

Review and Comments on
Delaware River Basin Commission's
Proposed Natural Gas Regulations
of December 9, 2010

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Executive Summary

The construction and operation of natural gas wells to extract natural gas from the Marcellus Shale and other formations within the Delaware River Basin can have significant and adverse impacts on the water quality and water supplies of the Special Protection Waters of the Delaware River Basin. The Delaware River Basin Commission is anticipating the construction of thousands of natural gas wells. The Commission has an obligation to ensure that the water quality of the Special Protection Waters will not be degraded.

In its proposed Natural Gas Regulations, the Commission has neither reviewed nor accounted for the chemicals that are used in the fracturing process to extract the natural gas. Some of these chemicals, as reported by the Pennsylvania Department of the Environmental Protection, exceed maximum concentration levels standards, while other chemicals—such as petroleum distillates—have no maximum concentration levels.

The Commission would be wise to consider locations within the Delaware River watershed where drilling for natural gas should be off limits. The Commission may find some direction from local zoning, such as steep slopes, conservation zones, aquifer overlay zones, wetlands, and important wildlife areas, including Pennsylvania Natural Diversity Inventory (PNDI) sites.

The Commission has not positioned itself to review applications for natural gas wells according to their potential cumulative impacts on water quality and supplies in the Delaware River watershed. Cumulative impact evaluation is especially important because of the large number of anticipated wells and because most of those wells would be sited in the part of the Delaware River Basin designated as Special Protection Waters.

About the Author

Tom Daniels, Ph.D. is a Professor in the Department of City and Regional Planning at the University of Pennsylvania. He teaches Land Use Planning and Environmental Planning. He is the author of *The Environmental Planning Handbook* (2003, American Planning Association) and numerous articles on environmental planning and land use planning. From 1989 to 1998, he managed Lancaster County's farmland preservation program. The opinions expressed in this report are stated to a reasonable degree of professional certainty.

Introduction

Extraction of natural gas from the Marcellus Shale requires “large amounts of fresh water to fracture the formation to release the natural gas. A significant amount of water used in the extraction process is recovered, but this “frac water” includes natural gas and chemicals added to facilitate the extraction process, as well as brine and other contaminants released from the formation” (DRBC 2011, p. 1). A natural gas drilling project includes the drilling pad, all accompanying facilities and related activities, and all locations of water withdrawals used or to be used to supply water to the project (DRBC 2011, p. 3). Fracturing of shale formations cannot

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occur without the approval of the Delaware River Basin Commission. Commission approval is also required for any natural gas exploratory wells (DRBC 2011, p. 3).

The Delaware River Basin Commission has legal authority over both water quality and water quantity-related issues throughout the Basin. The Commission has identified areas of concern:

1. Gas drilling projects in the Marcellus Shale may have a substantial effect on the water resources of the basin by reducing the flow in streams and/or aquifers used to supply the significant amounts of fresh water needed in the natural gas mining process.
2. On-site drilling operations may potentially add, discharge or cause the release of pollutants into the ground water or surface water.
3. The recovered “frac water” must be treated and disposed of properly (DRBC 2011, p. 2).

The Commission has noted that “Most of the shale formations that may be subject to horizontal drilling and hydraulic fracturing techniques requiring large volumes of water in the basin are located within the drainage area to the DRB-designated Special Protection Waters” (DRBC 2011, pp. 2-3)(see Figure 1). Special Protection Waters have exceptionally high scenic, recreational, ecological, and/or water supply values and are subject to stricter control of wastewater discharges, non-point pollution control, and reporting requirements to prevent degradation. The drainage area of the Special Protection Waters is the land area that drains into the 197-mile stretch of the Delaware River from Hancock, NY to Trenton, NJ (DRBC 2011, p. 3)(see Figure 2).

DRBC Executive Director Carol R. Collier has noted that there are “thousands of wells projected to be installed in the basin over the next several years” (DRBC 2011, p. 4).

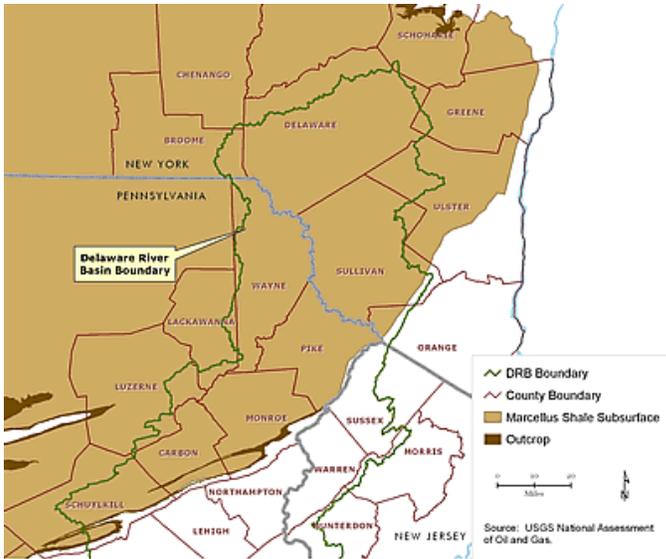


Figure 1. Marcellus Shale Subsurface within Delaware River Basin.
(Source: DRBC 2011)



