DEPARTMENT OF ENVIRONMENTAL PROTECTION
Bureau of Point and Nonpoint Source Management

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TITLE: Sewage Facilities Planning Module Review for Onlot Sewage Systems Proposed in High Quality and Exceptional Value Watersheds

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AUTHORITY: Pennsylvania Clean Streams Law (35 P.S. §§ 691.1 - 691.1001); Pennsylvania Sewage Facilities Act (Act 537) (35 P.S. §§ 750.1 – 750.20a); 25 Pa. Code Chapters 71 (Administration of Sewage Facilities Planning Program), 72 (Administration of Sewage Facilities Permitting Program), 73 (Standards for Onlot Sewage Treatment Facilities), 93 (Water Quality Standards), and 102 (Erosion and Sediment Control).

POLICY: The Department will assure that cost-effective and reasonable best management practices (BMPs) for nonpoint source control are achieved to maintain and protect water quality when reviewing sewage facilities planning modules for proposed individual or community onlot sewage systems in high quality and exceptional value watersheds.

PURPOSE: The purpose of this guidance is to describe BMPs for individual and community onlot sewage systems that can achieve nonpoint source control in High Quality and Exceptional Value waters, and to provide a process to select appropriate BMPs to achieve such control.

APPLICABILITY: This guidance applies to Department and delegated agency review of sewage facilities planning modules proposing the use of individual and community onlot sewage systems in High Quality or Exceptional Value watersheds.

DISCLAIMER: The policies and procedures outlined in this guidance are intended to supplement existing requirements. Nothing in the policies or procedures shall affect regulatory requirements.

The policies and procedures herein are not an adjudication or a regulation. There is no intent on the part of DEP to give the rules in these policies that weight or deference. This document establishes the framework within which DEP will exercise its administrative discretion in the future. DEP reserves the discretion to deviate from this policy statement if circumstances warrant.

PAGE LENGTH: 36 pages

DEFINITIONS: See 25 Pa. Code Chapters 71, 72, 73, 93 and 102 ; and Section II of this guidance.

I. Introduction

Individual and community onlot sewage systems provide important public health and water quality protection when properly located and managed. The Pennsylvania Department of Environmental Protection (DEP) and local agencies ensure that such systems are properly located and managed through planning and permitting processes established by law. Proper use of individual and community onlot sewage systems reduces the need for sewage facilities that result in direct discharges to surface waters, and such systems have largely been the sewage treatment option that has allowed residential development in High Quality (HQ) and Exceptional Value (EV) watersheds to proceed. Onlot systems involve the final disposal of treated sewage into the soil matrix, and are inherently superior to point source discharges from the standpoint of preserving water quality in potentially affected surface waters.

Uncertainty in the manner in which sewage facilities planning modules should be prepared and reviewed has arisen in regard to proposed onlot sewage systems for new land development in HQ and EV watersheds. In a legal challenge, the Environmental Hearing Board (EHB) sustained an appeal of DEP's approval of such a module (*Pine Creek Valley Watershed Assoc. v. DEP*, Docket No. 2009-168-L (November 10, 2011)) because of the approach used by DEP to demonstrate consistency of the proposed sewage facilities with the antidegradation requirements in Chapter 93. Following that decision, DEP conducted an extensive review of the scientific literature in this area, and evaluated various practices to address the fundamental question of maintaining and protecting HQ and EV waters when onlot sewage systems are proposed.

Onlot sewage systems are nonpoint sources, and the appropriate approach to controlling nonpoint sources of pollution is to employ cost-effective and reasonable best management practices (BMPs). This approach is consistent with the antidegradation requirements that have been employed to control other nonpoint sources (*Water Quality Antidegradation Implementation Guidance*, DEP ID: 391-0300-002 (Chapter 11)). BMPs can effectively attenuate nonpoint source pollution from onlot systems through limiting the density of onlot systems within an area, employing riparian buffers, providing advanced denitrifying technology, and other measures. When employed in the proper combination, these BMPs can ensure that onlot sewage systems maintain and protect water quality in HQ and EV watersheds. This guidance explains the factors considered by DEP in developing these cost-effective and reasonable BMPs, and describes the process recommended to determine the appropriate combination of BMPs.

This guidance addresses the most common form of onlot sewage treatment system that is commonly referred to as a septic system and involves the subsurface disposal of treated sewage to a soil absorption field. Other forms of onlot sewage treatment involve application of the treated sewage to the soil surface (*Manual for Land Treatment of Wastewater;* DEP ID: 362-2000-009) or reuse of treated wastewater (*Reuse of Treated Wastewater Guidance Manual*; DEP ID: 385-2188-002) that may involve land application through irrigation. These alternatives are outside of the scope of this guidance. This guidance applies whenever the onlot sewage treatment system is located in an HQ or EV watershed, and does not apply otherwise. This guidance applies to new individual or community onlot system installations only. Nevertheless, the policy and practices contained in this guidance are recommended for replacement residential or community onlot system installations in HQ or EV watersheds as well.

In Pennsylvania, DEP and the local agency must approve the planning of proposed onlot sewage systems as part of the Act 537 planning process, but most onlot treatment systems are permitted by local Sewage Enforcement Officers (SEOs). DEP's planning approval is subject to the antidegradation requirements in Chapter 93, and the permitting function performed by the SEO must be consistent with approved planning.

II. Definitions

Best management practice (BMP): Methods, measures or practices selected in accordance with this guidance to meet onlot system nonpoint source control needs. BMPs include but are not limited to structural and nonstructural controls and operation and maintenance procedures. BMPs can be applied before, during and after pollution-producing activities to reduce or eliminate the introduction of pollutants into receiving waters. See 40 C.F.R. § 130.2(m).

Community onlot sewage system: A system of piping, tanks or other facilities serving two or more lots and collecting, treating and disposing of sewage into a soil absorption area or retaining tank located on one or more of the lots or at another site. 25 Pa. Code § 71.1.

Discharge: An addition of any pollutant to surface waters of this Commonwealth from a point source. 25 Pa. Code § 92a.2.

Equivalent dwelling unit (EDU): For the purpose of determining the number of lots in a subdivision only as it relates to the determination of planning exemptions and fees for planning module reviews under Chapter 71, that part of a multiple family dwelling or commercial or industrial establishment with flows equal to 400 gallons per day. These flow figures are not intended to be used for the calculation of flows for the design of community sewerage systems or for the allocation of flows related to community sewerage systems. Community sewerage system flows for design and permitting purposes shall be calculated using the procedures established in the Department's Domestic Wastewater Facilities Manual (DEP-1357). 25 Pa. Code § 71.1.

Exceptional value (EV) waters: Surface waters of high quality which satisfy § 93.4b(b). 25 Pa. Code § 93.1.

High quality (HQ) water: Surface waters having quality which exceeds levels necessary to support propagation of fish, shellfish, and wildlife and recreation in and on the water by satisfying § 93.4b(a). 25 Pa. Code § 93.1.

gpd: gallons per day.

Large volume onlot sewage system: An individual or community onlot sewage system with a design capacity to discharge subsurface sewage flows which are in excess of 10,000 gpd. 25 Pa. Code § 71.1.

Local agency: A municipality (or any combination of municipalities acting cooperatively or jointly under the laws of the Commonwealth), county, county department of health or joint county department of health. 25 Pa. Code § 71.1.

Municipality: A city, town, township, borough or home rule municipality other than a county. 25 Pa. Code § 71.1.

Nonpoint source: A pollution source that is not a point source discharge. 25 Pa. Code § 93.1.

Official plan: A comprehensive plan for the provision of adequate sewage systems, adopted by a municipality or municipalities possessing authority or jurisdiction over the provision of the systems, and submitted to, and approved by, the Department as provided by the Pennsylvania Sewage Facilities Act, and Chapter 71. 25 Pa. Code § 71.1.

Onlot sewage system or onlot system: An individual or community sewage system which uses a system of piping, tanks or other facilities for collecting, treating and disposing of sewage into a soil absorption area. See 25 Pa. Code § 71.1. For the purposes of this guidance, onlot sewage systems are referred to as septic systems.

Point source: A discernible, confined and discrete conveyance, including, but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, CAAP (as defined in Chapter 92a), CAFO (as defined in Chapter 92a), landfill leachate collection system, or vessel or other floating craft, from which pollutants are or may be discharged. 25 Pa. Code § 92a.2.

Point source discharge: A pollutant source regulated under the National Pollutant Discharge Elimination System (NPDES) as defined in § 92a.2. 25 Pa. Code § 93.1.

Potable Water Supply (PWS): A potable water supply used by the public as defined by the Federal Safe Drinking Water Act, 42 U.S.C.A. § 300F, or by other water users that require a permit from the Department under the Pennsylvania Safe Drinking Water Act (35 P. S. §§ 721.1—721.18), or the act of June 24, 1939 (P. L. 842, No. 365) (32 P. S. §§ 631—641), after conventional treatment, for drinking, culinary and other domestic purposes, such as inclusion into foods, either directly or indirectly. 25 Pa. Code § 93.3.

Riparian buffer: A BMP that is an area of permanent vegetation along surface waters. 25 Pa. Code § 102.1.

Riparian forest buffer: A type of riparian buffer that consists of permanent vegetation that is predominantly native trees, shrubs and forbs along surface waters that is maintained in a natural state or sustainably managed to protect and enhance water quality, stabilize stream channels and banks, and separate land use activities from surface waters. 25 Pa. Code § 102.1.

Sewage enforcement officer (SEO): An official of the local agency who reviews permit applications and sewage facilities planning modules and issues permits as authorized by the Pennsylvania Sewage Facilities Act and conducts the investigations and inspections that are necessary to implement the Act and regulations thereunder. 25 Pa. Code § 71.1.

Sewage management program: A program authorized by the official action of a municipality for the administration, management and regulation of the disposal of sewage. 25 Pa. Code § 71.1.

Groundwater Under the Direct Influence (GUDI) (of surface water): Any water beneath the surface of the ground with the presence of insects or other macroorganisms, algae, organic debris

or large diameter pathogens such as Giardia lamblia and Cryptosporidium, or significant and relatively rapid shifts in water characteristics such as turbidity, temperature, conductivity or pH which closely correlate to climatological or surface water conditions. The term does not include finished water. 25 Pa. Code § 109.1.

Water Quality-Based Effluent Limit (WQBEL): An effluent limitation based on the need to attain or maintain the water quality criteria and to assure protection of designated and existing uses. 25 Pa. Code § 92a.2.

Water Quality Network (WQN): The instream water quality sampling stations used by DEP to collect data to evaluate the quality of waters of the Commonwealth.

III. Regulatory Requirements

Municipalities are required to develop and implement comprehensive official plans which provide for the resolution of existing sewage disposal problems, provide for the future sewage disposal needs of new land development and provide for the future sewage disposal needs of the municipality. 25 Pa. Code § 71.11.

