Riparian and Wetland Buffers

Guide | Model Regulations

Lehigh Valley Planning Commission

January 2011

LEHIGH VALLEY PLANNING COMMISSION

Steven L. Glickman, Chair
Robert A. Lammi, Vice Chair
Kent H. Herman, Treasurer

Ron Angle
Norman E. Blatt, Jr., Esq.
Becky Bradley (Alternate)
Dean N. Browning
John B. Callahan
Donald Cunningham
Michael D. D'Amore
John N. Diacogiannis
Percy H. Dougherty
Liesel Dreisbach
Cindy Feinberg (Alternate)
Charles L. Fraust
George F. Gemmel
Matthew Glennon
Armand V. Greco
Michael C. Hefele (Alternate)
Darlene Heller (Alternate)
Benjamin F. Howells, Jr.
Edward D. Hozza, Jr.
Terry J. Lee
Ronald W. Lutes
Earl B. Lynn
Jeffrey D. Manzi
Ross Marcus (Alternate)
Kenneth M. McClain
Thomas J. Nolan
Salvatore J. Panto, Jr.
Edward Pawlowski
Stephen Repasch
Michael Reph
Ronald E. Stahley
John Stoffa
Donna Wright

LEHIGH VALLEY PLANNING COMMISSION STAFF

David P. Berryman, Senior Planner, Project Manager

Alice J. Lipe, Senior Planning Technician, Layout and Cover Design

Lynette E. Romig, Senior GIS Analyst, Graphics Design

Susan L. Rockwell, Senior Environmental Planner, Editor

This project was funded in part by a grant from the Pennsylvania Department of Conservation and Natural Resources, Bureau of Recreation and Conservation, Growing Greener Environmental Stewardship Fund, administered by the D&L NHC, Inc.

Cover photo: Courtesy of Michael N. Kaiser.

TABLE OF CONTENTS

Page

LIST OF MAPS

LIST OF FIGURES

LIST OF GRAPHS

LIST OF TABLES

INTRODUCTION

The U.S. Environmental Protection Agency estimates that more than half of all stream pollution comes from land runoff, which can contain pollutants such as sediment, oil, fertilizers and pesticides. Increasing the amount of pavement in a watershed, or even changing land use from forests to fields, can increase discharge to streams since both of these greatly reduce land permeability and soil storage. Streams in the Lehigh Valley are constantly under pressure from the combined effects of farming uses and the continued urbanization of the Lehigh Valley.

Riparian buffers are a natural, effective means of protecting the watercourses in the Lehigh Valley. These strips of grass, shrubs and/or trees along the banks of rivers and streams provide a range of environmental benefits. Riparian buffers filter polluted runoff, stabilize streambanks, reduce erosion, store floodwaters and provide a transition zone between water and our use of the land. Buffers are also complex ecosystems that provide habitat and improve the health of the watercourse they protect. Buffers work best when they contain a diverse mixture of native plants as different plants have different rooting structures. The effectiveness of pollutant removal will vary by plant type, as well as pollutant type. The more diverse the vegetation, the more the buffer will catch before it enters the water. Grasses are more quickly established and, in terms of sediment and chemical removal, are more effective than a buffer comprised of trees. Forested buffers, however, are not as easily inundated during a flood and may provide greater resistance.

Within the last 50 years, the natural vegetation of most Lehigh Valley riparian buffers has been cleared and replaced by row crops, converted to grazed pastures or planted with grass. Stream channels have been straightened and deepened, and agricultural chemicals, such as nitrogen and phosphorus, can drain directly into streams. There is a renewed interest in preserving existing riparian buffers or restoring them in places where they have been cleared. The map on Page 3 illustrates the degredation of riparian buffers in the Lehigh Valley. Preservation and restoration are achieved in two basic ways. One, by municipal regulation. The LVPC has put together model regulations to serve as a starting point for implementing quality regulatory standards for riparian buffers for interested municipalities. The second way is by volunteer or non-profit initatives. The *Lehigh Valley Greenways Plan*, approved and released by the LVPC in 2007, details numerous local projects and initiatives to restore riparian buffers along local watercourses.

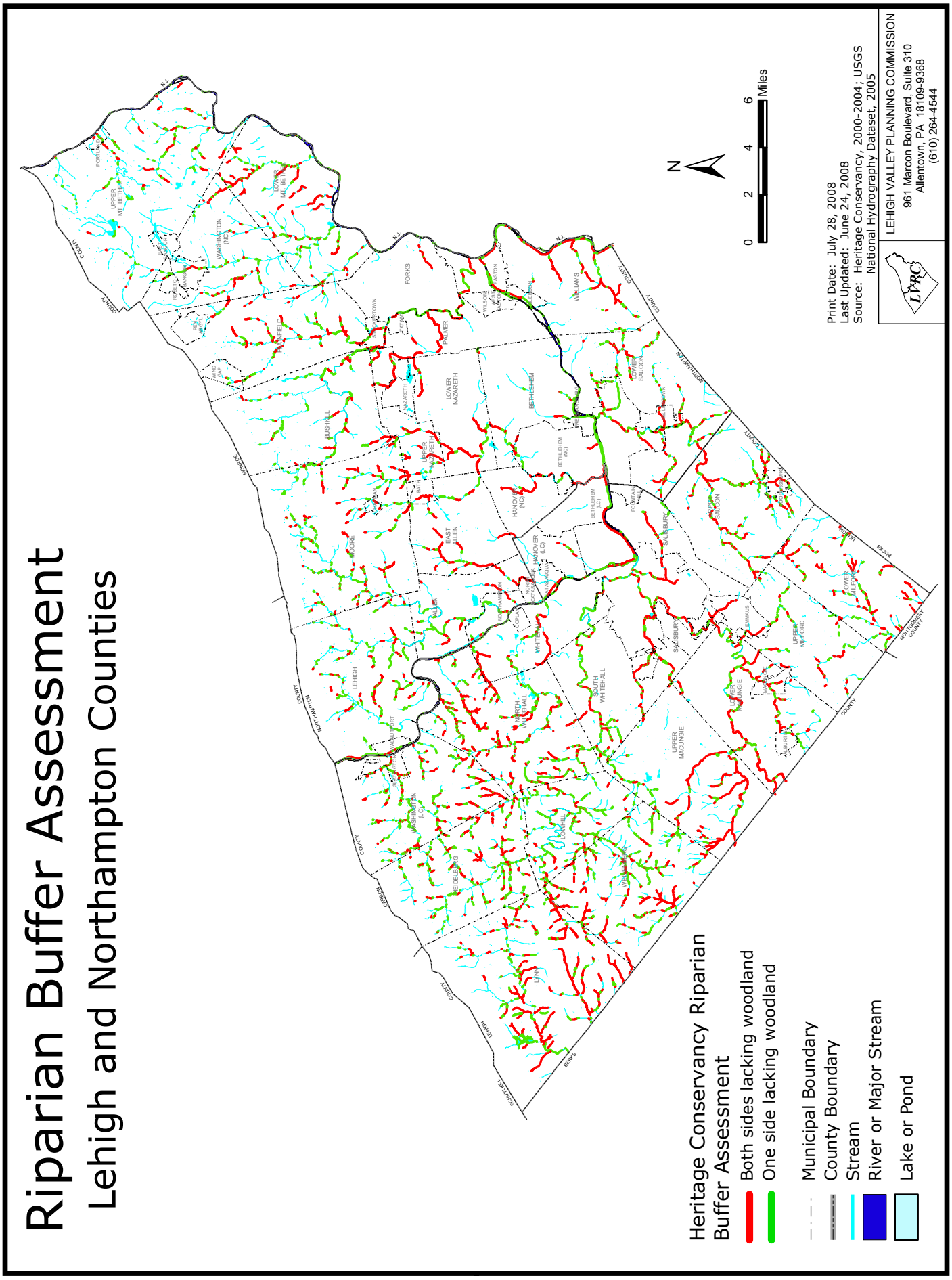
The LVPC encourages the restoration of riparian buffers on lands that border rivers and streams whether they are privately owned or owned by local government via non-regulatory and regulatory means.

AUTHORITY TO REGULATE RIPARIAN BUFFERS

The basis for enacting municipal riparian buffer regulations is found in the federal statutes, the Commonwealth's Constitution and in the Pennsylvania Municipalities Planning Code (MPC).

FEDERAL AUTHORITY

The 1972 Federal Water Pollution Control Act, or Clean Water Act, requires states to enact land use measures to control nonpoint source water pollution. However, there are no federal laws that specify riparian buffer width. In some cases, very specific legislation mandated protection of riparian buffers. For example, in 16 USC (United States Code) 539(d), the National Forest Timber Utilization Program (a.k.a. the 1990 Tongass Timber Reform Act):


Riparian Buffer Assessment
Lehigh and Northampton Counties
Heritage Conservancy Riparian Buffer Assessment
Both sides lacking woodland
One side lacking woodland
Municipal Boundary
County Boundary
Stream
River or Major Stream
Lake or Pond
N
0 2 4 6 Miles
Print Date: July 28, 2008
Last Updated: June 24, 2008
Source: Heritage Conservancy, 2000-2004; USGS National Hydrography Dataset, 2005
LVPC
LEHIGH VALLEY PLANNING COMMISSION
961 Marcon Boulevard, Suite 310
Allentown, PA 18109-9368
(610) 264-4544

"In order to assure protection of riparian habitat, the Secretary shall maintain a buffer zone of no less than one hundred feet in width on each side of all Class I streams in the Tongass National Forest, and on those Class II streams which flow directly into a Class I stream, within which commercial timber harvesting shall be prohibited…"

Timber harvesting from the National Forest System has also been regulated, in general, through the National Forest System Land and Resource Management Plan which states, without providing strict guidelines, that harvesting plans must, "insure that timber will be harvested from National Forest System lands only where soil, slope, or other watershed conditions will not be irreversibly damaged" and where "protection is provided for streams, streambanks, shorelines, lakes, wetlands, and other bodies of water from detrimental changes in water temperatures, blockages of water courses, and deposits of sediment, where harvests are likely to seriously and adversely affect water conditions or fish habitat" (16 USC 1604).

