

Adams County, Pennsylvania



Riparian Forest Buffer Protection

A Guide for Municipal Officials &
Citizens of Adams County

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Existing riparian forest buffer along Marsh Creek

Introduction



In February of 2010, the Adams County Commissioners adopted the *Adams County Greenways Plan* as an amendment to the County Comprehensive Plan. The Greenways Plan builds upon the concept of a countywide network of greenways introduced in the County Comprehensive Plan (1991) and again in the Parks, Recreation, and Open Space Plan (1997). One of the key components in establishing a county-wide greenway network is through the preservation of land along waterways for active, passive, and conservation uses. The Greenways Plan provides recommendations to accomplish this goal. These recommendations were summarized into an Action Program, which serves as a guide to implement the Greenways Plan. Several recommendations involve the idea of establishing riparian buffers and conserving Adams County's important natural areas and habitats, as well as educating the public on the value of conserving land and water resources.

The *Riparian Buffer Protection* guidebook was collaboratively developed by the Adams County Office of Planning & Development and the Adams County Conservation District as an initial step in educating the municipalities and citizens of Adams County about the benefits of riparian buffers. This guide explains what buffers are and, if there is interest, how municipalities and individual landowners can begin to establish and protect riparian buffers.



What are Riparian Buffers?

Riparian areas are the lands located along watercourses and water bodies, such as floodplains and stream banks. These productive streamside landscapes have high ecological and economic values. In their natural, forested state, riparian areas provide habitat for fish and wildlife. These areas also help control stream stability, flow, and water quality.

For the purpose of this document, these vegetated streamside forests will be referred to as riparian forest buffers. Forest buffers are recognized as the most beneficial type of stream buffer because of their ability to improve water quality, while protecting or restoring streamside ecosystems. These riparian forest buffers also serve as highly effective filters. They can reduce pollution from adjacent land uses by filtering the runoff, as well as decrease the amount of pollutants in an already impaired stream. Riparian forest buffers reduce floodwater velocity and also provide shade, temperature control, and sources of food for many aquatic species.

When adjacent land uses are significantly different, or have the potential for conflict, it is common to create a buffer between them. Riparian buffers serve as a buffer between developed or disturbed land and a stream. As the amount of nutrients, chemicals, sediment, and runoff from adjacent land uses increase, so does the importance of buffers.

The USDA Forest Service estimates that over one-third of Pennsylvania's streams and rivers have experienced conversion or degradation of adjoining buffered areas. This can result in adverse effects on the quality of water and aquatic habitats, which are linked in part to contamination from nutrients, sediment, animal waste, and other pollutants associated with agricultural and urban runoff.



The Pennsylvania Department of Environmental Protection (DEP) has defined a **Riparian Forest Buffer** as:

“a type of riparian buffer that consists of permanent vegetation that is predominantly native trees and shrubs 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”

The Executive Council of the Chesapeake Bay Program has defined a **Riparian Forest Buffer** as:

“an area of trees, usually accompanied by shrubs and other vegetation that is adjacent to a body of water and which is managed to maintain the integrity of stream channels and shorelines, to reduce the impact of upland sources of pollution by trapping, filtering, and converting sediments, nutrients, and other chemicals, and to supply food, cover, and thermal protection to fish and other wildlife”

Functions and Benefits of Riparian Buffers



- ☒ Stabilize and protect stream channels
- ☒ Provide habitat and food for wildlife and aquatic species
- ☒ Reduce fluctuations in stream temperature
- ☒ Provide temporary storage and gradual conveyance of floodwater to the stream and water table
- ☒ Slow the velocity of stormwater runoff
- ☒ Reduce the level of downstream flooding
- ☒ Filter and store sediment from erosion in the watershed
- ☒ Filter and trap excess nutrients and pollutants from overland runoff of fertilizers, eroded soils, ag operations, etc.
- ☒ Filter and trap nutrients and sediment in the stream
- ☒ Improve air quality
- ☒ Reduce noise and odor



Leaf Food
Leaves fall into a stream and are trapped on woody debris (fallen trees & limbs) and rocks where they provide habitat for small bottom dwelling creatures (such as insects, amphibians, crustaceans & small fish) which are critical to the aquatic food chain.

Filtering Runoff
Rain and sediment that runs off the land can be slowed and filtered in the forest, settling out sediment, nutrients, and pesticides before they reach streams. Infiltration rates 10-15 times higher than grass turf and 40 times higher than a plowed field are common.

Canopy and Shade
The leaf canopy provides shade that keeps the water cool, retains dissolved oxygen, and encourages the growth of diatoms, beneficial algae, and aquatic insects. The canopy improves air quality by filtering dust from wind erosion, construction, or farm machinery.

Fish/ Wildlife Habitat
Wooded stream corridors provide the most diverse habitats for fish and other wildlife. Woody debris provides cover for fish while preserving the stream habitat over time. Forest diversity is valuable for birds.

Nutrient Uptake
Fertilizers and other pollutants that originate on land are taken up by tree roots. Nutrients are stored in leaves, limbs, and roots instead of reaching the stream. Through a process called "denitrification" bacteria in the forest floor convert harmful nitrate to nitrogen gas which is released into the air.

Flat Run

Buffer Descriptions in Different Landscapes



Riparian buffers are not limited to rural locations. They may be found in different land use settings, including: Forested, Agricultural, Suburban/ Developing, and Urban Landscapes.

Forested Landscape: The riparian area of forested land is that portion of forest closest to the water. When the landscape is managed for wood products, this area is typically referred to as a *streamside management zone (SMZ)*.

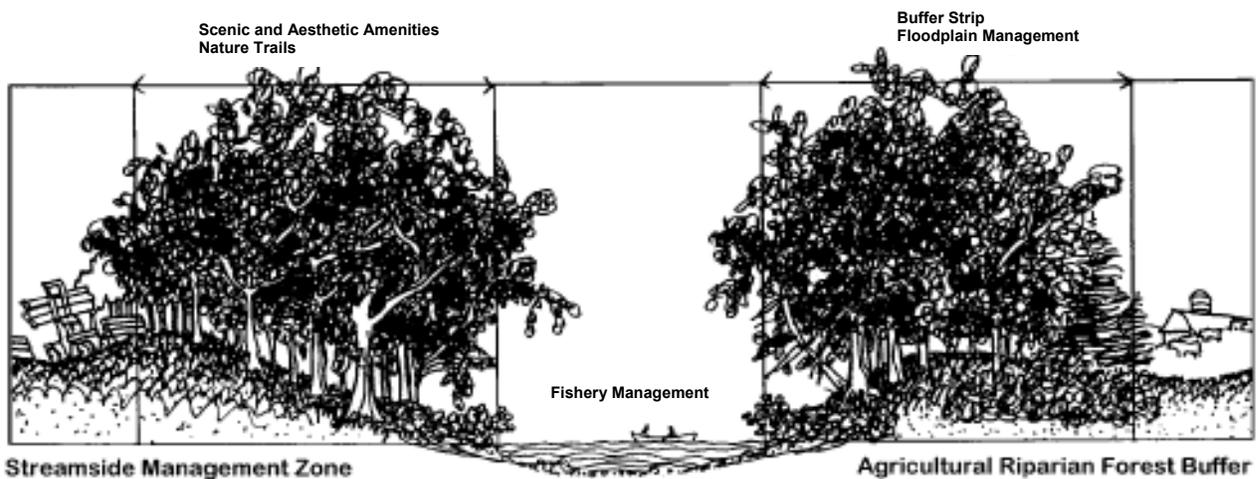
Activities related to forestry are generally considered to be low impact land uses. If the land is managed for wood products (silviculture), composition of the SMZ commonly consists of an assortment of native species. Widths may vary from 25 feet to more than 300 feet, depending on slope or biological considerations. The objective of maintaining riparian forest buffers in forested landscapes is focused on water quality protection and habitat concerns. A properly managed riparian forest can provide forest products while protecting the stream, water quality, and habitats.