Municipalities are required to revise their official plans when a new subdivision is proposed. 25 Pa. Code § 71.51. An official plan revision must be submitted to DEP in the form of a completed sewage facilities planning module that contains required information, including an evaluation of the consistency of the proposed sewage facilities with antidegradation requirements that maintain and protect the HQ and EV waters. 25 Pa. Code §§ 71.52(a)(3)(v), 71.21(a)(5)(i)(E); 25 Pa. Code Chapter 93.

The water quality in HQ and EV waters must be maintained and protected. 25 Pa. Code § 93.4a. This mandate is implemented differently for point source discharges and nonpoint sources of pollution. 25 Pa. Code § 93.4c (b). New, additional or increased point source discharges to HQ or EV waters cannot occur if environmentally sound and cost-effective alternatives are available. 25 Pa. Code § 93.c (b)(1). Onlot sewage systems often provide such alternatives and avoid point source discharges to HQ and EV waters. However, such systems are nonpoint sources that must be controlled by achieving cost-effective and reasonable BMPs. 25 Pa. Code § 93.4c (b)(2).

The Board's decision in the *Pine Creek* case did not address the relationship between § 93.4a (the requirement to maintain and protect water quality in HQ and EV waters) and § 93.4c (b)(2) (the requirement to control nonpoint sources by achieving cost-effective and reasonable BMPs). DEP has employed BMPs to control nonpoint sources from many other activities, including agricultural operations, general construction/land development, timber harvesting, resource extraction, and waste management (*Water Quality Antidegradation Implementation Guidance*, DEP ID: 391-0300-002 (Chapter 11)). This guidance identifies cost-effective and reasonable BMPs that may be used in sewage facilities planning and permitting in HQ and EV watersheds to ensure consistency with the antidegradation requirements in Chapter 93.

IV. Onlot Sewage Systems and Water Quality

In a typical onlot sewage system configuration, the sewage flows into the septic tank where anaerobic processes predominate, and then to the soil absorption field (septic drain field, leach field, or sand mound) where aerobic processes predominate. In the septic tank, solids are

anaerobically digested. In the soil absorption field, organic compounds are degraded and impurities are filtered out in the soil matrix. A septic system that is properly designed, located, installed, and maintained through periodic pumping of the septic tank can treat sewage safely and effectively for decades.

Septic systems that are properly designed, located, installed, and maintained effectively treat nearly all of the typical pollutants of concern in sanitary wastewater treatment, including biochemical oxygen demand, suspended solids, phosphorus, and microbes. These pollutants either are removed in the system or effectively sequestered or attenuated in the soil absorption field (Table 1). Within a short distance of the soil absorption field, these pollutants normally are not present in detectable quantities above background values. For this reason, septic systems are usually desirable as a nondischarge alternative in HQ and EV watersheds, where the alternative is a piped and treated point source discharge to the HQ or EV surface water. However, some inorganic compounds, especially anions, may not be effectively removed. A compound that is not subject to biochemical degradation in the septic tank or soil absorption field, is not volatile, is soluble in water, and tends to stay in solution in the soil matrix may have reasonable potential to cause water quality impacts away from the soil absorption field, including possible impacts on surface waters.

Table 1 - Pollutant Removal Efficiency in Soil Absorption Field (Typical)

Constituents	Measure (Units)	Percolate at 3 to 5 ft depth (% removal)
Oxygen demand	BOD_5 (mg/L)	>90%
Particulate solids	TSS (mg/L)	>90%
Nitrogen	Total N (mg N/L)	10-20%
Phosphorus	Total P (mg P/L)	0-100% (85-95% typical)
Bacteria (e.g., Clostridium perfringens, Salmonella, Shigella)	Fecal coliform (organisms per 100 mL)	>99.99%
Virus (e.g., hepatitis, polio, echo, coxsackie, coliphage)	Specific virus (pfu/mL)	>99.9%
Organic chemicals (e.g., solvents, petro-chemicals, pesticides)	Specific organics or totals (µg/L)	>99%
Heavy metals (e.g., Pb, Cu, Ag, Hg)	Individual metals (µg/L)	>99%

Source: EPA 2002, Chapter 3

Important considerations related to evaluating the potential effects of septic systems on HQ and EV surface waters are:

1. Identification and characterization of pollutants of concern, those that have the potential to affect surface water quality at a detectable, statistically significant level.
2. Occurrence of the pollutants of concern in the environment.
3. Fate and transport considerations related to the pollutants of concern.
4. Projecting the net effect of the above factors on water quality in the potentially affected HQ or EV surface water, and limiting those effects to an appropriate level using a BMP-based approach.

Pollutants of Concern

Water quality studies related to septic systems have focused on potential groundwater pollution. Shallow groundwater directly beneath septic systems has been shown to be contaminated with boron, calcium, chloride, nitrate, orthophosphate, potassium, and sodium. In anoxic conditions, certain trace metals can be entrained in the plume. But with the exception of nitrate, these concerns normally are limited and localized. In most soils, pollutants other than nitrate either will not migrate beyond the soil absorption field or are not present in sufficient quantity to prompt far-field concerns. Groundwater quality studies related to far-field effects of the operation of septic systems focus on nitrate almost exclusively (EPA 2002, EPA May 2010).

Nitrate has been demonstrated to have substantive far-field effects on water quality in both groundwater and, to a lesser extent, surface water. Therefore, reasonable potential to affect water quality in HQ and EV waters has been established and nitrate is a pollutant of concern. Other pollutants (including non-naturally occurring pollutants) should be considered possible pollutants of concern if they have been demonstrated to originate from the operation of properly designed, located, installed, and maintained septic systems and have reasonable potential to affect surface waters. DEP considers such pollutants to be of concern when one or more peer-reviewed scientific studies demonstrates that, through fate and transport analysis and confirmatory sampling, the pollutant migrates away from the soil absorption field and is present in affected surface waters at elevated concentrations due to the operation of one or more septic systems. DEP is not aware of any other pollutant that meets this standard at this time. Based on these considerations and for the purposes of this guidance document, nitrate is the pollutant of concern from onlot systems.

Regulatory requirements for onlot systems have been established to control the potential nitrate contamination of groundwater and surface water. For instance, all points along the perimeter of a soil absorption field must be at least 100 ft away from any water supply well, and 50 ft away from any surface water (25 Pa. Code § 73.13 (c)). However, studies of groundwater plumes from septic systems indicate that these minimum isolation distances should not be expected to always protect water supply wells and surface waters from nitrate. Studies also have shown that after the treated percolate enters groundwater it can remain as a distinct plume for as much as several hundred feet (EPA 2002).

Occurrence of Nitrate

Nitrate in groundwater is primarily a human health concern (methemoglobinemia). Together with excess loadings of agricultural fertilizers, septic systems commonly have been implicated as a cause or contributor of nitrate contamination of water supply wells, especially where conventional septic systems are installed in high-density residential developments or subdivided lots. In Pennsylvania, planning requirements (hydrogeologic evaluation, lot size, soil absorption field, and isolation distances) are established to control average groundwater concentrations of nitrate-N to less than 10 mg/L in groundwater at the property boundary.

In addition to drinking water concerns, nitrate in surface waters is a threat to aquatic life and recreational water uses. Although practically nontoxic to aquatic life, excess nitrate may contribute to nutrient enrichment and excess plant growth with consequent adverse effects on aquatic life and recreational uses. Protecting water uses entails preventing these adverse effects,

but no well-established criterion applies in surface waters other than the Chapter 93 limit of 10 mg/L nitrate-N plus nitrite-N for groundwater under the direct influence (GUDI) of surface water and public water supply (PWS) intakes. Septic systems generally are not capable of affecting surface waters to the degree where the 10 mg/L limit may be threatened, but for the purposes of this guidance, a more stringent standard applies. The requirement to maintain and protect the water quality in HQ and EV waters means preventing or reducing effects on surface water quality for the pollutant of concern to nondetectable or statistically insignificant levels.

Nitrate is a naturally-occurring compound and examination of its sources and fate and transport in the environment is useful. Nitrate and ammonium are present in the atmosphere due primarily to atmospheric (i.e., lightning), combustion and animal sources, and are the primary nitrogen-based compounds in precipitation. The U.S. Geological Survey (USGS) maintains the National Atmospheric Deposition Program/National Trends Network (NTN) monitoring system for water quality in precipitation. Monitoring sites predominantly are located away from urban areas and point sources of pollution. Each site has a precipitation chemistry collector and gage. The automated collector ensures that the sample is exposed only during precipitation (wet-only sampling). Based on 2010 NTN precipitation-weighted data, mean concentrations of nitrate and ammonium in precipitation in Pennsylvania are fairly uniform at about 0.8 mg/L nitrate-N and 0.2 mg/L ammonium-N. Ammonium-N generally will rapidly nitrify to nitrate-N in the terrestrial and aquatic environment, so this is equivalent to about 1 mg/L nitrate-N on average in precipitation, even in relatively pristine watersheds. Nitrogen in precipitation is trending downward, as similar data for 1999 showed an average nitrate plus ammonium-N concentration of nearly 1.8 mg/L. Also, DEP (1997) reported a mean annual concentration of 2 mg/L nitrate-N in precipitation in 1996.

Based on the NTN 2010 data, the annual average net deposition rate from precipitation is about 12.5 kg/ha, or 11.2 lb/acre nitrate-N annually. Concentration of ammonium and nitrate in precipitation generally varies inversely with rainfall intensity and duration.

Nitrogen (mg/L) in Precipitation	**Annual Mean**			
	2010		**1999**	
	NH4	**NO3**	**NH4**	**NO3**
PA00 Adams County	0.34	0.91	0.41	1.89
PA15 Centre County	0.22	0.82	0.26	1.53
PA18 Clinton County	0.20	0.81	0.19	1.27
PA29 Elk County	0.17	0.69	0.20	1.61
PA42 Huntingdon County	0.24	0.80	0.25	1.62
PA47 Lancaster County	0.54	0.82	---	---
PA72 Pike County	0.16	0.84	0.17	1.24

Source: USGS National Atmospheric Deposition Program/National Trends Network data

The natural background concentration of nitrate-N in groundwater in the contiguous 48 states has been estimated to be on the order of 0.1 to 0.2 mg/L. But since essentially all watersheds have been influenced substantially by anthropogenic sources, the concept of a “relative background” concentration of 1 mg/L nitrate-N has been introduced to reflect this reality (Nolan et al., 2003). This value is consistent with nitrate-N in precipitation in Pennsylvania, and also with other estimates of background concentration of nitrate-N in groundwater in the contiguous United States. However, the same study documented that nitrate-N in groundwater can be substantially lower in forested watersheds (0.1 mg/L or less nitrate-N) compared to other watersheds.

Nizeyimana et al. (1997) has previously estimated that about 38% of nitrate in groundwater was the result of atmospheric deposition in Pennsylvania watersheds. DEP and others have estimated that concentrations in groundwater exceeding 1 to 3 mg/L typically are indicative of human activity. In Pennsylvania, nitrate in groundwater is trending downward overall and this may be related to improved practices in land use and reductions in atmospheric deposition (Reese and Lee, 1998).