Figure 2 . Special Protection Waters (shaded gray area), from Hancock, NY to Trenton, NJ.
(Source: DRBC 2011).

The Delaware River Basin Commission’s Proposed Natural Gas Regulations

The Delaware River Basin Commission’s proposed natural gas regulations state in Section 7.1 that “[t]he purpose of this article is to protect the water resources of the Delaware River Basin during the construction and operation of natural gas projects” (DRBC 2010a, p. 3). Section 7.1 “establishes standards, requirements, conditions and restrictions to prevent, reduce or mitigate depletion and degradation of surface and groundwater resources and to promote sound practices of watershed management including control of runoff and erosion” (DRBC 2010a, p. 3). The proposed regulations would apply to all new natural gas wells, exploratory or otherwise, in the Basin and to water withdrawals, well pad and related activities, and wastewater disposal activities.

The Delaware River Basin Compact of 1961 provides the Commission with the authority to adopt the proposed regulations on natural gas extraction; the proposed regulations, once approved, would be incorporated into the Commission’s Comprehensive Plan of 2001. The amendment of the Comprehensive Plan is meant “to facilitate the optimum planning, development, conservation, utilization, management and control of the water

resources of the Basin to meet present and future needs” (DRBC 2010a, p. 3). Therefore, any rulings on proposed natural gas projects by the Commission must be in keeping with the rules and regulations spelled out in the Comprehensive Plan. This authority is also expressed in the 1961 Compact.

The proposed regulations establish a planning framework regarding natural gas development and extraction in general terms:

Section 7.1(e)

(4) Manifests regulations through a strategic regulatory framework that addresses water withdrawals, well pad siting, wastewater disposal, surface and groundwater monitoring, and water use accounting. The framework implements standards for well construction and operations primarily by relying on host state review and requirements as specified in Section 7.1(i). The framework includes:

- (i) Water withdrawal requirements that preserve river flows to protect instream living resources and downstream withdrawers, and ensure adequate assimilative capacity for approved discharges;
- (ii) Well Pad requirements that protect surface and groundwater resources and facilitate tracking of water use from the withdrawal or diversion point to the point of use, and wastewater from the point of production to the point of treatment and disposal;
- (iii) Natural Gas Development Plan requirements that foster protection of water resources through broad scale, rather than limited site-by-site decision making, with due consideration of environmentally sensitive landscapes;
- (iv) Wastewater Docket provisions that protect receiving waters within the Delaware River Basin; and
- (v) Commission approval processes that may take the form of coverage by, a protected area permit, a site-specific docket, an area-wide or leasehold area docket based on a Natural Gas Development Plan, or an Approval by Rule” (DRBC 2010a, p. 5).

The Comprehensive Plan of the Delaware River Basin Commission is the guiding document in the Commission’s decision making process and is the basis for setting standards and promulgating regulations. “The Plan shall include all public and private projects and facilities which are required, in the judgment of the Commission, for the optimum planning, development, conservation, utilization, management and control of the water resources of the Basin to meet present and future needs” (DRBC 2001, p. 5). Moreover, "No project having a substantial effect on the water resources of the basin

shall hereafter be undertaken by any person, corporation or governmental authority unless it shall have been first submitted to and approved by the commission...The commission shall approve a project whenever it finds and determines that such project would not substantially impair or conflict with the comprehensive plan and may modify and approve as modified, or may disapprove any such project whenever it finds and determines that the project would substantially impair or conflict with such plan." (Article 1.10.1 of the Water Code of the Comprehensive Plan, DRBC 2001, p. 1 and Section 3.8 of the Delaware River Basin Compact, DRBC 1961).

Section 7.3 of the proposed natural gas regulations applies to "applications by project sponsors and reviews by the Commission in accordance with Section 3.8 of the Compact. [E]ach of the following types of projects require individual review unless the Executive Director approves otherwise:

- (1) Water withdrawals and water use for natural gas development.
- (2) Natural Gas Development Plans (NGDP).
- (3) Well pads for natural gas development.
- (4) Treatment and/or discharge of wastewater that was generated or reused for natural gas development (DRBC 2010a, p. 16)."