Riparian conservation has been cited within the USC as one of the purposes for the establishment of National Parks and as directives to the Secretary of the Interior (e.g. 16 USC Sec. 460). Several subsections within this section of USC address riparian zones of other national parks likewise, to "contribute to public enjoyment," "protect important resource values," etc. In all cases, the statutes are site-specific, and the riparian zones discussed are between 100 and 300 feet.

Voluntary participation programs such as the Conservation Reserve Program (CRP) and the Conservation Reserve Enhancement Program (CREP) provide landowners financial incentives to protect land and waterbodies through maintenance of buffers, wetlands and by planting cover crops (7 CFR 1410). The CRP is administered through the U.S. Department of Agriculture's Farm Service Agency (USDA-FSA) (7 CFR, Chap. VII) with technical assistance provided by the National Resources Conservation Service (USDA-NRCS) (7CFR, Chap. VI).

PENNSYLVANIA AUTHORITY

The "Environmental Rights Amendment" of the Pennsylvania Constitution (Article 1, Section 27) has been interpreted by the courts as a responsibility equally shared by the Department of Environmental Protection and municipalities. Pennsylvania's municipalities have the responsibility to apply Section 27 in planning and regulation of land use. Section 27 states:

"The people have a right to clean air, pure water, and to the preservation of the natural, scenic, historic and esthetic values of the environment. Pennsylvania's public natural resources are the common property of all the people, including generations yet to come. As trustee of these resources, the Commonwealth shall conserve and maintain them for the benefit of all the people."

Section 27 provides a right, in very broad terms, to environmental quality and specifies the Commonwealth as "trustee of these resources." Despite its broad language, Section 27 has not had important effects in litigation.

The Commonwealth's Department of Environmental Protection has historically indirectly regulated riparian buffers with the enforcement of the Clean Streams Law, the Dam Safety and Encroachments Act and the Storm Water Management Act. However, in November 2010, the Commonwealth passed major changes to the Erosion and Sediment Control and Stormwater Management regulations found in Chapter 102 of the State Code. The Department now requires a 150 foot riparian buffer for earth disturbance activities of one (1) acre or greater within high quality and exceptional value watersheds. Agricultural planting and tilling and animal heavy use areas are not subject to these requirements. The regulations apply to a perennial or intermittent watercourse within the Exceptional Value (EV) or High Quality (HQ) Coldwater streams. DEP defines designated uses for streams throughout the state that include warm water fishes, trout stocking fishes and cold water fishes in addition to the

HQ and EV designations. In watersheds where the riparian buffer requirement applies, if the stream is meeting its designated use, the riparian buffer is essentially an area where the land cannot be disturbed. However, for streams not meeting those designated uses outlined above, a forested riparian buffer is required.

The map on page 6 shows the impact of the new Chapter 102 regulations. The high quality designation applies to about 38.5% of the total stream length in the Lehigh Valley. The exceptional value designation applies to about 2% of total stream length.

Direct authority for riparian buffers can be found in the Pennsylvania Municipalities Planning Code (MPC). The MPC, in effect since 1969 and updated several times since, provides the enabling legislation for municipalities land use planning with mechanisms such as the creation of comprehensive plans, and zoning and subdivision ordinances. The general intent of the MPC is to give municipalities police powers to guide coordinated development such as uses of land, structures, streets, and public facilities; and to promote preservation of natural and historic resources. The MPC provides the authority for municipalities to adopt regulations relative to riparian buffers. These sections are specifically:

Section 301(a) (6). The municipal comprehensive plan shall include a plan for the protection of natural and historic resources to the extent not preempted by federal or state law. This clause includes, but is not limited to, wetlands and aquifer recharge zones, woodlands, steep slopes, prime agricultural land, floodplains, unique natural areas and historic sites.

Section 503(2) (v). A subdivision and land development ordinance may include provisions for ensuring that land, which is subject to flooding, subsidence, or underground fires, either shall be safe for the proposed use or that these areas shall be set aside for uses that do not endanger life or property.

Section 603(c) (7). Zoning ordinances may contain provisions to promote and preserve prime agricultural land, environmentally sensitive areas, and areas of historic significance.

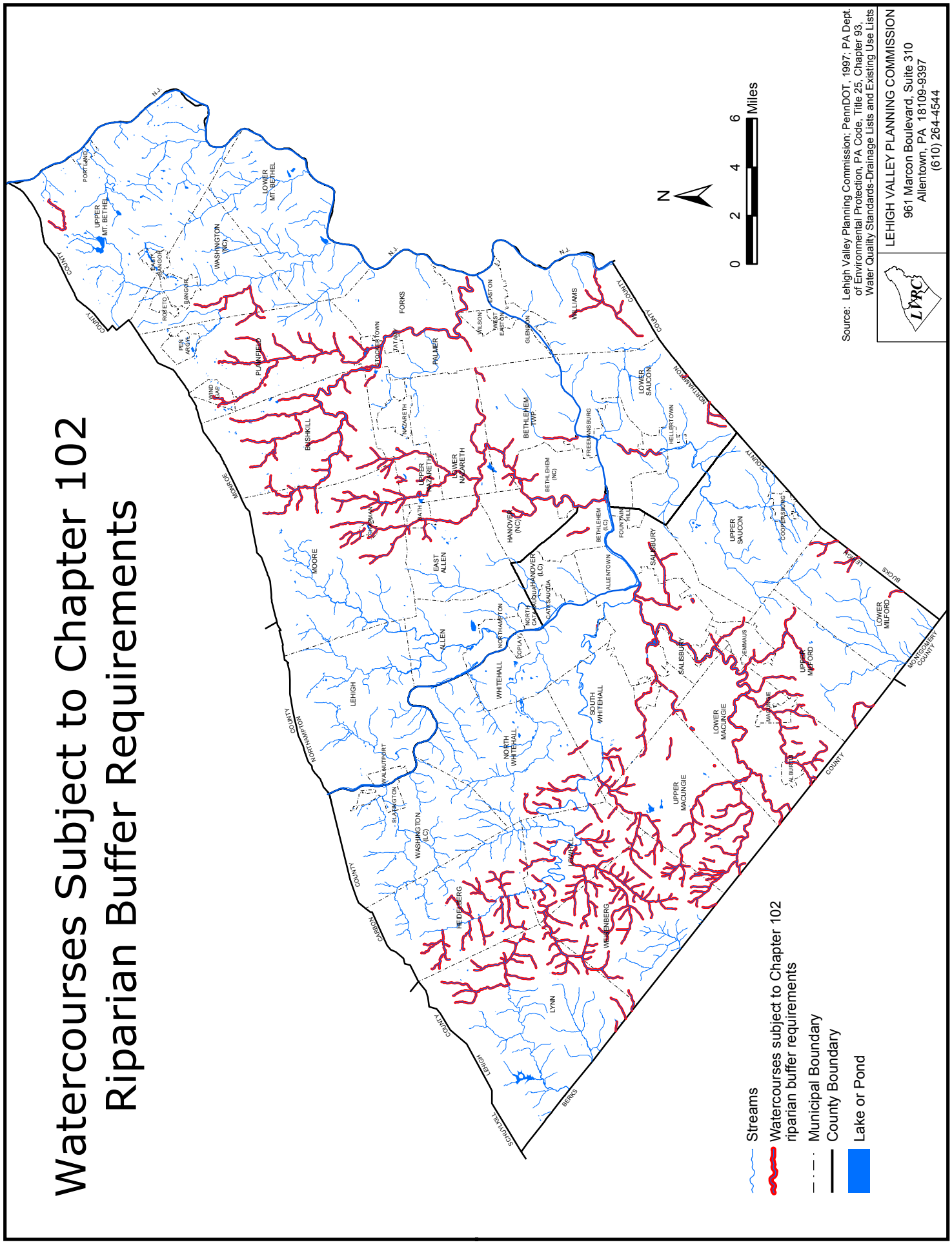
Section 605(2) (ii), (iii), and (vii). Where zoning districts are created, all provisions shall be uniform for each class of uses or structures, within each district, except that additional classifications may be made within any district for the regulation, restriction, or prohibition of uses or structures at, along, or near natural or artificial bodies of water, places of relatively steep slope or grade, or other areas of hazardous geological or topographical features, floodplain areas, agricultural areas, sanitary landfills, and other places having a special character or use affecting or affected by their surroundings.

Section 606. The zoning ordinance shall include or reference a statement of community development objectives relating to the need for protecting natural resources.

Section 609.1(c) (3) and (4) and Section 916.1(c) (5) (iii) and (iv). In evaluating a substantive challenge to the validity of a zoning ordinance by a landowner, the governing body or the zoning hearing board shall determine the suitability of the site for the intensity of use proposed by the site's soils, slopes, woodlands, wetlands, floodplains, aquifers, natural resources, and other features. It shall also evaluate the impact of the proposed use on the site's soils, slopes, woodlands, wetlands, floodplains, natural resources, and natural features, the degree to which these are protected or destroyed, the tolerance of the resources to development, and any adverse environmental impacts.

Conclusion

While federal legislation indirectly permits the regulation of riparian buffers, the Commonwealth's Constitution, and more specifically, the MPC, clearly authorizes local municipalities to adopt riparian buffer regulations.


Watercourses Subject to Chapter 102
Riparian Buffer Requirements
Streams
Watercourses subject to Chapter 102 riparian buffer requirements
Municipal Boundary
County Boundary
Lake or Pond
N
0 2 4 6 Miles
Source: Lehigh Valley Planning Commission; PennDOT, 1997; PA Dept. of Environmental Protection, PA Code, Title 25, Chapter 93, Water Quality Standards-Drainage Lists and Existing Use Lists
LVPC
LEHIGH VALLEY PLANNING COMMISSION
961 Marcon Boulevard, Suite 310
Allentown, PA 18109-9397
(610) 264-4544

THE SCIENCE OF RIPARIAN BUFFERS

Municipal riparian buffer regulations should be based on scientific research. The LVPC did not attempt to judge the merit or adequacy of the scientific studies. In the preparation of the model regulations, we considered the expansive amount of research on the subject of riparian buffers, and acknowledged local concerns, issues and the history of riparian buffer regulation in the Lehigh Valley. The model regulations are a product of balancing the scientific documentation on the benefit of riparian buffers versus political realities in regulating the buffers at the local level. We see riparian buffer regulations as a planning tool, not as an absolute approach to watershed management, and used our best professional judgment in drafting model regulations for consideration by Lehigh Valley municipalities.

