

## BMP 5.4.2: Protect /Conserve/Enhance Riparian Areas



The Executive Council of the Chesapeake Bay Program defines 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."

<p style="text-align: center;"><b><u>Key Design Elements</u></b></p> <ul style="list-style-type: none"> <li>▪ Linear in Nature</li> <li>▪ Provide a transition between aquatic and upland environments</li> <li>▪ Forested under natural conditions in Pennsylvania</li> <li>▪ Serve to create a "Buffer" between development and aquatic environment</li> <li>▪ Help to maintain the hydrologic, hydraulic, and ecological integrity of the stream channel.</li> <li>▪ Comprised of three "zones" of different dimensions:             <ul style="list-style-type: none"> <li>▪ <b>Zone 1:</b> Adjacent to the stream and heavily vegetated under ideal conditions (Undisturbed Forest) to shade stream and provide aquatic food sources.</li> <li>▪ <b>Zone 2:</b> Landward of Zone 1 and varying in width, provides extensive water quality improvement. Considered the Managed Forest.</li> <li>▪ <b>Zone 3:</b> Landward of Zone 2, and may include BMPs such as Filter Strips.</li> </ul> </li> </ul>	<p style="text-align: center;"><b><u>Potential Applications</u></b></p> <p>Residential:            Commercial: Ultra Yes Yes            Urban: Industrial: Yes Yes                      Retrofit: Yes Yes            Highway/Road:</p>
	<p style="text-align: center;"><b><u>Stormwater Functions</u></b></p> <p>Volume Reduction: Medium            Recharge: Medium            Peak Rate Control: Low/Med.            Water Quality: Very High</p>
	<p style="text-align: center;"><b><u>Water Quality Functions</u></b></p> <p>TSS: Preventive            TP: Preventive            NO3: Preventive</p>

There are two components to Riparian Buffers to be considered in the development process:

1. Protecting, maintaining, and enhancing existing Riparian Forest Buffers.
2. Restoring Riparian Forest Buffers that have been eliminated or degraded by past practices.

BMP 5.4.2 focuses on protection, maintenance, and enhancement of existing Riparian Forest Buffers. Restoration of Riparian Forest Buffers is treated in Chapter 6 as a Structural BMP.