These landscapes can be found along many of the streams of Michaux State Forest in Franklin Township and Hamiltonban Township.

Agricultural Landscape: In agricultural settings, riparian forest buffers are the areas of trees and vegetation which separate cropland or pasture from a body of water or groundwater recharge area. These areas serve as the zone which mitigates sediment, nutrients, and chemicals that may leave the cropland or pasture through surface water runoff or subsurface flow. This zone buffers the stream from water quality impacts of agricultural land use and on-lot septic systems found in rural areas. Riparian forests in agricultural areas may also be managed as woodlots, recreational open space, or wildlife habitat.

Riparian forests in agricultural landscapes have often times been cleared on farms that are managed for livestock, so restoration may be needed in some areas. These buffers provide shade, improve water quality for down stream uses, and restore stream habitat.

Examples of riparian forest buffers in an agricultural setting can be seen along Marsh Creek in Cumberland Township and Freedom Township.

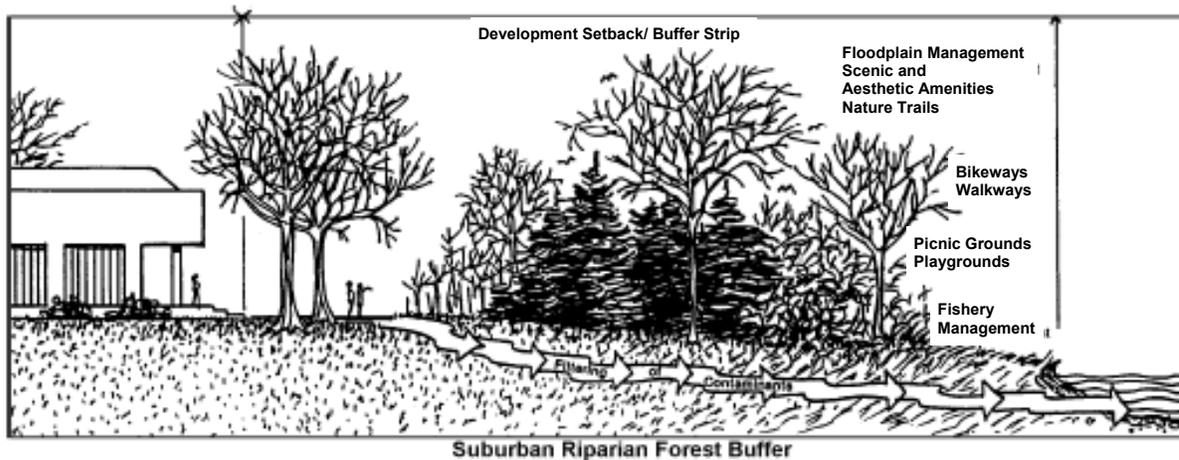


Source: The Chesapeake Bay Riparian Handbook, USDA



Suburban/ Developing Landscape: The suburban, or developing landscape, riparian buffer can be characterized by corridors of forests or woodlands bordered by parks, roadways, lawns, and structures. This landscape is more commonly found in Adams County. The challenge in this developing landscape is to retain existing riparian buffers, while planning how they can be sustained in the future. Suburban riparian corridors provide the natural function of sediment filtering, infiltration, temperature moderation, and wildlife habitat, as well as noise control, screening, and aesthetics. They can protect water quality by treating nutrients from road runoff and lawn fertilizers that may be washed away during a storm. Riparian buffers also contribute to higher property values.

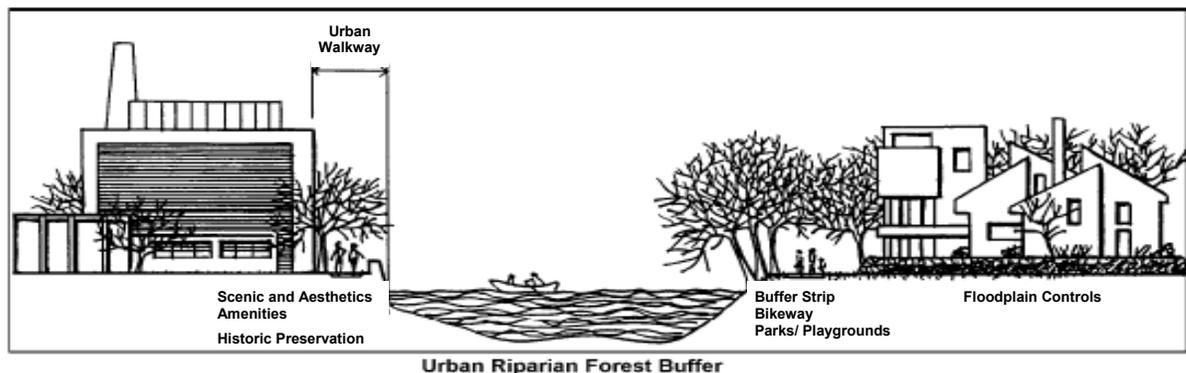
Tom's Creek in Carroll Valley Borough is an example of a developing landscape.



Source: The Chesapeake Bay Riparian Handbook,

Urban Landscape: Riparian buffers located in an urban landscape are usually more narrow or highly irregular in extent or distance. They are often used as stormwater management facilities in conjunction with wet ponds or stream erosion control. They provide refuge for birds and other wildlife and recreation opportunities for humans through the accommodation of streamside trails. While not as common in Adams County, there are borough settings where this type of buffer exists and where protection would be beneficial.

Areas along the Conewago Creek in East Berlin and Arendtsville are appropriate for establishment or expansion of riparian buffers.



Source: The Chesapeake Bay Riparian Handbook, USDA

Determining an Appropriate Buffer Width



Determining the width of riparian buffers depends on the purpose of the buffer. Many studies have been conducted analyzing the effectiveness of buffers. Unfortunately, a consensus has not been reached on an “ideal” buffer width to achieve the greatest level of protection or how to best delineate and manage a buffer.

One of the most important factors in determining the effectiveness of a buffer is its size or width. Site specific variables should also be taken into consideration. To determine a minimum buffer width, set several priorities to attain the desired set of functions. The US Forest Service recommends the following minimum width ranges, based on specific functions of buffers. The illustration below also provides a generalized range of minimum widths to achieve specific objectives.

