwater would be regulated through Dam Safety and Waterway Management provisions.

New York's DEC suggests, though it does not now nor plans to require, that drilling permit applicants attempt to reach water transport agreements with local municipalities. Applicants must file such an agreement, or any trucking plan and a record of any attempts to reach an agreement, with the DEC. However, this filing is for informational purposes only and

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[18] 18 C.F.R. § 801.3 (2008).
[19] Draft SGEIS, *supra* note 3, at §7.1.1.4 (citing SRBC, Policy 2003-01).
[20] 18 C.F.R. § 410.2.5 (2009).
[21] Draft SGEIS, *supra* note 3, at §7.1.1.4.
[22] Manual Chapter 4, *supra note 14*, at 52.

will not be considered in the decision to grant or deny a permit.[23] Pennsylvania could consider going one step further and requiring at least an attempt to reach such an agreement before granting a permit application. This would minimize issues with mass trucking of water from source to site.

See the "Community Impacts - Infrastructure" section, below, for a further discussion on mitigating the impacts of drilling activities on roads.

Frackwater

Chemical Additives

Pennsylvania requires the general reporting of chemical additives used in frackwater to the DEP. There is a general list available of fracking additives on the DEP's website.[24] However, the disclosure is just a general list of all the chemicals the operator uses; the concentrations are not site-specific, and chemicals used may vary by site. Moreover, there are no regulations on frackwater additives beyond the disclosure requirement. Even diesel, the use of which has been discontinued in Pennsylvania after an agreement between key natural gas producers and the United States Environmental Protection Agency, is not banned.[25]

Pennsylvania House Bill 2213 would require a more complete disclosure of chemicals and chemical compounds used in fracturing fluid products. The new list would include the Chemical Abstract Service registry number for each constituent chemical, the concentration of each constituent chemical, and the formula for each chemical compound. This new list, whose requirement overcomes any trade secret claim, would be published on the Pennsylvania DEP website.[26] Adopting this bill would slightly improve disclosure, although the list should be publicized and not just published. A further suggestion would be that Pennsylvania follow New York in adding more details to the disclosure requirements, such as whether the chemicals used in fracturing water appear again in flowback water and in what concentrations.[27] Although no agency examined here requires site-specific public disclosure of frackwater or flowback water composition, requiring such disclosure is the best way to allow local stakeholders to monitor the

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[23] Draft SGEIS, *supra* note 3, at §7.11.
[24] *See* http://www.dep.state.pa.us/dep/deputate/minres/oilgas/FractListing.pdf (Accessed April 2010).
[25] U.S. EPA, A Memorandum of Agreement Between The U.S. EPA and BJ Services Co., et al.. Available at: http://www.epa.gov/safewater/uic/pdfs/moa_uic_hyd-fract.pdf (viewed April, 2010).
[26] H.B. 2213, Sess. of 2010, § 208.1(a) (Pa. 2010).
[27] Draft SGEIS, *supra* note 3, at §6.1.1.

effect of extraction on their environment. Pennsylvania could set an important trend by being the first to create such a requirement, which would immensely aid stakeholders while creating minimal additional burdens for operators. Since current disclosure laws already overcome any trade secret claims, site-specific disclosure requirements should do the same. Colorado already requires site-specific disclosure to the commission in cases where necessity demands it (for example, to clean up a spill or where land may have been contaminated), however that disclosure is not public.[28] Colorado also requires site-specific disclosure to medical professionals who are treating persons who may have been exposed to the chemicals.[29] Pennsylvania should require at least an equal level of site-specific disclosure, though it does not address all the concerns of local stakeholders.

Storage of Frackwater

As discussed above, any storage of frackwater using a dam system is regulated under Pennsylvania's dam regulations. An operator must report any significant spills, including planned remediation, to the DEP within two hours of discovery.[30] Applicable to all gas development practices, including the storage of frackwater on-site, the Pennsylvania Oil and Gas Act sets forth that, "Unless rebutted by one of the five defenses established in subsection (d), it shall be presumed that a well operator is responsible for the pollution of a water supply that is within 1,000 feet of the oil or gas well, where the pollution occurred within six months after the completion of drilling or alteration of such well."[31] Liability for damage to public and/or private water supplies caused by leaked frackwater is covered under Pennsylvania Code Chapter 78: "A well operator who affects a public or private water supply by pollution or diminution shall restore or replace the affected supply with an alternate source of water adequate in quantity and quality for the purposes served by the supply."[32] A proposed revision to the Oil and Gas Act extends that distance to 2,500 feet.[33] Another suggestion would be that Pennsylvania also ensure that efficient remediation plans that cover possible frackwater spills are filed with permit applications.

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[28] 2 COLO. CODE REGS. §205(d) (2009).
[29] 2 COLO. CODE REGS. §205(e) (2009).
[30] 25 Pa. Code § 78.66 (2010).
[31] Oil and Gas Act, 58 PA. STAT. ANN. §§ 601.208(a)-(f) (2009).
[32] 25 Pa. Code § 78.51(a) (2010).
[33] H.B. 2213, Sess. of 2010, § 208(c) (Pa. 2010).

New York's existing GEIS has similar distance provisions which provide for the requirement of environmental impact statements prior to the siting of gas wells near municipal water wells.[34]

See the "Post Development" section, below, for storage and treatment of frack and produced water in pits and tanks.

Fracking

Surface Water and Groundwater Protection During Fracking

Current Pennsylvania regulations do not include provisions pertaining explicitly to any threat to water quality or quantity presented specifically by the fracking process. However, any damage to the water supply caused by fracking would fall under the broad liability imposed by Pennsylvania Code Chapter 78, as discussed above in relation to frackwater.[35] Furthermore, it is "presumed that a well operator is responsible for the pollution of a water supply that is within 1,000 feet of the oil or gas well, where the pollution occurred within six months after the completion of drilling or alteration of such well."[36] If adopted, a pending Pennsylvania General Assembly bill would amend this presumption to include diminution, as well as pollution, of water supplies and increase the distance from one thousand to 2,500 feet.[37] Adoption of this amendment would create greater liability and incentive for safety on the part of well operators.

While not included in the regulations, the Pennsylvania DEP gives some instructions regarding safe fracking practices in its Oil and Gas Operators Manual. The Manual directs well operators that, when fracking an existing well, they "should consider the location of abandoned, orphan and unplugged wells in the area" because the presence of unplugged wells in the vicinity "may contribute to groundwater and/or surface water pollution incidences."[38] Additionally, the SRBC requires that the operator of any natural gas well subject to SRBC review and approval monitor daily use of, among other things, the amount of water used per day for hydrofracture

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[34] New York Generic Environmental Impact Statement on the Oil, Gas and Solution Mining Regulatory Program (GEIS), Vol 1, Ch. 8, Section E. Water Quality. Available at: http://www.dec.ny.gov/docs/materials_minerals_pdf/dgeisv1ch8.pdf

[35] 25 Pa. Code § 78.51(a) (2010).

[36] Oil and Gas Act, 58 PA. STAT. ANN. § 601.208(c) (2009).

[37] H.B. 2213, Sess. of 2010, § 208(c) (Pa. 2010).

[38] Manual Chapter 4, *supra note 14*, at 73.

stimulation.[39]

Several states have taken or are considering interesting additional measures to protect their water supplies, all of which Pennsylvania should consider. The West Virginia DEP has created an online GIS tool with information on water flow for operators to use in an effort to minimize their impact on the watershed.[40] Colorado has designated areas, such as the "Greater Wattenberg Area," a densely populated region north of downtown Denver, as requiring special protection and has set forth more specific siting criteria, such as well spacing units, well density limits, and initial baseline water testing for these areas.[41] Likewise, New York has exempted the watersheds that supply water to New York City and Syracuse from its draft SGEIS and will individually review the environmental impacts of each proposed natural gas drilling project in those watersheds.[42] Colorado has also required additional precautions where a drilling operation is to occur within a buffer zone, or a designated Sensitive Area[43] or Sensitive Wildlife Habitat[44]. The additional precautions are required to prevent the environment, public health, safety, and welfare, and wildlife resources from being negatively affected by the activities and may include pitless drilling systems, enclosed tanks for storage of drilling fluids, baseline water testing, notification to the downstream water system of intended operations, and preparation of an emergency response program.[45] In its draft SGEIS, New York has proposed *requiring* well operators to conduct pre-drilling testing of water wells within one thousand feet of the proposed natural gas well[46] and ongoing testing of the water wells through one year after fracking.[47]

Casing and Cementing

Casing of gas wells, the practice of installing pipeline within the well bore, is required in Pennsylvania to protect oil, water, and/or coal bearing strata from contamination. Protection of groundwater is an explicit concern in the regulatory casing requirements, which require that the well operator case and cement a well to "[p]revent the migration of gas or other fluids into

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[39] 18 C.F.R. § 806.22(f)(4) (2008).
[40] W. Va. Dep't of Env. Prot, GUIDANCE: WATER WITHDRAWALS FROM WEST VIRGINIA STREAMS (Apr. 15, 2010), *available at* http://gisonline.dep.wv.gov/wwt/index.html.
[41] 2 COLO. CODE REGS. §§ 404-318A,318B (2009).
[42] N.Y. State Dep't of Envtl. Conservation, *DEC Announces Separate Review for Communities with "Filtration Avoidance Determinations"*, (Apr. 23, 2010), http://www.dec.ny.gov/press/64699.html.
[43] 2 COLO. CODE REGS. § 404-901(e)-(f), .
[44] 2 COLO. CODE REGS. §§ 404-1201, 1203.
[45] 2 COLO. CODE REGS. § 404-317B(c)-(f) (2009).
[46] Draft SGEIS, *supra* note 3, at app. 10, ¶ 5.
[47] Draft SGEIS, *supra* note 3, at app. 10, ¶ 6.