Nitrate concentrations in surface waters vary substantially based on anthropogenic sources, including fertilizers, animal wastes, highway runoff, leaking sewer lines, and atmospheric deposition. Agricultural activities are estimated to contribute about half of the total nitrogen loading to the Chesapeake Bay. Septic contributions are less certain but are a small factor in total nitrogen loading to the Bay.

Based on all Water Quality Network (WQN) data collected in Pennsylvania's rivers and streams from 1998 to 2011, the mean concentration of nitrate-N is 1.34 mg/L, and the median concentration is 0.56 mg/L (13,000+ observations). Ammonium-N and nitrite-N generally are present in substantially lower concentrations compared to nitrate-N, and are not considered here. Based on all data collected at WQN reference stations from 1998 to 2011, the mean concentration of nitrate-N is 0.46 mg/L, and the median concentration is 0.32 mg/L (940 observations). The WQN reference stations are those located to be least affected by anthropogenic sources, and consequently should exhibit generally better water quality. Based on all data collected in at WQN stations located in HQ or EV watersheds from 1998 to 2011, the mean concentration of nitrate-N is 0.87 mg/L, and the median concentration is 0.29 mg/L (1,600 observations). The 1998 to 2011 timeframe was divided into two time periods to identify possible trends in nitrate concentration in surface waters in Pennsylvania.

Nitrate-N (mg/L) in Rivers and Streams	Mean	Median	Min	Max
1998 to 2011				
All WQN	1.36	0.56	0.04	165
Reference WQN	0.46	0.32	0.04	6.6
HQ/EV WQN	0.87	0.29	0.04	6.02
1998 to 2004				
All WQN	1.62	0.64	0.04	165
Reference WQN	0.35	0.33	0.04	0.86
HQ/EV WQN	0.95	0.29	0.04	6.00
2005 to 2011				
All WQN	1.08	0.50	0.04	15.1
Reference WQN	0.38	0.31	0.04	2.90
HQ/EV WQN	0.77	0.30	0.04	6.02

Note: All values below the Method Detection Limit were treated as values equivalent to the Method Detection Limit (0.04 mg/L). Station WQN0259 was not considered a reference station for the purposes of this analysis.

Although mean and median nitrate concentrations for all WQN stations did decrease between the two selected timeframes, mean and median nitrate concentrations in generally higher quality waters (reference stations and HQ/EV stations) generally did not decrease despite substantial decreases in nitrate loading from both precipitation and groundwater. This may suggest that surface water quality with respect to nitrate is more sensitive to nonpoint source contributions from poor local land use practices (e.g. excess fertilization), and that surface waters may have a

threshold assimilation capacity for nitrate. That is, instream nitrate below a certain threshold concentration may be rapidly incorporated into biomass, denitrified, or otherwise transformed, resulting in a relatively constant nitrate level as observed at the reference and HQ/EV stations. The decrease in nitrate concentration observed overall may reflect improved land use practices.

Fate and Transport Considerations (Nitrate)

Nitrate from septic systems can affect surface waters only indirectly, after first having traveled through groundwater and having been subject to the associated fate and transport processes. In Pennsylvania, source water (precipitation, runoff, and groundwater) on average exhibits higher concentrations of nitrate than the surface water that is produced from the source water, and it is useful to examine the associated sources and sinks of nitrate. Nitrate removal is not expected to occur in precipitation. Nitrate removal occurs in groundwater through denitrification, plant uptake, and microbial immobilization, as the nitrate is converted to nitrogen gas or organic nitrogen. Nitrate is also removed by similar pathways in surface waters.

Nitrate converted to organic nitrogen via plant uptake or microbial immobilization may subsequently be converted back to ammonia via ammonification and then to nitrate via nitrification. But in watersheds characteristic of HQ and EV waters in Pennsylvania, the organic nitrogen may readily exit the system as dead or decaying plants and leaf litter, or other stormwater runoff, before the conversion back to ammonia and nitrate occurs. In addition, where local decomposition of vegetation does occur, some of the ammonia volatilizes to the atmosphere; and decomposition provides the vegetative biomass and organic material (carbon) needed to support microbial denitrifiers, such that denitrification becomes a competing pathway especially in saturated soils. Based on these considerations and for the purposes of this guidance, nitrate converted to organic nitrogen via plant uptake or other mechanisms is considered to be lost to the system.

The amount of nitrate that is produced by a typical residential septic system can be estimated several ways. For the purpose of performing hydrogeological evaluations in the planning process, DEP assumes that a residential septic system will produce an average of 262.5 gpd (25 Pa. Code § 71.62 (c)(3)). Similarly, the typical nitrate-N concentration in septic effluent is assumed to be 45 mg/L.

Once nitrate from the onlot system reaches the groundwater table, it moves freely with little retardation. The nitrate tends to stay in the shallow aquifer, and under most conditions denitrification is minimal in the shallow aquifer unless and until the groundwater intersects a carbon source, which is necessary to support active denitrification. This carbon source normally is most available and accessible in the uppermost few feet of the soil column, but denitrification is a ubiquitous natural process that follows first-order reaction kinetics, and it probably always proceeds at some positive rate even under unfavorable (i.e. oxygen rich and/or carbon poor) conditions. In a summary of previous studies of onlot system nutrients in the shallow aquifer, McCray et al. (2005) reported a median denitrification rate of 0.025/d and a minimum denitrification rate of 0.004/d. At a decay rate of 0.004/d, 45 mg/L of nitrate will be reduced to 1 mg/L of nitrate in 952 days. Nitrate in groundwater, therefore, may be expected to attenuate to background concentrations eventually. Nevertheless, denitrification and other loss pathways generally are severely constrained in the shallow aquifer, such that reduction of nitrate concentrations occurs primarily through dispersion and groundwater recharge by precipitation (EPA 2002).

Over a sufficiently long period of time, nitrate from the onlot system will migrate to greater depths in the aquifer based on dispersion and recharge. Active denitrification or other nitrate losses may occur at greater depths in the aquifer, but this may be more a function of the very long retention times. Groundwater at greater depths in the aquifer flows even more slowly and may not reach surface waters for many years. Although all groundwater will eventually manifest as surface waters at some point, this may not occur in the HQ/EV watershed. Some of the groundwater may flow out of the HQ/EV watershed as groundwater and will not be available to potentially degrade HQ/EV surface waters. Under most conditions, however, groundwater in the shallow aquifer, including any nitrate, should manifest as surface water locally.

Groundwater in the shallow aquifer must cross the groundwater/surface water interface in order to manifest as surface water. Although active denitrification may occur anywhere in an aquifer if the conditions are favorable, it is at the groundwater/surface water interface that active denitrification is most likely, especially if a vegetative or riparian buffer is present. Denitrification is most effective in saturated root-zone soil layers where carbon sources are available for the denitrifying bacteria. Numerous researchers have reported that it is the complex interaction between vegetation and below-ground environment that provides the appropriate conditions for denitrification to occur (Lowrance et al., 1995). In the root zone, plant uptake of nitrate also is maximized.

In a riparian buffer, denitrification occurs year round, but during the growing season, plant uptake may account for the majority of nitrogen removed. During the dormant season, most nitrogen may be removed by denitrification. Nitrogen removal may be substantial both during the growing season and during the dormant season. Wetlands generally offer good conditions for denitrification. As much as 1,800 to 2,700 lb/yr of nitrate-N can be denitrified per acre of wetlands, depending on the hydraulic conditions (IETC/UNEP 2003).

Nitrate in the deeper aquifer may bypass the root zone of a riparian buffer by flowing below it, but this is unlikely to be a significant factor in the watersheds typical of HQ and EV waters. On the lower order streams typical of HQ/EV waters, there is the greatest potential for interaction between water and riparian areas (Lowrance et al., 1995). Denitrification also may occur in the benthic environment of the river or stream. Riparian buffers have been extensively demonstrated and documented as effective in reducing both surface and subsurface nitrogen loading to surface waters (Mayer et al., 2005; DEP 2010), and should be a component of any BMP-based approach to water quality protection.

Protection and Maintenance of Water Quality

Previous DEP efforts to project the water quality effects of onlot systems in HQ/EV watersheds have employed an idealized, steady-state plume dispersion model similar to that which is commonly used to model dispersion of pollutants in groundwater. The idealized, steady-state plume dispersion approach, however, is of limited value for evaluating nitrate flow through the subsurface to surface waters where fate is not well characterized. This is not an end-of-pipe point source discharge with a steady loading to the surface water that allows localized effects on water quality at the point of discharge to be predicted with confidence and confirmed through measurement. Although the analyst could reasonably predict or otherwise confirm the general direction of the plume through groundwater monitoring, its concentration-loading profile is unlikely to exhibit steady-state characteristics, especially for nitrate. Unlike any water quality

analysis applicable to point source discharges, the net effect on water quality from any single septic system through measurement of instream nitrate concentrations will be undetectable. Predictions of nitrate loading from septic systems using the dispersion modeling approach that cannot be verified through water quality sampling and analysis do not provide a sound scientific basis for DEP decision-making.

The idealized, steady-state plume dispersion plume methodology may reasonably be used to model the average concentration profile for a pollutant in groundwater once the pollutant source has been well characterized in groundwater, and especially if the pollutant is less soluble and its movement in groundwater is retarded to some degree. But such modeling is not capable of producing reliable results for projecting loadings to surface water at a particular point in the stream to predict a change in water quality with the required degree of accuracy and precision. Where fate and transport are well quantified, projections based on such models may be appropriate for predicting the average loading to surface water over time, especially if results are aggregated and verifiable.

DEP does employ the idealized, steady-state plume dispersion methodology in some applications, primarily for screening purposes, where a conservative approach is used to rule out the potential for water quality impacts and avoid more involved and expensive analyses. The methodology generally is reasonable and appropriate to demonstrate that a pollution source has no potential for unacceptable water quality effects. As a screening tool, conservative assumptions used to simplify important fate considerations are more appropriate because the errors introduced by the simplifying assumptions are normally not critical.

Evaluation of possible water quality effects due to nitrate contribution from nonpoint sources such as septic systems can most reasonably be evaluated and predicted using a watershed-based approach. Although nonpoint sources cannot be expected to behave as point sources with steady-state loadings, the net average effect of multiple or area-wide nonpoint sources can more reasonably be evaluated in the aggregate. While the effect on surface water quality from a single septic system may be undetectable, the cumulative effect of multiple nonpoint sources is more likely to be detectable if present.