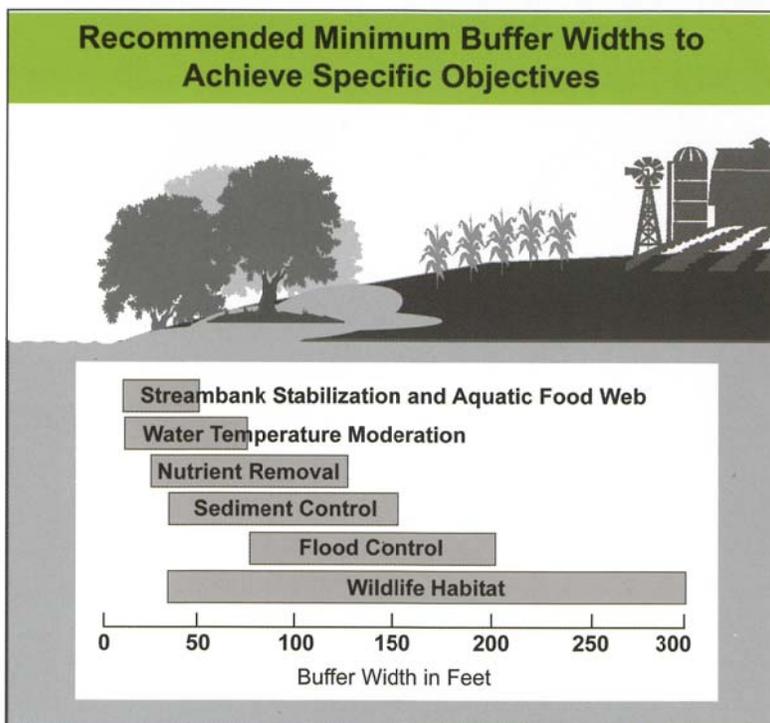
Buffer Width Ranges for Meeting Specific Objectives

-  Streambank Stabilization and Aquatic Food Web Processes: 10' - 50'
-  Water Temperature Moderation: 10' - 60'
-  Nutrient Removal: 30' - 140'
-  Sediment Control: 40' - 155'
-  Flood Control: 60' - 200'
-  Wildlife habitat: 40' - 300'

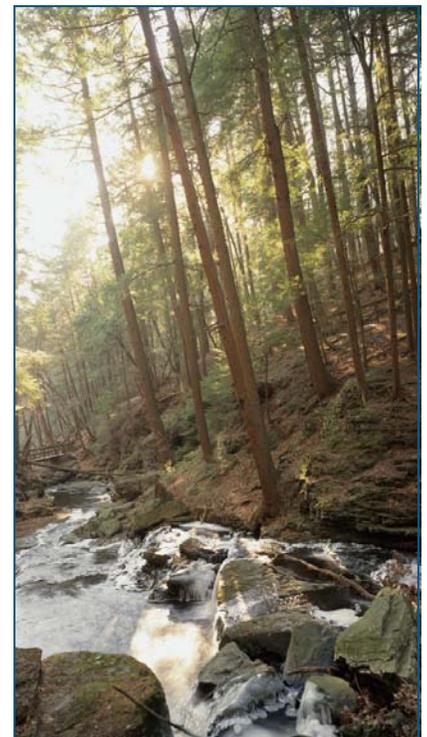
Four criteria are generally discussed when determining the adequate width of riparian buffers for protection of streams. They include:

1. Existing or potential value of the resources to be protected
2. Site, watershed, and buffer characteristics
3. Intensity of adjacent land use
4. Specific water quality and/ or habitat functions desired

The Chesapeake Bay Riparian Handbook



Virginia Dept of Forestry



Determining an Appropriate Buffer Width



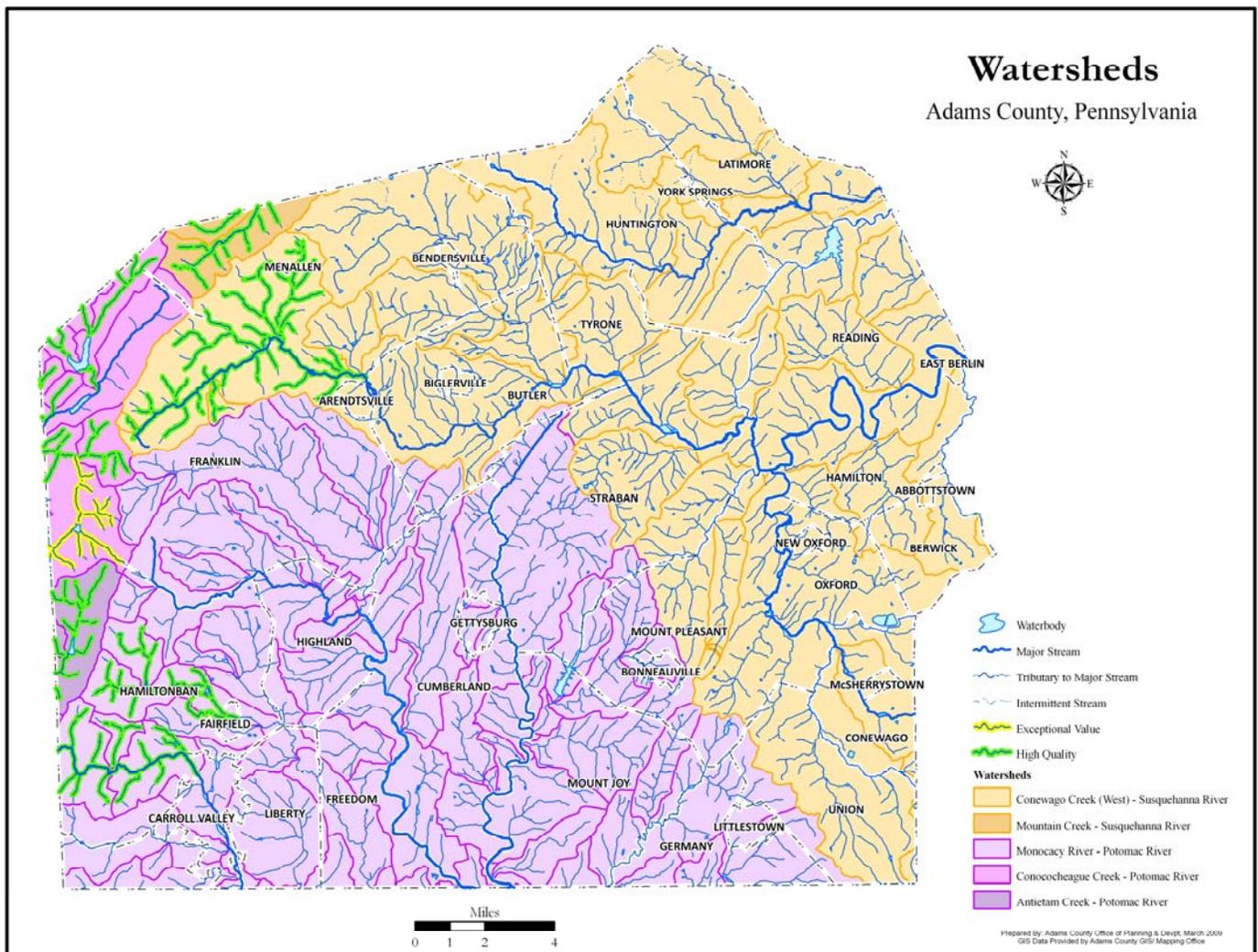
Most riparian buffer widths are defined in one of two ways: fixed or variable. This discussion will focus on fixed width buffers because variable width buffers can be difficult to regulate or defend. A fixed width is a set distance, usually measured from the stream bank on each side of the stream. This method is popular because it is easy to implement and administer. Fixed width buffers are most often developed by compromise, so they may provide more than adequate protection to some areas, and inadequate protection in other areas. The widths used can range from 25 feet to over 300 feet. PA DEP recommends an average minimum riparian forest buffer width of 100 feet. DEP also suggests that this width be extended to 150 feet along perennial or intermittent streams, rivers, lakes, ponds, and reservoirs designated as Exceptional Value (EV) or High Quality (HQ) waters.