Table 1: Distance Requirements between Natural Gas Wells and Various Places		
	New York	**Pennsylvania**
Private House	100 feet	200 feet
Water Well	Not specified	200 feet
Public Building	150 feet	200 feet
Road	75 feet	Not specified
Body of Water or Waterway	50 feet	100 feet
Wetland	Not specified	100 feet
Gas Well of the Same Pool	1320 feet	Not specified
Lease Boundary	660 feet	Not specified
NY-PA State Boundary	330 feet	Not specified

Statewide spacing requirements between natural gas wells may decrease localized environmental impacts in any given area. If Pennsylvania were to institute statewide spacing requirements, it should consider an exception for multiple horizontal wells drilled from the same well pad, which result in less total disturbed area than multiple well pads. Furthermore, Pennsylvania should consider how such spacing requirements would interact with the state's property regime for natural gas resources, which currently utilizes a Rule of Capture.[63]

Information Requirements

Pennsylvania's Oil and Gas Act protects certain important public resources from drilling by requiring that the Pennsylvania DEP take those resources into consideration in issuing permits, although it does not require that the DEP make any certain determination based on those considerations:

> The department shall, on making a determination on a well permit, consider the impact of the proposed well on public resources to include, but not be limited to, the following:
> (1) Publicly owned parks, forests, gamelands and wildlife areas.
> (2) National or State scenic rivers.
> (3) National natural landmarks.
> (4) Habitats of rare and endangered flora and fauna and other critical communities.
> (5) Historical and archaeological sites listed on the Federal or State list of historic places.[64]

For proposed projects within the Susquehanna River Basin, the SRBC may require that applicants for water withdrawal permits submit information on the "[a]nticipated impact of the proposed project on" the potential for recreation, wildlife habitat, the natural environment and

[63] Pa. Dep't of Env. Prot., Landowners and Oil and Gas Leases in Pennsylvania: Answers to Questions Frequently Asked by Landowners About Oil and Gas Leases and Drilling, Doc. No. 5500-FS-DEP2834, at 3 (2007).
[64] Oil and Gas Act, 58 PA. STAT. ANN. § 601.205(c) (2009).

cultural or archaeological sites, among other things.[65] However, the SRBC is not bound to take any action subsequent to that information.

New York has a more expansive list of environmental features to be considered by the New York DEC before permitting a well. Unlike their counterparts in Pennsylvania, well operators in New York are required to disclose information on topics such as project site vegetation, present land uses within a quarter mile, farmland, 100-year flood plains, and visual resources of statewide significance. The presence of such resources, among others, may require that well operators in New York obtain additional permits, approvals and/or mitigation measures.[66] Although not part of the permitting process, the New York draft SGEIS also proposes requiring operators prepare mitigation plans for greenhouse gas emissions and invasive species.[67] Pennsylvania should take all of these explicit factors into consideration in deciding whether to issue a permit to drill a natural gas well.

A further provision that Pennsylvania should adopt is Colorado's requirement for the operator to consult in good faith with the surface land owner, Local Government, the Division of Wildlife, and the Department of Public Health and Environment in regards to siting of all proposed gas operations towards protection of landowner interests, wildlife habitats, and regarding public health, safety, welfare, or impacts to the environment.[68] (Colorado also requires that operators consult with landowners before commencing remediation,[69] see below.)

Restrictions on State Lands

Some state lands in Pennsylvania also receive special protection with respect to the siting of natural gas wells. Surface development is prohibited within State Parks, Wild Areas (areas within state forests where permanent development is prohibited) and Natural Areas (protected areas meant to provide places for "scientific observation of natural systems to protect unique plant and animal communities and to protect outstanding examples of natural interest and beauty"). However, subsurface rights are available for lease in these protected areas with the

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[65] 18 C.F.R. § 806.14(b)(1)(v) (2008).
[66] Div. of Mineral Resources, N.Y. State Dep't of Envtl. Conservation, Environmental Assessment Form, 85-16-5 (1/07)—10b at 1-2, *available at* http://www.dec.ny.gov/energy/1777.html (follow "Environmental Assessment Form")[hereinafter Environmental Assessment Form].
[67] Draft SGEIS, *supra* note 3, at app. 10, ¶ 1.
[68] 2 COLO. CODE REGS. § 404-306(a)-(d) (2009).
[69] 2 COLO. CODE REGS. § 404-306E (2009).

sources of fresh groundwater" and to "[p]revent pollution or diminution of fresh groundwater."[48] While the regulations go on to provide specific standards related to surface casing and coal protective casing, production casing (as used in the fracking process) is excluded from these regulations.[49] 25 Pa. Code 78.73 does set forth that the operator *may* cement or install sufficient intermediate or *production casing* or take other actions approved by the Department necessary to prevent the migration of gas and other fluids from lower formations into fresh groundwater. The Pennsylvania DEP is considering promulgating a rule that would require casing and cementing to meet specific technical standards.[50] Although an analysis of the specifics of the proposed technical requirements is beyond the scope of this review, it seems that implementing specific standards might simplify enforcement of casing requirements. Colorado has specific standards for cementing, and addresses both intermediate and production casing.[51] Colorado also sets forth additional specifications regarding casing when drilling is to occur within the identified Environmental Protection Areas.[52]

New York has stronger current and proposed casing requirements than Pennsylvania, especially concerning production casing. While Pennsylvania explicitly excludes production casing from its specific casing and cementing standards,[53] New York instructs well owners to use sufficiently strong production casing for stimulation processes.[54] In its draft SGEIS, New York considers requiring that intermediate or production casing be fully cemented to the surface.[55] The New York draft SGEIS also contains a provision that would require pressure testing of the casing prior to fracking operations.[56] Adequate production casing and cementing of production casing are important to protecting groundwater. For example, insufficient production casing cement and failure to properly vent the annulus between the surface casing and the production casing can lead to excessive pressure in the annulus, which in turn can "result in the

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[48] 25 Pa. Code § 78.81(a) (2010).
[49] 25 Pa. Code § 78.81(c) (2010).
[50] Oil and Gas Wells, 40 Pa.B. 623 (Advance Notice of Proposed Rulemaking issued January 30, 2010)(to be codified at 25 Pa. Code Ch. 78.83-78.85).
[51] 2 COLO. CODE REGS. § 404-317(h),(i) (2009).
[52] 2 COLO. CODE REGS. § 404-317(a)-(c) (2009), and § 404-901(e)-(f).
[53] 25 Pa. Code § 78.81(c) (2010).
[54] N.Y. Dep't of Envtl. Conservation, *Casing and Cementing Practices* ¶15 (last visited Apr. 1, 2010), http://www.dec.ny.gov/energy/1757.html.
[55] Draft SGEIS, *supra* note 3, at app. 10, ¶ 27.
[56] Draft SGEIS, *supra* note 3, at app. 10, ¶ 30.

potential creation of subsurface pathways outside the surface casing," through which "natural gas could migrate into potable groundwater."[57] Pennsylvania should consider such measures.

SITING CRITERIA

Environmental Considerations and Sensitive Areas

Distance Requirements

The Pennsylvania Oil and Gas Act creates buffer zones around certain socially and environmentally important and/or sensitive areas:

> (a) Wells may not be drilled within 200 feet measured horizontally from any existing building or existing water well without the written consent of the owner thereof....
> (b) No well site may be prepared or well drilled within 100 feet measured horizontally from any stream, spring or body of water... or within 100 feet of any wetlands greater than one acre in size....[58]

However, the protections set out by the Oil and Gas Act are not comprehensive. Variances conditioned on additional safety measures are available for the distance requirement between wells and buildings or water wells. Similarly, waivers conditioned on additional safety measures are available for the distance requirement between wells and bodies of water and wetlands.[59] Requests for waivers also require a showing that "there are no alternative sites that are not within the 100 feet and the location is needed to recover the oil and gas reserves."[60]

A comparison of the distance requirements in New York and Pennsylvania is provided in Table 1. In general, Pennsylvania's distance requirements are greater than those of New York for distance from inhabited places and water wells, bodies of water and wetlands. However, New York, unlike Pennsylvania, sets statewide spacing requirements for the distances between wells, as well as the distances from wells to lease boundaries and the New York-Pennsylvania state border.[61] The New York DEC may permit exceptions to these distance requirements for "good and sufficient reason."[62] Pennsylvania regulations do not address drilling in relation to lease boundaries or State borders.

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[57] Draft SGEIS, *supra* note 3, at 6-36.
[58] Oil and Gas Act, 58 PA. STAT. ANN. §§ 601.205(a)-(b) (2009).
[59] *Id.*
[60] Manual Chapter 4, *supra note 14*, at 68.
[61] N.Y. Comp. Codes R. & Regs. tit. 6, § 553.1-553.2 (2006).
[62] N.Y. Comp. Codes R. & Regs. tit. 6, § 553.4 (2006).

Pennsylvania should consider making implementation of its suggested BMPs part of its permit approval process.