The LVPC used a variety of sources, including the Internet and numerous references and scientific publications, specifically examining the literature focused on Pennsylvania. More regional and national resources were included when appropriate. Given the contentiousness of the issue, an extensive literature review was conducted on recommended buffer widths for riparian and wetland areas in support of the LVPC regulations. Much of the reviewed literature focused on water quality protection, and for good reason. Water quality issues include sediments, nutrients, pesticides and thermal impacts. Excess nitrogen and phosphorous from fertilizers and animal waste, as well as other pollutants originating from pesticides and herbicides, often bond to soil particles. The nutrient-loaded sediment contained in surface runoff then flows to the nearest waterbody and is deposited. Buffers function as filters for harmful nutrients and pollutants. Buffer plants slow sediment-laden runoff and, depending upon their width and type of vegetation, may filter 50 to 100% of sediments as well as the nutrients and pollutants attached to them.

WIDTH

How wide should these riparian buffers be? One size doesn't fit all. It depends on the purpose of the buffer, what can be practically enforced and natural factors such as slope, soil type and rainfall. There isn't one generic size buffer that will keep the water clean, stabilize the stream bank, protect fish and wildlife, and satisfy human demands on the land. Realistically, however, most decisions about buffer widths will be a compromise between ideal widths based on environmental goals (wildlife corridors, streambank stabilization and water quality protection) and landowner concerns and economic constraints. Generally, riparian buffers are widely used to control water pollution and achieve goals such as enhancing fish and wildlife habitat.

Riparian buffers are a subject that is not short on analysis or study. Hundreds of studies have been conducted over the past three decades on riparian buffers, their effectiveness, and how width and the type of vegetation make them more effective in filtering out chemicals and sediment, reducing water temperature, and providing animal habitat. With this amount of study, there are many variables. The effectiveness of a riparian buffer is largely dependant on the width and the types of vegetation in the buffer. However, site specific variables must be taken into consideration. The scientific data suggests that buffers need to be wider if steep slopes are adjacent to the watercourse to allow time for the velocity of water to decrease. Soil features, such as the depth to the water table, permeability, texture, chemistry, and organic matter content, can affect the infiltration of runoff and the processing of nitrogen and other contaminants.

Ultimately, in assembling a model regulation, some judgments must be made about the objectives, width, and measurement of the buffer.

There are generally two approaches to regulating the width of riparian buffers: fixed and variable width. A fixed width, usually measured from the stream bank or high water mark, is a popular method for ease of implementation and administration. A buffer width that varies depending on the natural or built features adjacent to the watercourse can allow for steep slopes or unique features of a site. However, this approach requires site visits

by surveyors or other qualified persons to measure slopes or identify the natural features. In a literature review of scientific studies on the subject of buffer width, the Idaho Forest Wildlife and Range Policy Analysis Group (Belt, et al, 1992) concluded that there is no demonstrable scientific benefit of choosing one approach over the other. The LVPC chose a fixed width for ease of implementation and administration.

The scientific research suggests, at a minimum, all perennial and intermittent streams and wetlands be protected by buffers. The baseline widths and criteria for the riparian buffer widths found in the LVPC regulations are derived from several specific resources.

The Natural Resources Conservation Service (NRCS) standards for riparian buffer establishment call for a minimum width of 75 feet and a maximum average width of 150 feet. The national standards can be modified by each state NRCS office to fit local conditions.

In 1996, the United States Forest Service published criteria for determining riparian buffer width including the value of the resource, the site and watershed traits, intensity of adjacent land uses, and desired buffer functions. The following minimum width ranges are recommended based on specific functions (Figure 1):

- Streambank stabilization and aquatic food web processes - 10 ft to 40 ft.
- Water temperature moderation - 10 ft to 60 ft.
- Nutrient removal - 30 ft to 140 ft.
- Sediment control - 50 ft to 160 ft.
- Flood mitigation - 65 ft to 225 ft.
- Wildlife habitat - 45 ft to 255 ft.

FIGURE 1

USDA RECOMMENDED BUFFER WIDTHS

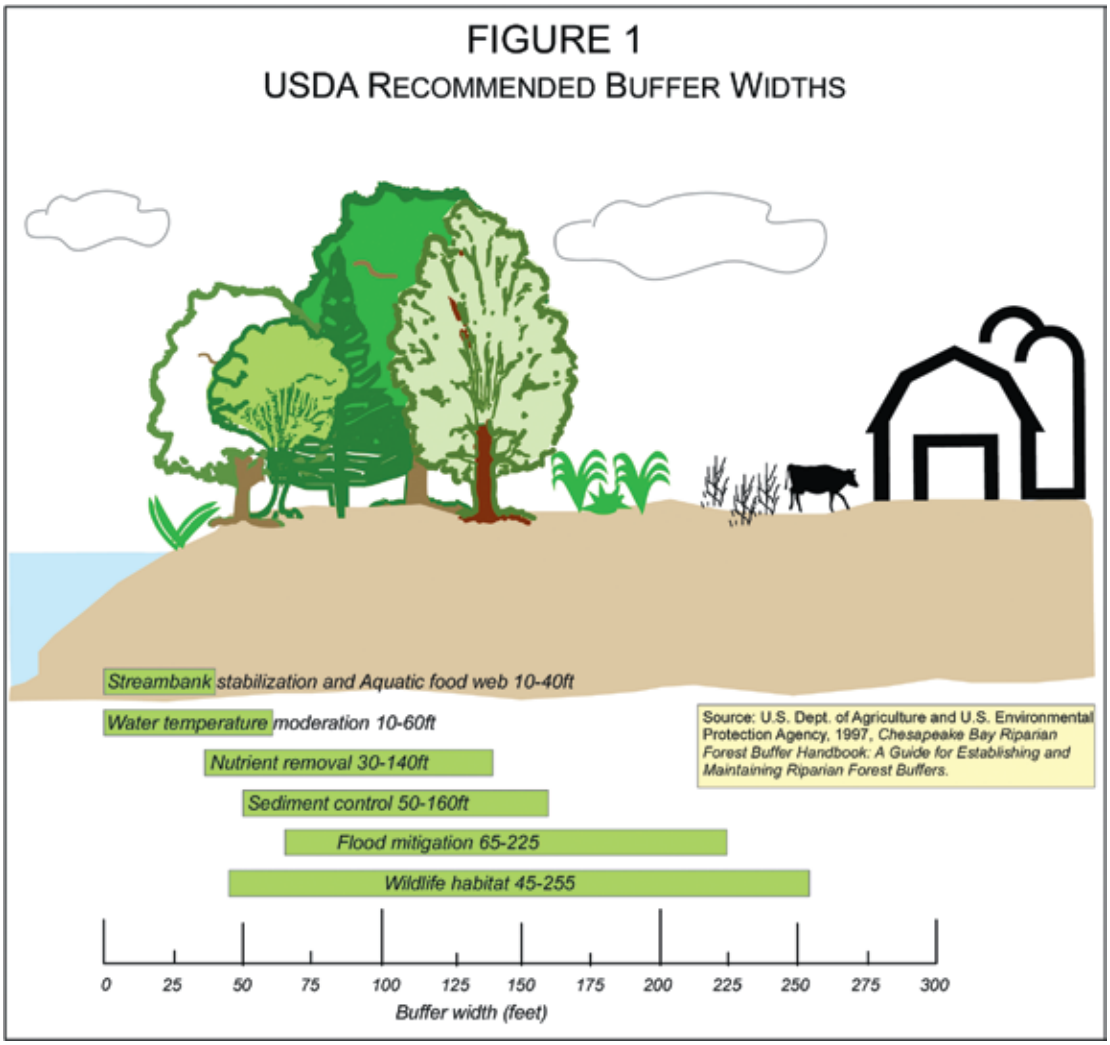
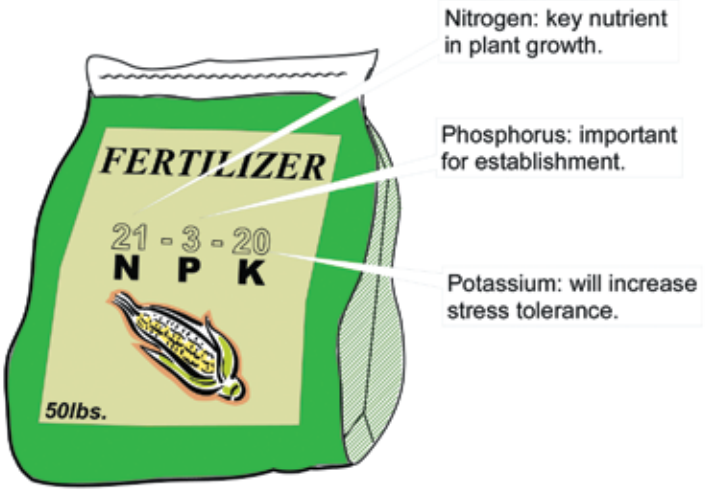


FIGURE 2

BASICS ON NUTRIENTS AND EUTROPHICATION



A "complete" fertilizer generally consists of the most commonly applied nutrients: Nitrogen (N), Phosphorus (P), and Potassium (K). It became customary to apply the three together. On land, fertilizer is very desirable for crops, gardens and lawns. However, when excessive amounts of fertilizer run off the land and enter a stream, those nutrients continue to stimulate plant growth in the water, usually in the form of algae, which results in more oxygen entering the stream for a short amount of time. As the algae continue to reproduce, they cloud the water making it difficult for larger, submerged vegetation to get light. When the plants and algae die and decompose, dissolved oxygen is removed from the water by bacteria. Lowered oxygen levels and reduced vegetation make it difficult for fish and other aquatic organisms to survive. Nutrient rich runoff will continue entering the stream, which gradually becomes a toxic mixture of nutrients and chemicals.

