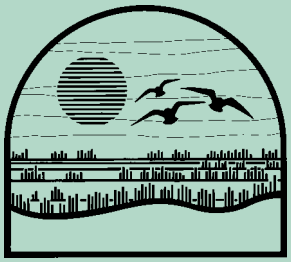
North Carolina National Estuarine Research Reserve
Technical Paper Series:

# Vegetated Buffers:

## Improving Environmental Quality in Coastal North Carolina

No. 5



## Why are buffers important to coastal water quality?

As development along our shorelines increases and seasonal and year-round populations in coastal communities grow, controlling nonpoint source pollution becomes critical. In recent years coastal North Carolina has been subject to problems related to pollution from nonpoint sources, such as stormwater runoff where upland pollutants find their way into the state's coastal waters. The problems associated with this pollution include harmful algal blooms, fish kills, sediment plumes and shellfish closures. Increasing conversion of natural land cover to impervious surfaces, such as parking lots, houses and roads, is the major factor contributing to this problem (see Figure 3, page 4). Instead of filtering runoff, impervious surfaces channel it into coastal and riparian waters. The creation of buffers, a naturally vegetated transitional zone between both differing land uses and the land/water interface, function as a barrier to and filter of surface water runoff. Starting in the 1950s, vegetated buffers were used as best management practices (BMPs) in the fields of forestry and agriculture to prevent water quality degradation. Currently they are applied in both engineered and natural settings to curb the effects of nonpoint source pollution.

Vegetated buffers improve water quality by removing sediment, nutrients, chemicals and bacterial and viral agents from surface water before it reaches riparian and coastal waters. By shielding the soil surface from the impacts of rainfall and surface water runoff, vegetated buffers help reduce sediment loads to local water bodies. Sediment runoff has numerous negative impacts on receiving waters including decreased light penetration, which reduces photosynthesis. Increased sediments in coastal waters may also clog filter feeding organisms' (e.g. clams, scallops, oysters) gills threatening their survival. Additionally, many pollutants such as heavy metals and nutrients are attached to sediments. The removal of total nitrogen and phosphorus, which are responsible *(continued on page 4)*

Table 1: Effectiveness of Vegetated Buffers Based on Width
(Adapted from Desbonnet et. al., 1994)

| Buffer Width (ft) | Pollutant Removal Effectiveness | Wildlife Habitat Value |
|---|---|---|
| 15 | 50% or greater sediment and pollutant removal | Poor habitat; good temporary wildlife activities |
| 35 | 60% or greater sediment and pollutant removal | Minimally protects stream habitat; poor habitat value; good for temporary wildlife activities |
| 50 | 70% or greater sediment and pollutant removal | Minimal general wildlife and avian habitat |
| 65 | 70% or greater sediment and pollutant removal | Minimal general wildlife habitat; some value as avian habitat |
| 100 | 70% or greater sediment and pollutant removal | May have use as a wildlife travel corridor and avian habitat |
| 165 | 75% or greater sediment and pollutant removal | Minimal general wildlife and avian habitat value |
| 245 | 80% or greater sediment and pollutant removal | Fair to good general wildlife and avian habitat value |
| 330 | 80% or greater sediment and pollutant removal | Good wildlife habitat value; may protect significant wildlife |
| 660 | 90% or greater sediment and pollutant removal | Excellent wildlife value; may support a diverse community |
| 2000 | 99% or greater sediment and pollutant removal | Excellent wildlife value;supports a diverse community; protection of significant wildlife |

# Buffer Benefits

In addition to improving water quality, vegetated buffers have many other benefits, including flood control, groundwater recharge, soil erosion prevention, conservation of coastal and riparian wildlife habitats and protection of scenic natural areas. By reducing the velocity and providing a collection area for stormwater runoff and precipitation, vegetated buffers stabilize the soil, reduce sediment runoff and encourage water infiltration into the ground rather than flooding low-lying areas. Buffers are also beneficial in recharging groundwater supplies and promoting groundwater flow.