Carbaugh Run, located in Franklin Township and a small portion of Hamiltonban Township, is the only Exceptional Value stream in Adams County. High Quality waters are found in the western Adams County. To determine if your stream is designated as EV or HQ, contact the Conservation District or ACOPD.

The Chesapeake Bay Riparian Handbook lists the three main considerations for determining minimum width as:

- **Function**
- **Risk**
- **Sustainability**

The Chesapeake Bay Riparian Handbook



Authority to Regulate Riparian Buffers



In Pennsylvania, regulation of land use has been given to the municipalities through the Municipalities Planning Code (MPC). The MPC provides enabling legislation to municipalities to adopt regulations (ie zoning and subdivision & land development ordinances) to protect natural and environmentally sensitive areas.

If a municipality chooses to enact riparian buffer ordinances to preserve and protect their streams and water resources for their residents, the ordinance should cite the appropriate provisions of the MPC. Any minimum buffer widths established by the ordinances should be supported by science. The municipality should also keep in mind the rights of private property owners and include additional provisions which take into account pre-existing homes and allow for certain non-invasive permitted uses¹.

At the state level, riparian buffers were recognized for their role in mitigating stormwater runoff from land development activities, controlling point and nonpoint source pollution, removing excess nutrients and sediment from surface runoff, and releasing excess storm



Existing riparian forest buffer - Marsh Creek

flow evenly. On November 19, 2010, PA Code Chapter 102 (Erosion and Sediment Control and Stormwater Management) was amended to establish provisions for riparian forest buffers in certain land development situations.

The Pennsylvania Department of Environmental Protection (DEP) has also released a “*Riparian Forest Buffer Guidance*” document in 2010, which recommends the Two-Zoned Riparian Forest Buffer with a minimum width of 100 feet. This guide can also be used in conjunction with those projects requiring buffers through Chapter 102.

Specific sections of the MPC allowing for the protection of: stream quality, natural features, and health & safety of residents:

§ 301(a)(6) - Protection of natural resources in the comprehensive plan.

§ 503(2)(v) - Subdivision & land development ordinances may include provisions that flood-prone land may be made safe or set aside for uses that do not endanger life or property.

§ 603(b)(1) - Zoning ordinances may regulate uses of land, water courses, and other bodies of water.

§ 603(b)(5) - Protection and preservation of natural resources may also be regulated by the zoning ordinance.

Other sections of **Article VI (Zoning)** state that zoning ordinances must include provisions to protect environmentally sensitive areas, promote public health and safety, provide a safe and reliable water supply, and preserve forests, wetlands, aquifers, and floodplains.

1. Royer, Matthew B., (2006). *A Legal Analysis of Riparian Buffer Ordinances in Pennsylvania*

Two-Zoned Riparian Forest Buffer



The Pennsylvania Department of Environmental Protection (DEP) published their *Riparian Forest Buffer Guidance* in November of 2010. This document outlines recommendations for installation and protection of riparian forest buffers. This guidance assists DEP staff in providing and developing riparian forest buffer recommendations and may also assist other interested parties in understanding the functions and values of riparian buffers.

DEP recommends the “Two-Zoned Riparian Forest Buffer” for newly established riparian buffers. These buffers are composed of two distinct zones with a combined minimum width of 100 feet. The following is an excerpt from *Riparian Forest Buffer Guidance*.

Zone 1 - Undisturbed Native Trees:

Location

Zone 1 should begin at the top of the streambank or normal pool elevation of a lake, pond, or reservoir and occupy a strip of land with a minimum width of 50'. Predominant vegetation should be composed of a variety of native tree species.

Purpose

The purpose of Zone 1 is to: (1) Create a stable ecosystem adjacent to the water's edge; (2) Provide soil/ water contact area to facilitate nutrient buffering processes; (3) Provide shade to moderate and stabilize water temperature, encouraging the production of beneficial algal forms; and (4) Contribute necessary detritus and large woody debris as food to the ecosystem.

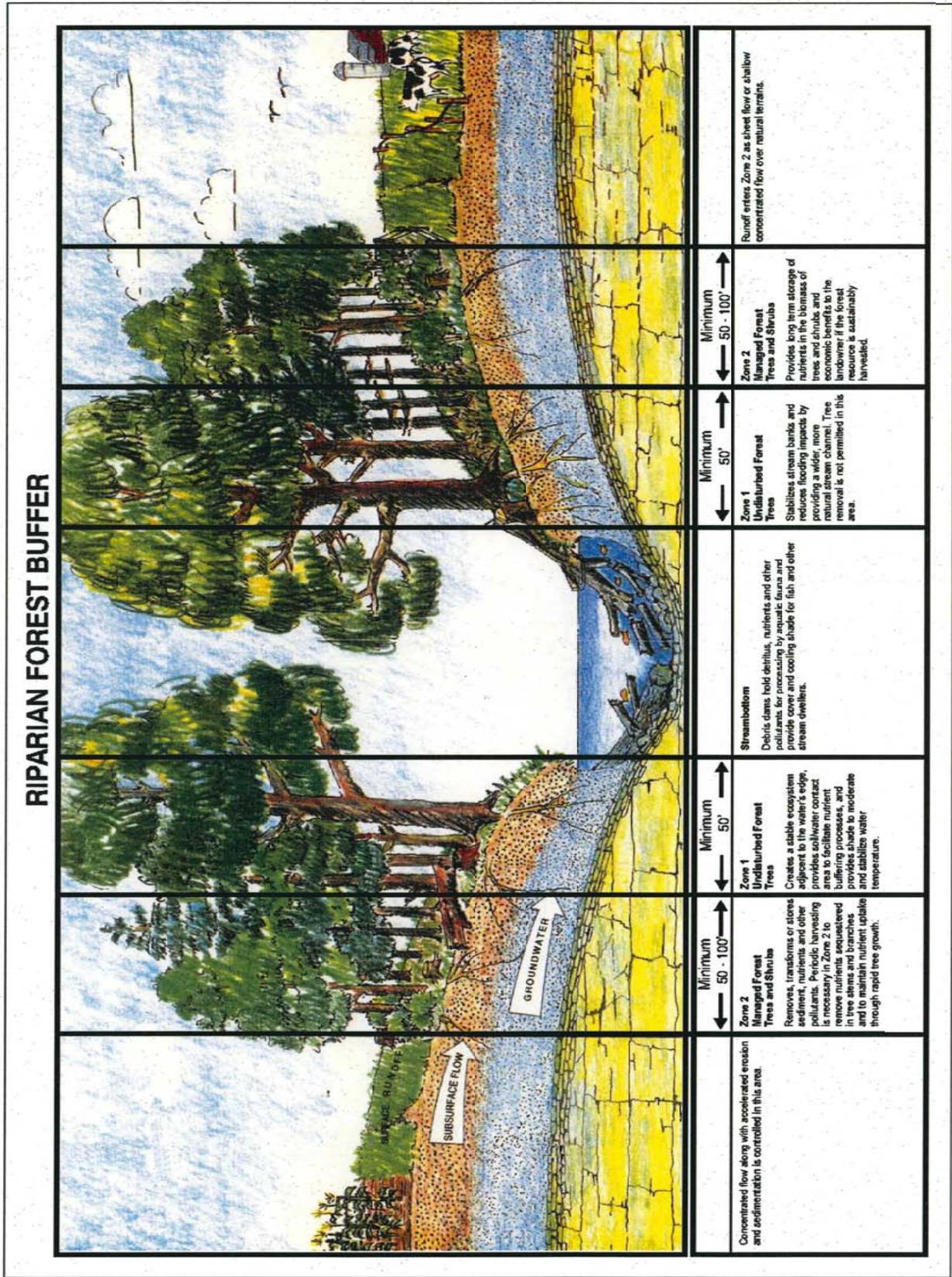
Zone 1 stabilizes stream banks and reduces flooding impacts by providing a wider, more natural stream channel and flood prone area.