The proposed Natural Gas Regulations would amend the Commission's 2001 Comprehensive Plan. While it is important and commendable to try to keep the Comprehensive Plan up to date and to reflect changing challenges to water quality and supply conditions, the Comprehensive Plan omits three crucial elements: impacts on water supply, impacts on water quality, and limits on appropriate locations for drilling .

Water Supply Impacts

The Comprehensive Plan overlooks the recommendation of the Commission's strategic plan, Water Resources Program FY 2010-2015, which calls for the Commission under Natural Gas Development regulations to "**Perform Cumulative Impact Analysis on water supply 2011-12 Funding permitting**" (DRBC 2010b, p. 17 (emphasis added)). The Commission has not yet undertaken a cumulative impact analysis of natural gas development on water supplies in the watershed. This lack of an impact analysis undermines the Commission's ability to implement effective and sufficiently protective regulations.

Also, it is important to note that the 2004 Water Resources Plan for the Delaware River Basin was never adopted by the Commission into the Comprehensive Plan, which is the guiding document for decision making (DRBC 2004).

Section 2.1 Conservation of the Water Code, which is part of the Comprehensive Plan, states a policy to reduce water use (*Resolution No. 76-17*). Specifically, “The Commission will undertake a long-range continuing program to reduce water use throughout the basin for the purposes of:

- A. Reducing the likelihood of severe low stream flows that can adversely affect fish and wildlife resources and recreational enjoyment.
- B. Assisting in the maintenance of good water quality by provision of minimum dilution flows and repulsion of salinity.
- C. Deferring the need for construction of new storage reservoirs and other water supply structures” (DRBC 2001, p. 2).

The use of water for thousands of anticipated natural gas wells will not help reduce water use in the Delaware River Basin and will not support achieving these stated purposes.

In addition, Section 2.20.2 on the preservation of underground water (*Resolution No. 64-11*) states, “The underground water-bearing formations of the Basin, their waters, storage capacity, recharge areas, and ability to convey water shall be preserved and protected” (DRBC 2001, p. 45).

Also, Section 2.30.2 (*Resolution No. 91-9*) points out that “[t]he waters of the Delaware River Basin are limited in quantity and the Basin is frequently subject to drought warnings and drought declarations due to limited water supply storage and streamflow during dry periods” (DRBC 2001, p. 49). The occurrence of drought should be considered in assessing the potential cumulative impacts of thousands of natural gas wells on water supply.

The use of water for the natural gas extraction process appears contrary to the conservation policy to reduce water use throughout the basin and the preservation of underground water.

Water Quality Impacts

The Pennsylvania Department of Environmental Protection has published a Summary of Hydraulic Fracture Solutions – Marcellus Shale (PADEP 2011) (see Table 1). Some of these solutions exceed EPA standards for drinking water, while others such as Petroleum Distillates and Hydrochloric Acid do not have standards. The Water Code of the Delaware River Basin is part of the Commission’s Comprehensive Plan. The Water Code simply defines the term cumulative impact rather than applying it to the approval of natural gas: 11) "Cumulative Impact" is the net sum of all individual impacts including all point and non-point source impacts” (DRBC 2001,p. 61). The Water Code does not list the additives used to fracture shale formation, nor does it cite any maximum contaminant levels.

The Water Code of the Comprehensive Plan does not include, among others, the following chemicals that are used in the fracturing of Marcellus Shale to extract natural gas: Petroleum Distillate Blend, methanol, Propargyl Alcohol, Ethylene Glycol, Hydrochloric Acid (see PADEP, 2011; DRBC 2001 (see Table 1)).

Some of these chemicals have maximum contaminant levels set by the EPA, but these levels are exceeded by the reported concentration in the Fracking Solution (see Table 1). For instance, Propargyl Alcohol has a Frac concentration of 0.23 ppm while the EPA limit is 0.073ppm (product vendor BJS); Ethylene Glycol has a Frac concentration of 123.19 ppm while the EPA limit is 73ppm (product vendor Universal). The EPA has not set a limit on hazardous substances such as Hydrochloric Acid, Petroleum Distillate Blend, Ammonium Bisulfate, or Glutaraldehyde, nor has the DRB Commission (see Water Code of the Comp Plan pp. 138-145).

The Water Resources Program FY 2010-2015 raises the questions “Are the current water quality standards adequate? Should uniform criteria be developed?”(DRBC 2010b, p. 14). The proposed amendments to the Comprehensive Plan do not give assurance that water quality standards governing the use of chemicals in the natural gas fracking process are adequate to ensure adherence to the Safe Drinking Water Act standards.