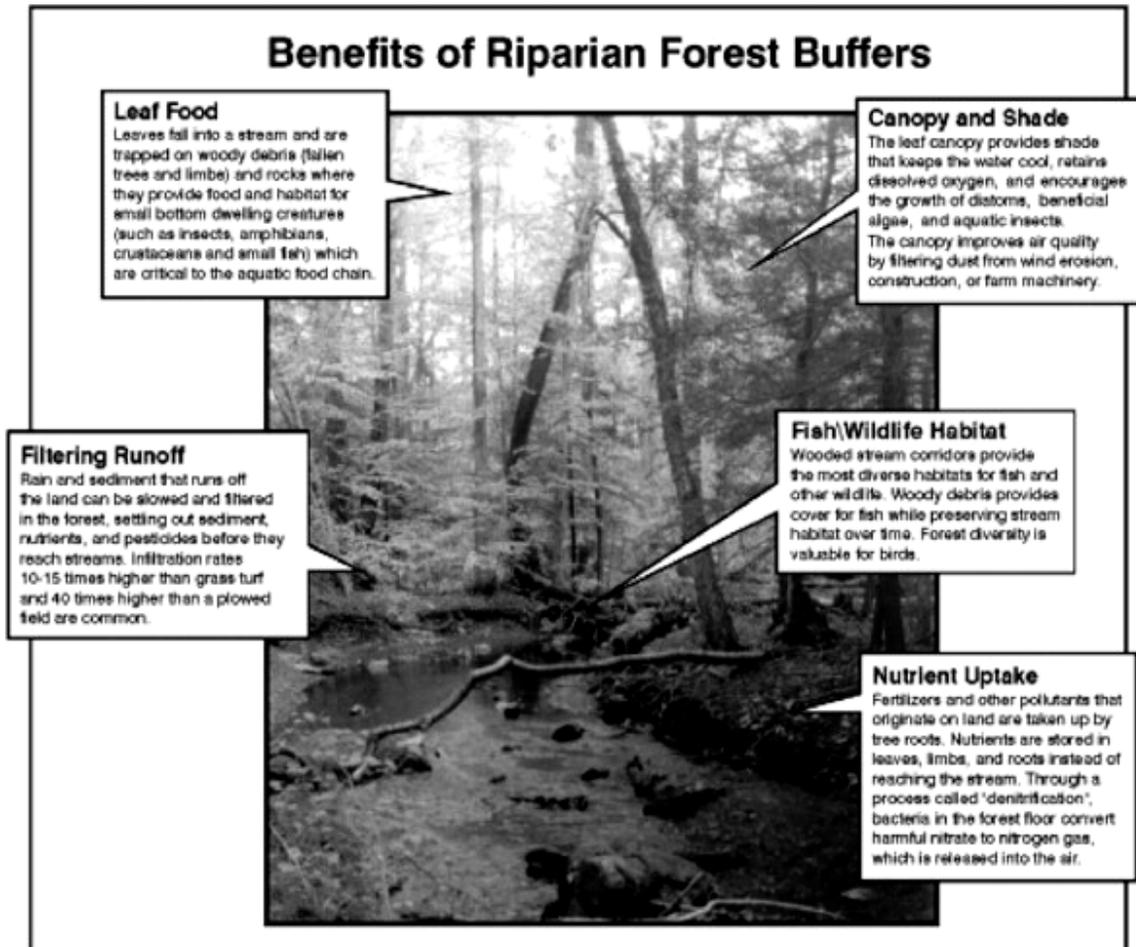


Figure 5.2-1. Riparian buffer zones support various ecological functions.

### Detailed Stormwater Functions

Riparian Corridors are vegetated ecosystems along a waterbody that serve to buffer the waterbody from the effects of runoff by providing water quality filtering, bank stability, recharge, rate attenuation and volume reduction, and shading of the waterbody by vegetation. Riparian corridors also provide habitat and may include streambanks, wetlands, floodplains, and transitional areas. Functions can be identified and sorted more specifically by Zone designation:

**Zone 1:** Provides stream bank and channel stabilization; reduces soil loss and sedimentation/nutrient and other pollution from adjacent upslope sheet flow; roots, fallen logs, and other vegetative debris slow stream flow velocity, creating pools and habitat for macroinvertebrates, in turn enhancing biodiversity; decaying debris provides additional food source for stream-dwelling organisms; tree canopy shades and cools water temperature, critical to sustaining certain macroinvertebrates, as well as critical diatoms, which are essential to support high quality species/cold water species. Zone 1 functions are essential throughout the stream system, especially in 1st order streams.

**Zone 2:** Removes, transforms, and stores nutrients, sediments, and other pollutants flowing as sheet flow as well as shallow sub-surface flow. A healthy Zone 2 has the potential to remove substantial quantities of excess nitrates through root zone uptake. Nitrates customarily can be significantly elevated when adjacent land uses are agricultural or urban/suburban. Healthy vegetation in Zone 2 slows surface runoff while filtering sediment and particulate bound phosphorus. Total nutrient removal is facilitated through a variety of complex processes: long-term nutrient storage through microbe uptake, denitrification through bacterial conversion to nitrogen gases and additional microbial degradation processes.

**Zone 3:** Provides the first stage in managing upslope runoff so that runoff flows are slowed and evenly dispersed into Zone 2. Some physical filtering of pollutants may be accomplished in Zone 3 as well as some limited amount of infiltration.