Recommendations

- Runoff to be filtered by Zone 1 should be limited to sheet flow or natural subsurface flow only. Concentrated flow and accelerated erosion and sedimentation should be controlled in the area up-grade and immediately adjacent to the riparian forest buffer. Outflow from subsurface drains should not be allowed to pass through the riparian forest buffer in pipes or tile drains.
- Dominant vegetation should be composed of a variety of native riparian tree species. For a complete list of native trees and shrubs, please see DEP's *Riparian Forest Buffer Guidance*.
- Management of Zone 1 should be limited to bank stabilization and activities or practices used to maintain the riparian forest buffer, including the disturbance of existing vegetation, and tree and shrub removal as needed to allow for natural succession of native vegetation and the protection of public health and safety.
- Livestock should be excluded from Zone 1 through the use of stream fencing, except for designated stream crossings.
- Recommended Width: 50 feet - 75 feet

Source: Riparian Forest Buffer Guidance, DEP

Two-Zoned Riparian Forest Buffer - PADEP Recommended Approach



Adapted from Welsch (*Riparian*)

Two-Zoned Riparian Forest Buffer



Zone 2 - Managed Native Trees and Shrubs:

Location

Zone 2 should begin at the edge of Zone 1 and occupy an additional strip of land with a minimum width of 50'. Predominant vegetation should be composed of a variety of native riparian tree and shrub species.

Purpose

The purpose of Zone 2 is to remove, transform, or store sediment, nutrients, and other pollutants.

Zone 2 also provides habitat and corridors for wildlife habitat and economic benefits to the landowner if the forest resource is sustainably harvested.

Recommendations

- Concentrated flow and accelerated erosion and sedimentation should be controlled in the area immediately adjacent to the riparian forest buffer. Since concentrated flow may erode the forest floor and impede the ability of the riparian forest buffer to intercept pollutants, an herbaceous strip or appropriate Best Management Practice may be needed to protect the riparian forest buffer.
- Dominant vegetation should be composed of a variety of native riparian tree and shrub species.
- Management activities such as sustainable harvesting, conducted in accordance with a Forest Management Plan, are allowed in Zone 2 as long as 60% of the canopy cover is maintained.
- Noxious weeds and invasive plant species should be removed or controlled to the extent possible.
- Livestock should be excluded from Zone 2, except for designated stream crossings.
- Recommended Width: 50 feet - 100 feet.

Several Tree or shrub species which are native to Pennsylvania and prefer wet growing conditions:

- Red Maple
- River Birch
- Black Gum
- Sycamore
- Pin Oak
- Sugar Maple
- American Beech
- Smooth Alder
- Mountain Laurel



Red Maple



River Birch



American Beech

Three-Zone Concept



A three-zone concept has also been developed to provide flexibility in achieving water quality and landowner objectives. This approach is recommended by the Federal Interagency Stream Corridor Restoration Working Group (15 Federal Agencies) and is described in the *Chesapeake Bay Riparian Handbook*. The following is an excerpt from the *Chesapeake Bay Riparian Handbook*, more detail is provided in the *Handbook*.

Zone 1 - Undisturbed Forest

Location

Zone 1 is the “near stream” portion of the buffer. It stretches upland from the edge of the stream.

Purpose

The purpose of Zone 1 is to stabilize the stream bank and provide habitat for aquatic organisms. Tree roots serve to hold the soil together to resist erosion from flowing water and keep sediment out of the stream. A leafy tree canopy provides shade to help control water temperature. While Zone 1 improves habitat along all streams, the greatest impact will be along smaller streams where the canopy completely covers the water surface.

Recommendation

- Minimum width of 15 feet.
- Tree removal should generally not be permitted.

Zone 2 - Managed Forest

Location

Zone 2 is located immediately upslope from Zone 1.

Purpose

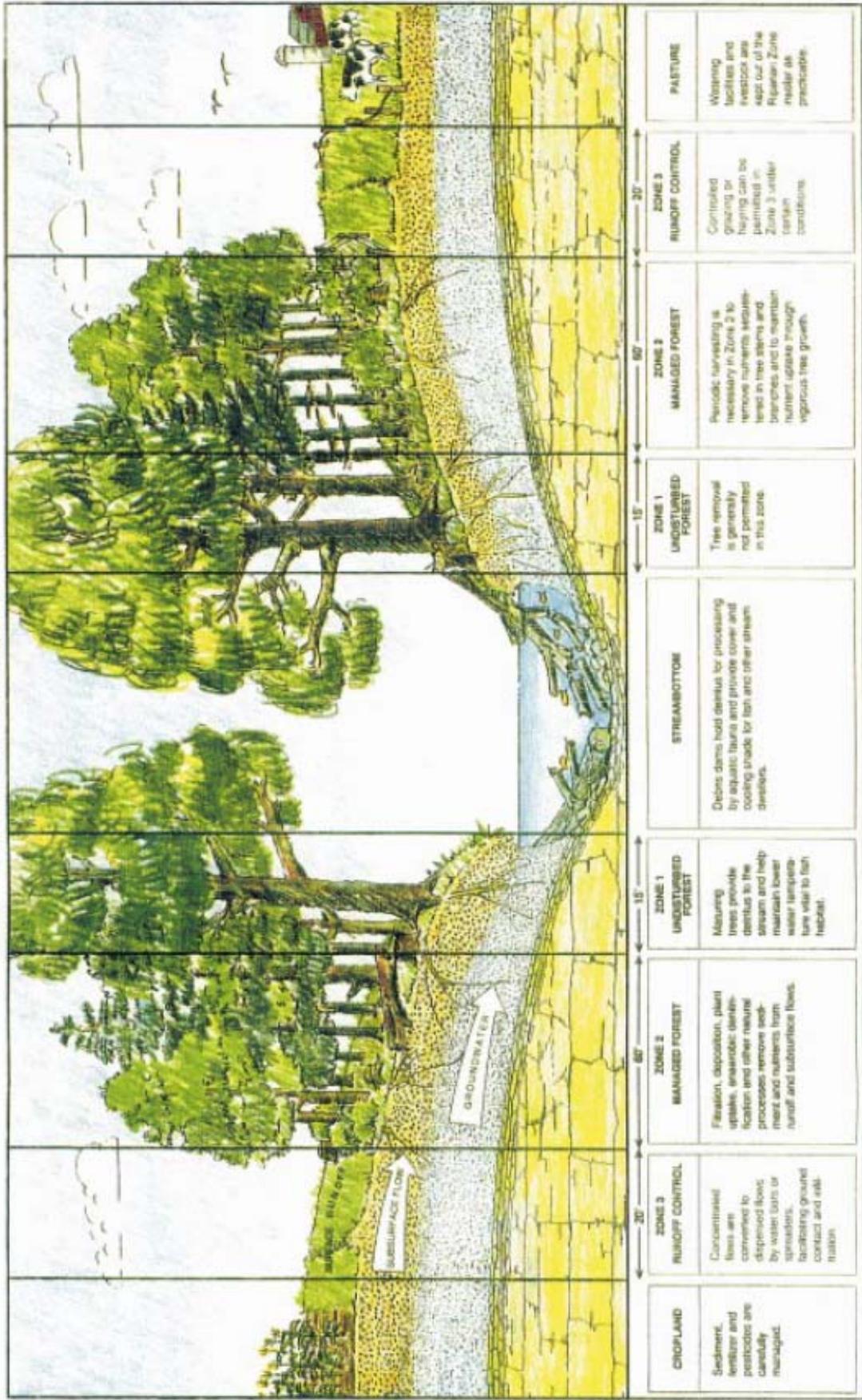
The purpose of Zone 2 is to remove, transform, or store nutrients, sediment, and other pollutants from overland runoff and subsurface flows. Zone 2 can remove 50 - 80% of the sediment in runoff from upland fields.