The water quality and water quantity protection goals of the Comprehensive Plan and the Water Code are not well served by the natural gas extraction process being proposed, nor adequately protected by the draft regulations proposed.

Appropriate Drilling Locations

The proposed Delaware River Basin Commission Natural Gas Regulations of December 9, 2010 (DRBC 2010a) are well-intended but are not adequate for managing thousands of applications for natural gas wells. The large number of applications means that neither the traditional case-by-case approval approach nor the Natural Gas Drilling Plans (NGDP) will include a thorough consideration of the cumulative impacts on water supplies and water quality of existing and new natural gas wells. Most of the natural gas drilling will take place in those parts of the Delaware River basin that the Commission has designated Special Protection Waters. Therefore, the Commission should err on the side of caution in its review and approval of new natural gas wells. The Commission should institute a vigorous water quality and quantity monitoring program with an emphasis on identifying and anticipating the cumulative impacts on water supplies and water quality of widespread natural gas drilling and the use of a variety of contaminants to fracture shale formations.

The Commission would be wise to consider locations within the Delaware River watershed where drilling for natural gas should be off limits. The Commission may find some direction from local zoning, such as steep slopes, conservation zones, aquifer overlay zones, wetlands, and important wildlife areas, including Pennsylvania Natural Diversity Inventory (PNDI) sites.

Table 1. Summary of Hydraulic Fracture Solutions – Marcellus Shale (Source: PA DEP, 2011).

TABLE 1
SUMMARY OF HYDRAULIC FRACTURE SOLUTIONS - MARCELLUS SHALE

Product Vendor	Application Sequence	Product Name	Hazardous Components (MSDS)	(From	Hazardous Ingredient Weight %	Pounds of hazardous ingredient / pound water	Gallons of Frac solution per stage	Concentration in Frac Solution (ppm)	EPA Risk Based Concentration Residential Tapwater (ppm)
BJS	1	HCl	Hydrochloric Acid		8%	0.015834	2000	83.88	
		CI-14	Propargyl Alcohol		5%	0.0004327	2000	0.23	0.073
			Methanol		68%	0.000588472	2000	3.11	18
		Ferrotrol 300L	Citric Acid		70%	0.0035	2000	18.50	
	2	XLW-32	Methanol		90%	0.001583	42000	176.79	18
			Boric Oxide		20%	0.000354	42000	39.29	
		GW-3LDF	Petroleum Distillate Blend		60%	0.00321	42000	356.24	
			Polysaccharide		60%	0.00321	42000	356.24	
		GBW-20C	no hazardous ingredients		0%	0	42000	0.00	
		BF-7L	Potassium Carbonate		100%	0.0005725	42000	63.53	
		GBW-15L	Sodium Chloride		14%	0.000154	42000	17.09	
	3	FRW-14	Hydrotreated light distillate		40%	0.000424	334000	374.20	
			Ethoxylated Alcohol		5%	0.000053	334000	46.77	
		Alpha 125	Glutaraldehyde		30%	0.0000798	334000	70.43	
Fractech	1	HCL	Hydrochloric Acid		8%	0.0168896	2000	89.26	
		40 HTL	Methanol		10%	0.0002	2000	1.06	18
		NE100	Methanol		5%	0.0000485	2000	0.26	18
		FE100L	no hazardous ingredients		0%	0	2000	0.00	
	2	HVG-04	no hazardous ingredients		0%	0	42000	0.00	
		B9	Potassium Hydroxide		20%	0.000206	42000	22.86	
		BXL-2	Potassium Hydroxide		10%	0.000117	42000	12.98	