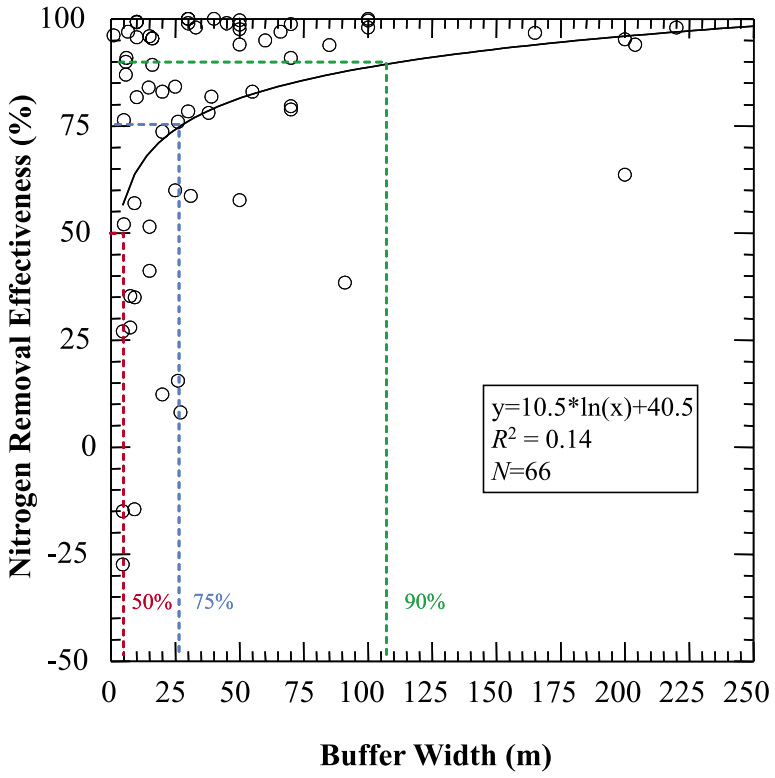
The Forest Service also states:

"The most commonly prescribed minimum buffer widths for use in water quality and habitat maintenance are approximately 75 to 100 feet."

THE NITROGEN PROBLEM: HOW IT AFFECTS WATER QUALITY AND BUFFER WIDTH

In 2005, the United States Environmental Protection Agency (EPA) published a document titled "Riparian Buffer Width, Vegetative Cover, and Nitrogen Removal Effectiveness: A Review of Current Science and Regulations". The EPA considers nitrogen one of the top pollutants in the waters of the United States and worldwide due to its widespread use and soluble nature, which allows it to move easily into shallow groundwater.

GRAPH 1



25m=82 ft., 75m=245 ft., 100m=328 ft.

Relationship of nitrogen removal effectiveness to riparian buffer width. All studies combined. Dashed lines indicate probable 50%, 75%, and 90% nitrogen removal efficiencies based on the fitted non-linear model.

Source: *Environmental Protection Agency.*

Excessive amounts of nitrogen found in agricultural and lawn fertilizers cause eutrophication (excessive plant and algae growth in a watercourse caused by elevated nutrient levels) (Figure 2). Excessive nutrients like nitrogen pollute groundwater, particularly in rural areas where shallow groundwater is used for domestic water supply. Furthermore, high levels of nitrogen in shallow groundwater may contaminate deeper layers of ground water, which is a common source for public water supply. Buffers remove nitrogen by plant uptake and by a process called denitrification, where microorganisms in the soil change nitrogen into a gas form to be released into the air.

The EPA conducted a comprehensive review of 14 comprehensive and regional reviews of forty studies with empirical data on the effectiveness of nitrogen removal in riparian buffers. Few of the studies conclude with a recommended specific width, but rather a range of widths. The width will vary according to individual site characteristics such as slope, soil type, vegetation cover type and the source of surface water drainage into the buffer. The lack of a standardized method for evaluating buffer effectiveness makes comparing the studies difficult. The EPA made generalizations on the relationship of nitrogen removal effectiveness to riparian buffer width. Graph 1 shows this relationship. The study concluded that the wider the buffer, the more effective it was at removing nitrogen.

CHOOSING WATER QUALITY AS THE OBJECTIVE IN DETERMINING WIDTH

The LVPC recognizes that riparian buffers provide animal habitat and can improve the stream environment for fish and invertebrates. Improved water quality positively affects animals, humans and the landscape. Unfortunately, there are a variety of pollutants and sediment that can enter a watercourse. In assembling model regulations for the Lehigh Valley, and based on the research provided by the EPA, the LVPC determined that writing regulations that effectively removed nitrogen from watercourses would be as equally effective in removing other pollutants and trapping sediment. Based on the research provided by the EPA, the LVPC determined that a buffer of 75 feet would remove nearly 75% of nitrogen and provide more overall water quality benefits than a 50 foot buffer, the width found in most local ordinances.

Further, the LVPC aimed to augment wetland protection by requiring a riparian buffer around wetlands. Wetlands have important filtering capabilities for collecting runoff from higher dry land before the runoff reaches streams and rivers, maintain stream flow during periods of drought, and can assist in replenishing groundwater. They also serve an important role in flood management. The holding capacity of a wetland can lessen the effects of a flooding event.

Figures 3 through 6 (pages 11-14) illustrate the LVPC model buffers applied to a watercourse with setbacks enforced and a wetland.

A NOTE ABOUT THE RIPARIAN SETBACK

The model regulations apply a 25 foot setback from the outer edge of the riparian buffer. Very few uses are permitted in this setback. Having an area of minimal or no impervious coverage allows for the overland flow of runoff to both slow down and spread out before running into the riparian buffer.

MEASURING THE BUFFER

One of the practical challenges in establishing a riparian buffer is determining the width of the buffer out in the field on a site. While municipalities can specify a fixed width in regulations, determining the boundary on a site can be a challenge given that the majority of watercourses do not flow in a perfect, straight line, and often the site has varying topography. Some parts of the watercourse may be eroded, steep or undercut, or all three may exist along the streambank. Many times, a property owner will have a buffer that will mirror the shape of the watercourse on his or her property.

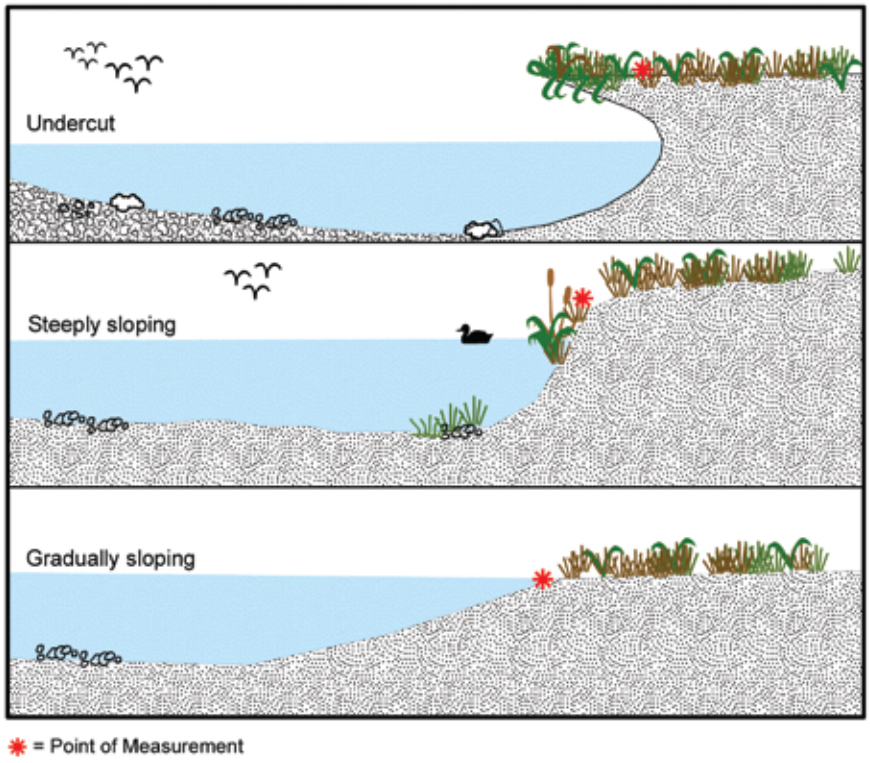
A buffer width is essentially two endpoints between the top of the streambank and an endpoint on the property perpendicular to the watercourse. The LVPC regulations define the top of the streambank as “the break in the slope between waterline and the surrounding land area.” Figure 3 (page 11) illustrates the location of the top of the bank on a variety of streambanks that one may encounter. The regulations establish an endpoint at this location (labeled Endpoint A). From this point, seventy-five feet is measured perpendicular to the watercourse for every five horizontal feet of the streambank (Endpoint B). Figure 4 (page 12) better illustrates this measurement. The regulations do not require a landowner to post the area identifying it as a riparian buffer nor require it to be dedicated to the municipality. The buffer remains in the possession of the property owner.