Sediment and Erosion Control Plan

In Pennsylvania, the submission of an Erosion and Sedimentation Control Plan that conforms to the BMPs is required before an operator may drill an enhanced recovery well or alter an existing well to be used as an enhanced recovery well,[121] as well as for any non-agricultural activity surpassing 5,000 square feet of total earth disturbance.[122] Among other things, the Erosion and Sediment Control Plan must contain information on the site topography, soil at the site, proposed earth disturbance activity, amount of anticipated runoff and where that runoff may reach, and a description of BMPs to be used at the site.[123]

Under current regulations, the Pennsylvania DEP requires that earth disturbance activities are "planned and conducted to minimize the extent and duration of the disturbance."[124] DEP has proposed additional goals for the soil and erosion controls under 25 Pa. Code Chapter 102, which would make clearer specific aims of minimizing disturbance. If adopted, these regulations would require that well operators plan and conduct earth disturbance, to the extent practicable, to "maximize protection of existing drainage features and vegetation," "minimize soil compaction," minimize additional stormwater runoff and "protect, maintain, reclaim and restore the quality of water and the existing and designated uses of waters within this Commonwealth."[125]

The New York Environmental Assessment Form requires a description of any erosion control measures "needed during construction of the access road and well site."[126] Unlike Pennsylvania, which requires an Erosion and Sediment Control Plan only for enhanced recovery wells and earth disturbances greater than 5,000 square feet,[127] New York requires a plan for erosion control measures for all natural gas well sites.[128] However, compared to the information required on New York's Environmental Assessment Form, Erosion and Sediment Control Plans in Pennsylvania must contain more detailed information on the soil at the site, proposed earth

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[121] 25 Pa. Code § 78.18 (2010).
[122] 25 Pa. Code § 102.4(b)(2)(i) (2008).
[123] 25 Pa. Code § 102.4(b)(5) (2008); Manual Chapter 4, *supra note 14*, at 12-16.
[124] 25 Pa. Code § 102.4(b)(4) (2008).
[125] Erosion and Sediment Control and Stormwater Management, 39 Pa.B. 5131 (proposed Aug. 29, 2009)(to be codified at 25 Pa. Code Ch. 102.4(b)(4)).
[126] Environmental Assessment Form, *supra note 66,* at 2.
[127] 25 Pa. Code § 78.18 (2010); 25 Pa. Code § 102.4(b)(2)(i) (2008).
[128] Environmental Assessment Form, *supra note 66,* at 2.

disturbance activity, runoff from the site and past, present and proposed land uses.[129]

Stormwater Runoff

In recent years, stormwater runoff has emerged as a significant concern in managing land development at natural gas well sites. Although a concern about stormwater runoff is implicit in Pennsylvania's regulations and BMPs for land management, Pennsylvania does not currently have regulations in place that adequately meet this concern. However, proposed regulations in Pennsylvania (25 Pa. Code Chapter 102) would address the problem if adopted. The proposed regulations include requirements for post-construction stormwater management (PCSM) that would require a PCSM plan be "developed, implemented, operated and maintained" for a range of activities, including the drilling and operation of natural gas wells.[130] The PCSM plan must be separate from the Erosion and Sediment Control Plan,[131] and include, among other things, information on the topography and geology of the site, "identification of the net change in volume and rate of stormwater from preconstruction hydrology to post construction hydrology for the entire project site and each drainage area," "identification of the location of surface waters, which may receive runoff," and a description of PCSM BMPs to be used.[132]

Requirements for stormwater control were adopted in Colorado. The Colorado Commission sets forth that well site operators shall use BMPs in developing stormwater control on well sites in order to control stormwater runoff in a manner that minimizes erosion, transport of sediment offsite, and site degradation.[133]

Sensitive Areas

Although the Pennsylvania DEP recognizes that land management BMPs are site-specific,[134] it does not provide greater requirements for particularly sensitive areas where natural gas drilling is permitted to occur. Proposed regulations include additional requirements for riparian forest buffers for activities "located within an Exceptional Value watershed, and the project site contains, is along or within, 150 feet of a river, stream, creek, lake, pond or

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[129] 25 Pa. Code § 102.4(b)(5) (2008); Manual Chapter 4, *supra note 14*, at 12-16.
[130] Erosion and Sediment Control and Stormwater Management, 39 Pa.B. 5131 (proposed Aug. 29, 2009)(to be codified at 25 Pa. Code Ch. 102.8(a)).
[131] Erosion and Sediment Control and Stormwater Management, 39 Pa.B. 5131 (proposed Aug. 29, 2009)(to be codified at 25 Pa. Code Ch. 102.8(d)).
[132] Erosion and Sediment Control and Stormwater Management, 39 Pa.B. 5131 (proposed Aug. 29, 2009)(to be codified at 25 Pa. Code Ch. 102.8(f),(g)).
[133] 2 COLO. CODE REGS. § 404-1002(f) (2009).
[134] Manual Chapter 4, *supra note 14*, at 12.

which tend to be less for vertical wells than for non-vertical wells and all Marcellus Shale wells.[109] In contrast, New York and Colorado have additional requirements for well operators to meet in order to drill a non-vertical well. New York regulations allow for controlled non-vertical drilling upon New York DEC approval of written application from the natural gas well operator. The application must give the "reason for the proposed intentional deviation," along with information on the operators and the location of the surface and target bottomhole location relative to the lease boundaries.[110] Likewise, directional drilling is specifically recognized in Colorado's regulations, which require additional plats, plots, and surveys depicting the precise locations of the wellbore through the directional/horizontal drilling process.[111]

Both New York and Colorado's rules seem more concerned with property issues than environmental issues. They require information on the location of well, but not about the drilling practice. As discussed above, New York and Colorado have forced pooling rules in place, but Pennsylvania does not provide for forced pooling for most of its natural gas resources. Therefore, the adoption of directional drilling rules similar to those of New York and/or Colorado may not make sense in Pennsylvania, where the Rule of Capture applies and "gas [may] be produced or captured from a well outside [the] property tract boundaries."[112] However, plotting the location of the horizontal wellbore in relation to surface and ground waters directly above the wellbore may reveal significant environmental issues for consideration.

Site Clearing and Land Development

Significant land development is generally required to prepare the site for well pad construction and drilling related operations. With respect to fracking, particularly when combined with horizontal drilling, the West Virginia DEP instructs well operators that the well sites "are likely to result in considerably larger" well sites than traditional well sites.[113] Although horizontal drill sites may take the place of several vertical drill sites, resulting in less total surface disturbance. The West Virginia DEP goes on to say that "horizontal or vertical, larger

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[109] 25 Pa. Code § 78.19 (2010).
[110] N.Y. Comp. Codes R. & Regs. tit. 6, § 554.5(d) (2006).
[111] 2 COLO. CODE REGS. § 404-321 (2009).
[112] Pa. Dep't of Env. Prot., Landowners and Oil and Gas Leases in Pennsylvania: Answers to Questions Frequently Asked by Landowners About Oil and Gas Leases and Drilling, Doc. No. 5500-FS-DEP2834, at 2-3 (2007).
[113] W. Va. Dep't of Env. Prot, Industry Guidance: Gas Well Drilling/Completion: Large Water Volume Fracture Treatments, at 3 (Jan. 8, 2010).

sites create greater challenges for sediment and water control."[114]

Best Management Practices (BMPs)

Pennsylvania regulations "require persons proposing or conducting earth disturbance activities to develop, implement and maintain BMPs to minimize the potential for accelerated erosion and sedimentation" with the obligation that "BMPs shall be undertaken to protect, maintain, reclaim and restore water quality and the existing and designated uses of waters...."[115] General BMPs for planning and using the access road and well site are set forth in the Pennsylvania Oil And Gas Operators Manual.[116] Some examples of such BMPs include:

> "Select the size of the well site that minimizes the amount of disturbed area and is compatible with safe drilling and completion practices";
> "Care should be taken to keep water above the well site from entering the site"; and
> "Sediment traps are needed when a sufficient vegetative filter strip is not present and slope lengths exceed the maximum allowable for sediment barriers."

The Manual also notes that natural gas well sites are variable and cautions operators "to develop the plan with the specific best management practices that are required for that individual site or project."[117]

New York and Colorado make certain best management practices conditions of the permit to drill and operate the gas well. Online guidance from the New York DEC indicates that

> "Site-specific permit conditions are attached to each permit to mitigate potential impacts related to the natural features present at the site, the type of activity, and the procedures the permittee elects to follow. For example, a permit condition imposing erosion control measures might be required for an access road or well site with steep slopes and highly erodible soils which drain to a river and/or other particularly sensitive natural resources.[118]"

In Colorado, unless the surface owner waives certain rules, the State sets forth express conditions on the siting and development of well pads and access roads.[119] Conditions include the collection and segregation of topsoils to facilitate in later reclamation, avoidance of steep slopes, and minimizing surface disturbance area in order to minimize impacts to wetlands and riparian habitats, minimize impacts to wildlife resources, and minimize cumulative impacts.[120]

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[114] *Id.*
[115] 25 Pa. Code § 102.2 (2008).
[116] Manual Chapter 4, *supra note 14*, at 9-11, 24-51.
[117] Manual Chapter 4, *supra note 14*, at 12.
[118] N.Y. State Dep't of Envtl. Conservation, *Designing and Drilling Your Well* (last visited April 1, 2010), http://www.dec.ny.gov/energy/1628.html.
[119] 2 COLO. CODE REGS. § 404-1002 (a)-(f) (2009).
[120] 2 COLO. CODE REGS. § 404-1002 (a)-(e) (2009).

property rights,"[95] it is perhaps not surprising that the state does not have a forced pooling system.

Due to the potential environmental and economic benefits of forced pooling, Pennsylvania ought to consider implementing forced pooling regulations that would apply to drilling in the Marcellus shale. As they consider doing so, relevant examples for study include the Pennsylvania Oil and Gas Conservation Act and its implementing regulations, New York's compulsory integration regulations and Colorado's commingling regulations. These three regimes are discussed in some detail here.