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Product Vendor	Application Sequence	Product Name	Hazardous Components (From MSDS)	Hazardous Ingredient Weight %	Pounds of hazardous ingredient / pound water	Gallons of Frac solution per stage	Concentration in Frac Solution (ppm)	EPA Risk Based Concentration Residential Tapwater (ppm)
	3	ICI-3240	Dazomet	24%	0.0000698	334000	61.42	
			Sodium Hydroxide	4%	0.0000116	334000	10.24	
		ICI-150	Glutaraldehyde	50%	0.00014125	334000	124.65	
			Methanol	5%	0.000014125	334000	12.47	16
		FRW-50	Diesel (use discontinued)	20%	0.000194	334000	171.21	
		FRW-25	no hazardous ingredients (used in place of FRW-50)	0%	0	334000	0.00	
Universal	1	Iron Check	no hazardous ingredients	0%	0	2000	0.00	
		HCl	Hydrochloric Acid	8%	0.0168896	2000	89.26	
	2	Unilink 8.5	Ethylene Glycol	40%	0.00111	42000	123.19	73
			Boric Acid	7%	0.00019425	42000	21.56	
		GBL-8x	n/a	0%	0	42000	0.00	
		Unigel 19XL	no hazardous ingredients (guar gum)	0%	0	42000	0.00	
	3	FRP-21	no hazardous ingredients	0%	0	334000	0.00	
		Bioclear 200	2,2-Dibromo-3-Nitrilopropionamide	20%	0.0000625	334000	55.16	
			Polyethylene Glycol Mixture	60%	0.0001875	334000	165.48	
Halliburton	1	HAI-OS	Methanol	60%	0.001068	2000	5.64	18
			Propargyl Alcohol	10%	0.000178	2000	0.94	0.073
		FE-1A	Acetic Acid	60%	0.001235042	2000	6.53	
			Acetic Anhydride	100%	0.002184454	2000	11.54	
		HCl	Hydrochloric Acid	8%	0.0168896	2000	89.26	
	2	K-34	Sodium Bicarbonate	100%	0.001271735	42000	141.13	
		BC 140	Monoethanolamine	30%	0.000523988	42000	58.15	
			Ethylene Glycol	30%	0.000566485	42000	62.87	73
			Boric Acid	30%	0.000808982	42000	67.56	
		Delta Frac 140	no hazardous ingredients	0%	0	42000	0.00	

SUMMARY OF HYDRAULIC FRACTURE SOLUTIONS - MARCELLUS SHALE								
Product Vendor	Application Sequence	Product Name	Hazardous Components (From MSDS)	Hazardous Ingredient Weight %	Pounds of hazardous Ingredient / pound water	Gallons of Frac solution per stage	Concentration in Frac Solution (ppm)	EPA Risk Based Concentration Residential Tapwater (ppm)
	3	FR-46	Ammonium Bisulfate	30%	0.000375	334000	330.95	
		Aldacide G	Glutaraldehyde	30%	0.0000798	334000	70.43	
Superior	1	AI-2	Glycol Ether (ethylene glycol monobutylether)	30%	0.000291	2000	1.54	18
			Propargyl Alcohol	30%	0.000291	2000	1.54	0.073
			Isopropyl Alcohol	30%	0.000291	2000	1.54	
			Proprietary Component	7%	0.0000879	2000	0.36	
		IC-100L	Citric Acid	100%	0.00154	2000	8.14	
		OB-Fe	Propylene Glycol	40%	0.000452	2000	2.39	730
			Ferrous Sulfate, Heptahydrate	30%	0.000339	2000	1.79	
		Super OW-3	Isopropyl Alcohol	40%	0.00018	2000	0.95	
			Methanol	13%	0.0000585	2000	0.31	18
		Super Pen 2000	Ethylhexanol	70%	0.000322	2000	1.70	
			Proprietary Component	30%	0.000138	2000	0.73	
		Super 100NE	Isopropyl Alcohol	30%	0.00015525	2000	0.82	
			Glycol Ethers	7%	0.00007245	2000	0.38	18
		HCl	Hydrochloric Acid	8%	0.0168896	2000	89.26	
	3	Bioclear 200	2,2-Dibromo-3-Nitriopropionamide	20%	0.0000625	334000	55.16	
			Polyethylene Glycol Mixture	60%	0.0001875	334000	165.48	
		SAS-2	Hydrotreated Light Distillate	30%	0.000306	334000	270.06	
			Mineral Spirits	25%	0.000255	334000	225.05	
			Propylene Glycol	26%	0.000255	334000	225.05	730
			Ethoxylated Alcohols	4%	0.0000408	334000	36.01	

Special Protection Waters

It is appropriate to examine the existing condition of the Special Protection Waters given that most of the natural gas drilling would occur in that part of the Delaware Basin that have been designated as Special Protection Waters. "High water quality is recognized in the 197-mile non-tidal Delaware River, from Hancock, NY to Trenton, NJ that have been designated by the Commission as Special Protection Waters" (DRBC 2010b, p. 7)(see Figure 3).

Waters with exceptional values may be classified by the Commission as either Outstanding Basin Waters or Significant Resource Waters. The Water Code of the Comprehensive Plan classified the following stream reaches as Outstanding Basin Waters:

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“(a) The Upper Delaware Scenic and Recreational River (Delaware River between River Mile 330.7 and 258.4);

(b) Those portions of intrastate tributaries located within the established boundary of the Upper Delaware Scenic and Recreational River Corridor;

(c) The Middle Delaware Scenic and Recreational River (Delaware River between River Miles 250.1 and 209.5);

(d) Those portions of tributaries located within the established boundary of the Delaware Water Gap National Recreation Area.