Conclusion

Most local buffer widths are fixed, and these buffers range in width from 50-100 feet on each side of the watercourse. Most jurisdictions arrived at their buffer width requirement by borrowing other state and local criteria, local experience and, finally, through political compromise during the buffer adoption process. The LVPC recognizes that the scientific studies conclude that a buffer wider than 75 feet provides even greater environmental

FIGURE 3

VARIOUS TYPES OF STREAMBANKS



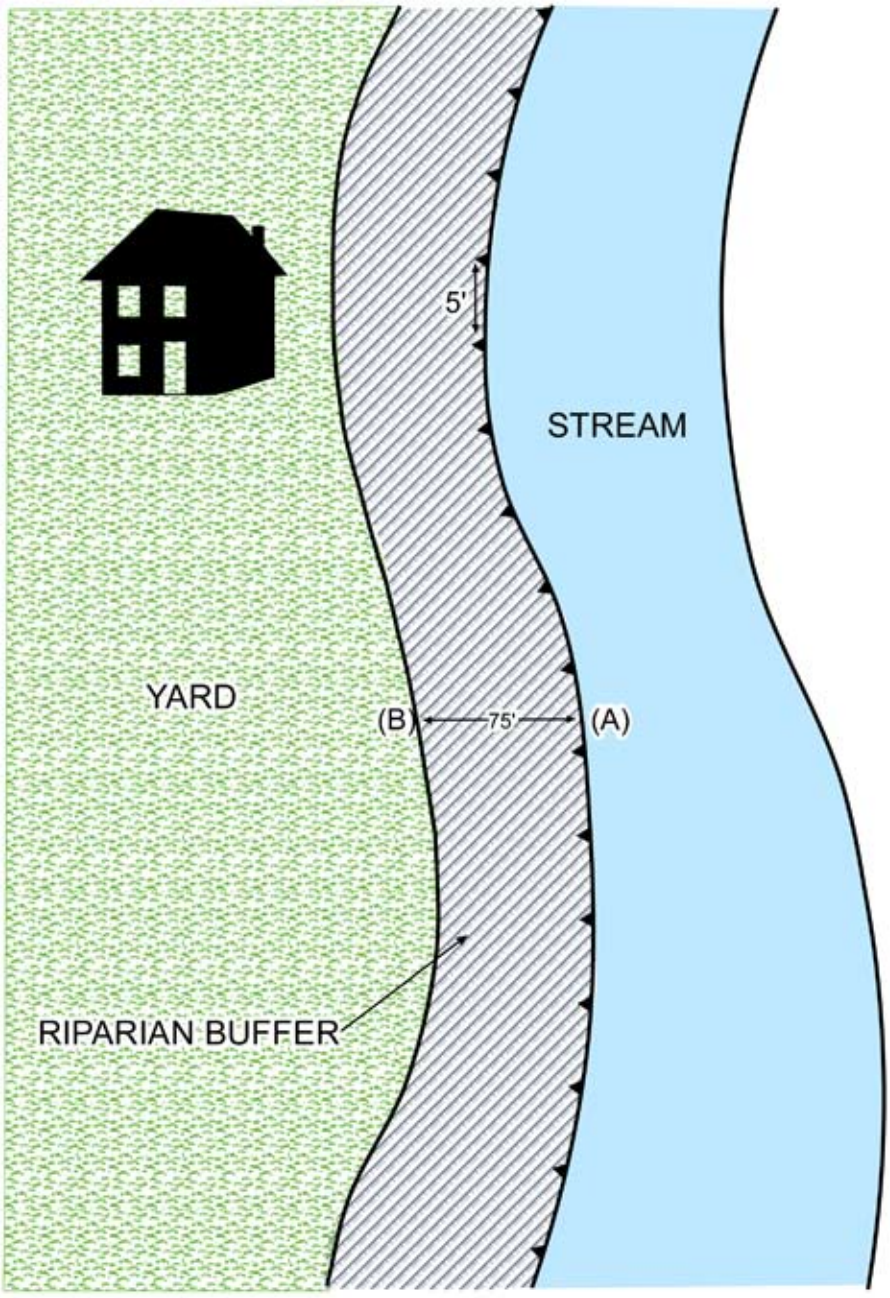
benefits. Given the breadth of the EPA review of buffer studies and the guidance provided by the NRCS and USDA, the LVPC judged that a buffer of 75 feet was beneficial to improving water quality. We believe that this width is supported by the science, acceptable to local officials, and practically enforced without the need for considerable site analysis (soil testing).

TYPE OF VEGETATION

Native trees, shrubs and plants (such as grasses, wildflowers and ferns) are the basic types of vegetation in a riparian buffer. One, two or all three types can be incorporated to create a buffer. Each type provides certain benefits. Table 1 (page 15) compares grasses, shrubs and trees for the relative level of benefits derived for different priorities. Native plants have adapted to local physical conditions such as soil, geology and climate. They require less maintenance, are substantially pest and disease resistant, and require minimal fertilization and irrigation once established. There are two excellent resources on the subject of native vegetation in Pennsylvania. The second edition of *The Plants of Pennsylvania: An Illustrated Manual* (Ann Fowler Rhoads and Timothy A. Block, 2000) identifies the nearly 3,400 species of trees, wildflowers, ferns, grasses, sedges, aquatic plants and weeds native to Pennsylvania. Another resource, *The Trees Of Pennsylvania: A Complete Reference Guide*

FIGURE 4

MEASUREMENT OF BUFFER ALONG WATERCOURSE



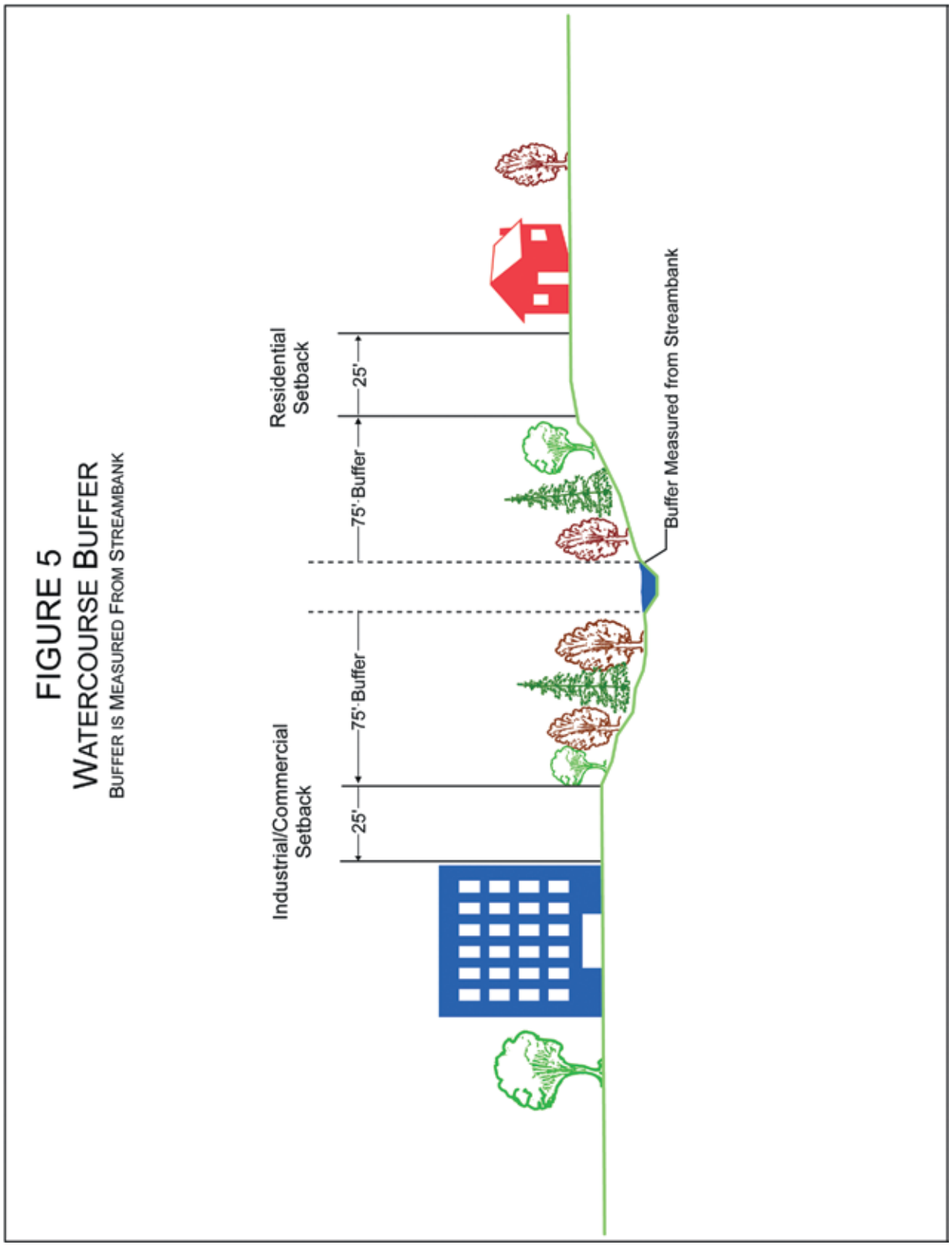


FIGURE 5
WATERCOURSE BUFFER
BUFFER IS MEASURED FROM STREAMBANK
Residential Setback
25'
75' Buffer
Buffer Measured from Streambank
Industrial/Commercial Setback
25'
75' Buffer