A watershed-based approach is consistent with the methods that DEP generally uses to evaluate water quality throughout Pennsylvania. DEP reviews watershed characteristics such as upstream land use, confluences of tributaries, point source discharges, and stream habitat, to select representative points in watersheds to perform biological and chemical sampling. Water quality data from selected sampling locations in a watershed are used to assess the attainment of water quality standards for the entire watershed as attaining uses, including use as an HQ or EV water, or to designate segments as impaired. These evaluations are used to assess the net effects of all sources affecting water quality within the watershed, and possible changes in water quality as part of DEP's standard water quality protocols. Similarly, projections of possible effects on water quality for antidegradation purposes should focus on how potential sources of pollution may affect long-term water quality at the evaluation points, and how they may affect water quality in the watershed as a whole.

V. BMP Requirements and Options

The effectiveness of BMPs is inherently difficult to quantify, but the goal is to implement BMPs sufficient to reduce the concentration of nitrate that originates from septic system absorption

fields to the average concentrations typically found in other nonpoint sources (i.e. precipitation and groundwater) that, based on observation and experience in Pennsylvania, are not degrading to surface waters. For the purposes of this guidance, BMPs are assigned protection factors based on their projected effectiveness in reducing nitrate from septic systems to levels that protect surface water quality. High nitrogen removal efficiencies, in conjunction with source control measures, should ensure that nitrate concentrations are reduced to concentrations equal to or less than other nonpoint sources that affect HQ and EV waters. Precipitation and groundwater contributions generally average approximately 1 mg/L nitrate-N in the absence of local and substantial anthropogenic sources. Considering the uncertainty associated with quantitative estimates of the effectiveness of BMPs for nitrogen removal and also that base levels of nitrate-N in precipitation and groundwater already may be 1 mg/L, the product of all BMP protection factors should be at least 45 to ensure consistency with the antidegradation requirements of Chapter 93. A total protection factor of 45 is designed to reduce nitrate concentrations by a factor of 45; that is, from 45 mg/L nitrate-N to approximately 1 mg/L nitrate-N.

Based on the rationale provided for each BMP, DEP considers the BMPs described in this section to be cost-effective and reasonable nonpoint source controls for onlot sewage systems. By selecting and implementing BMPs with a total protection factor of 45 or greater, the water quality in the HQ or EV water is expected to be maintained and protected. The total protection factor for a system is calculated by multiplying the individual protection factors for each proposed BMP.

1. Onlot system density BMP: Onlot system density should not be less than 1 acre per Equivalent Dwelling Unit (EDU) on average, and a protection factor of 4 should be assigned based on a proposed average lot size of 1 acre per EDU. (A protection factor of 4 means that the concentration of nitrate-N from the septic system is reduced by a factor of 4 compared to what it might be without the BMP.) Higher protection factors may be assigned for proposed average lot sizes greater than 1 acre per EDU as described below.

   Rationale: Source control or reduction is an important component of any BMP-based strategy to prevent degradation of surface waters. The mean annual groundwater recharge rate for Pennsylvania is 13.7 inches (Reese and Risser 2010), or 652,000 gal/sq mile/day. For the purpose of hydrogeologic evaluation, DEP estimates the average amount of sewage generated by a septic system is 262.5 gpd. Assuming a base scenario of one septic system (one EDU) per one acre residential lot and an average concentration of 1 mg/L nitrate-N in the recharge water from precipitation, on a mass balance basis the septic effluent is diluted in groundwater from 45 mg/L to 10 mg/L nitrate-N. This is consistent with the general planning goal that nitrate concentrations in groundwater be limited to 10 mg/L on average at the lot boundary to avoid impacts to offsite receptors.

   By decreasing the allowable density of onlot systems, the potential loading to surface waters is proportionally reduced. The minimum average lot size of one acre per EDU is cost-effective because most projects propose lot sizes of at least 1 acre, and flexibility is retained by requiring only that the lot size averages 1 acre. Smaller lots will achieve the desired level of protection if they are offset by larger lot sizes elsewhere or dedicated green space. The default protection factor of 4 is applicable at an average lot size of 1 acre per EDU (the default protection factor of 4 at an average lot size of 1 acre per EDU may be revised based on a site-specific determination of recharge rate). For average lot sizes greater than 1 acre per EDU, an additional proportional protection factor

may be assigned for every 1 acre increase in average lot size per EDU. This is based on the expectation that the protection factor is directly proportional to average lot size (for example, an average lot size of 2 acres per EDU will be twice as protective as an average lot size of 1 acre per EDU). Example: If the average lot size for a proposed development is 3.5 acres per EDU, the protection factor applicable under this BMP is (3.5 acres/1 EDU) × 4 = 14. Example: If the average lot size is 4.5 acres per 2 EDU, the protection factor is (4.5 acres/2 EDU) × 4 = 9.

2. Setback Distance BMP: For lots that are not proximate to the HQ or EV surface water, lot-specific protection factors may be assigned as listed below. The setback distance is measured from the edge of the soil absorption field to the surface water.

Distance	Protection factor
< 200 ft	1
200 - 1,000 ft	2
> 1,000 ft	4

Rationale: The potential for significant water quality effects on HQ or EV surface waters is greatest for onlot systems located proximate to the surface water. This potential is reduced for onlot systems located farther away from the surface water. While the onlot system density BMP is designed to account for dilution due to recharge, this BMP is designed to account for other fate and transport processes. At greater distances, it normally will take years or even decades for nitrate in groundwater to reach the surface water. Over a period of years, even fate processes that proceed at a slow rate will have a substantial mitigating effect. For example, denitrification in the shallow aquifer may normally be minor and discounted as insignificant, but at some point that assumption is no longer reasonable, even if conditions are generally unfavorable for denitrification. Similarly, microbial immobilization and fate processes in the deeper aquifer are expected to play a greater role as time and distance increases.

For onlot systems located less than approximately 200 ft from the HQ or EV surface water, these supplemental fate and transport processes are expected to remain as minor considerations, except to the extent that they are addressed under the riparian buffer or riparian forest buffer BMPs. For example, at 25 Pa. Code Chapter 102, DEP has established increased water quality protection requirements for earth disturbance activities located within 150 ft of HQ or EV surface waters. EPA (May 2010) recommends nitrogen removal to 5 mg/L for onlot systems within 200 ft of surface waters in the Chesapeake Bay watershed. For systems located between 200 and 1,000 ft of surface waters, EPA recommends nitrogen removal to 10 mg/L (twice that recommended within 200 ft). Beyond 1,000 ft, EPA recommends nitrogen removal to 20 mg/L (four times that recommended within 200 ft). Based on the nature and geology of Pennsylvania watersheds, DEP generally agrees that these threshold distance values and proportional water quality protection measures are reasonable, except that a greater overall level of water quality protection is applicable under this guidance.

No additional costs are applicable under this BMP. Regional staff has discretion to assign intermediate protection factor values for lots located on or close to a threshold distance, except that no protection factor should be assigned if any part of the soil absorption area is within 200 ft of the HQ or EV surface water. Land area assigned and

used as a riparian buffer or riparian forest buffer should not also be assigned as a setback distance, so only the distance beyond the buffer should be counted towards a setback distance.

3. Riparian Forest Buffer BMP: A riparian forest buffer established and maintained in accordance with the descriptions and requirements established at 25 Pa. Code § 102.14 (b), (c)(2), (c)(3), (f), (g) and (h) for HQ and EV waters (except that width may be less than 150 ft as described below) may be assigned a protection factor under this guidance. DEP has produced comprehensive guidance applicable to the establishment and maintenance of riparian forest buffers (DEP 2010). Based on DEP's composite assessment of the studies of riparian forest buffers that have estimated the removal efficiency of nitrate in the shallow aquifer, protection factors may be assigned as described below:

Riparian Forest Buffer BMP	
Width	Protection factor
50 ft	2
100 ft	3.33
150 ft or more	10

Rationale: Riparian forest buffers are generally recognized as an effective, sustainable means of protecting aquatic ecosystems against nonpoint sources of pollution including nitrate. As subsurface water moves downslope through the streamside area to the stream, nitrate can be removed through two primary processes: denitrification and plant uptake. Denitrification has been widely recognized as the dominant removal pathway, although uptake by plants has been shown to be significant as well.

Buffer effectiveness depends on its ability to intercept nitrate traveling along surface or subsurface pathways. The extent to which riparian buffers remove nitrate and subsequently improve water quality is generally recognized as a function of buffer width in concert with landscape and hydrogeomorphic characteristics. Buffers may be extremely effective at removing nitrate if wide enough with favorable subsurface pathways. In addition to plant uptake and microbial denitrification there is another service related to nitrate removal that is attributed to riparian forest buffers -- processing of nitrate and other pollutants that reach the stream. The leaves of native trees in the riparian forest buffer that wash into the stream serve as a rich food source for benthic macroinvertebrates which are capable of instream nitrate processing.

Riparian forest buffers are an existing requirement under Chapter 102 related to construction activities in HQ and EV watersheds, and have already been demonstrated to be reasonable and cost-effective during development of Chapter 102. In addition to source control and reduction, riparian forest buffers are the most important and reliable surface water quality protection measure. Studies of the effectiveness of nitrate removal by riparian forest buffers report variable removal efficiencies, but riparian forest buffers generally are effective at removing nitrate, and particularly nitrate in subsurface flow (groundwater). Based on an EPA summary of the effectiveness of riparian buffers in removing nitrate in subsurface flow (Mayer et al., 2005), a 150 ft buffer would have a mean nitrogen removal efficiency of 81% considering both surface and subsurface pathways. Removal of subsurface nitrogen, however, is more efficient and reliable and

less dependent on buffer width. Removal of subsurface nitrogen did not vary substantially for any buffer width over 35 ft, although removal efficiency was more certain and less variable with greater buffer width. Mean nitrogen removal efficiency in subsurface flow was 90%.

For the purpose of establishing a protection factor for a riparian forest buffer BMP for onlot sewage systems in HQ and EV watershed, a buffer with a width of 150 feet should reliably remove 90% of the nitrate in the subsurface flow, which is equivalent to a reduction in nitrogen concentration by a factor of 10 and, therefore, a protection factor of 10. Riparian forest buffers with lesser widths may be assigned lower protection factors as described above. These lower protection factors have been established for buffers less than 150 ft wide in order to take an appropriately conservative approach and as a cautionary note based on a 15-year study performed in Pennsylvania by Stroud Water Research Center that showed lower efficiencies than the average for similar studies (Newbold et al. 2010). The recommended protection factors, applicable either to the entire watershed or to a single project, may be assigned as described in Section VI, Planning. NOTE: Nothing in this guidance affects or reduces the requirements of Chapter 102 with regard to riparian forest buffers. A riparian forest buffer established for the purposes of compliance with Chapter 102 satisfies the riparian forest buffer BMP within this guidance and the full protection factor of 10 may be assigned. If a riparian forest buffer is not required under Chapter 102 for earth disturbance activities associated with the project, a riparian forest buffer can nevertheless be established and maintained consistent with the Chapter 102 requirements as a BMP under this guidance to obtain the recommended protection factor.