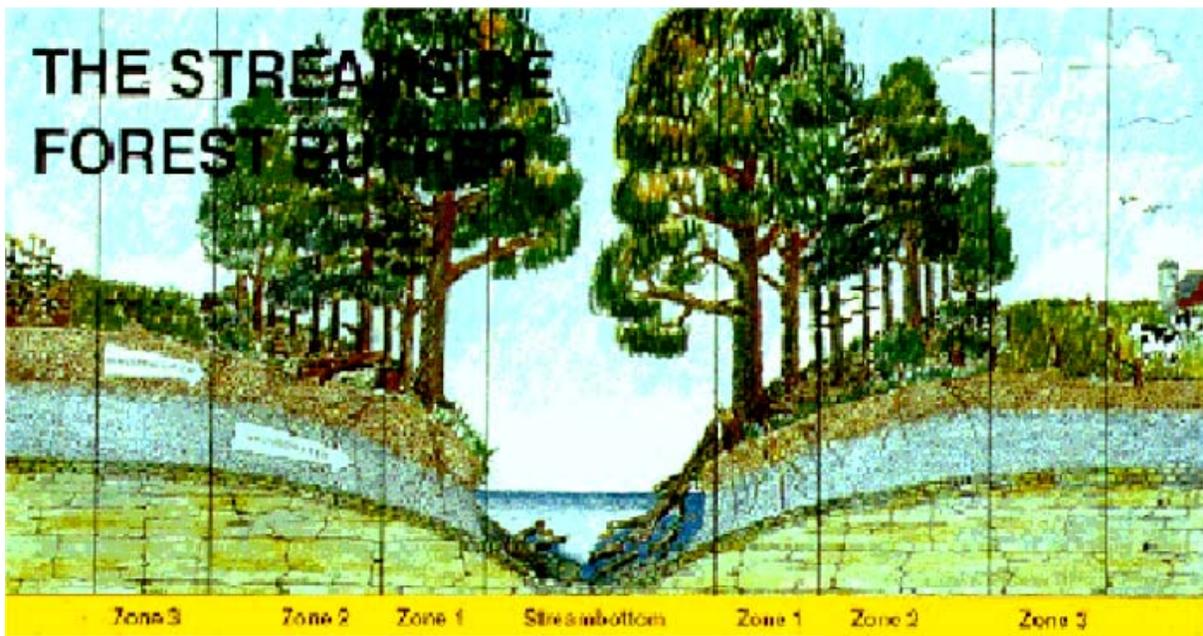


Figure 5.2-2. Riparian buffer zones (DJ Welsh, 1991).

### Design Considerations/Variations

Although this manual refers frequently to the Chesapeake Bay Program's Riparian Handbook, many different sources of guidance have been developed in recent years. Not all of these are exactly comparable in terms of their recommendations and specifications. To some extent these variations relate to different land use development contexts.

Riparian Forest Buffer Zone widths should be adjusted according to site conditions and type of upslope development. Variation in standards (see Specifications below) should vary with the function to be performed by the forested buffer. In undisturbed forested areas where minimal runoff is expected to be occurring, standards can be made more flexible than in agricultural contexts where large quantities of natural vegetation have been removed and significant quantities of runoff are expected. In addition to factors related to technical need, practical and political factors also must be considered. In urbanized settings where hundreds, if not thousands of small lots may abut riparian areas and already intrude into potential forested buffer zones, buffer standards must be practicable.

Lastly, confusion has emerged between the concept of floodplain and riparian forest buffer. In many cases, mapped and delineated floodplain may overlap and even largely coincide with riparian forest buffer zones. On the other hand, mapped 100-year floodway/floodplain may not coincide with the forest buffer due to either very steep topography or very moderate slopes. A second important clarification is that floodplain ordinances typically manage use to prevent flood damage, which contrasts to riparian forest buffer regulation which manages clearing and grading actions in the zones, specifically for environmental reasons.

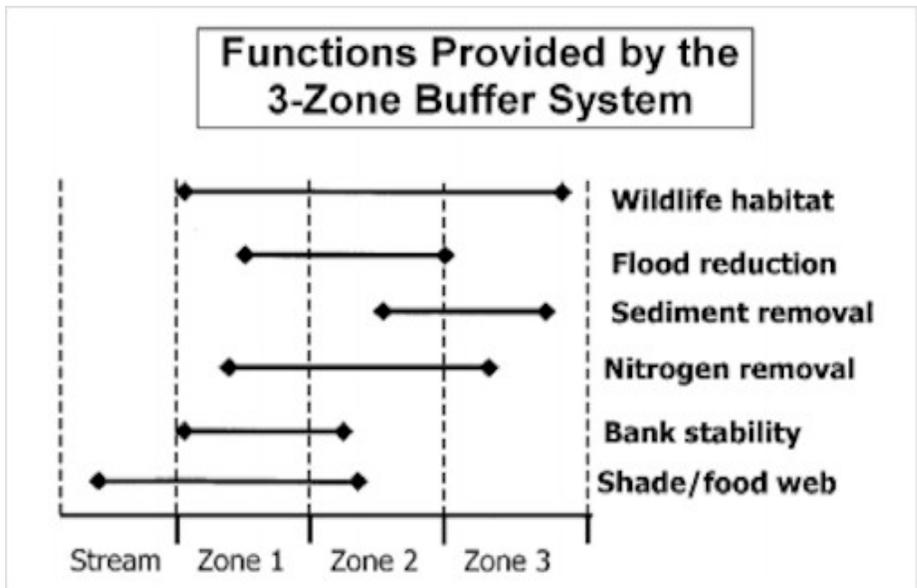


Figure 5.2-3. Riparian buffer zone functions.