Although not applicable to drilling in the Marcellus shale, there is precedent in Pennsylvania for the use of forced pooling with respect to natural gas drilling. The Oil and Gas Conservation Act applies only to wells that are deeper than Marcellus shale wells.[96] The Act's implementing regulations provide that "[a]fter the expiration of the time allotted in the integration order for the nonparticipating operator to contribute his share of the estimated cost, the participating operators may acquire the nonparticipating operators' operating rights or leasehold interest..."[97] Notice and a public hearing are required prior to the issuance of an integration order[98] and that integration orders must be made on "terms and conditions that are just and reasonable."[99]

New York state law provides for forced pooling and has procedure in place to mitigate property rights concerns. Subject to a public hearing, the New York DEC may promulgate "an order establishing well spacing" unit to "promote effective development, use, or conservation of the natural resources of oil and gas."[100] "Before compulsory integration proceeds, the operator must attest to control of oil and gas rights for at least 60% of the acreage in a spacing unit."[101] The New York DEC is then required to make an order integrating tracts within a spacing unit if

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[95] W. VA. CODE § 22-1A-2 (2009).
[96] The Oil and Gas Conservation Act (with implementing regulations at 25 Pa. Code Chapter 79) applies to "oil and gas wells which are drilled to a depth of at least 3,800 feet, and penetrate the Onondaga horizon." Manual Chapter 2, *supra* note *70,* at 1. Wells drilled into the Marcellus shale are not governed under Chapter 79 regulations because the Marcellus shale formation directly overlies the Onandaga horizon. U.S. Department of Energy, Office of Fossil Energy National Energy Technology Laboratory, Modern Shale Gas Development in the United States: A Primer at 21 (Apr. 2009).
[97] 25 Pa. Code § 79.33(d) (1998).
[98] Oil and Gas Conservation Law, 58 PA. STAT. ANN. § 408(a) (2009).
[99] *Id.*
[100] N.Y. Comp. Codes R. & Regs. tit. 6, § 553.3(a), (b) (2006).
[101] Div. of Mineral Resources, N.Y. State Dep't of Envtl. Conservation, Landowner's Guide to Compulsory Integration Options (June 2008).

(1) there is not a voluntary integration and (2) New York DEC has found "after detailed study and analysis, notice and hearing that the integration of interests in spacing units, under conditions then existing in [the] state, or in the field or pool to be affected, is necessary to" both "prevent waste" and protect "the correlative rights of all owners and the rights of all persons including landowners and the general public."[102] (Unlike New York's, Pennsylvania's forced pooling requirements for deep wells do not require a detailed study by the DEP or any certain findings to move forward with forced pooling.) New York landowners who are compelled to integrate can then choose between integration as a royalty owner, participating owner or non-participating owner.[103] As in Pennsylvania, New York requires that integration orders be made on "terms and conditions that are just and reasonable."[104]

Colorado addresses forced pooling through a term they call "commingling".[105] Specifically, "[t]he commingling of production from multiple formations or wells is encouraged in order to maximize the efficient use of wellbores and to minimize the surface disturbance from oil and gas operations."[106] However, Colorado recognizes that commingling may not be proper in all situations, and also that private property rights may be impaired as a result of commingling, thus the Commission may order commingling to be inappropriate in certain regions, fields, geologic formations, etc. upon a motion by the Commission or upon an application by an aggrieved property owner.[107] The Commission goes on to set forth the procedure to be followed in the event of involuntary pooling, whereby a landowner may be heard.[108]

WELL DEVELOPMENT

Directional Drilling

Marcellus Shale gas well operators tend to use non-vertical drilling techniques to maximize the recovery of gas in the region. The Pennsylvania Oil and Gas Act implementing regulations do not recognize variability in drilling direction except with regard to permit fees,

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[102] N.Y. Envtl. Conservation Law §§ 23-0901(2), (3), 23-0301 (2009).
[103] Div. of Mineral Resources, N.Y. State Dep't of Envtl. Conservation, Landowner's Guide to Compulsory Integration Options (June 2008).
[104] N.Y. Environmental Conservation Law § 23-0901 (3) (2009).
[105] 2 COLO. CODE REGS. § 404-322 (2009).
[106] *Id.*
[107] *Id.*
[108] 2 COLO. CODE REGS. § 404-530(a)-(c) (2009).

modified adjoining dam or reservoir[83] or when the natural gas well penetrates a workable coal seam.[84] Additionally, the SRBC may require that applicants for permits for projects that require SBRC review and approval submit information on "site development considerations" including "geology, topography, soil characteristics, adjoining and nearby land uses, [and] adequacy of site facilities."[85]

In New York, "the known geology of the area" will be taken into account by the New York DEC for determination of what permits and plans are required for the prevention of pollution by polluting fluids.[86] New York's requirement to consider regional geology applies to a broader range of natural gas development activities than the limited requirement of Pennsylvania. However, the New York requirement is likely too vague to guide operators or provide a means of challenging a permit.

Geologic considerations may gain importance in Pennsylvania if the DEP promulgates the proposed Chapter 102 amendments to its erosion and sediment control regulations. The proposed amendments indicate that Erosion and Sediment Control Plans must "[i]dentify naturally occurring geologic formations or soil conditions that may have the potential to cause pollution during earth disturbance activities and include BMPs to avoid or minimize potential pollution and its impacts from the formations."[87] The identification of such features and use of BMPs would hopefully translate into a real decrease in the potential for pollution. An Erosion and Sediment Control Plan, as outlined in Pennsylvania Code Chapter 102, is required for enhanced recovery well sites and for any earth disturbance greater than 5,000 square feet.[88]

Topographic Considerations

Topography is an important consideration when reviewing an application to site a well pad. The DEP's Oil and Gas Operators Manual instructs well operators to "[i]f possible, pick a flat or gentle slope for the well site..." and to "[p]lan to grade the location so the rig site will be

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[83] 25 Pa. Code § 105.81(c)(4) (2008).
[84] Coal and Gas Resource Coordination Act, 58 PA. STAT. ANN. §513(d) (2009).
[85] 18 C.F.R. § 806.14(b)(1)(v)(E) (2008).
[86] N.Y. Comp. Codes R. & Regs. tit. 6, § 554.1(c)(1) (2006).
[87] Erosion and Sediment Control and Stormwater Management, 39 Pa.B. 5131 (proposed Aug. 29, 2009)(to be codified at 25 Pa. Code Ch. 102.4(b)(5)(xii)).
[88] 25 Pa. Code § 78.18 (2010); 25 Pa. Code § 102.4(b)(2)(i) (2008). Based on plain language, it seems that a well to be used for fracking would be considered an "enhanced recovery" well. However, no definition for "enhanced recovery" was included in the Oil and Gas Act (58 P.S. § 601.101), Pa. Code Ch. 78 or the DEP's "Oil and Gas Operators Manual."

level, but the balance of the cleared area should slope gently to the sides where sediment from the location can be trapped and contained."[89] Additionally, Erosion and Sediment Control Plans are required to include information on the "existing topographic features of the project site and the immediate surrounding area."[90] However, no indication is given on how that information will be utilized in assessing the Erosion and Sediment Control Plan. Pennsylvania ought to make the topographic considerations for siting natural gas operations more specific and explicit.

Unfortunately, there is no good example at hand for how Pennsylvania should do so. None of the other entities that were reviewed surpass Pennsylvania in utilizing topographic information for the siting of natural gas wells. The SRBC may require information regarding topography[91] and New York requires topographic information,[92] as does Colorado,[93] but no specific requirements on topography are laid out.

Forced Pooling

Forced pooling (also known as forced integration, forced unitization, compulsory integration or commingling) regulations compel landowners to lease their mineral rights in conjunction with neighbors who are willing to lease theirs. These regulations can present several benefits to the industry, landowner, and the environment including promoting financially efficient operations in addition to environmentally friendly drilling operations to decrease forest and/or habitat fragmentation.[94] However, forced pooling may also lead to property rights concerns.

Current Pennsylvania regulations do not include forced pooling provisions relevant to drilling in the Marcellus shale. West Virginia also does not have forced pooling. Given West Virginia's concern for property rights, exemplified by its explicit commitment that the West Virginia DEP "follow certain procedures to ensure constitutional protection of private real

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[89] Manual Chapter 4, *supra note 14*, at 10.
[90] 25 Pa. Code § 102.4(b)(5)(i) (2008).
[91] 18 C.F.R. § 806.14(b)(1)(v)(E) (2008).
[92] Environmental Assessment Form, *supra* note *66,* at 2 (inquiring into slope of the land at the project site); N.Y. Comp. Codes R. & Regs. tit. 6, § 552.1(b) (2006) (requiring that a plat keyed to a topographical map accompany applications for permits to drill, deepen, plug back or convert wells).
[93] 2 COLO. CODE REGS. § 404- 303(d)(3)(H) (2009).
[94] *See, e.g.*, 25 Pa. Code Ch. 78 (2010); Anya Litvak, *Marcellus Shale leaders to push Pennsylvania on drilling rights issue*, PITTSBURGH BUSINESS TIMES, Feb. 5, 2010, available at http://pittsburgh.bizjournals.com/pittsburgh/stories/2010/02/08/story12.html (last viewed Mar. 13, 2010).

restriction that any development drilling be done on adjacent land.[70] The revenue from the sale of natural gas resources by the state goes to the Oil and Gas Lease Fund, from which funds are "reinvest[ed]... into public conservation assets benefiting all Pennsylvanians."[71]

In contrast, the current policy of the New York State Office of Parks, Recreation and Historic Preservation, is that the "development, extraction, or offer for leasing of state-owned oil and gas resources is *prohibited* within State Parks and State Historic Sites."[72] Exceptions are available for existing leases and for privately held gas rights beneath state parkland, the only known instance of which were obtained prior to creation of the park.[73] Revenue from gas leases on state land are directed to the state's General Fund for State Reforestation and Multiple Use Areas, Conservation Fund for Wildlife Management Areas and to other state agencies as appropriate.[74] Pennsylvania should consider reviewing its investment scheme as to revenue derived from said natural gas resources toward conservation and reclamation efforts.