4. Riparian Buffer BMP: A riparian buffer of at least 50 ft width average and 30 ft width minimum established and maintained consistent with the requirements of 25 Pa. Code § 102.14 (c)(2), (c)(3), (f), (g) and (h) may be assigned a protection factor under this guidance. No specific requirements for vegetation types or quantities are applicable. DEP has produced comprehensive guidance applicable to the establishment and maintenance of riparian buffers (DEP 2010). Based on DEP's composite assessment of the studies of riparian buffers that have estimated the removal efficiency of nitrate in the shallow aquifer, protection factors may be assigned as described below:

Riparian Buffer BMP

Width	Protection factor
50 ft	1.5
100 ft	2
150 ft	3.33

Rationale: Riparian buffers, which can be composed of any type of vegetation, also have been demonstrated to be effective in mitigating the adverse effects of nonpoint sources of pollution (including nitrate) on surface waters. But riparian buffers that are not forested generally remove less nitrogen from subsurface flow and removal efficiencies are more variable when buffer width is less than 150 ft, and this is reflected in the recommended protection factors. Therefore, unforested (or herbaceous) riparian buffers share many of the important water quality protection characteristics of riparian forest buffers, but generally are not as protective as riparian forest buffers. Similar to riparian forest

buffers, riparian buffers are an existing requirement associated with certain land disturbance activities under Chapter 102.

Based on DEP's internal review of scientific literature documenting studies of the effect of herbaceous buffers on subsurface nitrate removal, a buffer that is on average 150 ft wide has a removal efficiency approaching 70%. Because a riparian buffer may have grasses and forbs as opposed to shrubs and trees, the removal efficiency due to plant uptake may be less than riparian forest buffers where plant species have greater height and root mass. In addition, a riparian forest buffer composed of native species provides additional protection to the stream by providing leaf litter, a rich food source for benthic macroinvertebrates which are capable of instream nitrate processing. The herbaceous riparian buffer will not provide this additional protection.

The recommended protection factors, applicable either to the entire watershed or to a single project, may be assigned as described in Section VI, Planning. NOTE: Nothing in this guidance affects or reduces the requirements of Chapter 102 with regard to riparian buffers. A riparian buffer established for the purposes of compliance with Chapter 102 satisfies the riparian buffer BMP within this guidance and the full protection factor may be assigned. If a riparian buffer is not required under Chapter 102 for earth disturbance activities associated with the project, a riparian buffer can nevertheless be established and maintained consistent with the Chapter 102 requirements as a BMP under this guidance to obtain the recommended protection factor.

5. Permeable Reactive Barrier BMP: Based on the information currently available, a protection factor of 4 is recommended when permeable reactive barriers are installed as described below:

- Barrier to be installed adjacent to the soil absorption field in a vertical configuration designed to intercept the septic effluent in and above the shallow aquifer
- Length at least 10% greater than the longest dimension of the soil absorption field
- Isolation distance from soil absorption area at least 50 ft
- Width at least 2 ft
- Depth at least 2 ft into the water table (seasonal low conditions)
- Composed of pH-stabilized substrate with a persistent, biodegradable carbon source such as wood chips and/or sawdust
- Design hydraulic retention time of minimum 5 days
- Design hydraulic conductivity (permeability) at least twice that of surrounding natural substrate
- Final cover of local soil or other appropriate cover and vegetation

Rationale: Permeable reactive barriers have been demonstrated as effective in reducing subsurface pollution, including nitrate-N in septic flow (Vallino and Foreman 2008; Robertson and Cherry 1995; Lombardo et al. 2005; EPA 1998). Although experience with permeable reactive barriers is still limited and design and performance standards are evolving, this is a promising technology that is recommended by EPA for reducing nitrate-N in septic effluent (EPA 2010). The barriers can be installed at relatively low cost, require essentially no maintenance, and when properly designed the barriers should support active denitrification for decades, or the life of the soil absorption field. The

recommended protection factor is based on an assessment of the results of studies performed to date.

Although permeable reactive barriers may be installed in either a vertical or horizontal position, only the vertical configuration is expressly authorized through this guidance. In a vertical configuration, permeable reactive barriers may be most cost-effective where the depth to groundwater is limited.

Costs range from about $5,000 to $15,000 per EDU, depending on soil geology, depth to groundwater, subsurface hydrogeology, construction access, existing infrastructure, and other factors (EPA 2010). Until design standards become more standardized, barriers should be designed by an engineering consultant or other qualified persons with experience with permeable reactive barriers. Design standards for barriers that differ from those described in this guidance, including horizontal configurations, may be considered by DEP on a case-by-case basis.

6. Denitrifying onlot treatment system technology BMP: Onlot systems may be equipped with advanced onsite denitrifying wastewater treatment technology that has been demonstrated to achieve a consistent reduction in total nitrogen loading to the soil absorption field of average 50% or greater compared to the expected nitrogen loading of a conventional septic system. This BMP should result in a protection factor of 2 provided that an average removal rate of total nitrogen of 50% removal standard has been demonstrated, appropriate system maintenance is secured, and the sewage management program is developed to assure proper operation and maintenance. A proportionally higher protection factor may be awarded if the system has been demonstrated to achieve reliably higher proportional nitrogen removal. Approvals of proposals for new onlot systems equipped with advanced onsite denitrifying wastewater treatment technology should include provision for ongoing service and maintenance as per manufacturer's specifications. Other equivalent arrangements to assure ongoing and proper operation of each denitrifying onlot treatment system may be acceptable at the discretion of regional planning staff, including any option described in 25 Pa. Code § 71.72.

   Rationale: Source control or reduction is a critical component of any BMP-based strategy to prevent degradation of surface waters. EPA (2002) recommends denitrifying or other nitrogen removal technology for onlot systems located near "sensitive aquatic areas." EPA (May 2010) also promotes the use of nitrogen removal technology for onlot systems in the Chesapeake Bay watershed. Capital costs for add-on denitrification units range from $3,500 to $7,000 or more per EDU, with operation and maintenance expenses of less than $100 per year (Washington State Department of Health, 2005). More recent experience in Pennsylvania indicates that operation and maintenance costs are closer to $300 per year. Cost efficiency and treatment system effectiveness can be optimized through the use of cluster (community) systems with advanced nitrogen removal technology. This BMP achieves the important goal of source reduction and is recommended.

Other BMPs: For BMPs not specifically described in this guidance, the DEP region retains the discretion to assign protection factors and approve planning provided that BMPs comparable to those described herein will be implemented to protect and maintain water quality. Regional staff should develop these protection factors in coordination with central office staff, and central

office staff should assure that the regions apply protection factors for BMPs not described in this guidance with reasonable consistency. Sewage facilities planning modules proposing the use of other BMPs should provide sufficient supporting documentation to allow the local agency and DEP to evaluate the effectiveness of the proposed BMP.

Determination of Total Protection Factor (Examples): A proposed new housing development in an HQ watershed has an average lot size of 2 acres with 1 EDU per lot (onlot density BMP: protection factor is 8). Several scenarios are evaluated below:

- The new housing development is contiguous with the HQ stream, and Chapter 102 requirements are applicable such that a 150 ft riparian forest buffer is required and will be implemented in accordance with Chapter 102 requirements and this guidance (riparian forest buffer BMP: protection factor is 10). The total protection factor is $8 \times 10 = 80$.

- No provision for a riparian buffer has been established or proposed, but the individual lots are separated from the HQ stream a minimum of 250 ft because of a power line corridor that runs parallel to the stream (setback distance BMP: protection factor is 2). The developer will install permeable reactive barriers with each onlot system (permeable reactive barrier BMP: protection factor is 4). The total protection factor for the lot closest to the HQ stream is $8 \times 2 \times 4 = 64$.

- There is some existing housing adjacent to the HQ stream and between the proposed development and the HQ stream, and the township has since established a riparian buffer (100 ft) ordinance applicable to the entire HQ watershed that applies to any new development (riparian buffer BMP: protection factor is 2). The minimum setback distance is 450 ft (setback distance BMP: protection factor is 2). Denitrifying onlot systems will be installed (denitrifying onlot system BMP: protection factor is 2). The developer has modified the original proposal to include green space at another location in the watershed that the township will maintain as a park. The green space is sized such that average lot size will increase by 0.6 acres to 2.6 acres (onlot density BMP: protection factor is 10.4). The total protection factor is $10.4 \times 2 \times 2 \times 2 = 83$.

VI. Planning

The use of the BMPs for onlot sewage systems in HQ and EV watersheds should be addressed in official sewage facilities plans prepared by municipalities, as well as sewage facilities planning modules submitted to revise such plans when new land development is proposed. Summarized below are key considerations for preparing and reviewing official plans and sewage facilities planning modules to revise those plans.

Official Plans, Official Plan Update Revisions and Special Studies (when applicable)

1. Official sewage facilities plans prepared by municipalities must address the consistency of the proposed sewage facilities with the antidegradation requirements contained in Chapters 93 (25 Pa. Code § 71.21(a)(5)(i)(E)). When an official plan is being prepared, the plan should address how any proposed use of onlot sewage systems in HQ and EV watersheds will be consistent with the antidegradation requirements.

2. Official sewage facilities plans prepared by municipalities should be consistent with their local ordinances. Municipalities should ensure that any new land development in their HQ and EV watershed(s) occurs in a manner that protects water quality. The BMPs recommended in this guidance can (and may already) be required through local zoning or subdivision and land development ordinances. When BMPs established in municipal ordinances apply to an entire HQ or EV watershed, the entire protection factor for that BMP can be applied to each new land development project proposed in that watershed.

   a. *Onlot system density BMP:* Municipalities typically control residential lot size through their local zoning ordinances and subdivision and land development ordinances. To qualify for the protection factor of four recommended in this guidance for the onlot system density BMP, the local ordinance would need to ensure that the average lot size in a proposed subdivision to be served by onlot systems in an HQ/EV watershed is a minimum of one acre per EDU. For the purposes of this BMP, the enumeration of EDUs is based on proposed sewage flow and not on the proposed number of lots to be created, e.g. 1 EDU = 400 gpd.

   b. *Riparian buffer BMP:* Municipalities may already control land use activities that occur within a certain distance from streams, lakes and other surface water through their land use ordinances. If such ordinances limit activities within 50 feet of any HQ or EV water and are consistent with the riparian buffer requirements in the erosion and sedimentation regulations (25 Pa. Code § 102.14), any onlot system proposed within that watershed would qualify for the protection factor of 1.5 recommended for the riparian buffer BMP. This protection factor is only available if the land bordering the HQ/EV waters is substantially undeveloped or can otherwise reasonably function as a riparian buffer. Municipalities may also choose to adopt a separate ordinance to protect riparian corridors. A sample riparian buffer ordinance that would achieve the protection factor recommended in this guidance is attached as Appendix B.

   c. *Riparian forest buffer BMP:* As with riparian buffers, municipalities can establish riparian forest buffer requirements for HQ/EV watersheds through their local land use ordinances. Again, the protection factors recommended in this guidance would only be available if the land bordering the HQ/EV waters is substantially undeveloped or can otherwise reasonably function or be converted into a riparian forest buffer. Such an ordinance would ensure the permanent protection of such buffers, which is critical to effective water quality protection. A sample riparian forest buffer ordinance that would achieve the protection factor recommended in this guidance is included as Appendix B.

   d. *Replacement soil absorption area:* Although not considered to be a BMP in this guidance, municipalities can protect water quality in their HQ/EV watersheds when onlot systems are proposed by requiring that both a primary and a replacement soil absorption area be sited for each lot during the planning process. This would prevent the potential need to encroach upon the riparian buffer areas in the event of a malfunction and the need to find a replacement soil absorption area.