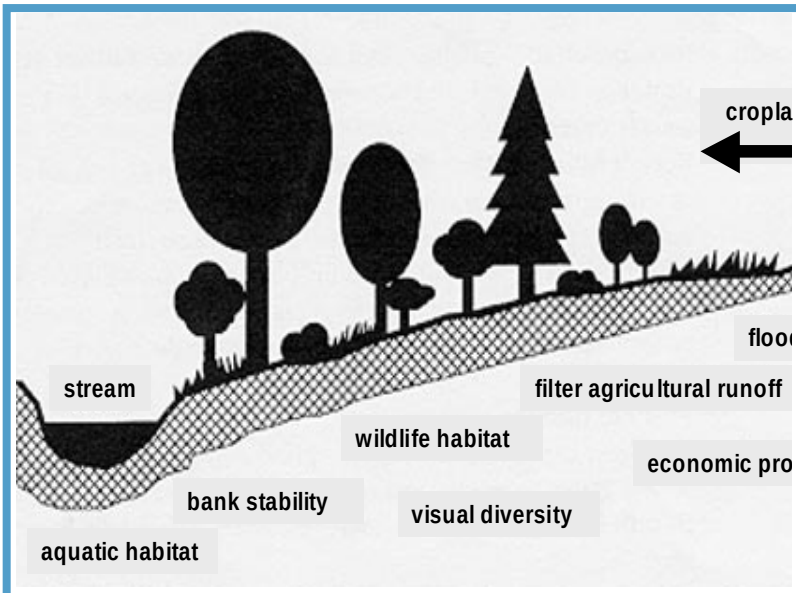



Figure 1. Generalized cross-section of a riparian vegetated buffer

(Adapted from http://waterhome.tamu.edu/texasyst/agroforestrynotes/afnote3.htm)

Vegetated buffers provide habitat for a variety of North Carolina plants and animals while conserving habitat of scenic and aesthetic importance. These natural areas provide breeding and nesting habitat and protect wildlife from predation. Vegetated buffers help increase the diversity of wildlife by providing sites for foraging and corridors for dispersal. Buffers have proven especially important along rivers that serve as spawning areas for anadromous fish, those that migrate from the ocean to spawn in rivers. Examples of these types of fishes in North Carolina waters are striped bass, American shad, alewife and Atlantic sturgeon.

The preservation of wildlife habitat through buffer establishment is critically important. Many of the species found in the transitional zones between open water, wetlands and upland habitats have become increasingly rare, if not threatened or endangered (Bill Crowell, pers. comm.). As with pollutant and sediment removal, the effectiveness of a vegetated buffer in providing suitable wildlife habitat is a function of its width (see Table 1, page 1). However, a significant amount of land must be set aside for a buffer to benefit wildlife.

## Home Landscaping and Water Quality

Adapted from Bruneau et. al., 1995

*Using common sense when planning and caring for your home's landscaping will reduce water pollution.*

*** Watering** - Moisten only the top 4 to 6 inches of soil; over-watering can cause fertilizers and pesticides to move beyond the root zone into groundwater. To reduce nutrient runoff on slopes, water with light, frequent applications following fertilizer application. Use native plants (see http://www.ces.ncsu.edu/depts/hort/consumer/factsheets/native/index-native.html), they are adapted to local rainfall.

*** Mowing** - Since grass clippings are mainly comprised of water, they decompose quickly. Leave clippings on your lawn after mowing, they will release nutrients reducing future fertilizer applications.

*** Fertilizing** - Apply slow-release sources of nitrogen whenever possible. If water-soluable or quick-release fertilizers are applied, use half the recommended amount in two applications 10 days apart. This will reduce the amount of fertilizer runoff to surface waters. The use of drop (gravity) type spreaders over centrifugal (rotary) type spreaders near water bodies will decrease the chance of fertilizer particles reaching these waters.