State Environmental Quality Review

The New York DEC's regulations to implement the State Environmental Quality Review Act (SEQRA) provide for the use of generic environmental impact statements (EIS) to assess the environmental impacts of "separate actions having generic or common impacts."[75] In 1992, a generic Environmental Impact Statement (GEIS) was prepared for the Oil, Gas and Solution Mining Regulatory Program.[76] At the time, the New York DEC also found that "issuance of a drilling permit for a location in a State Parkland, in an Agricultural District, or within 2,000 feet of a municipal water supply well, or for a location which requires other New York DEC permits, may be significant and requires a site-specific SEQRA determination."[77] Other activities that are ancillary to drilling, such as discharge of wastewater and siting and construction of gathering

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[70] Bureau of Oil and Gas Management, Pa. Dep't of Envtl. Prot., Oil and Gas Operators Manual, Compliance Responsibility, Document No. 550-0300-001, Chapter 2 at 8 (2001)[hereinafter Manual Chapter 2].

[71] Penn.Dep't of Conservation and Natural Resources, *DCNR Natural Gas Leasing Proposal* (last visited April 3, 2010), http://www.dcnr.state.pa.us/gasleasing/index.htm.

[72] N.Y. State Office of Parks, Recreation and Historic Preservation, Policy on the Development of Oil and Gas Resources in State Parks and Historic Sites at 1 (Oct. 16, 2009), *available at* http://www.nysparks.com/environment/documents.aspx, follow "OPRHP Policy On The Development Of Oil And Gas Resources (pdf)".

[73] *Id.* at 2.

[74] *Id.*

[75] N.Y. Comp. Codes R. & Regs. tit. 6, § 617.10(a)(3) (2006).

[76] Div. of Mineral Resources, N.Y. State Dept. of Envtl. Conservation, Draft Supplemental Generic Environmental Impact Statement On The Oil, Gas and Solution Mining Regulatory Program: Well Permit Issuance for Horizontal Drilling and High-Volume Hydraulic Fracturing to Develop the Marcellus Shale and Other Low-Permeability Gas Reservoirs, at 3-2 (Sept. 2009).

[77] *Id.*

lines, all discussed below, require separate SEQRA review. As previously discussed, the New York DEC is in the process of preparing a Supplemental GEIS to address the impacts of horizontal drilling and high-fluid-volume fracking. Pennsylvania does not have an analogous law to SEQRA requiring the production of environmental impact statements for state actions.

Region-Wide Impacts

Colorado has a progressive permitting process, requiring the operator to either participate in a Comprehensive Drilling Plan[78] or to file an application for a drilling permit.[79] The Comprehensive Drilling Plan, which is voluntary, is especially different than what Pennsylvania requires as far as a permitting process for drilling operations. The Act specifically states that the Plans are, "intended to identify foreseeable oil and gas activities in a defined geographic area, facilitate discussions about potential impacts, and identify measures to minimize adverse impacts to public health, safety, welfare, and the environment, including wildlife resources, from such activities."[80] The Comprehensive Plan is a regional approach to siting gas wells that takes into consideration the regional environmental aspects of the site and allows for an invitation for landowners, local government, Division of Wildlife, and Department of Public Health and Environment to participate in the development of a comprehensive drilling plan.[81] The goal is to include other regional gas well developers into the plans, so as to take a fully comprehensive approach to regional development and to account for cumulative impacts of gas drilling on the environment and public health. The Comprehensive Drilling Plan would then be available online, thus allowing for public disclosure of drilling activities, but for certain confidential or proprietary information.[82] Pennsylvania has no analogous program, but should consider instituting one.

Geologic Considerations

The Pennsylvania DEP currently considers geology only in limited circumstances related to natural gas wells – namely, when natural gas wells are developed in conjunction with a new or

[78] 2 COLO. CODE REGS. § 404-216 (2009).
[79] 2 COLO. CODE REGS. § 404- 303 (2009).
[80] 2 COLO. CODE REGS. § 404- 216 (2009).
[81] 2 COLO. CODE REGS. § 404- 216(d) (2009).
[82] *Id.*

reservoir."[135] (Exceptional Value waters are the most pristine surface waters in Pennsylvania.) Additionally, by definition, the river basins under the control of the SRBC and DRBC are receiving additional protection.

In comparison, Colorado has broad protections for particularly sensitive locales, which Pennsylvania should consider emulating. Colorado regulations allow the Director of the Commission to categorize a proposed well site and its surrounding surface land as a "sensitive area," which allows the Commission to issue additional operation requirements in order to ensure protection of regional groundwater and surface water.[136] Furthermore, Colorado regulations address gas drilling operations in designated sensitive areas[137], sensitive wildlife habitat areas and restricted surface occupancy areas, whereby additional restrictions on land development and siting are set forth to minimize the impacts on wildlife and to minimize land disturbance.[138]

Enhanced Recovery

As discussed above, Pennsylvania recognizes enhanced recovery and requires an Erosion and Sediment Control Plan for all enhanced recovery wells.[139] Pennsylvania regulations also require that operators of enhanced recovery wells submit to the DEP, upon request, a copy of the annual monitoring report submitted to the EPA to meet the requirements of the federal underground injection control program.[140]

Colorado's additional regulatory controls over enhanced recovery operations surpass those of Pennsylvania. In Colorado, should additional fluids be injected into the well for enhanced recovery, or other methods be used, the operator must submit an application and obtain Commission authorization as to every detail of the enhanced recovery procedure, including where the enhanced recovery fluids are obtained, their chemical analysis, the intended formation to receive the injected fluids, identification of groundwater locations, planned casing details, etc.[141] Obtaining approval for enhanced recovery operations involves a public hearing before the

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[135] Erosion and Sediment Control and Stormwater Management, 39 Pa.B. 5131 (proposed Aug. 29, 2009)(to be codified at 25 Pa. Code Ch. 102.14).
[136] 2 COLO. CODE REGS. § 404-901(e)-(f) (2009).
[137] 2 COLO. CODE REGS. § 404-901(e)-(f) (2009).
[138] 2 COLO. CODE REGS. §§ 404-1200-Series (2009), .
[139] 25 Pa. Code § 78.18 (2010).
[140] 25 Pa. Code § 78.125 (2010).
[141] 2 COLO. CODE REGS. § 404-401 (2009).

Colorado Commission.

Community Effects

Visual Impacts

The Pennsylvania DEP has not committed its staff to assessing visual impacts before permitting natural gas well drilling. However, the Pennsylvania DEP is required to "consider the impact of the proposed well on public resources" including public parks, scenic rivers and national natural landmarks.[142] Visual impacts may be part of that analysis. Furthermore, visual, noise, and lighting issues are largely managed by municipal ordinances in Pennsylvania.

Colorado and New York address visual impacts through different avenues. In order to mitigate visual impacts, Colorado requires that "[p]roduction facilities, regardless of construction date, which are observable from any public highway...be painted with uniform, non-contrasting, non-reflective color tones... and with colors matched to but slightly darker than the surrounding landscape...."[143] While this rule is better than no requirements for visual impacts, it does not address the visual impacts of access roads, site clearing, and other land development, nor does it address where facilities block the line of sight to visual resources.

New York takes a more comprehensive approach to protecting visual resources and does so before the well site is prepared by considering visual impacts in its permitting process. According to policy documents produced by the New York DEC,

> In the review of an application for a permit, Department staff must evaluate the potential for adverse visual and aesthetic impacts on receptors outside of the facility or property. When a facility is potentially within the viewshed of a designated aesthetic resource, the Department will require a visual assessment, and in the case where significant impacts are identified, require the applicant to employ reasonable and necessary measures to either eliminate, mitigate or compensate for adverse aesthetic effects.[144]

New York may even expand its visual impact mitigation provisions if the draft SGEIS is adopted as written – proposed regulations would require well operators to prepare a visual impacts mitigation plan.[145]

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[142] Oil and Gas Act, 58 PA. STAT. ANN. § 601.205(c) (2009).
[143] 2 COLO. CODE REGS. § 404-804 (2009).
[144] N.Y. State Dep't of Envtl. Conservation, Assessing and Mitigating Visual Impacts 2 (2000).
[145] Draft SGEIS, *supra* note 3, at app. 10, ¶ 1.

sulfide.[159]

Air emissions from equipment are addressed in regulations outside of those pertaining directly to natural gas drilling. For example, emissions and noise from frackwater trucks, which can idle for long periods at well sites, are addressed by the New York State Department of Transportation.[160] Pennsylvania, for example, does implement the provisions of the federal Clean Air Act[161], which approaches emissions from production equipment, through Pennsylvania's Air Pollution Control Act.[162]

The states examined here approach the issue of air emissions from wells with various concerns and use a range of techniques to meet those concerns. Several of these systems could be combined in Pennsylvania to minimize air emissions from wells. Such as BMPs for gas processing, compression, and transportation equipment.