3. The official plan should include a map of the HQ/EV waters in the municipality with the watershed delineated for these waters and clearly identify BMPs that are required for use in these areas.

4. Municipalities are required to establish and implement a sewage management program for onlot sewage systems in their official plans to ensure proper long-term operation and maintenance of such systems within their borders (25 Pa. Code § 71.71). Municipalities that contain HQ/EV waters should address within their sewage management programs the requirements for proper operation and maintenance of onlot sewage systems, including advanced technologies such as denitrifying onlot treatment systems.

5. All municipal ordinances, regulations or policies related to the sewage facilities and associated BMPs identified in official plans should be attached to and incorporated into the official plan.

Official Plan Revisions, Supplements and Exceptions

When new land development is proposed within a municipality, a revision/supplement to the sewage facility official plan must be submitted to the local agency and DEP for review and approval before such development can proceed, unless the development qualifies for an exception to this requirement (25 Pa. Code Chapter 71, Subchapter C). Planning modules related to this guidance are:

- Sewage Facilities Planning Module: Component 2 (Individual and Community Onlot Disposal of Sewage)

- Sewage Facilities Planning Module: Component 1 (Exception to the Requirement to Revise the Official Plan)

The following guidelines should be considered when preparing sewage facilities planning modules for new land development:

1. Sewage facilities planning modules proposing onlot sewage disposal systems as a part of new land development in HQ and EV watersheds should not be approved unless the municipality in which the project is located has adopted a sewage management program that adequately assures proper operation and maintenance of the onlot systems being proposed.

2. Sewage facilities planning modules for new land development in HQ and EV watersheds should describe the proposed BMP(s) to be implemented and explain how the total protection factor of 45 is achieved for each proposed building lot in sufficient detail to allow the local agency and DEP to effectively review the proposal.

3. Any municipal ordinance that relates to a proposed BMP should be discussed in the planning module narrative and a copy of the relevant provisions should be attached to the module.

4. When a protection factor for the onlot system density BMP is proposed, the planning modules should include sufficient detail to allow the local agency and DEP to determine

how the protection factor is calculated (e.g., size of each proposed lot and proposed EDUs for each lot). For the purposes of this BMP, the enumeration of EDUs is based on proposed sewage flows and not on the proposed number of lots to be created (e.g., 1 EDU = 400 gpd). Residual tract acreage should not be included in any calculation of onlot system density.

5. When a protection factor for the setback distance BMP is proposed, the plot plan included in the planning module should have all proposed sewage disposal absorption bed(s) on the proposed lot(s) closest to the stream mapped in place. The plot plan should designate the point from which the setback distance is being measured, and all buildings, dwellings, and other development that exists in the setback area should be shown. The planning module should explain how the protection factor for the setback distance is calculated. The scale of the plot plan should be such that the setback distance can be easily measured and evaluated. This BMP may require additional site testing at the planning stage.

6. When a protection factor for a riparian forest buffer and/or riparian buffer BMP is proposed, the planning module should describe the buffer in sufficient detail to support the proposed protection factor being recommended for the buffer. To ensure the local agency and DEP have sufficient information to review the planning modules, the planning module should include or address the following:

    a. When a riparian buffer is required under Chapter 102 for the earth disturbance associated with the proposed development, the documentation prepared to support compliance with Chapter 102 should be submitted with the planning module. When a riparian buffer is not required under Chapter 102, but is nonetheless recommended as a BMP for the onlot sewage system, the Chapter 102 requirements should serve as a guide in preparing documentation for the planning module. Protection factors proposed for riparian buffers and riparian forest buffers that achieve the requirements in Chapter 102 are expected to protect the quality of the HQ and EV waters from the sewage flow from the proposed onlot sewage system.

    b. The plot plan included with the planning module should delineate the riparian buffer area. Any deed restriction language or equivalent should be recorded on the plot plan, deed or deed notice and a copy of the plot plan, deed or deed notice should be submitted with the planning module. A sample of acceptable restrictive language is in this guidance as Appendix C.

    c. The planning module should demonstrate that the riparian buffer cannot be developed in the future.

    d. The planning module should include all supporting materials relied upon to determine the protection factors for the proposed BMPs.

    e. If the new land development is not contiguous to the stream, and no municipal watershed-wide riparian buffer ordinance exists, the developer may be able to apply a protection factor for an already existing riparian buffer or for a newly established one elsewhere in the watershed. In either case, a map showing the

location of the riparian buffer in relation to the proposed development should be included in the module.

- Where a hydrogeologic evaluation demonstrates that the shallow groundwater flow from the proposed lot will be intercepted by an existing or newly established riparian buffer before the groundwater flow enters the stream, the full protection factor for the riparian forest buffer and/or riparian buffer may be applied to the new land development.

- Where a hydrogeologic evaluation cannot demonstrate that the shallow groundwater flow from the lot will be intercepted by a riparian buffer, a protection factor may still be achievable through establishing a new riparian buffer elsewhere within the watershed. To qualify for the full protection factor, the newly established riparian buffer, as measured along the streambank, must have a length at least twice as long as the longest dimension of the newly proposed lot. To qualify for 50 percent of the recommended protection factor, the newly established riparian buffer, as measured along the streambank, must have a length at least as long as the longest dimension of the newly proposed lot. Alternately, the same protection factor determinations may be applied in aggregate based on the longest dimension of the development as a whole.

f. To facilitate tracking of riparian buffers, approval of such buffers as BMPs should be conditioned upon completion of the Chapter 102 reporting form, regardless if the buffer is being installed under Chapter 102 or not. A blank copy of this form should be attached to the developer's copy of the planning module approval letter. The form should be completed and submitted to DEP or the Conservation District within one year of establishment or protection of the riparian buffer. A copy of this form can be found in Appendix A. Additionally, copies of planning module approval letters conditioned upon the use of riparian buffer BMPs should be provided to the DEP Stream ReLeaf Program (P.O. Box 8555, Harrisburg, PA 17105-8555) to assist in tracking.

7. When a protection factor for a permeable reactive barrier BMP is proposed, the plot plan should show the location of the permeable reactive barrier. In addition, the planning module should include the proposed design of the permeable reactive barrier.

8. When a protection factor for a denitrifying onlot treatment system technology BMP is proposed, the planning module should include documentation that the new land development meets general site suitability for the installation of the onlot disposal system(s). The planning module should describe the nitrogen removal efficiency of the proposed system to support the recommended protection factor and include a management plan to ensure proper long-term operation and maintenance of the proposed technology. Finally, the module should include a commitment that the developer will seek and acquire a permit for a DEP-classified denitrifying onlot treatment system technology with the same removal efficiency as proposed in planning for each new lot.

9. Community or large volume onlot sewage disposal systems may present more complex issues in developing appropriate BMPs. Early coordination between the local agency, DEP, the developer and the developer's consultant is recommended.

10. When the new land development proposes the use of a privy(ies), the planning module must also demonstrate that soil and site suitability tests have been conducted and that the site is suitable for an onlot sewage system on each lot (25 Pa. Code § 71.63(f)(1)). Therefore, such proposals should include appropriate BMPs during the planning process that could be installed to achieve a protection factor of 45 if an onlot sewage system is installed on the lot in the future.

11. When BMPs other than those recommended in this guidance are proposed, the planning modules should provide a detailed description of the BMP and the rational for the protection factor recommended for the BMP. The Department retains the discretion to assign protection factors to the BMPs.

12. When source reduction is proposed as a means of meeting a lower total protection factor, the planning module should address the means of source reduction, the beginning nitrate concentration and the justification of meeting the long term sewage disposal needs of the new land development. For instance, a composting toilet is a conventional means of sewage disposal which removes a large amount of ammonia from the waste stream. The greywater (water from sinks, showers, etc.) would be treated and disposed of in a greywater system. A greywater system is classified as an alternate sewage system. However, if the proposed new land development could show general soil and site suitability for the installation of an onlot system, the Department has the discretion to approve this type of proposal and assign an appropriate protection factor to this source reduction.

13. The planning approval letter should be conditioned on the developer following through with the antidegradation consistency measures and the BMPs presented in the planning module. The planning approval letter should contain a statement about the proper installation and the operation and maintenance of the approved BMPs. If a PA Stream Buffer Tracking Form is being sent out for the long term establishment of buffers, then the approval letter should discuss the reporting requirements of this BMP in accordance with Chapter 102.

14. When the BMPs proposed in the sewage facilities planning module change substantially after the planning module has been approved, submission of a new planning module may be required.

VII. Permitting

1. Permits for onlot sewage systems in HQ and EV watersheds should describe the BMPs that were required for approval of the sewage facilities planning module, explain how those BMPs are to be implemented and include operation and maintenance requirements necessary for those BMPs to ensure long-term protection of water quality.

2. The local agency may not issue permits for individual or community onlot sewage systems unless the proposed system is consistent with the method of sewage disposal

contained in the approved official plan, special study or update revision. In addition, the permit must be issued consistent with all approved planning conditions. 25 Pa. Code § 72.23 (a)

IX. References

DEP, *Acid Deposition: Spatial and Temporal Variations in Pennsylvania - 1996,* Bureau of Air Quality, 1997.

DEP, *Riparian Forest Buffer Guidance*, DEP-ID 394-5600-001, November 2010.

EPA, *Guidance for Federal Land Management in the Chesapeake Bay Watershed;* Chapter 6 Decentralized Wastewater Treatment Systems. U.S. Environmental Protection Agency, EPA/841-R-10-002, May 2010

EPA, *Onsite Wastewater Treatment Systems Manual.* U.S. Environmental Protection Agency, EPA/625/R-00/008, 2002

EPA, *Permeable Reactive Barrier Technologies for Contaminant Remediation.* U.S. Environmental Protection Agency, Office of Research and Development, Office of Solid Waste and Emergency Response, Washington, DC, 1998.

Hanson, G.C., P.M. Groffman, A.J. Gold. *Denitrification in Riparian Wetlands Receiving High and Low Groundwater Nitrate Inputs.* J. Environmental Quality 23:917-922, 1994.

International Environmental Technology Centre (IETC)/United Nations Environment Programme (UNEP), *Phytotechnologies, A Technical Approach in Environmental Management*. March 2003.