Recommendation

- Recommended width: 75 feet - 100 feet
- Periodic harvesting is necessary to remove nutrients sequestered in tree stems and branches. This will maintain nutrient uptake and promote tree growth.

Three-Zone Concept - Recommended by the Chesapeake Bay Riparian Handbook

THE STREAMSIDE FOREST BUFFER



Three-Zone Concept



Zone 3 - Runoff Control

Location

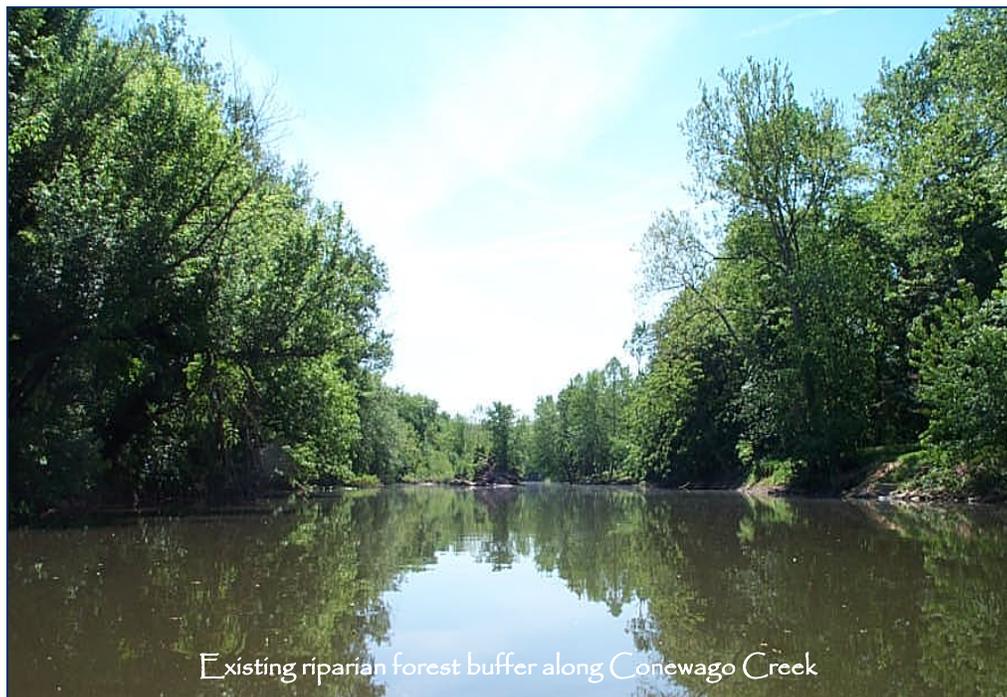
Zone 3 is located immediately upslope of Zone 2. In urban areas, infiltration trenches and stormwater control measures are commonly installed in Zone 3.

Purpose

The purpose of Zone 3 is to help slow runoff, filter sediment and associated chemicals, and allow water to infiltrate the ground. This is achieved through the use of grass filter strips or other control measures. These filter strips help protect the wooded areas so the forest buffer can perform at its full potential. Zone 3 also acts to spread out runoff and prevent it from eroding stream channels into the buffer.

Recommendation

- Minimum width of 20 feet.
- Controlled grazing or haying may be permitted under certain conditions
- Grass filter strips require periodic maintenance which includes the removal of sediment, reestablishment of vegetation, and removal of channels



Existing riparian forest buffer along Conewago Creek

What's Been Done



Adams County Citizens

There has been an ongoing effort led primarily by individual land-owners or farmers, with assistance from local, state, and federal conservation agencies, to restore riparian buffers along Adams County's streams.

- The Conservation Reserve Enhancement Program (CREP) is a voluntary program administered through the US Department of Agriculture (USDA). This program has provided the majority of funding to those property owners in Adams County who have installed buffers. The CREP Program provides funding for enrolling erodible or marginal cropland and establishing conservation plantings to improve water quality, reduce soil erosion, and maintain wildlife habitats. Through 2010, CREP funding has helped restore approximately 730 acres of riparian buffers in Adams County. For more information about this program, please contact the Adams County Conservation District at 334-0636. The picture below is of a CREP project on a property in Mount Joy Township.
- Conservation easements that have been voluntarily placed properties throughout Adams County have also been influential in the preservation of riparian buffers. For more information on conservation easements, contact the Land Conservancy of Adams County (LCAC) at 334-2828.





Adams County Municipalities

Techniques to conserve riparian areas at the municipal level have been recommended in several recently adopted joint municipal comprehensive plans. Conservation has begun through the adoption of riparian buffer ordinances or standards in several of Adams County's municipalities. Municipal Officials may contact the Planning Office at 337-9824 if interested in viewing examples of riparian buffer ordinances adopted in other municipalities and Pennsylvania Counties.

- *Southeast Adams County Joint Comprehensive Plan (2008)* - Recommended the establishment of riparian buffer requirements along watercourses through municipal ordinance amendments. Riparian buffers were also listed as a technique to protect water supplies.
- *Northwest Adams County Joint Municipal Comprehensive Plan (2010)* - Recommended the establishment of riparian buffer requirements along watercourses through zoning ordinance amendments. Riparian buffers were also listed as a technique to protect water supplies. Encourages landowner participation in DEP's Stream ReLeaf Program to restore and enhance riparian buffers.
- *Conewago Township Zoning Ordinance (2010)* - Includes provisions for riparian buffers in their zoning ordinance, mandating 75 foot buffers in certain situations.

Adopted Adams County Policy

Adams County Office of Planning & Development, with support from various state agencies (DCNR, PennDOT, DCED), has assisted with the preparation of the following plans. Each of these plans was adopted as County policy and established an approach for the development of riparian buffers.

- *Adams County Comprehensive Plan (1990)* - The County Comprehensive Plan recommended that the County prepare a model ordinance for the protection of stream corridors and promote the inclusion of such an ordinance in local zoning and subdivision & land development ordinances.
- *Adams County Vision for Parks, Recreation, & Open Space (1997)* - Recognized that the preservation of environmentally important areas along streams, as part of the open space network, contributes to Adams County's rural landscape. The Plan stated that stream buffers need specific protection or restoration initiatives to preserve water quality. Municipalities could include provisions in their ordinances to ensure the protection of open space and natural resources.



What's Been Done



- *Adams County Greenways Plan (2010)* - Lists the use of buffers as a way to preserve greenways. The plan suggests incorporating riparian buffers into municipal ordinances as one of the most economical ways to protect environmentally sensitive areas.