Infrastructure

Other than water supplies, roads probably present the local infrastructure most likely to be adversely affected by natural gas drilling. As the West Virginia DEP observes in its industry guidance on fracking, "[h]auling large volumes of water [for fracking] will result in significantly increased truck traffic that may create safety concerns, road damage, dust problems and other environmental issues."[163] (Of course, the alternate approach of pumping water for use in fracking may create its own stresses on infrastructure: "Stream access when pumping from streams must also be carefully considered. Boat launch ramps and other public access points could be damaged by excessive use and should be avoided."[164])

The Pennsylvania Oil and Gas Operators Manual lays out BMPs for planning access roads that take into account the effects on local public roads. For example, operators are instructed to avoid tracking mud onto public roads and to select "a location that provides a safe ingress and egress from the public road."[165] Additionally, the Pennsylvania Department of Transportation and local authorities may require that vehicles exceeding posted weight limits

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[159] Draft SGEIS, *supra* note 3, at app. 10, ¶ 21.
[160] *See, e.g.* N.Y. State Dep't of Transportation, Environmental Procedures Manual (2001), *available at* https://www.nysdot.gov/divisions/engineering/environmental-analysis/manuals-and-guidance/epm.
[161] The Clean Air Act, 42 USC 7401.
[162] 35 P.S. § 4001, et seq.
[163] W. Va. Dep't of Env. Prot, Industry Guidance: Gas Well Drilling/Completion: Large Water Volume Fracture Treatments, at 3 (Jan. 8, 2010).
[164] *Id.*
[165] Manual Chapter 4, *supra note 14*, at 9-10.

provide security in the form of a bond or other financial instrument to assure compliance with road maintenance and repair requirements.[166] Currently, the required security is set at $12,500 per linear mile for most public roads that would be used by natural gas industry vehicles.[167] In New York, towns may institute truck routes and weight limits to protect their roads.[168] An interesting approach taken by West Virginia that might work in Pennsylvania is to consider "any modification or reconstruction of an existing road open to the public use or private" as part of the access road and, therefore, subject to the same regulatory requirements as access roads.

Flowback Water (Storage, Treatment, Disposal)

For the most part, flowback water is not differentiated from produced water in Pennsylvania's regulatory framework for natural gas development. Therefore, the "Produced and Flowback Water" section, below, addresses the bulk of regulation regarding the storage, treatment and disposal requirements for flowback water. When flowback water is explicitly discussed in the regulatory framework, it is in the context of recycling it into frackwater for future fracking. The Pennsylvania DEP's Oil and Gas Operators Manual touts the re-use of flowback water:

> By containing the flow back from a well after hydrofracturing, it may be possible to re-use some of the water on successive stages of the same job or on other wells. On-site pretreatment, such as flocculation, settling or filtration may be necessary to re-use the water. This activity has a dual advantage in that: 1) flowback water is carefully controlled and not allowed to spill onto the land surface or discharge to streams, and 2) the total volume of water required is reduced. The re-use of frac water has caused formation plugging and may not be acceptable for every operation.[169]

New York regulations provide for the extension of time for the storage of polluting fluids in tanks or pits if that fluid "is to be used in subsequent operations according to [a] submitted plan."[170] New York's time extension is one way the state might encourage operators to re-use flowback water. West Virginia also encourages reuse of flowback water in future operations.[171]

New York's draft SGEIS includes several provisions regarding flowback water, all of which could be adopted by Pennsylvania tighten regulation on flowback water. The Draft SGEIS

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[166] 189 P.A. CODE §189.4 (2010).
[167] 189 P.A. CODE §189.4(d)(1)(i)(B) (2010).
[168] N.Y. Vehicle and Traffic Law § 1660 (2009).
[169] Manual Chapter 4, *supra note 14*, at 7.
[170] N.Y. Comp. Codes R. & Regs. tit. 6, § 554.1 (2006).
[171] W. Va. Dep't of Env. Prot, Industry Guidance: Gas Well Drilling/Completion: Large Water Volume Fracture Treatments, at 4 (Jan. 8, 2010).

Noise Emissions

Pennsylvania does not have regulations or guidance in place pertaining to noise at natural gas well sites, again leaving said oversight to the municipalities. As with visual impacts, discussed above, New York addresses noise through non-binding guidance and Colorado sets forth specific requirements for operators. The New York DEC guidance document lays out a number of best management practices for reducing noise and noise complaints, such as using mufflers, increasing setback distance and limiting loud work to typical workday hours.[146] Noise impact mitigation measures included with the permit for work on the natural gas well are enforceable by the New York DEC.[147] While maximum decibel limits are avoided when possible, they "may be established for an operation to ensure activities do not create unacceptable noise effects" when the need for such a limit is shown by an environmental impact statement, the need is established by the New York DEC at a public hearing, the operator requests a decibel limit to provide a safe harbor for compliance or a New York DEC program division establishes decibel limit as a permit condition "to demonstrate avoidance of unacceptable noise impact."[148]

In contrast, Colorado embraces decibel limits. It has created a schedule of zones (residential/agricultural/rural; commercial; light industrial; and industrial) and times (7AM to 7PM and 7PM to 7AM), and has assigned a maximum decibel level for each category.[149] Natural gas operations are required to comply with those maximum decibel levels, although some work (including stimulation of natural gas wells) is only "subject to the maximum permissible noise levels for industrial zones."[150] Although strict numerical limits might be easier to enforce, it is not clear whether the New York or Colorado system would be better if adopted in Pennsylvania.

Lighting

Pennsylvania does not have regulations or guidance in place with respect to reducing light emissions from machinery at natural gas well sites. The only lighting requirement identified in this review is Colorado's, which states that "[t]o the extent practicable, site lighting shall be directed downward and internally so as to avoid glare on public roads and building units within

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[146] N.Y. State Dep't of Envtl. Conservation, Assessing and Mitigating Noise Impacts 23-25 (2001).
[147] *Id.* at 26.
[148] *Id.*
[149] 2 COLO. CODE REGS. § 404-802(c) (2009).
[150] 2 COLO. CODE REGS. § 404-802(b) (2009).

seven (700) hundred feet."[151] Again, visual, noise, and lighting issues are largely managed by municipal ordinances in Pennsylvania.

Air Emissions

Pennsylvania's oil and gas specific regulatory framework lacks specific regulation on air emissions from most natural gas wells and says only that the "venting of gas to the atmosphere from a well is prohibited when the venting produces a hazard to the public health and safety."[152] For natural gas wells in areas that contain hydrogen sulfide, Pennsylvania requires certain special practices.[153]

West Virginia also restricts emissions from wells, but does so from a concern of wasting natural gas, rather than endangering the public: "[n]atural gas shall not be permitted to waste or escape from any well or pipeline, when it is reasonably possible to prevent such waste...."[154]

Colorado is concerned with odors that would "constitute a nuisance or hazard to public welfare."[155] Colorado sets out specific requirements for production equipment and operations in order to prevent odors and dust from becoming problematic to neighbors of the well. Colorado's regulations also require green well completion practices for wells that are likely "to be capable of naturally flowing hydrocarbon gas in flammable or greater concentrations...."[156]

Current New York environmental regulations limit the time during which (but not amount of) natural gas that is allowed to escape from natural gas wells. The regulations specify that no gas, "except such as is produced in a clean up period not to exceed 48 hours after any completion or stimulation operation, plus that used for the controlled testing of the well's potential in a period not to exceed 24 hours, plus that used in any operational requirements, shall be permitted to escape into the air."[157] Because fracking is a stimulation operation, gas would be allowed to escape from fracked wells for up to 48 hours after each occasion they are fracked. To this rule, the draft SGEIS, if adopted, would add a constraint that "[v]ented gas should be ignited whenever possible"[158] and add similar requirements for drilling in areas with hydrogen

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[151] 2 COLO. CODE REGS. § 404-803 (2009).
[152] 25 Pa. Code § 78.74 (2010).
[153] 25 Pa. Code § 78.77 (2010).
[154] W. VA. CODE § 22-6-31 (2009).
[155] 2 COLO. CODE REGS. § 404-805(a) (2009).
[156] 2 COLO. CODE REGS. § 404-805(b)(2),(3) (2009).
[157] N.Y. Comp. Codes R. & Regs. tit. 6, § 556.2(b) (2006).
[158] Draft SGEIS, *supra* note 3, at app. 10, ¶ 37.

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[163] W. Va. Dep't of Env. Prot, Industry Guidance: Gas Well Drilling/Completion: Large Water Volume Fracture Treatments, at 3 (Jan. 8, 2010).
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[165] Manual Chapter 4, *supra note 14*, at 9-10.

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[168] N.Y. Vehicle and Traffic Law § 1660 (2009).
[169] Manual Chapter 4, *supra note 14*, at 7.
[170] N.Y. Comp. Codes R. & Regs. tit. 6, § 554.1 (2006).
[171] W. Va. Dep't of Env. Prot, Industry Guidance: Gas Well Drilling/Completion: Large Water Volume Fracture Treatments, at 4 (Jan. 8, 2010).

requirements on flowback water include the following:

- "Piping and conveyance used for flowback water must be constructed of materials compatible with flowback water composition and in accordance with the fluid disposal plan approved by the Department...."[172]
- "Flowback water must not be directed to any on-site pit. Steel tanks are required for flowback handling and containment on the well pad. Fluid transfer operations from tanks to tanker trucks must be manned at the truck and at the tank if the tank is not visible to the truck operator from the truck."[173]
- "In no event will flowback water from this location be piped or transported to a centralized surface impoundment located within the boundaries of a primary or principal aquifer or an unfiltered water supply, or a centralized surface impoundment elsewhere that has not been approved by the Department...."[174]
- "Fluids recovered after high volume hydraulic fracturing operations must be tested for NORM [naturally occurring radioactive materials] during flowback operations prior to removal from the site...."[175]

POST DEVELOPMENT AND LONG TERM RESPONSIBILITY

Produced and Flowback Water

Storage

Produced water in Pennsylvania must be collected in a tank, pit, series of tanks or pits, or another device approved the DEP.[176] A pit is a temporary lined container built into the ground. Pits to be used for longer than nine months after completion of drilling are regulated under The Clean Streams Law (35 P. S. §§691.1 – 691.1001).[177] Any operator who does not remove or fill the pit within nine months after completion of drilling or have an extension from the DEP must have a permit under the Clean Streams Law. That permit application requires, among other things, descriptions of the plans for the construction, maintenance and closure of the pit and a