Lombardo, P., N. Brown, J. Barnes, K. Foreman, and W. Robertson. *Holistic Approach for Coastal Watershed Nitrogen Management.* In *Proceedings of the 2005 National Onsite Wastewater Recycling Association Annual Meeting.* Conference Proceedings, Cleveland, OH, October 2005.

Lowrance, R., L.S. Altier, J.D. Newbold, R.R. Schnabel, P.M. Groffman, J.M. Denver, D.L. Correll, J.W. Gilliam, J.L. Robinson, R.B. Brinsfield, K.W. Staver, W. Lucas, and A.H. Todd. *Water Quality Functions of Riparian Forest Buffer Systems in the Chesapeake Bay Watershed.* U.S. Environmental Protection Agency, Washington, DC. EPA 903-R-95-004/CBP/TRS 134/95, 1995.

Mayer, P.M., S.K. Reynolds Jr., T.J. Canfield, M.D. McCutchen. *Riparian Buffer Width, Vegetative Cover, and Nitrogen Removal Effectiveness: A Review of Current Science and Regulations.* U.S. Environmental Protection Agency, EPA/600/R-05/118, October 2005.

Mayer, P.M., S.K. Reynolds Jr., M.D. McCutchen, and T.J. Canfield. *Meta-Analysis of Nitrogen Removal in Riparian Buffers.* J. Environmental Quality 36:1172-1180, 2007.

McCray, J.E., S.L. Kirkland, R.L. Siegrist, G.D. Thyne. *Model parameters for simulating fate and transport of on-site wastewater nutrients.* Ground Water 43, 4, 628–639, 2005

Newbold, J.D., S. Herbert, B.W. Sweeney. *Mitigation of Nonpoint Pollution by a Riparian Forest Buffer in an Agricultural Watershed of the Mid-Atlantic Piedmont.* February 2009.

Newbold, J.D., S.H. Herbert, B.W. Sweeney, P. Kiry, and S.J. Alberts.. *Water Quality Functions of a 15-year-old Riparian Forest Buffer System.* Journal of the American Water Resources Association 46:299-310, 2010.

Nizeyimana, E., B.M. Evans, M.C. Anderson, G.W. Petersen, D. DeWalle, W. Sharpe, B. Swistock, 1997, *Quantification of NPS Pollution Loads Within Pennsylvania Watershed, Pennsylvania State University, Ground Water and Agriculture in Pennsylvania,* College of Agriculture, Circular 341, 21 pages.

Nolan, Bernard T. and Kerie J. Hitt. *Nutrients in Shallow Ground Waters beneath Relatively Undeveloped Areas in the Conterminous United States.* US Geological Survey, Water Resources Investigation Report 02-4289, 2003.

Reese, Stuart O., Joseph J. Lee, *Summary of Groundwater Quality Monitoring Data (1985 - 1997) from Pennsylvania's Ambient and Fixed Station Network (FSN) Monitoring Program.* Pennsylvania Department of Environmental Protection, 1997.

Reese, Stuart O., and Dennis W. Risser. *Summary of Groundwater-Recharge Estimates for Pennsylvania*. Pennsylvania Geological Survey, Pennsylvania Department of Conservation and Natural Resources, 2010.

Robertson, W.D., D.W. Blowes, C.J. Ptacek, and J.A. Cherry. *Long-term Performance of In Situ Reactive Barriers for Nitrate Remediation.* Ground Water, 38: 689-695, 2000.

Robertson, W.D., and J.A. Cherry. *In situ denitrification of septic-system nitrate using reactive porous media barriers: field trials.* Ground Water 33(1):99–111, 1995.

Vallino, J., and K. Foreman. *Effectiveness of Reactive Barriers for Reducing N-Loading to the Coastal Zone,* Submitted to The NOAA/UNH Cooperative Institute for Coastal and Estuarine Environmental Technology (CICEET). Ecosystems Center Marine Biological Laboratory, Woods Hole, MA, 2008.

Washington State Department of Health. *Nitrogen Reducing Technologies for Onsite Wastewater Treatment Systems*. Prepared for the Puget Sound Action Team, by Washington Department of Health, Olympia, WA, 2005.

APPENDIX A
STREAM RELEAF FORM
Reporting Form for Established Riparian Buffers

(See next page - electronic version of form available online)

3720-FM-BCR0100 2/2012

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF CONSERVATION AND RESTORATION

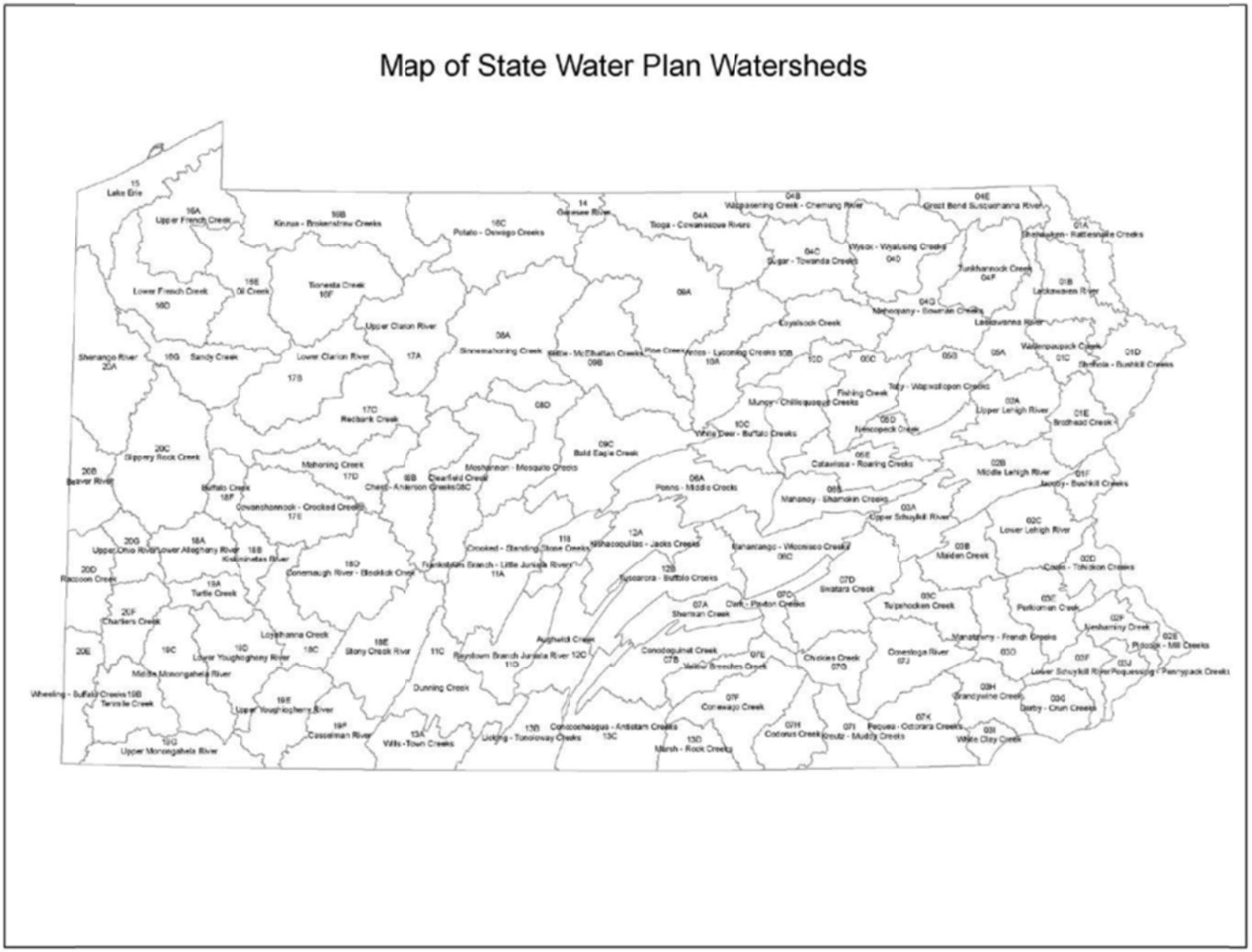
PA STREAM BUFFER TRACKING FORM

Project Contact Person: _____
Organization: _____
Email: _____ Phone #: _____
PROJECT IDENTIFICATIONS
Project Start Date: _____
Project Name: _____
Project Address: _____
County: _____
Stream Name: _____
104 Watershed Code: _____ Center of Site Latitude: _____ Longitude: _____
Water Body: ☐ Stream ☐ Wetland ☐ River ☐ Lake ☐ Pond ☐ Dam
TMDL/Impairment Status of Waterbody: _____
Water Use Designation: http://www.pacode.com/secure/data/025/chapter93/chap93toc.html
BUFFER POTENTIAL TO BECOME A MATURE FOREST
Reason for Buffer: Buffer Permanently Protected: ☐ Yes ☐ No
Riparian Forest Buffer Protection Agreement: ☐ Yes ☐ No Protection Status:
Condition of Stream Bank: ☐ Laid Back ☐ Undercut ☐ Bare ☐ Forested ☐ Needs Work ☐ Other
Health of Buffer: ☐ Poor ☐ Average ☐ Good ☐ Excellent
State After Project Completion: ☐ New ☐ Enhancement ☐ Existing
% Canopy Cover (Total Ground Area Shaded by Woody Vegetation): _____
% of Ground Cover in Buffer – Total Area Covered by Non-Woody Vegetation: _____
BUFFER CHARACTERISTICS
Adjacent Land Use: ☐ Herbaceous/Shrubs ☐ Farm ☐ Development ☐ Forest
Buffer Type: ☐ Forest ☐ Tree/Shrubs ☐ Grasses ☐ Fencing Only ☐ Fencing and Trees
Buffer Length 1st Side (Facing Downstream): _____ Buffer Width 1st Side: _____
Buffer Length 2nd Side (Facing Downstream): _____ Buffer Width 2nd Side: _____
Funding Source:

Please return to:

Pa. DEP, Bureau of Conservation and Restoration
PO Box 8555
Harrisburg, PA 17105-8555
Attn: Stream ReLeaf Program
Phone: 717.772.5637
Fax: 717.787.9549

Map of State Water Plan Watersheds



APPENDIX B
MODEL ORDINANCE
Riparian Buffers and Riparian Forest Buffers

Many model ordinances for riparian buffers have been developed by federal, state and local agencies and organizations. An internet search for model riparian buffer ordinances will yield examples for consideration by any municipality considering development of such an ordinance. Language in these model ordinances may need to be revised to be consistent with the types of riparian buffers and riparian forest buffers recommended in this guidance.

Municipalities are encouraged to coordinate with DEP when drafting an ordinance to establish riparian buffers or riparian forest buffers that will be used as best management practices for approving the use of onlot sewage disposal systems in high quality and exceptional value watershed. Listed below are examples of resources available to municipalities that are considering the development of riparian buffer ordinances.