Adams County Conservation District

The Adams County Conservation District has been a strong advocate for riparian buffers. The District works directly with landowners who express an interest in establishing riparian buffers, primarily through the CREP Program. They also proactively contact other property owners to educate them about available resources to improve existing buffers. For more information, please call the District at 334-0636.



Buffer along Cold Springs Road in Hamiltonban Township

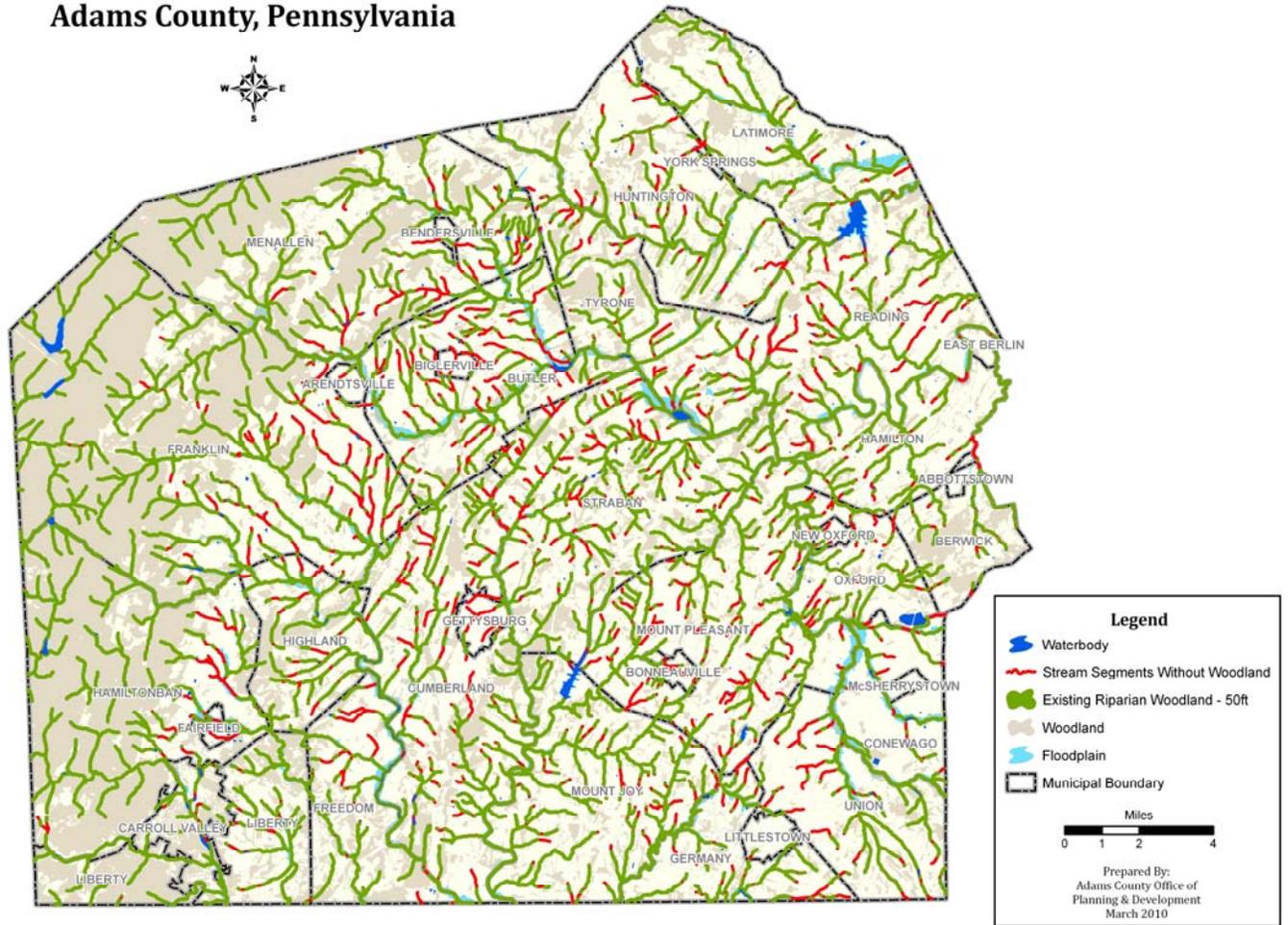
Buffers - Future Focus



Establishing New Buffers

Many of Adams County's streams are protected by existing riparian forest buffers. Many of the existing forest buffers coincide with the wooded areas of the County. If a citizen or municipality is interested in pursuing the establishment of riparian forest buffers, efforts could be focused on those stream segments that do not have a buffer on either one or both sides. Stream segments without a buffer of at least 50 feet are highlighted in red on the map below.