[172] Draft SGEIS, *supra* note 3, at app. 10, ¶ 11.
[173] Draft SGEIS, *supra* note 3, at app. 10, ¶ 35.
[174] Draft SGEIS, *supra* note 3, at app. 10, ¶ 36.
[175] Draft SGEIS, *supra* note 3, at app. 10, ¶ 47.
[176] 25 Pa. Code § 78.57(a) (2010).
[177] 25 Pa. Code § 78.56(d) (2010).

description of where the water will go after being removed from the pit. Among other requirements, the pit cannot be within 100 feet of a stream, wetland, or body of water (this requirement is waivable), the bottom of the pit must be at least 20 inches above the seasonal high groundwater table, at least 2 feet of freeboard must remain above the water level at all times and the pit lining must meet an impermeability standard.[178] Tanks are less stringently regulated than pits. Tanks are above-ground structures that can be open or closed at the top. The main requirement of a tank is that the entire series of pits and/or tanks have sufficient capacity to contain all polluting substances and wastes used or produced during drilling, altering, completing, and plugging the well.[179] An open tank must have 2 feet of freeboard remaining at all times or a sufficient overflow containment system to a standby pit or tank with sufficient volume to contain all excess fluid with 2 feet of freeboard.[180] Other water impoundments, which can be used instead of a tank or pit by request to the DEP if they provide equivalent or superior protection, have similar requirements. Impoundments are usually in-ground and meant for more long-term use than pits or tanks. An impoundment must be structurally sound, impermeable, protected from unauthorized acts of third parties, and must have at least 2 feet of freeboard at all times.[181]

Other states have different pit and tank requirements that Pennsylvania could base improvements on. New York's draft SGEIS would forbid centralized flowback water surface impoundments within the boundaries of primary and principal aquifers or unfiltered water supplies. It would also require that a double liner system and leak detection devices be used in pits, uncovered tanks, and impoundments.[182] Colorado bans pits in areas where pathways for communication to groundwater or surface water are likely to exist, and requires netting or fencing where necessary to protect wildlife.[183] In certain areas, the Commission may also require a leak detection device, monitoring systems, and other spill protection/retaining systems.[184] West Virginia requires provisions for diverting surface water from any pits.[185] All of these requirements create small additional burdens on operators while providing significant increases

[178] 25 Pa. Code §§ 78.57(c)(1-4)(2010).
[179] 25 Pa. Code § 78.56(a)(1) (2010).
[180] 25 Pa. Code § 78.56(a)(2) (2010).
[181] 25 Pa. Code § 91.35(a) (2010).
[182] Draft SGEIS, *supra* note 3, at §7.1.7.
[183] 2 COLO. CODE REGS. § 404-902 (2009).
[184] 2 COLO. CODE REGS. § 404-904 (2009).
[185] W. VA. CODE OF STATE RULES § 35-4-16.4.a (2010).

in environmental protection.

The most effective move Pennsylvania could make is to follow New York's lead and forbid long-term storage in pits and tanks. Unless an operator gets an extension from the New York DEC, which is granted only if there are circumstances beyond the operator's control, storage in a pit or tank prior to disposal can be for a maximum of only 45 days after drilling operations cease. The only standard exception is if the flowback water will be reused in subsequent operations.[186] This requirement, which predates the current draft SGEIS, if adopted in Pennsylvania, should assuage those complaints of Pennsylvania residents that come from long-term impoundments. These include obnoxious smells, leakage into groundwater, overflow during floods, and the death of animals who drink from it.[187] Forcing the reuse or proper treatment and disposal of wastewater soon after drilling operations are complete, something New York already does, would solve a slew of environmental problems caused by Marcellus Shale drilling in Pennsylvania.

New York creates an inspection right of wastewater storage facilities for its DEC that Pennsylvania should consider adopting. Any designated New York DEC officer or employee may enter and inspect any records and equipment involved with storage of hazardous wastes. This inspection right includes the ability to inspect monitoring stations, conduct tests and take samples to identify any actual or suspected release of a hazardous substance.[188] Colorado does not have an inspection requirement, but it does require that operators monitor the volumes of injected water disposed of in Class II brine injection wells.[189] West Virginia requires that operators using pits with a capacity greater than 5,000 barrels inspect those pits every three days until they are closed and provide monthly affidavits proving that the inspections were conducted.[190] Pennsylvania regulations also allow inspections to administer, implement, enforce

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[186] N.Y. Comp. Codes R. & Regs. tit. 6, § 554.1(c)(3) (2006).
[187] *See, e.g.,* Christie Campbell, Hopewell woman fighting Range water impoundment, Observer-Reporter, April 9 2010, *available at* http://www.observer-reporter.com/or/localnews/040910chappel-range.
[188] N.Y. Comp. Codes R. & Regs. tit. 6, § 596.1(e) (2006).
[189] 2 COLO. CODE REGS. § 404-312 (2009).
[190] West Virginia Department of Environmental Protection, Memorandum to Large Volume Pit/Pong Operators from Randy C. Huffman, Cabinet Secretary (Dec. 16, 2008), *available at* http://www.dep.wv.gov/oil-and-gas/Documents/Large%20Volume%20Pit%20Inspection%20Directive.pdf; *see also* W. VA. CODE OF STATE RULES § 35-4-21.6.b (proposed), *available at* http://www.wvdep.org/Docs/17404_prop35CSR4%20Oil%20and%20gas.pdf ("All pits and impoundments containing fluid [those with a capacity greater than 5,000 barrels) shall be inspected every three (3) days for the life of the pit or impoundment").

and determine compliance with statutes. The Pennsylvania DEP intends to conduct an inspection at least once during every step of the process from permit issuance to after remediation. The regulation does not set out in detail what tests inspectors can or will run or what operators must provide to inspecting employees.[191] Pennsylvania should consider adopting stronger inspection requirements, especially with regard to wastewater storage facilities.

Treatment and Disposal

All states studied promote reuse of produced flowback water in future operations as it is the optimal disposal method available. For water that is not reused in Pennsylvania, disposal wells or injection wells are the preferred disposal method for produced water, per the Oil and Gas Operators Manual.[192] However, those sites are not the preferred disposal location for fracking fluids (e.g., flowback water). Instead, the DEP's Oil and Gas Operators Manual suggests creating disposal wells leading to depleted oil and gas reservoirs after extraction wells drilled into the reservoir are plugged.[193] This returns the produced water to approximately the same depth and formation as it was removed from, although drilling and removing of the gas has somewhat changed the formation. Disposal wells, like the fracking wells themselves, are excluded from the requirement of obtaining a National Pollutant Discharge Elimination System (NPDES) permit.[194] Discharge by land application is permitted in Pennsylvania for tophole water (fresh water obtained from shallow ground while drilling down) and water in pits from precipitation so long as there is no contamination of the water by drilling fluids and produced water. Any such discharge cannot be within 100 feet of a stream, wetland or body of water or within 200 feet of a water supply (this requirement is waivable).[195] Treatment and discharge to surface water is another disposal method available to well operators. Treatment facilities for produced water must obtain Water Quality Management Part II Permits. To discharge produced water into surface water, an operator must obtain a NPDES permit.[196] These permits come with monitoring requirements as well as disclosure, public notice, and minimum water quality standards. Any water discharged to a Municipal Sewage Treatment Plant must meet the requirements set out in 25 Pa. Code § 93 (2010). Furthermore, any discharge that could be

[191] 25 Pa. Code §§ 78.57(c)(1-4)(2010).
[192] Manual Chapter 4, *supra note 14*, at 79.
[193] Id.
[194] 25 Pa. Code § 92.4(a)(4) (2010).
[195] 25 Pa. Code § 78.60(b) (2010).
[196] Bureau of Oil and Gas Management, Pa. Dep't of Envtl. Prot., Oil and Gas Wastewater Permitting Manual, Document No. 550-2100-002, Chapter 1 at 1 (2001).

hazardous to the health of fish must satisfy the Pennsylvania Fish and Boat Code.[197] The DEP has expressed concerns about disposing wastewater through municipal plants. DEP has asked certain facilities to stop taking in wastewater pending further review. Others are only planning to take in or are taking in wastewater as only a "very small percentage of influent volume."[198] One other alternative the DEP considers to be a beneficial use of produced water is road-spreading.[199]

Recently, high concentrations of total dissolved solids (TDS) from discharges into surface water, especially the Monongahela River, have shown that current discharge regulations are not working.[200] In response, proposed changes to 25 Pa. Code Chapter 95 regulations, planned to take effect January 01, 2011, would establish "criteria for new sources of wastewaters resulting from fracturing, production, field exploration, drilling or completion of oil and gas wells." It would also ban new discharges from fracking operations directly into Pennsylvania waters and apply these new standards to land application as well.[201] Adopting and implementing these proposed changes is an important first step toward improving disposal techniques.