DEP provides resources related to riparian buffers, particularly forest riparian buffers, through its Stream Releaf Program, including information on municipal riparian buffer ordinances, available at http://www.dep.state.pa.us/dep/deputate/watermgt/WC/Subjects/StreamReLeaf/default.htm. Model ordinance information is available in the Forest Buffer Tool Kit under Buffer Preservation.

The United States Environmental Protection Agency has developed a model ordinance to create stream buffer zones and also provides sample stream buffer ordinances from various parts of the country. These documents are available at http://water.epa.gov/polwaste/nps/buffers.cfm.

Montgomery County has developed a *Guidebook for Riparian Corridor Conservation*, which includes a model ordinance for a riparian corridor conservation district. This guidebook is available from the Montgomery County Planning Commission at http://planning.montcopa.org/planning/cwp/view,a,1462,q,84449.asp.

The model ordinance developed by Montgomery County is presented in its *Guidebook for Riparian Corridor Conservation*. This version of the model ordinance is available in the Library of the Pennsylvania Land Trust Association at http://conservationtools.org/libraries/1/library_items/74-Model-Ordinance-Riparian-Buffer.

APPENDIX C
MODEL DEED LANGUAGE
Riparian Buffers, Riparian Forest Buffers, and Other BMPs

DECLARATION OF ENVIRONMENTAL COVENANT

This Declaration of Environmental Covenant is executed this ___ day of _____, 20__, by [***Name of Property Owner***] ("Grantor") to [***Name of Municipality***] ("Holder"), and approved by the Pennsylvania Department of Environmental Protection ("Department"), pursuant to the Pennsylvania Uniform Environmental Covenants Act, act of December 18, 2007, P.L. 450, No. 68, as amended, 27 Pa. C.S. §§ 6501 – 6517.

WITNESSETH:

WHEREAS, the Grantor owns certain land situated in [***Name of Municipality***], [***Name of County***], Pennsylvania, being more fully described in the deed between [***Seller***] and the [***Name of Property Owner***] dated _____, and recorded in the [***Name of County***] Recorder of Deeds Office in Deed Book ____, Page ____ (copy of deed attached hereto as Exhibit A), and shown as Lot __ on the approved subdivision plan recorded in Plan Book ___, Volume ___, Page ___ (copy of plan attached hereto as Exhibit B) (the "Property").

WHEREAS, the Grantor desires to construct a single family home on the Property and to collect, treat and dispose of sewage from the home by properly designing, constructing, operating and maintaining an individual onlot sewage system on the Property consistent with applicable laws and regulations administered by the Holder and the Department;

WHEREAS, the Holder and the Department have approved an official plan revision for new land development to allow construction of an individual onlot sewage system on the Property in accordance with the Pennsylvania Sewage Facilities Act, act of Jan. 24, 1966, P.L. (1965) 1535, No. 537, as amended, 35 P.S. §§ 750.1-750.20a, provided that the Property be used consistent with certain conditions imposed to protect and maintain the water quality in [***Name of Surface Water***];

NOW THEREFORE, in consideration of the above approval by the Holder and the Department, the Grantor agrees to be bound by the terms of this Declaration of Environmental Covenant set forth below, and hereby declares that the Property shall be held, transferred, conveyed, leased, occupied or otherwise disposed of and used subject to this Declaration of Environmental Covenant, which shall run with the land and be binding on all heirs, successors, assigns, and lessees.

1. Purpose. The purpose of this Declaration of Environmental Covenant is to ensure use and maintenance of the Property in a manner that protects and maintains water quality in [***Name of Surface Water***] while allowing the construction of an individual onlot sewage system and single family home on the Property.

2. Duration. The provisions of this Declaration of Environmental Covenant shall continue until such time as sewage is no longer disposed on the Property and the Holder and the Department consent to termination of this Declaration of Environmental Covenant.

3. Individual Onlot Sewage System. The individual onlot sewage system approved for use on the Property shall be designed, permitted, constructed, operated and maintained in accordance with

requirements of the Holder and the Department in compliance with all applicable laws and regulations. [Specific operation and maintenance requirements could be added, if desired.]

4. Best Management Practices. To protect and maintain the water quality in [***Name of Surface Water***], the following best management practices shall be implemented and maintained on the Property:

[*The following are examples of provisions that could be included for the BMPs discussed in the guidance.*]

(a) *Riparian Forest Buffer*. The portion of the Property located within one hundred and fifty (150) feet of the top of the streambank of [***Name of Surface Water***] as measured perpendicular to the surface water shall be established and/or maintained in predominantly native trees, shrubs and forbs that provide at least sixty percent (60%) uniform canopy cover. Noxious weeds and invasive species shall be removed or controlled to the extent possible. Wetlands in the riparian forest buffer shall be protected and maintained. The following practices and activities are prohibited in this riparian forest buffer: (i) soil disturbance by grading, stripping of topsoil, plowing, cultivating or other soil disturbance practices except as necessary to establish and/or maintain the forest riparian buffer; (ii) draining by ditching, underdrains or other drainage systems; (iii) housing, grazing or otherwise maintaining animals for agricultural or commercial purposes; (iv) storing or stockpiling materials; (v) off-road vehicular travel. The following practices and activities are allowable in the riparian forest buffer when authorized by the Holder and the Department: (i) construction or placement of roads, bridges, trails, storm drainage, utilities or other structures; (ii) water obstructions or encroachments; (iii) restoration projects. The following practices and activities are allowed within the riparian forest buffer: (i) timber harvesting activities in accordance with a riparian forest buffer management plan authorized by Holder and the Department; (ii) passive or low impact recreational activities that do not impair the functioning of the riparian forest buffer; (iv) emergency response and other similar activities; (v) research and data collection activities, which may include water quality monitoring and stream gauging.

(b) *Riparian Buffer*. The portion of the Property located within one hundred and fifty (150) feet of the top of the streambank of [***Name of Surface Water***] as measured perpendicular to the surface water shall be established and/or maintained in permanent vegetation. Wetlands in the riparian buffer shall be protected and maintained. The following practices and activities are prohibited in this riparian buffer: (i) soil disturbance by grading, stripping of topsoil, plowing, cultivating or other soil disturbance practices except as necessary to establish and/or maintain the riparian buffer; (ii) draining by ditching, underdrains or other drainage systems; (iii) housing, grazing or otherwise maintaining animals for agricultural or commercial purposes; (iv) storing or stockpiling materials; (v) off-road vehicular travel. The following practices and activities are allowable in the riparian buffer when authorized by the Holder and the Department: (i) construction or placement of roads, bridges, trails, storm drainage, utilities or other structures; (ii) water obstructions or encroachments; (iii) restoration projects. The following practices and activities are allowed within the riparian buffer: (i) timber harvesting activities in accordance with a riparian buffer management plan authorized by Holder and the Department; (ii) passive or low impact recreational activities that do not impair the functioning of the riparian buffer; (iv) emergency response and other similar activities; (v) research and data collection activities, which may include water quality monitoring and stream gauging.

(c) *Subdivision Prohibited.* The individual onlot sewage system shall be maintained on a minimum lot size of ___ acres. The Property shall not be subdivided in a manner that results in the system being located on less than a lot of this acreage.

(d) *Setback Distance:* The absorption area for the individual onlot sewage system located on the Property shall be at least _____ feet from the top of the streambank of [***Name of Surface Water***] as measured perpendicular to the surface water.

(e) *Permeable Reactive Barrier.* A permeable reactive barrier shall be installed and maintained on the Property at least ___ feet down gradient from the soil absorption area associated with the individual onlot sewage system. [Specific maintenance requirements could be added.]

(f) *Denitrifying Onlot Treatment System Technology:* The individual onlot sewage system shall include denitrifying technology approved by the Holder and the Department. This technology shall be properly designed, constructed, operated and maintained. [Specific operation and maintenance requirements could be added.]

5. Subsequent Transfers. This Declaration of Environmental Covenant shall be expressly identified and incorporated by reference in any deed or other instrument by which Grantor conveys any interest in all or any portion of the Property by sale, exchange, lease, easement, devise, gift or other conveyance. The Holder and the Department shall be given written notice of any such conveyance, including the conveyance document, within thirty (30) days of the date of such conveyance. Failure of Grantor to perform any act required by this paragraph shall not impair the validity of this Declaration of Environmental Covenant or limit its enforceability in any way.

6. Recordation. Grantor shall record this Declaration of Environmental Covenant in the Recorder of Deeds Office of [***Name of County***], Pennsylvania, within thirty (30) days of its execution. Grantor shall pay all recording costs necessary to record this instrument.

7. Notices. All notices, consents, approvals or other communications required under the provisions of this Declaration of Environmental Covenant shall be in writing and shall be deemed properly given if hand delivered, sent by a nationally recognized overnight courier, or sent by United States certified mail, return receipt requested, addressed to the appropriate party or successor in interest, as follows:

(a) Grantor: [***Street address of Property***]

(b) Holder: Administrative offices of [***Name of Municipality***]

(c) Department: [***Appropriate Regional Office;***
Attn: Sewage Planning Program]

8. Rights of Holder and Department. The Holder and Department shall have all rights provided by law, including but not limited to the Pennsylvania Uniform Environmental Covenants Act, act of December 18, 2007, P.L. 450, No. 68, as amended, 27 Pa. C.S. §§ 6501 – 6517.

9. Miscellaneous Provisions.

(a) Severability. If any provision of this Declaration of Environmental Covenant or its application to any person or circumstance is found to be invalid, its remaining provisions and its application to other persons or circumstances shall remain in effect.

(b) Amendment. This Declaration of Environmental Covenant may not be amended or in any way modified by the Grantor without the express approval of the Holder and the Department.

(c) Controlling Law. The interpretation and performance of this Declaration of Environmental Covenant shall be governed by the laws of the Commonwealth of Pennsylvania.

(d) Captions. The captions in this instrument have been inserted solely for convenience of reference and are not a part of this instrument and shall have no effect upon construction or interpretation.

IN WITNESS WHEREOF, the Grantor has duly executed, on the day and year first written above, this Declaration of Environmental Covenant, which has been approved by the Holder and the Department.

[***Name of Owner***], Grantor

Attest:

By: _____

Name: _____

_____

Title: _____

APPROVED BY:

[***Name of Municipality***], Holder

By: _____

Name: _____

Title: _____

Date: _____

APPROVED, by Commonwealth of Pennsylvania,
Department of Environmental Protection

By: _____

Name: _____

Title: _____

Date: _____

COMMONWEALTH OF PENNSYLVANIA)
)
COUNTY OF _____) SS:

On this ___ day of _____, 20__, before me, the undersigned officer, personally appeared _____ [Owner/Grantor] who acknowledged himself/herself to be the person whose name is subscribed to this Declaration of Environmental Covenant, and acknowledged that s/he executed same for the purposes therein contained.

In witness whereof, I hereunto set my hand and official seal.

_____
Notary Public