The following stream reaches are classified as Significant Resource Waters:

(a) The Delaware River between River Miles 258.4 (the downstream boundary of the Upper Delaware Scenic and Recreational River) and 250.1 (the upstream boundary of the Delaware Water Gap National Recreation Area);

(b) The Lower Delaware River between River Miles 209.5 (the downstream boundary of the Delaware Water Gap National Recreation Area) and 134.34 (the Calhoun Street Bridge near the Head of Tide at Trenton, NJ)” ((DRBC 2001).

The Water Code states: “1) Outstanding Basin Waters shall be maintained at their existing water quality. Point and non-point sources of pollutants originating from outside the boundaries of stream reaches classified as Outstanding Basin Waters shall be treated as required and then dispersed in the receiving water so that no measurable change occurs at Boundary and Interstate Control Points. Point sources of pollutants discharged to Outstanding Basin Waters shall be treated as required and then dispersed in such a manner that complete mixing of effluent with the receiving stream is, for all practical intents and purposes, instantaneous.

2) Significant Resource Waters shall not be degraded below existing water quality as defined in these regulations, although localized degradation of water quality may be allowed for initial dilution if the Commission, after consultation with the state NPDES permitting agency, finds that the public interest warrants these changes. Point and non-point sources of pollutants originating from outside the boundaries of stream reaches classified as Significant Resource Waters shall be treated as required and then dispersed in the receiving water so that no measurable change occurs at Boundary and Interstate Control Points” (DRBC 2001, p. 63).

The Delaware River Basin Commission’s proposed regulations do not demonstrate how the water quality of Outstanding Basin Waters will be maintained if water withdrawals

are allowed for up to thousands of natural gas wells, and if well operators are allowed to use fracking chemicals that will enter ground water and surface water.