## North Carolina's Shoreline Buffer Rules

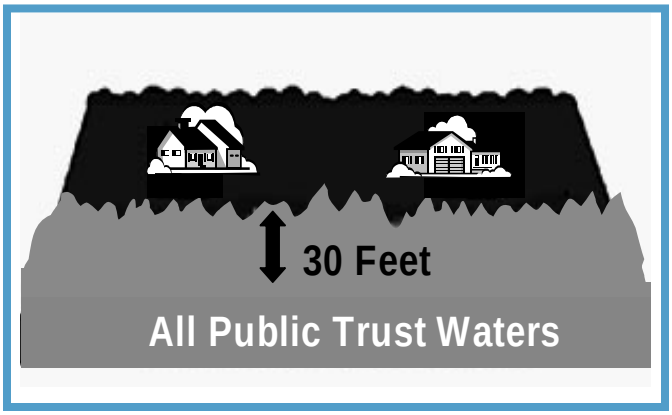



Figure 2. 30-foot buffer zone

In August of 2000 the state adopted a 30-foot buffer rule for all new development in the 20 coastal counties governed by the Coastal Area Management Act (CAMA). This rule applies to all navigable waterways excluding the oceanfront, which has previously established setback requirements. Development within this buffer is restricted unless the structure is water-dependent, such as docks and boat ramps. For more information, including the history of this rule and exceptions, see the Division of Coastal Management's Web site: http://www.nccoastalmanagement.net/Facts/buffer.htm

## Physical Characteristics

When constructing vegetated buffers, it is important that they be sited where stormwater runoff will pass through them. The most effective way to trap nutrients and pesticides associated with agriculture is to locate buffers as close as possible to treated fields. In addition to site selection, there are numerous physical factors that contribute to their effectiveness including width, slope and vegetation coverage.

### Width

Many pollutants and nutrients transported by surface water runoff are attached to fine-grained sediments, such as clay and silt. To achieve maximum effectiveness, a vegetated buffer's width must increase to account for the slower settling times of these small soil particles. Buffer widths will also vary with nearby land uses and the resources designated for protection. Table 1 (page 1) gives the minimum buffer width to achieve various levels of pollutant removal and wildlife habitat. As buffer width increases, so does its ability to remove pollutants and its value to wildlife.

### Slope

To promote the deposition of sediments, removal of pollutants and absorption of nutrients by buffer vegetation, slow, evenly spread water flow through the buffer resulting from shallow slopes is crucial. It is reported that slopes less than 15% allow sufficient water retention time and pollutant removal (Palmstrom 1991). Steep slopes may promote erosion and channelization of surface runoff, undermining the objective of the buffer.

### Vegetation

By removing pollutants and nutrients, providing wildlife habitat and contributing to aesthetic quality, vegetation is a critical component in buffer effectiveness. Additionally, vegetation aids in soil stabilization and reduces velocity of surface water runoff, preventing channelization while promoting absorption and infiltration. Buffer vegetation can be either natural or planted and may be manipulated in a variety of ways to achieve both environment quality goals and cost-effectiveness (Desbonnet et. al. 1994). Buffer vegetation includes grasses, shrubs and trees. Grass buffers are proven successful at decreasing surface water flow velocities, absorbing nutrients and removing suspended sediments (Gilliam et. al. 1997). Forested buffers are believed to remove nutrients that grasses are unable to uptake. While not practical in many areas, an ideal buffer would consist of a grassed area leading to a forested area before leading to the shoreline (see Figure 1).

*(continued from page 1)* for over-production of algae that leads to decreased dissolved oxygen and possible fish kills, is closely related to sediment removal. It has been reported that buffers can remove up to 90% of sediment and nitrate and nearly 50% of phosphorus when properly constructed (Gilliam 1994). Vegetated buffers are also beneficial when situated close to or within agriculture lands, helping control the spread of pesticides and fertilizers beyond farm boundaries. Finally, vegetated buffers help to filter out many of the pathogens that lead to shellfish closures, demonstrating how environment quality and economics are closely linked.