Existing Woodland Riparian Buffers Adams County, Pennsylvania



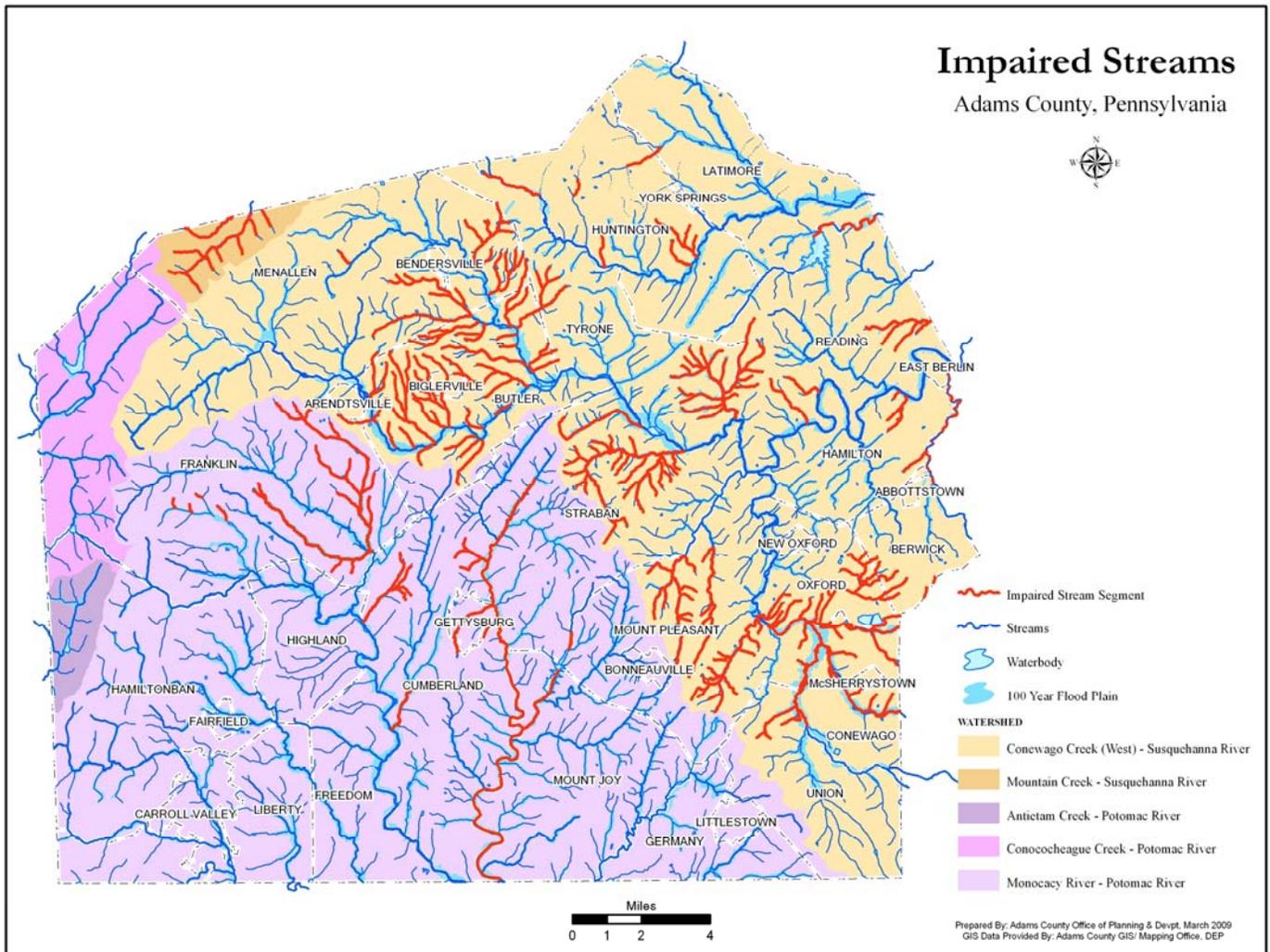
Buffers Along Impaired Streams

Water quality is periodically assessed by DEP to identify those stream segments that are "impaired". An impaired stream means that it is not attaining any of the four designated uses, which include aquatic life, water supply, fish consumption, and/ or recreation. The impaired streams in Adams County refer to those that do not support aquatic life, which pertains to maintaining the flora and fauna indigenous to aquatic habitats.

Buffers - Future Focus



Approximately 22% of the Adams County's streams are impaired. These stream segments are highlighted in red on the "Impaired Streams" map below. Siltation thought to be associated agriculture is the primary causes and source of impairment in Adams County. Other sources of impairment include: urban/ residential runoff, industrial point sources, channelization, etc. Riparian forest buffers could be installed and maintained along impaired streams to improve the health of the these waterways by filtering and trapping excess nutrients, sediment, & pollution.



If sediment and pollution removal is one of the primary goals of the buffer, site factors are important when evaluating the buffers effectiveness and performance. The role of riparian forest buffers as nutrient and sediment filters can be based on soil conditions and the route and rate of surface and ground water movement through the buffer. The width of the buffer also influences the level of pollutant removal.

Buffers - Future Focus



The following table lists several site factors that may enhance, or limit, the buffers effectiveness in removing pollutants.

Factors That Enhance Effectiveness	Factors That Reduce Effectiveness
Slopes less than 5 percent	Slopes greater than 5 percent
Contributing flow length <150 feet	Overland flow paths over 300 feet
Seeps, high water table - subsurface flow	Flow path to deep or regional groundwater
Permeable, but not highly sandy soils	Compacted soils
Level spreaders or flow dispersal	Concentrated storm flow
Organic matter, humus, or mulch layer	Snowmelt, ice conditions, low organic soil
Entry runoff velocity less than 1.5 feet/ sec	Entry runoff velocity more than 5 feet/ sec
Routine maintenance	Sediment buildup at entrance
Poorly-drained soils, deep roots	Shallow root system
Forest and dense grass cover (6 inches)	Tall bunch grass, sparse vegetative cover

Source: Chesapeake Bay Riparian Handbook, USDA

Buffers As a Stormwater Management Tool

Riparian forest buffers can also be integrated into stormwater management planning in different landscape settings. The *Chesapeake Bay Riparian Handbook* states that forests can capture, absorb, and store amounts of rainfall 40 times greater than disturbed soils, such as agricultural fields or construction sites. While buffers can be an important component of stormwater management planning, it is important to keep in mind that buffers cannot treat all of the stormwater runoff generated within a watershed.

The *Pennsylvania Stormwater Best Management Practices Manual* includes riparian forest buffers as a best management practice (BMP) for stormwater management. The practice of protecting, maintaining, and enhancing existing forest buffers is considered a non-structural BMP. Non-structural BMPs are typically a combination of practices which provide benefits to the environment through the preservation of open space, protection of natural systems, and the incorporation of existing natural features into an overall site design. Non-structural BMPs also encourage the treatment, infiltration, evaporation, and transpiration of precipitation close to where it falls. The establishment of a new riparian forest buffer is also an effective BMP. More detail is provided in the Manual.

Cost of Buffers



While each project is site-specific, the cost of establishing and maintaining a riparian forest buffer should be considered for budgeting purposes. The following table provides an *estimated* cost of establishing a new riparian forest buffer, which can range from \$385 to \$4,723 / acre.

Establishing New Riparian Forest Buffer: Per Acre Estimated Costs
(Based on 2009 dollars)

	Estimated Cost Per Item	Estimated Total Cost	Estimated Total Cost
	Establishment	110 Trees per acre (20' spacing)	435 Trees per acre (10' spacing)
Planting	Hardwood tree seedlings \$3.50/ seedling (no shelter)	\$385	\$1,523
Subtotal (Establishment)			
	Optional/ Maintenance Costs		
Reinforcement Planting	50 Seedlings/ acre (30') @\$3.50/ seedling (12"-18")	\$175	\$175
Invasives Removal	\$200 per acre	\$200	\$200
Seedling Protection	Shelter/ stake, \$5/ tree installed	\$550	\$2,175
Competition Control	Herbicide treatment/ Mowing \$130/ acre annually for 5 yrs	\$650	\$650
Subtotal (Optional costs)		\$1,575	\$3,200
Total Costs (Establishment + Optional)		\$1,960	\$4,723

Source: Riparian Forest Buffer Guidance, DEP



Members (Mark Kessler & Dave Swope) of Adams County Trout Unlimited plant native trees along Opossum Creek in Menallen and Butler Townships.

Resources



- **Riparian Forest Buffer Guidance, PA DEP (2010)**
www.elibrary.dep.state.pa.us/dsweb/Get/Document-82308/394-5600-001.pdf
- **Chesapeake Bay Riparian Handbook: A Guide for Establishing and Maintaining Riparian Forest Buffers, USDA Forest Service (1998)**
www.chesapeakebay.net/content/publications/cbp_13019.pdf
- **Riparian Buffer Width, Vegetative Cover, & Nitrogen Removal Effectiveness: A Review of Current Science and Regulations, US EPA (2005)**
www.epa.gov/nrmrl/pubs/600R05118/600R05118.pdf
- **Riparian Forest Buffers: Function and Design for Protection and Enhancement of Water Resources, USDA Forest Service Northeastern Area, Welsch (1991)**
www.ncrs.fs.fed.us/pubs/viewpub.asp?key=955
- **Stream Corridor Restoration: Principals, Processes, and Practices, FISRWG (1998/ 2001)**
www.nrcs.usda.gov/technical/stream_restoration/
- **Pennsylvania Stormwater Best Management Practices Manual, PA DEP (2006)**
www.elibrary.dep.state.pa.us/dsweb/View/Collection-8305
- **Stroud Water Research Center in Avondale, PA compiled a list of riparian forest resources:**
[www.stroudcenter.org/education/BufferBibliography\(1\).htm](http://www.stroudcenter.org/education/BufferBibliography(1).htm)
- **Adams County Conservation District
Agricultural & Natural Resources Center
670 Old Harrisburg Road, Suite 201
Gettysburg, PA 17325
717-334-0636
www.adamscounty.us**
- **Adams County Office of Planning Development
Union Square Building
19 Baltimore Street, Suite 101
Gettysburg, PA 17325
717-337-9824
www.adamscounty.us**