However, other states have already gone further than even the proposed changes. New York's DEC requires a comprehensive plan for disposal of flowback and produced water before any permit can be granted. Pennsylvania only requires such a plan exist before waste is created. The New York DEC may also require a second contingency plan in case the primary plan becomes unsafe or impracticable during disposal.[202] New York also forbids operators from conducting disposal operations themselves. Such disposal must be done by a waste transporter with an approved permit.[203] The transporter must obtain a beneficial use determination ("BUD") before removing any brine from the well site. The BUD application must include results from a New York State Department of Health laboratory detailing the composition of the brine and

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[197] Id. at 3-5.
[198] "Municipal Authorities' Perspective: Marcellus Shale Natural Gas Wastewater Treatment," PA Senate Environmental Resources and Energy Committee Hearing (January 27, 2010), 4. *Available at* <http://www.municipalauthorities.org/wp-content/uploads/2009/04/pa-senate-hearing-marcellus-shale-wastewater-1-27-101.pdf>
[199] Manual, Chapter 4, *supra note 14*, at 81-83.
[200] Don Hopey, State wants to tighten controls on waste water from gas wells, Pittsburgh Post-Gazette, April 08, 2010, *available at* http://www.post-gazette.com/pg/10098/1048747-454.stm.
[201] Wastewater Treatment Requirements, 39 Pa.B. 6467 (proposed Nov. 7, 2009)(to be codified at 25 Pa. Code Ch. 95).
[202] N.Y. Comp. Codes R. & Regs. tit. 6, § 554.1(c)(1) (2006).
[203] New York State Department of Environmental Conservation, Fresh Water Aquifer Supplementary Permit Conditions, *available at* http://www.dec.ny.gov/energy/42714.html.

performing several tests on it, such as for pH, oil and grease, and dissolved solids.[204] This allows local stakeholders at both the well site and the disposal site, as well as New York's DEC, to better monitor local water. Furthermore, any discharges in New York must have State Pollutant Discharge Elimination System (SPDES) permits and require site-specific review under New York's State Environmental Quality Review Act (SEQRA). SPDES incorporates and expands on NPDES requirements. Pennsylvania could avoid future problems similar to the Monongahela River pollution by following New York's lead and requiring secondary contingency disposal plans, independent testing of the composition of wastewater, and site-specific review. Further, Pennsylvania can obtain EPA assistance in conducting this review by eliminating the NPDES exemption for disposal wells.

Road spreading is no longer allowed to be used as a disposal method for Marcellus Shale drilling wastewater in New York.[205] Road spreading, even under strict guidelines, makes it impossible to control where dangerous chemicals and dissolved solids in the wastewater will go. Although it creates some benefit from the wastewater, it is a high-risk practice and Pennsylvania should consider following New York's lead in banning its use as a disposal method for Marcellus Shale drilling wastewater.

Site Remediation

Pennsylvania has some of the most thorough requirements for site remediation of the states studied. Pennsylvania regulations require re-vegetation of the well area, unless it would interfere with the landowner's further use of the land, in which case the operator must still stabilize the land against erosion.[206] Most states studied only recommend re-vegetation. There remain, however, a few areas where Pennsylvania could improve remediation requirements. As discussed in the produced water storage section above, New York requires that all wastewater be removed from the site for treatment and disposal within 45 days, unless it will be reused for future operations. Pennsylvania allows operators as much as nine months to remove all such water and complete remediation, leading to many of the complaints discussed above. [207] By banning long-term storage of wastewater on site, Pennsylvania can significantly reduce the

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[204] Id.

[206] 25 Pa. Code §§ 78.62(a)(1-18)(2010).
[207] Manual Chapter 4, *supra note 14*, at 86.

amount of time needed for remediation. Further, Pennsylvania could adopt Colorado's investigation requirements for well sites, which include sampling of soil and groundwater[208] Colorado also requires that operators consult with landowners before commencing remediation, allowing the landowner to request proper remediation for their planned future land use, even permitting the landowner to request a certain seeding mix for re-growth.[209] Such a requirement would be only a small step beyond Pennsylvania's current regulations (allowing the landowner to ask that the area not be re-vegetated) but would significantly aid landowners in continuing productive use of the land.

Gathering Lines

Pennsylvania does not formally regulate gathering lines; however, the DEP's Oil and Gas Operator's Manual provides BMPs for pipelines, including gathering lines. These BMPs are concerned with the installation of pipelines, as well as pipeline crossings of roads, streams and wetlands.[210] Notably, these BMPs do not instruct operators on the siting of gathering lines, how to minimize leaks from gathering lines or what should happen to gathering lines after they are no longer in use.

The Pennsylvania Public Utility Commission ("PUC") is currently assessing its jurisdiction to regulate gas pipelines.[211] A finding that the PUC has such jurisdiction could lead to significant improvement in pipeline regulation as the process of siting, permitting, and tracking pipelines would be done separately and by a different agency from that of wells, allowing it to get proper focus. The Pennsylvania PUC could model its pipeline management regulations on those of New York's Public Service Commission ("PSC"), which fills the same role in New York. New York's PSC requires a full environmental impact review of the siting, design, construction, and operation of major intrastate electric and natural gas transmission facilities.[212]

If Pennsylvania's PUC does not find it has jurisdiction over gas pipelines, Pennsylvania's DEP should look to Colorado in improving its best management practices framework. Colorado

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[208] 2 COLO. CODE REGS. § 404-909 (2009).
[209] 2 COLO. CODE REGS. § 404-306E (2009).
[210] Manual Chapter 4, *supra note 14*, at 52-60.
[211] Don Hopey, PUC sets hearing on Marcellus shale pipes, Pittsburgh Post Gazette, Mar. 18, 2010, available at http://www.post-gazette.com/pg/10077/1043759-113.stm.
[212] N.Y. Comp. Codes R. & Regs. Tit. 16 §85-1.0 (2006).

expands upon Pennsylvania's BMP's by ensuring the protection of not only streams and wetlands but also riparian habitats and wildlife resources.[213] Furthermore, Colorado's pipeline regulations set forth detailed requirements for pipeline materials, design to prevent corrosion and to handle gas pressures, line burial, soil protection obligations on croplands, erosion protection methods when burying lines, and testing requirements upon installation.[214]

Plugging

Plugging is required in Pennsylvania.[215] Detailed plugging requirements are set out in 25 Pa. Code §§ 78.65-78.98 (2010) or the operator could use an approved alternate method under 58 P.S. § 601.211. The operator must ensure that no gasses are present in the well at an amount that could interfere with cementing. Operators must use bridge plugs immediately above and below any gas storage reservoir or reservoir protective area unless the DEP has approved an alternate plugging plan.[216] Before plugging a well, an operator must give no less than 3 and no more than 30 days notice by submitting a "Notice of Intention to Plug a Well." Within 30 days of plugging, the operator must submit a "Certificate of Well Plugging," documenting details of the work.[217]

Pennsylvania's plugging requirements are fairly comprehensive and similar to states such as New York. One improvement that could be made, extending the minimum plug size to 50 feet on each side of a formation that has borne oil, and that is used in New York, is already being considered and should be implemented.[218] Furthermore, New York requires that an operator give its DEC ten days notice before plugging (Pennsylvania requires only three days notice) because a New York DEC employee must witness the plugging.[219] Pennsylvania should consider implementing a similar inspection requirement to ensure that its strong and complex plugging regulations are followed. Pennsylvania DEP's proposed rulemaking revisions to 25 Pa. Code 78 address additional plugging requirements and should also be considered.[220]

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[213] 2 COLO. CODE REGS. § 404-1002E (2009).
[214] 2 COLO. CODE REGS. § 404-1101 (2009).
[215] 25 Pa. Code § 78.91(a) (2010).
[216] 25 Pa. Code §§ 78.91(e-f) (2010).
[217] Manual Chapter 4, *supra note 14*, at 92.
[218] Oil and Gas Wells, 40 Pa.B. 623 (Advance Notice of Proposed Rulemaking issued January 30, 2010)(to be codified at 25 Pa. Code Ch. 78.92).
[219] N.Y. Comp. Codes R. & Regs. Tit.16 §555.4-5 (2006).
[220] Oil and Gas Wells, 40 Pa.B. 623 (Advance Notice of Proposed Rulemaking issued January 30, 2010)(to be codified at 25 Pa. Code Ch. 78.92).

Bonds

As shown in the table below, every state studied requires bonds to be posted for unplugged wells. Currently, Pennsylvania's bonds, $2,500 for a single well or $25,000 for a blanket bond, are among the lowest of any state studied.[221] New York's begin at that level but rise depending on the depth of the well.[222] Colorado's are similar for the well itself but require significant additional blanket bonds for gathering, processing and storage facilities and additional bonds per disposal well.[223] West Virginia's are currently double that of Pennsylvania.[224]

A proposed bill (H.B. 2213) would increase Pennsylvania's bond requirements higher than any other state studied. The proposed changes, covering only Marcellus Shale wells (unique among the states studied), would increase the per-well bond to $150,000 and forbid blanket bonds.[225] This would make Pennsylvania the only state studied to include considerations of the special issues and dangers involved in Marcellus Shale drilling in its bond requirements. Adopting such a change, or one substantially similar to it, is the best improvement Pennsylvania can make in its bond requirements. Pennsylvania should also consider implementing a high minimum liability insurance requirement for operators, as Colorado does.[226]

Please see comparison table on next page.

[221] 25 Pa. Code §§ 78.303(c-e) (2010).
[222] New York State Department of Environmental Conservation, Financial Security, *available at* http://www.dec.ny.gov/energy/1622.html.
[223] 2 COLO. CODE REGS. §§ 404-706 to 404-712 (2009).
[224] W. VA. CODE OF STATE RULES § 22-6-26(b-c)(2010).
[225] H.B. 2213, Sess. of 2010 (Pa. 2010).
[226] 2 COLO. CODE REGS. § 404-712 (2009).

Bond Comparisons:

State	Single Well	Blanket Bond
Pennsylvania Current	$2,500	$25,000
Pennsylvania Proposed	$150,000	Forbidden
New York	$2,500 (below 2,500 feet) $5,000 (between 2,500 and 6,000 feet) Higher for even deeper wells	Vary but available
West Virginia	$5,000	$50,000
Colorado	$2,000 for non-irrigated land $5,000 for irrigated land	$25,000 Additionally: $50,000 for gathering/processing storage facilities $50,000 per Class II disposal well $1,000,000 general liability insurance requirement