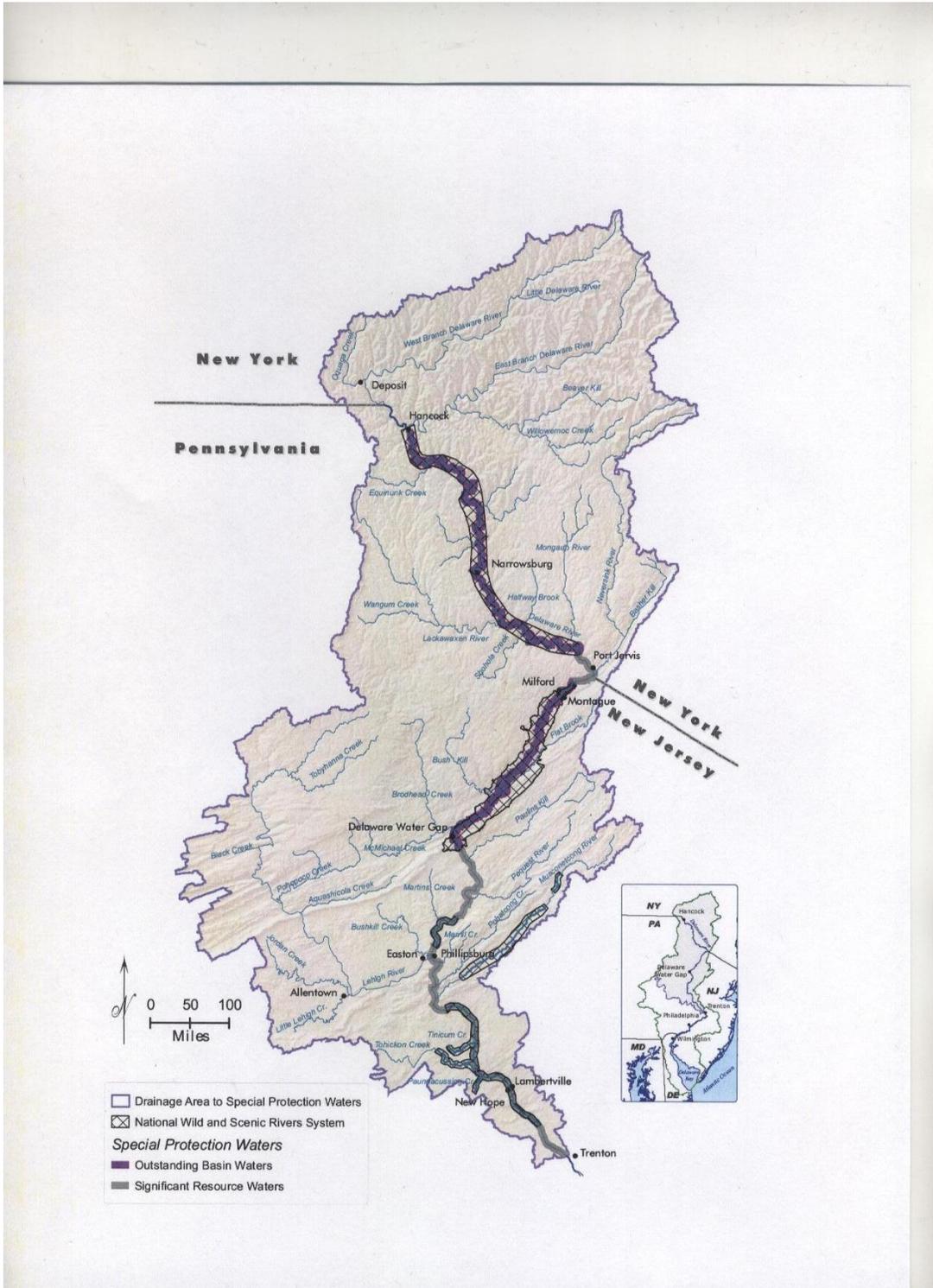


Figure 3. Special Protection Waters. (Source: DRBC 2011)

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An important purpose of the Commission is to prevent the degradation of Special Protection Waters from excess withdrawals and pollution. Proposed regulation Section 7.1 states, “This Article also helps implement the Commission’s Special Protection Waters (SPW) anti-degradation program where natural gas development projects are located within or affect waters designated by the Commission as Special Protection Waters or their drainage areas. The SPW regulations require among other things that a project cause no measurable change to existing water quality from point or nonpoint sources at control points identified in the SPW regulations and that the project implement non-point source controls (WQR 3.10.3A.2.b. and e.). An applicant for approval of a natural gas development project located in the drainage area of Special Protection Waters must comply with all SPW regulations in addition to this Article” (DRBC 2010a, p. 6).

The Water Code of the Comprehensive Plan states the following policy about Special Protection Waters in Section 3.10.3.A.2: (*Resolution Nos. 92-21, 94-2, and 2008-9*): “It is the policy of the Commission that there be no measurable change in existing water quality except towards natural conditions in waters considered by the Commission to have exceptionally high scenic, recreational, ecological, and/or water supply values” (DRBC 2001, p. 58).

Overall, the water quality was assessed as Fair in the Commission’s 2008 Water Quality Assessment covering Zones 1A, 1B, 1C, 1D, and 1E of the upper Delaware River in Pennsylvania (DRBC 2010b, p. 8)(See Figure 4).

The Water Code states that “Direct discharges of wastewater to Special Protection Waters are discouraged” but not forbidden (DRBC 2001, p. 63). However, groundwater, once contaminated, is very expensive and difficult to clean up. The potential for direct discharges renders the draft regulations inadequate for ensuring that Special Protection Waters are not degraded.

In the siting of natural gas wells, especially within the parts of the basin designated Special Protection Waters, it is important to ascertain the amount of deforestation that would occur from the development and operation of natural gas wells. Deforestation reduces water filtration, particularly if the deforestation occurs in stream headwaters, and produces erosion and sedimentation which degrade water quality. Sedimentation is especially detrimental to aquatic life. However, the well registration criteria listed in the Water Code (DRBC 2001, pp. 46-48) makes no mention of deforestation. To address

these issues, the Commission's draft regulations should be revised to incorporate erosion and sedimentation plans and techniques and tree retention standards to minimize impacts on water quality.

Finally, The Delaware River Basin Commission has not anticipated in its proposed regulations that a moratorium on natural gas drilling may be needed sometime in the future to assess the cumulative impact of natural gas extraction on the water supplies and water quality of the basin's waters. The Delaware River Basin Commission should include a moratorium as a potential action should incidences of water pollution and water shortages become widespread throughout the basin or become concentrated in particular parts of the basin, especially in those watersheds that drain into the Special Protection Waters.