FIGURE 6
WETLAND BUFFER
BUFFER IS MEASURED FROM DEFINED EDGE OF WETLAND

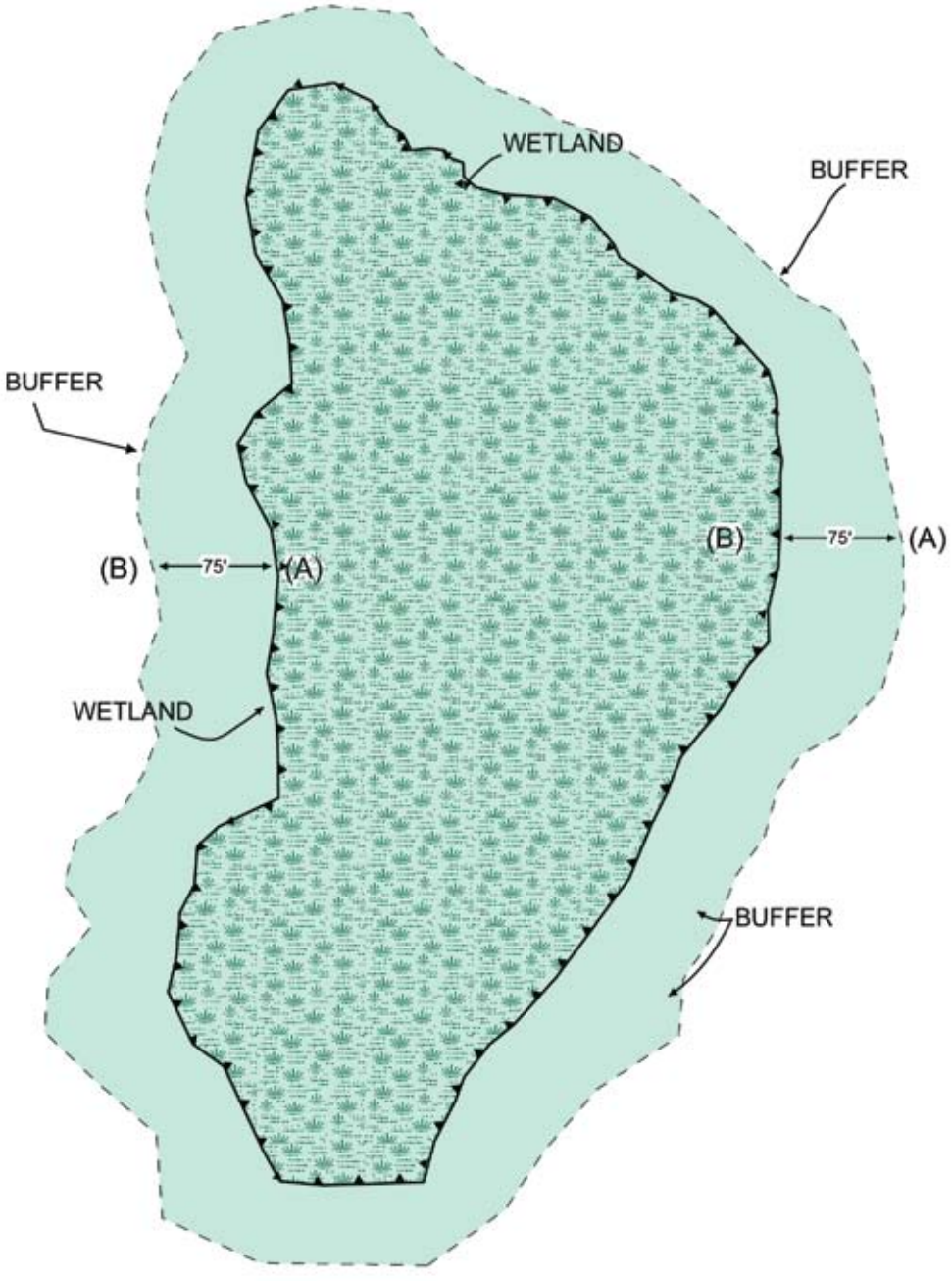


TABLE 1
RELATIONSHIP OF VEGETATION TYPE
TO RIPARIAN BUFFER EFFECTIVENESS

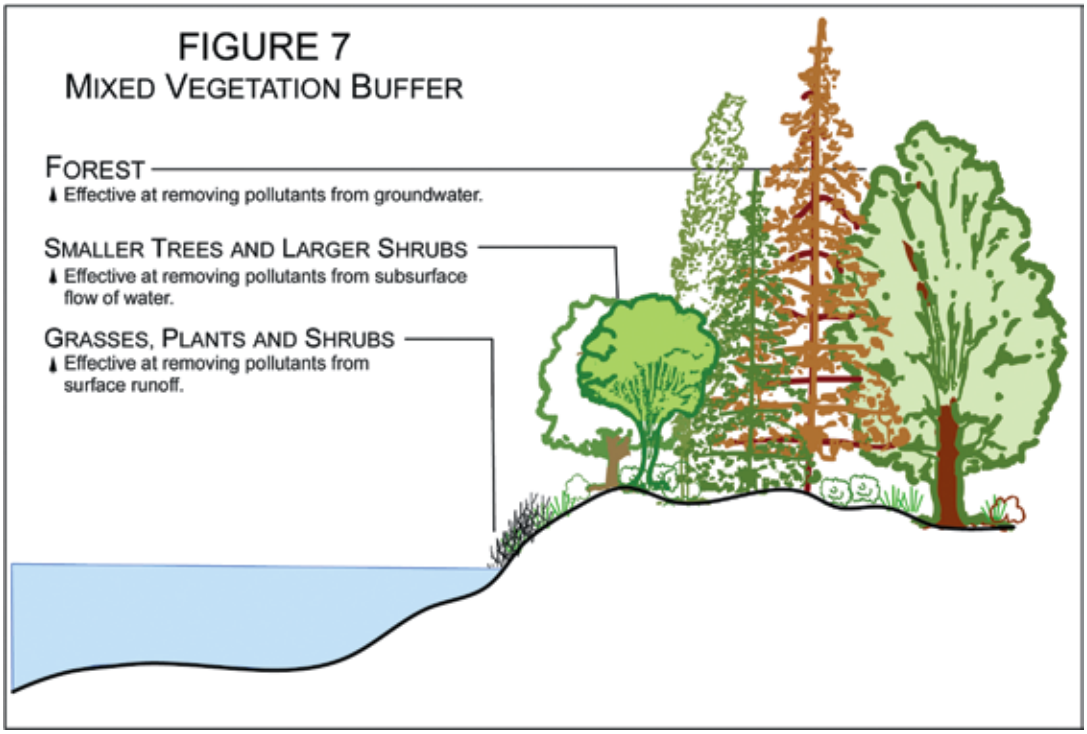
	Vegetation Type		
Benefit	**Grass**	**Shrub**	**Tree**
Stabilize bank erosion	Low	High	High
Filter sediment	High	Low	Low
Filter nutrients, pesticides, microbes			
• Sediment bound particle removal	High	Low	Low
• Soluble particle removal	Medium	Low	Medium
Aquatic habitat	Low	Medium	High
Wildlife habitat			
• Range/pasture/prairie wildlife	High	Medium	Low
• Forest wildlife	Low	Medium	High
Flood protection	Low	Medium	High
Water temperature	Low	Low	High

Source: *Natural Resource Conservation Service.*

An existing riparian buffer along the Bushkill Creek. Note the variety of vegetation.

(Fowler and Block, 2004) provides detailed descriptions and information on native trees in Pennsylvania. Appendix A of this report includes internet links to DCNR and DEP publications on native and non-native vegetation in Pennsylvania.

Riparian buffers that contain a mix of trees, shrubs and grasses are more effective at capturing pollutants than a riparian buffer that is largely one type of vegetation. Figure 7 shows how a mix of vegetation can provide water quality benefits.



Generally, grass filter strips are effective in removing sediment, while the forested buffer effectively removes nitrates. Grasses have shallower roots that slow runoff and trap sediments. Trees have a deeper root system that can trap and uptake nutrients from the groundwater and lessen erosion.

Forests provide additional functions that grasses and shrubs cannot. Trees shade the water and provide an important habitat for wildlife.

CONCLUSION

The most effective riparian buffers should include a mix of trees, shrubs and herbaceous plants native to the region.

The type of vegetation used in a riparian buffer largely depends on the intended goal or benefit of the riparian buffer. These model regulations focus on water quality. However, riparian buffers are widely known to provide a host of other benefits including the enhancement of wildlife and their habitat. If the enhancement of wildlife is a goal, consideration will need to be given to the preferred vegetation of species of wildlife in the area.

Relative to the LVPC model regulations, a buffer can be left to naturally succeed. We realize that a buffer created from natural succession will contain invasive vegetation. There is a tradeoff between having a buffer solely of native vegetation and creating an unreasonable burden on a property owner. We believe natural succession can provide a riparian buffer while minimizing the financial burden on a homeowner to plant only native plants within the buffer. The model regulations require a property owner to be responsible for the maintenance of the buffer, such as removing dead vegetation, but at no time is required to install additional plantings.

LOCAL APPLICABILITY AND ISSUES

The majority of the literature reviewed focused on the effect of riparian buffers on sites that were either in forest or agricultural land uses. Buffers can take many forms and serve their function in rural, suburban and urban

areas alike. In the rural areas of the Lehigh Valley, the main objective of riparian buffers tends to be improving water quality by filtering runoff from agricultural fields and residential yards and protecting valuable land from erosion. In urban areas, where most of the areas adjacent to the watercourse are developed, riparian buffers can also provide for aesthetics, recreation and flood control.

Quite a few communities in the Lehigh Valley were founded along major waterways as centers of commerce and industry that relied on rivers for water supply, power and the transportation of goods. As a result, buildings were sited as close as possible to the river, eliminating natural vegetation for the purpose of siting buildings or storage yards. Today, those communities look at those buildings and land as attractive sites for industrial and commercial redevelopment projects. As this redevelopment occurs, municipalities could be flexible with subdivision or zoning regulations by permitting the revegetation of the watercourse to count towards landscaping or open space requirements.

Riparian buffers will conflict with most municipal weed ordinances, which require property owners to keep lawn below a specified height at all times. Weed ordinances have been a useful tool to prevent unsightliness from poor property maintenance and to prevent hazards from vermin and fire, which were believed to be caused by unkempt vegetation. Riparian buffers are managed, but not manicured, and do not pose the hazards that weed laws are intended to address. Communities will have to examine changes to those weed ordinances to provide a reasonable, workable compromise between riparian buffer and code enforcement objectives.

Homeowners may be reluctant to have a riparian buffer on their property. In Virginia Scott Jenkins' 1994 book *The Lawn: A History of America's Obsession*, the history of how lawns were first introduced to America, became popular, and then became both a necessity and expectation for a homeowner, is examined. Our desire for a green lawn has been part of American culture for nearly 100 years. For most, we like our lawns to be a crisp, dark green, tidy and rival a manicured golf course. Riparian buffers, especially ones left to natural succession, take time to develop and are unsightly to some in comparison to the traditional lawn.