**Construction Issues**

Riparian Forest Buffer Protection should be defined and included in municipal ordinances, including both the zoning ordinance and subdivision and land development ordinance (SALDO). The Riparian Forest Buffer should be defined and treated from the initial stages of the land development process, similar to floodplain, wetland or any other primary conservation value. It is the municipality’s responsibility to determine a fair and effective riparian forest buffer program, balancing the full range of water resource and watershed objectives along with other land use objectives. A fair and effective program should evolve for all municipal landowners and stakeholders. State-supported River Conservation Plans, Act 167 Stormwater Management Plans, and other planning may contribute to this effort.

Whether a respective municipality has included riparian forest buffers in its ordinances or not, landowners/developers/applicants should include riparian forest buffers in their site plans from the initiation of the site planning process. If standards and guidelines have been set forth by the municipality or by other relevant planning group, these standards and guidelines should be followed. If none of these exist, standards recommended in this manual should be followed.

The ease of accommodating a riparian forest buffer can be expected to vary based on intensity of land use, zoning at the site and size of the parcel. Holding all other factors constant, as site size decreases, the challenges posed by riparian zone accommodation can be expected to increase. As sites become extremely small, reservation of site area for riparian forest buffer may become problematic, thereby requiring riparian forest buffer modification in order to accommodate a reasonable building program for the site. Zoned land use intensity is another factor to be considered. As this intensity increases and specifications for maximum building area and impervious area and total disturbed area are allowed to grow larger, reserving site area for the riparian forest buffer becomes more challenging. Riparian forest buffer programs need to be sensitive to these constraints.

All of these factors should be reviewed and integrated by the municipality as the riparian forest buffer program is being developed.

### **Cost Issues**

Costs of riparian forest buffer establishment are not significant, defined in terms of direct development. In these cases, costs can be reasonably defined as the lost opportunity costs of not being able to use acreage reserved for the riparian forest buffer in the otherwise likely land use. A likely land use might be defined in terms of zoned land use. Depending upon the zoning category provisions and the degree to which a riparian forest buffer's Zone 1 or Zone 2 or Zone 3 might be able to be included as part of a land development plan or as part of yard provisions for lots in a residential subdivision acreage included within the riparian forest buffer may or may not be able to be included as part of the development. If riparian acreage must be totally subtracted, then it's fair value should be assessed as a cost. If riparian forest buffers can be credited as part of yards (though still protected), then that acreage should not be considered to be a cost. Any one-time capital cost can be viewed alternatively as an annualized cost.

To the extent that the riparian forest buffer coincides with the mapped and regulated floodplain, where homes and other structures and improvements should not be located, then attributing any lost opportunity costs exclusively to riparian forest buffers is not reasonable. The position can be argued that any riparian forest buffer area, which is included within floodplain limits, should not be double-counted as a riparian forest buffer cost. Alternatively, any riparian forest buffer area that extends beyond the floodplain could be assigned a cost.

Lost opportunity costs can be expected to vary depending upon land use. Alternative layouts, including reduced lot size configurations, may be able to provide the same or close to the same number of units and the same level of profitability.

Over the long-term, some modest costs are required for periodic inspection of the riparian forest buffer plus modest levels of maintenance. Generally, the buffers require very little in the way of operating and maintenance costs.

If objective cost-benefit analysis were to be undertaken on most riparian forest buffers, results would be quite positive, demonstrating that the full range of environmental and non-environmental benefits substantially exceeds costs involved. Protection of already existing vegetated areas located adjacent to streams, rivers, lakes, and other waterways is of tremendous importance, given their rich array of functional benefits.

### **Stormwater Management Calculations**

Stormwater calculations in most cases for Volume Control and Recharge and Peak Rate will not be affected dramatically. See Chapter 8 for more discussion relating to Water Quality.