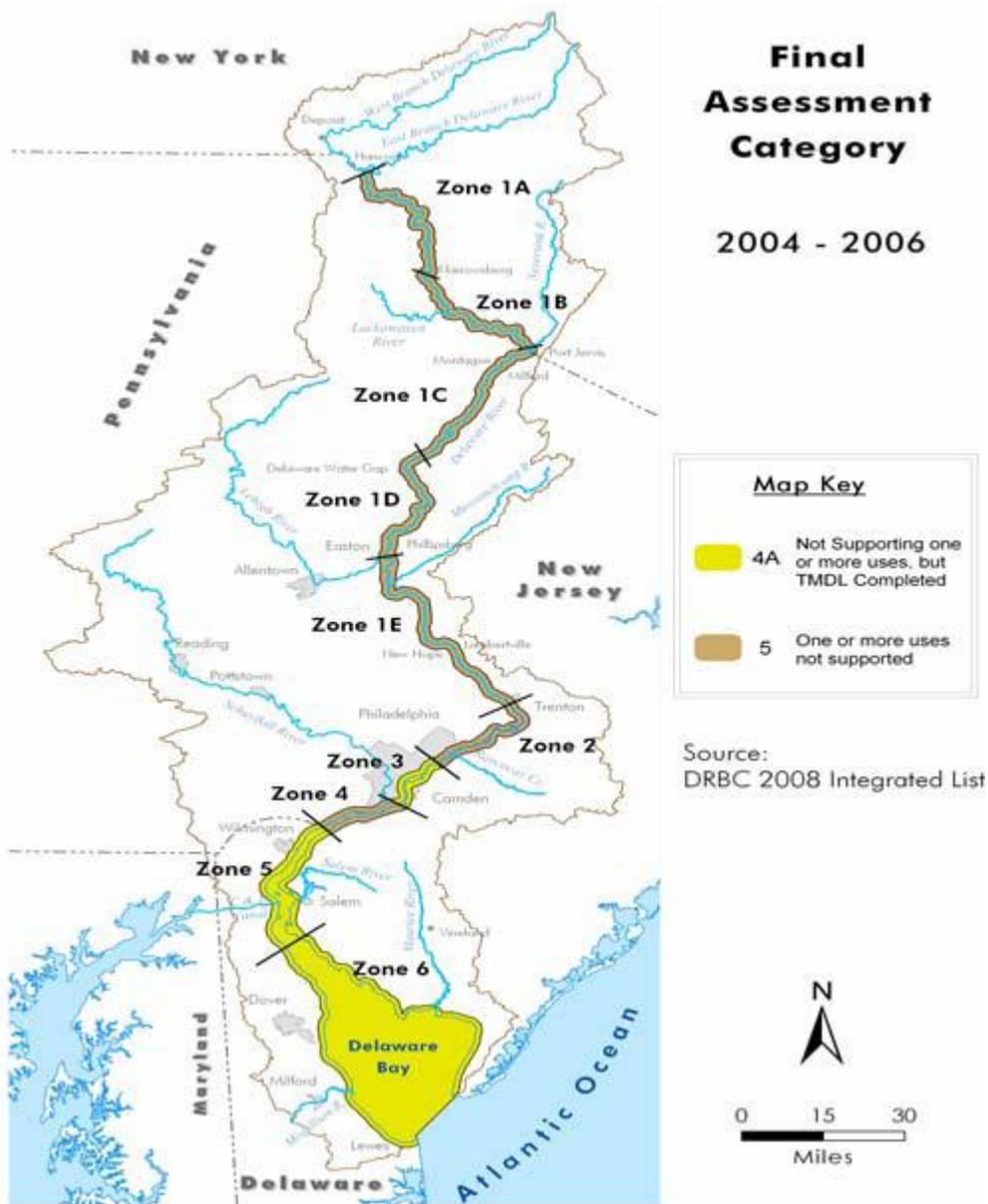


Figure 4. Zones of the Delaware River (Source: DRB, 2010b)

Conclusions

The Commission's Water Resources Program FY 2010-2015 states that "Additional demand of water for use in energy exploration, e.g., natural gas drilling, is increasing,

although the full effect of this demand sector has yet to be identified” (DRBC 2010b, p. 4) The Water Resources Program adds, “There will need to be more analysis of the water needs for energy projects and energy needs for water treatment as well as an evaluation of the carbon and water footprints” (DRBC 2010b, p.11). In other words, the Commission does not have a good sense of the potential cumulative impact of up to tens of thousands of natural gas wells on water withdrawals and on ground water and surface water quality from the use of fracking chemicals. These shortcomings are reflected in the lack of mention in the proposed Natural Gas Regulations of assessing cumulative impacts in the process of deciding whether the Commission should approve a natural gas well or a Natural Gas Development Plan of several wells.

Sound watershed management requires assessing the potential cumulative environmental impacts of individual wells and Natural Gas Development Plans in the Delaware River Basin, especially in those areas that have been designed as Special Protection Waters and in forested areas where deforestation could cause erosion and sedimentation and thus reduce water quality and aquatic habitat. A case-by-case review of development proposals is not sufficient given the large number of applications for wells anticipated over the next several years. The Commission should explain in its regulations and Comprehensive Plan how the cumulative impact of so many wells will be anticipated, measured, and scientifically monitored, and how the existing and potential cumulative effects of well drilling will be considered in the approval of individual natural gas wells and Natural Gas Development Plans. This is especially important for waters designated Outstanding Basin Waters, which are required to be maintained at their high quality (DRBC 2001, p. 63).

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