Further, homeowners may be concerned about riparian buffers becoming fire hazards, home to vermin, breeding areas for mosquitoes, and a source of pollen (allergy sufferers). In Bret Rappaport's 1993 article *As the Natural Landscape Movement Takes Root, We Must Weed Out Bad Laws; How Natural Landscaping and Aldo Leopold's Land Ethic Collide With Unenlightened Weed Laws and What Must Be Done About It*, scientific evidence and case law showed that natural landscapes such as riparian buffers do not directly create safety or health hazards. Educating homeowners about the benefits of riparian buffers and a proposed municipal buffer regulation may overcome homeowner objections and skepticism.

Evidently, regulation of riparian buffers only goes so far in practical and successful implementation on the local level. The LVPC model regulations will cover some properties, but not all. Property owners who do not infringe on the buffer area or setback are not required to plant a buffer. Buffers are not enforced retroactively. Further, it does not cover land used for agriculture, since zoning permits are not required to farm land. Consequently, there will be areas along a watercourse that have no riparian buffers. The solution to this problem is education and advocacy. A municipality could partner with conservation districts, land trusts, conservancies, and other organizations that specialize in stream restoration and promoting the positive benefits of a buffer. Municipalities and non-profit organizations could apply for restoration funding from state programs or acquire the land needed for a buffer through conservation easements or acquisition.

We recognize there is disagreement over the optimal width for riparian buffers. Three factors influence ideal buffer widths: slope, soil type, and vegetation mix. A buffer with a steep slope needs to be wider because the water will rush over it faster, giving it less time to be absorbed. The type and density of soil also affects the speed of absorption. The type of vegetation in the buffer is perhaps most important--buffers with a wide variety of

vegetation types (trees, grasses, bushes, etc.) will absorb more nutrients than buffers with just one type of vegetation. It is impossible to generalize ideal buffer zone widths due to the individual needs of specific streams.

Regional organizations were asked to critically review the proposed regulations and recommend changes as necessary. Review comments were duly considered and incorporated, as appropriate, into a revised Guide.

The LVPC believes that the recommendations in this Guide are based on the best available science. Further, one of the primary objectives that the staff had in the development of the Guide was to ensure that it was science based. Staff resource limitations would not allow the LVPC to conduct a Lehigh Valley-based scientific study to comprehensively evaluate how successful recommended buffers have been in protecting riparian areas.

We believe, after a review of the science, that a 75-foot buffer is the minimum standard to achieve water quality benefits, regardless of the method of buffer measurement or site specific topography. We realize the best available science that was reviewed in the preparation of this model regulation can suggest buffers of smaller or larger widths. We believe local issues related to practical enforcement of buffer regulations and the balance of enviromental benefit versus the financial burden on a homeowner are reasonable justifications for the departure from the best available science.

The LVPC recognizes that there are locations where it will be challenging to provide the “default” buffer width recommended by the Guide. It is anticipated projects involving development, or redevelopment, with existing structures in the riparian buffer would not be able to meet the minimum riparian buffer width. The intent of this Guide is not to place unreasonable restrictions on these projects; however, it is also true that the functions and values of riparian areas within urban areas deserve no less protection than elsewhere in the Lehigh Valley. In the end, if a municipality feels that buffer recommendations developed through application of this Guide are impractical, the LVPC encourages municipalities to adopt riparian buffer regulations with narrower widths rather than having no regulations at all.

LEHIGH VALLEY RIPARIAN BUFFER EXAMPLES

An example of a riparian buffer that could be installed for residential properties along a watercourse. Note that there appears to be no installation of "new" plants, but rather is an area of the site no longer mowed.
Photo courtesy of Frederic H. Brock.

An example of an existing property where the riparian buffer has been removed. This is the 13th Street Silk Mill in Easton. The redevelopment of this site could reinstall the riparian buffer as part of the project.
Photo courtesy of Easton Redevelopment Authority.

An example of a riparian buffer with a variety of vegetation. Note how the trees shade this section of the Bushkill Creek.
Photo courtesy of Michael N. Kaiser.

An example of a predominately forest riparian buffer. The mature trees provide two very important benefits. One, shading the water during the summer months, and two, preventing soil erosion on the steeply sloped banks.
Photo courtesy of Melanie A. Martin.

A NOTE ABOUT THE MODEL REGULATIONS

The model regulations are designed as a section in a zoning ordinance. By including it in the municipal zoning ordinance, a municipality can regulate when a buffer is required and the uses permitted within the buffer. The model regulations are for the purpose of providing guidance to Lehigh Valley municipalities interested in regulating riparian buffers in their communities. They are provided here only for review, reference and example purposes. This is not a legal document or the provision of legal advice. For the model regulations to be valid and legally enforceable, they may need to be modified and reviewed by the municipality.

Please note that the LVPC and DEP approaches to riparian buffer regulation are different in approach. The passage of the DEP riparian buffer regulations means there will be an inevitable overlapping jurisdiction of buffers in some Lehigh Valley municipalities. For situations where the amended Chapter 102 regulations (see commentary on page 4) require a 150 foot riparian buffer, the LVPC recommended 75 foot buffer would be satisfied. However, we do not recommend a municipality wholly rely on the Chapter 102 regulations for riparian buffer protection as it does not provide "universal" coverage of all watercourses. The Chapter 102 required riparian buffers only cover approximately 30% of the watercourses in the Lehigh Valley, and only then for development activities involving one (1) acre of earth disturbance. The LVPC model regulation outlined below provide a broader degree of coverage.

MODEL REGULATIONS

A. PURPOSE

It is the purpose of this article to establish requirements for the establishment, maintenance and preservation of riparian buffers, as defined herein, to protect the watercourses and wetlands in (Municipality) otherwise not regulated or superseded by Section 102 of the Pennsylvania State Code.

B. AUTHORITY

This article is established in accordance with the Pennsylvania Constitution, Art. 1, Sec. 27 (the "Environmental Rights Amendment"), and Sections 301(a)(6), 503(2)(v), 603(c)(7), 605(2)(ii, iii, and vii), 606, 609.1c(3)(4), 916.1(c)(5)(iii and iv) of the PA Municipalities Planning Code, 53 P.S. § 10101 et seq.

C. APPLICABILITY

1. This article shall apply to all lands within (Municipality) that are adjacent to a watercourse or wetland.
2. This article shall apply to any subdivision plan, zoning permit or building permit not included in Section C.3 after the effective date of this article.
3. This article shall not apply to any application after the article's effective date or to a development or land disturbance that:
   a. Is covered by an approved plan in accordance with (Municipality) Subdivision and Land Development Ordinance; or
   b. Is covered by a current, executed public works agreement; or
   c. Is covered by a valid, unexpired (Municipality) Zoning Heard Board (ZHB) approval or building permit; or
   d. Is a lot line adjustment plan; or
   e. Is a zoning or building permit for accessory structures or improvements to existing primary or accessory structures that do not encroach upon the riparian buffer zone. [1]

[1] The intent of the regulations is to restrict development inside the riparian buffer zone and not the entirety of the site. Without specific exemptions, confusion can arise as to whether a property owner is required to have a riparian buffer on his property regardless of where development occurs on the property.

D. GENERAL DESIGN STANDARDS

1. For sites where a riparian buffer does not exist, it is acceptable to allow the buffer to succeed naturally through a "no-mow" area where native vegetation is able to establish itself naturally.
2. The riparian buffer shall be:
   a. Seventy-five feet from the top of the streambank of a watercourse,
   b. Seventy-five feet from the outer edge of a wetland.
3. Principal structures and areas of impervious coverage, unless permitted in Section E of this article, shall be set back from the outer edge of the riparian buffer a minimum of twenty-five feet.
4. It shall be lawful, but not required, to supplement the riparian buffer with planting of native vegetation. Native plants can include ferns, shrubs and trees. Native vegetation (as defined in *The Plants of Pennsylvania: An Illustrated Manual*, (Ann Fowler Rhoads and Timothy A. Block, June 2000 or current version thereof) and *The Trees of Pennsylvania: A Complete Reference Guide* (Ann Fowler Rhoads and Timothy A. Block, May 2004 or current version thereof) must be used in such efforts. Any supplemental plantings shall be installed to allow for proper plant growth and maintenance.

E. PERMITTED USES/ACTIVITIES WITHIN THE RIPARIAN BUFFER

1. Roads, bridges, trails, storm drainage, stormwater management facilities and utilities are permitted within the buffer provided that an alternatives analysis has clearly demonstrated that no other feasible alternative exists and that minimal disturbance will take place.
2. Stream restoration projects and activities approved by (Municipality).
3. Horticulture practices used to maintain the health of vegetation in the riparian buffer.
4. Removal of non-native vegetation or trees in danger of falling, causing damage to dwellings or other structures, or the blockage of a watercourse.
5. Agricultural uses existing at the time of adoption of this article with best management practices.

F. PROHIBITED USES/ACTIVITIES WITHIN THE RIPARIAN BUFFER

1. All structures.
2. Impervious coverage unless permitted in Section E.
3. Creation of new lawn areas.[2]
4. Lawn care service.
5. Planting of non-native vegetation.
6. Removal, burning or mowing of native vegetation.[3]
7. Soil disturbance, inclusive of grading, stripping of topsoil, plowing, cultivating or other practices.
8. Septic systems.
9. The production, storage or use of a substance or material, underground or aboveground, that is buoyant, flammable, explosive, or injurious to property, water quality, or human, animal, plant, fish or aquatic life.
10. The production, storage or use of explosives.

---

[2] Lawn grass is shallow-rooted and provides very little in the way of erosion protection. Without vegetation having a deeper, well defined root structure, lawn along the streambank cannot withstand runoff, and erosion will occur.

[3] Root growth stops when the above-ground portion of a plant is repeatedly removed. The roots die back, reducing plant vigor. The plants become weak, smaller in size and are more susceptible to bank erosion. Repeated cutting eventually kills trees and shrubs. Trees and shrubs, unlike grass, build on existing growth, and are not able to continually come back from the roots. The growing points of trees and shrubs are located on the tips of the branches, unlike grasses that have roots as growing points.