## Specifications

The Chesapeake Bay Program's Riparian Handbook provides an in-depth discussion of establishing the proper riparian forest buffer width, taking into consideration:

1. existing or potential value of the resource to be protected,
  2. site, watershed, and buffer characteristics,
  3. intensity of adjacent land use, and
  4. specific water quality and/or habitat functions desired.
- (Handbook, p. 6-1)

At the core of the scientific basis for riparian forest buffer establishment are a variety of site-specific factors, including: watershed condition, slope, stream order, soil depth and erodibility, hydrology, floodplains, wetlands, streambanks, vegetation type, and stormwater system, all of which are discussed in the Handbook. Positively, this body of scientific literature has expanded

tremendously in recent years and provides excellent support for effective buffer management. The downside is that this scientific literature now exceeds quick and easy summary. Fortunately, this Handbook and many additional related references are available online without cost (given the comprehensiveness of the Handbook itself, it is recommended that the reader start here).

**Zone 1:** Also termed the "streamside zone," this zone "...protects the physical and ecological integrity of the stream ecosystem. The vegetative target is mature riparian forest that can provide shade, leaf litter, woody debris, and erosion protection to the stream. The minimum width is 25 feet from each streambank (approximately the distance of one or two mature trees from the streambank), and land use is highly restricted...." (Handbook, p. 11-8)

**Zone 2:** Also termed the "middle zone," this zone "...extends from the outward boundary of the streamside zone and varies in width depending on stream order, the extent of the 100-year flood plain, adjacent steep slopes, and protected wetland areas. The middle zone protects key components of the stream and provides further distance between upland development and the stream. The minimum width of the middle core is approximately 50 feet, but it is often expanded based on stream order, slope of the presence of critical habitats, and the impact of recreational or utility uses. The vegetative target for this zone is also mature forest, but some clearing is permitted for stormwater management Best Management Practices (BMPs), site access, and passive recreational uses...." (Handbook, p. 11-8)

**Zone 3:** Also termed the "outer zone," this zone "...is the 'buffer's buffer.' It is an additional 25-foot setback from the outward edge of the middle zone to the nearest permanent structure. In many urban situations, this area is a residential backyard. The vegetative character of the outer zone is usually turf or lawn, although the property owner is encouraged to plant trees and shrubs to increase the total width

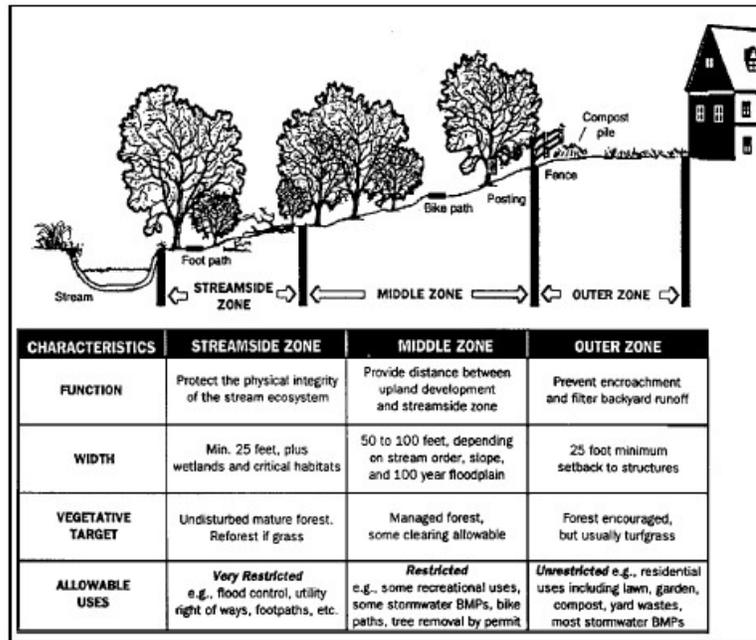


Figure 5.2-4. Three zone urban buffer system (Schueler, 1995 and Metropolitan COG, 1995).

of the buffer... The only significant restrictions include septic systems and new permanent structures.”  
(Handbook, p. 11-9)

The Handbook also provides more detailed specifications for riparian forest buffers (Appendix 1), as developed by the USDA’s Forest Service.