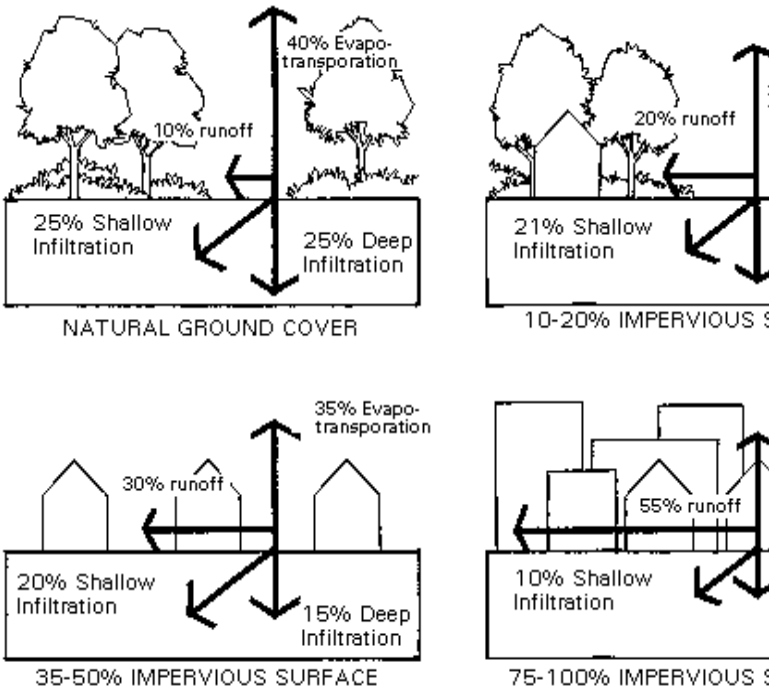



Figure 3: How paved surfaces increase stormwater runoff
(Adapted from Livingston and McCarron, 1992)

## Literature Cited:

Bruneau, A.H., S.C. Hodges, and L.T. Lucas. 1995. Water Quality and Home Lawn Care. North Carolina Cooperative Extension Service Publication WQWM-15.

Crowell, Bill. Personal Communication. Senior Policy Analyst, North Carolina Division of Coastal Management. June 2001.

Desbonnet, A., P. Pogue, D. Reis, J. Boyd, J. Willis, and M. Imperial. 1995. Vegetated Buffers in the Coastal Zone - A Summary Review and Bibliography. Coastal Resources Center Technical Report No. 2064. University of Rhode Island Graduate School of Oceanography. Narragansett, RI 02882. 72 pp.

Gilliam, J. W. 1994. Riparian wetlands and water quality. J. Environmental Quality. 23:896-900.

Gilliam, J. W., D.L. Osmond, and R.O. Evans. 1997. Selected agricultural best management practices to control nitrogen in the Neuse River Basin, North Carolina Agricultural Research Service Technical Bulletin 311, North Carolina State University, Raleigh, NC.

Livingston, E.H., and E.McCarron. 1992. Stormwater Management.-A Guide for Floridians. Florida Department of Environmental Regulation, Tallahassee.

Palmstrom, N. 1991. Vegetated buffers strip designation method guidance manual. Narragansett Bay Project Final Report No. NBP-91-55. Providence RI. 30pp.

## Information Clearinghouse

A website with additional information about coastal environmental topics is available through Coastal Community Services at **www.ncnerr.org**

**This document was funded in part by the National Oceanic and Atmospheric Administration and the North Carolina Division of Coastal Management.**

**X copies of this public document were printed at a cost of $X per copy.**

**For More Information, Contact:**
**NCNERR Education Office**
**135 Duke Marine Lab Road**
**Beaufort, NC 28516**
**(252) 728-2170**
**www.ncnerr.org**