11. The storage or disposal of materials used for snow and ice control including sand, salt and other deicing chemicals.
12. Sanitary landfills, dumps, junk and salvage yards, and outdoor storage of vehicles and/or materials.
13. The storage or disposal of any soil, loam, peat, sand, gravel, rock, or other mineral substance, refuse, trash, rubbish, debris, or dredged/excavated spoil.
14. Draining, excavating, or dredging, or removal or relocation of loam, peat, sand, gravel, soil, rock, or other mineral substance, except as accessory to work permitted as of right or by special permit.
15. Manure storage facilities and manure stockpiles.
16. The maintenance, housing or grazing of animals.

G. PERMITTED USES WITHIN THE RIPARIAN BUFFER SETBACK

Lawns, lawn care service, accessory structures, roads, driveways, utilities and passive outdoor recreation and education facilities are permitted within the setback area provided any structure associated with such uses is located outside the riparian buffer.

H. BOUNDARY DETERMINATION

The developer, applicant, property owner or designated representative shall be responsible for the initial width determination of the riparian corridor and identifying this area on any plan that is submitted to the municipality for subdivision, land development, or other improvements that require plan submissions or permits. This determination shall be subject to review by the (Municipality) Zoning Officer.[4]

I. VARIANCES

Applications filed with the ZHB shall contain the basis for the appeal of the Zoning Officer or Engineer's decision and a description of the relief requested. Plans submitted shall be prepared by a licensed professional acceptable to the ZHB and shall include the following:

1. Location of streams, ponds or other water resources on the property to be developed;
2. Species, location and size of trees within the riparian buffer setback;
3. Location of any proposed building or structure; and
4. Any other information deemed relevant by the ZHB.

In addition to these standards and criteria, the following shall be considered by the ZHB in rendering affirmative decisions where applicable:

1. A showing of good and sufficient cause.
2. Whether strict application of this article would deny the applicant reasonable use of the property, or whether the article would have severe impact and would render the property unusable or unsuitable for development.
3. Whether plan modifications or conditions of approval can achieve conservation objectives of this article.

[4] There are generally two approaches to regulating the width of riparian buffers. A fixed width, usually measured from the streambank or high water mark, is a popular method for ease of implementation and administration. A buffer width that varies depending on natural or built features adjacent to watercourses can allow for steep slopes or unique features of a site. However, this approach requires site visits by surveyors or other qualified persons in order to measure slopes or identify sensitive natural features. The LVPC regulations designate a municipal official to determine the riparian buffer area on a property using a fixed width of seventy-five feet from the defined edge of a watercourse or wetland.

4. That the relief granted is the minimum necessary and does not conflict with any municipal, state or federal regulations.

J. DEFINITIONS

Flood, One Hundred Year. A flood that has a 1% chance of being equaled or exceeded in any given year. Over a long period, it is a flood that is likely to occur, on average, once for every 100 years of record.

Floodplain Area. A relatively flat or low land area which is subject to partial or complete inundation from an adjoining or nearby stream, river or watercourse; and/or any area subject to the unusual and rapid accumulation of surface waters from any source.

Lawn. An area maintained with grass adjacent to a structure. The term does not include athletic fields, cemeteries, golf courses, fields, parks and public utility or highway right-of-ways.

Lawn Care Service. Providing services for lawn upkeep including fertilizing, mowing or performing other lawn treatment services.

Native Vegetation. Vegetation that has arrived and inhabited an area naturally, without deliberate assistance by man.

Natural Succession. The process by which a habitat or environment naturally rejuvenates itself.

Non-native Vegetation. Vegetation reproducing outside its native range and outside cultivation that disrupts naturally occurring native vegetation by altering structure, composition, natural processes or habitat quality.

Passive Outdoor Recreation. Recreational activities that do not involve a developed site, and have minimal impact on natural resources.

Riparian Buffer. An area of trees and other vegetation adjacent to a watercourse or wetland that forms a transition area between the aquatic and terrestrial environment, and designed to intercept runoff for the purpose of mitigating the effects of nutrients, sediment, organic matter, pesticides, or other pollutants before entry into surface waters and to provide control of water temperature.

Riparian Buffer Setback. The portion of a site where structures and uses of land are to be minimized expressly for the purpose of preserving and protecting a riparian buffer.

Streambank. The break in the slope between the waterline of a watercourse and the surrounding land area.

Watercourse. A watercourse is a channel or conveyance of surface water having defined bed and banks, whether natural or artificial, with perennial or intermittent flow. Manmade swales, constructed specifically for stormwater management purposes, are excluded from this definition.

Waterline. The highest water level of a watercourse which is common and usual.

Wetland. All lands regulated as wetlands by the Pennsylvania Department of Environmental Protection and/or the United States Army Corps of Engineers. Such areas are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions, including swamps, marshes, bogs and similar areas.

BIBLIOGRAPHY

Baltimore Co., MD. Buffer Protection and Management Ordinance. http://www.epa.gov/OWOW/NPS/ordinance/language.htm

Belt, George H., Jay O'Laughlin, and Troy Merrill. 1992. Design of Forest Riparian Buffer Strips for the Protection of Water Quality: Analysis of Scientific Literature. Idaho Forest, Wildlife and Range Policy Group, Report No. 8. http://www.uidaho.edu/cfwr/pag/pagr8p7.html.

Broadmeadow, S. and Nisbet, T.R. 2004. The effects of riparian forest management on the freshwater environment: a literature review of best management practice. Hydrology and Earth System Sciences, 8(3), 286-305.

Chesapeake Bay Committee. Chesapeake Bay Riparian Handbook: A guide for establishing and maintaining riparian forest buffers. http://www.chesapeakebay.net/pubs/subcommittee/nsc/forest/handbook.htm

Connecticut Association of Wetland Scientists. Jontos, R. 2004. Vegetative buffers for water quality protection: an introduction and guidance document. http://www.ctwetlands.org/Draft%20Buffer%20Paper%20Version%201.0.doc

Fischer, R.A. and Fischenich, J.C. 2000. Design recommendations for riparian corridors and vegetated buffer strips. U.S. Army Engineer Research and Development Center, Environmental Laboratory. Vicksburg, MS.

Maryland Department of Natural Resources Forest Service. Riparian forest buffers: function and design for protection and enhancement of water resources. http://www.dnr.state.md.us/forests/publications/buffers.html

Mayer, Paul M., S.K. Renolds Jr., T.J. Canfield. October 2005. Riparian Buffer Width, Vegetative Cover and Nitrogen Removal Effectiveness: A Review of Current Science and Regulations. Prepared for U.S. Environmental Protection Agency (EPA) Office of Research and Development National Risk Management Research Laboratory. EPA/600/R-05/118.

National Agroforestry Center. Riparian forest buffers. http://www.unl.edu/nac/riparian.html

Rappaport, B., "As the Natural Landscape Movement Takes Root, We Must Weed Out Bad Laws; How Natural Landscaping and Aldo Leopold's Land Ethic Collide With Unenlightened Weed Laws and What Must Be Done About It", *26 J. Marshal L. Rev. 865*, 1993

U.S. Army Corps of Engineers. 1991. Buffer strips for riparian zone management. Waltham, MA.

USDA Natural Resources Conservation Service. Buffers for conservation in New Hampshire: http://www.nh.nrcs.usda.gov/features/Buffers/what_buffers.html

Welsch, D.J. 1991. Riparian forest buffers: function and design for protection and enhancement of water resources. USDA Forest Service, NA-PR-07-91. http://www.na.fs.fed.us/spfo/pubs/n_resource/buffer/cover.htm

Wenger, S. 1999. A review of the scientific literature of riparian buffer width, extent and vegetation: http://outreach.ecology.uga.edu/tools/buffers/lit_review.pdf

APPENDIX A

Additional Resources on Native and Non-native Vegetation

Places

Bowman's Hill Wildflower Preserve, Washington Crossing Historic Park, PO Box 685, New Hope, PA 18938-0685, Tel (215) 862-2924, Fax (215)862-1846, Native plant reserve, plant sales, native seed, educational programs, www.bhwp.org

Department of Conservation and Natural Resources; Bureau of Forestry; PO Box 8552, Harrisburg, PA 17105-8552, Tel (717)787-3444, Fax (717)783-5109, Invasive plant brochure; list of native plant and seed suppliers in PA; list of rare, endangered, threatened species.

Morris Arboretum of the University of Pennsylvania; 9414 Meadowbrook Avenue, Philadelphia, PA 19118, Tel (215)247-5777, www.upenn.edu/morris, PA Flora Project Website: Arboretum and gardens (some natives), educational programs, PA Flora Project, www.paflora.org

Pennsylvania Native Plant Society, 1001 East College Avenue, State College, PA 16801 www.pawildflower.org

Western Pennsylvania Conservancy; 209 Fourth Avenue, Pittsburgh, PA 15222, Tel (412)288-2777, Fax (412) 281-1792, www.paconserve.org

Other Internet Sites

Lady Bird Johnson Wildflower Center, www.wildflower.org

The New England Wildflower Society, www.newfs.org/index.html

U.S. Environmental Protection Agency, Green Landscaping with Native Plants, www.epa.gov/greenacres/

Books

Bir, Richard. *Growing and Propagating Showy, Native Woody Plants*. University of North Carolina Press. ISBN# 0-8078-4366-0

Dirr, M.A. 1990. *Manual of Woody Landscape Plants*, 4 ed. Stipes Publishing Co; 10-12 Chester St; Champaign, IL 61820. ISBN# 0-87563-347-1

Rhoads, A.F. and Klein, W.M. 1993. *The Vascular Flora of Pennsylvania, Annotated Checklist and Atlas*. American Philosophical Soc.; 104 S. Fifth St.; Philadelphia, PA 19106. ISBN# 0-8122-3535-5

Rhoads, A.F. and Block, T.A. 2000. *The Plants of Pennsylvania, An Illustrated Manual*. Philadelphia: University of Pennsylvania. ISBN# 0-8203-1851-5

Source: Pennsylvania Department of Conservation and Natural Resources. http://www.dcnr.state.pa.us/forestry/wildplant/native.aspx