Riparian Buffers Modification & Mitigation Guidance Manual

Virginia Department of Conservation and Recreation
Chesapeake Bay Local Assistance

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PREFACE

The purpose of the Chesapeake Bay Preservation Act is to protect and improve the water quality of the Chesapeake Bay, its tributaries and other state waters by minimizing the impacts of human activity on the waters and within locally designated Chesapeake Bay Preservation Areas. **The intent of this Manual is to provide guidance and clarification for Tidewater local governments, at their request, regarding the section of the Regulations describing buffer exemptions and modifications.** These guidelines are intended to aid local governments in helping a property owner use and enjoy his property while avoiding activities in conflict with the intent of the Bay Act and the program's Regulations.

The program's regulations require that a 100-foot wide buffer area be designated as the landward component of the Resource Protection Area (RPA). The Act defines RPA as "… that component of the Chesapeake Bay Preservation Area comprised of lands adjacent to water bodies with perennial flow that have an intrinsic water quality value due to the ecological and biological processes they perform or are sensitive to impacts which may result in significant degradation to the quality of state waters." As part of the RPA, the Regulations require that "…a 100-foot wide buffer area of vegetation that is effective in retarding runoff, preventing erosion, and filtering non-point source pollution from runoff shall be retained if present and established where it does not exist."

The number of scientific studies and guidance manuals documenting the many values of riparian forest buffers would fill many bookshelves. In the Bay Act program, the RPA buffer area is viewed as the last line of defense against pollution, transported in overland runoff, reaching the Bay and its tributaries. In light of the abundant scientific evidence that woody vegetation is of significant value for accomplishing these goals, the Regulations were crafted to protect existing woody vegetation. The values and functions of the buffer for achieving these goals are discussed in *Chapter 2* of this manual and serve as a guide to clarifying the purpose of the buffer and the reasons for retaining as much woody vegetation as possible, subject to the allowed exemptions and modifications discussed herein.

Generally, the intent of the Regulations is as follows:

- Protect existing wooded buffers, while allowing certain modifications to the extent that they do not diminish the ability of the buffer to perform its water quality functions.
- Where no vegetation exists in a buffer, or the existing vegetation is insufficient to accomplish the three functions of retarding runoff, preventing erosion and filtering non-point pollution, effective vegetation must be established and woody buffer plantings are encouraged.
- Where a property had a lawn prior to the adoption of the local Bay Act program, no additional planting is required, although the addition of woody vegetation is encouraged for the benefits they would provide.

Scientists consider the multi-tiered buffer (with mature canopy trees, understory trees and shrubs and groundcover) to constitute the ideal buffer that will accomplish the maximum buffer functions. Therefore that model is presented in this Manual as the goal. However, the Board and Department staff acknowledge that meeting this model may not always be achievable.

While the entire 100-foot wide buffer is required to accomplish the buffer requirements, scientific studies have noted that, on first, second and third-order streams (headwater streams and those less than approximately sixty feet wide), the twenty-five feet closest to the stream provide functions critical to the stream health that are in addition to the benefits the remainder provides.[1] The ability of this portion of the buffer to moderate water temperature, provide bank stabilization and supply organic debris for aquatic organisms makes it especially sensitive to potentially harmful activity such as chemical use, or excessive removal of vegetation and ground floor debris. Because of this sensitivity, owners should try to avoid activity in these areas, leaving them undisturbed to the degree feasible.

The process established by the local government for approval of buffer modifications should include a water quality impact assessment (WQIA) for any disturbance in accordance with § 9 VAC 10-20-130.1.a. This would not apply to exempted activities. However shoreline erosion control, access paths that involve construction activity or woodlot management activity, such as removal of large amounts of invasives resulting in land disturbance, would require a WQIA.

Each chapter is intended to stand alone and may, therefore, contain information that has been presented in prior chapters. Included in these chapters and appendices are suggestions and recommendations, based on scientific studies, and the most current guidance available in the literature about on how to achieve the goals of the Chesapeake Bay Preservation Act while permitting reasonable modifications and activities that do not diminish the functions of the buffer: retarding runoff, preventing erosion and filtering non-point pollution. Ultimately, each local government will have to determine how to best address oversight of buffer exemptions and modifications and the decisions associated with them.

[1] Lowrance, Richard, et al. (August 1995, Reprint 1998). *Water Quality Functions of Riparian Forest Buffer Systems in the Chesapeake Bay Watershed.* pp 5-17.

1 - Introduction

Purpose

The purpose of this guidance manual is to provide assistance to local government staff for the implementation of the buffer modification provisions of the Chesapeake Bay Preservation Area Designation and Management Regulations (Regulations). Local Bay Act program administrators should use this document when working with riparian landowners on buffer establishment, management, and restoration issues. This guidance manual has the potential to greatly enhance local administration of the Regulations through improved riparian buffer management strategies, thereby protecting and, in some cases, helping to improve the water quality of the Chesapeake Bay and its tributaries. Although this manual was written specifically for Tidewater Virginia localities, it may also serve as a resource for other communities interested in riparian buffer protection and management.

Project Background

The Regulations require that a vegetated buffer area not less than 100-feet wide be located adjacent to and landward of all tidal shores, tidal wetlands, certain associated non-tidal wetlands, and along both sides of all water bodies with perennial flow. These aquatic features, along with the 100-foot buffer area, comprise the Resource Protection Area (RPA) and serve a direct water quality function by reducing excess sediment, nutrients, and potentially harmful or toxic substances from groundwater and surface water entering the Chesapeake Bay and its tributaries. Riparian buffers also help to reduce the magnitude and frequency of periodic flood surges, provide critical habitat to terrestrial and aquatic species, stabilize stream banks, and provide recreational, aesthetic, and economic benefits.

Since the original adoption of the Regulations in 1989, the Chesapeake Bay Local Assistance Department, now a part of the Department of Conservation and Recreation, has noticed significant impacts to riparian buffers in the Tidewater region. Many of these impacts are a direct result of unmanaged buffer activities within the 100-foot buffer portion of the RPA. Under the Regulations, vegetation in the 100-foot buffer must be preserved if present and established where it does not exist. However, the Regulations

permit a property owner to modify the buffer by removing vegetation for the following reasons: (i) to provide for reasonable sight lines, (ii) the construction of access paths, (iii) general woodlot management, and (iv) shoreline erosion control projects. However, these permitted buffer modifications raise many administrative and technical issues for local government staff. If buffer modifications are not implemented and monitored correctly, these actions have the potential to impair the water quality functions of riparian buffers. The Department recognized that the local governments need specific guidance on how to interpret and implement the sections of the Regulations that address buffer establishment, conservation, restoration, and modification.

The Department sought funds to provide for riparian buffer research and the eventual development of a formal guidance manual that could be distributed to local governments in the Tidewater region. In October 2001, the Department was awarded a grant from the U.S. Forest Service (through the Chesapeake Bay Program's Forestry Workgroup) to undertake the *Riparian Buffer Project.* The primary goals were (1) to promote the establishment and conservation of riparian forest buffers within Tidewater localities through the development and distribution of informational materials and (2) to publish a buffer guidance manual. A Buffer Issues Committee was formed and included staff from Tidewater local governments and the Department. The committee met several times, discussed the major riparian buffer issues, and assisted with the development of this manual. A Technical Committee was also established to assist with the more technical aspects of the project such as buffer planning, design, and establishment (planting). A list of the contributing members for this project can be found in Appendix H of this manual.

USING THE MANUAL

This guidance manual is intended to provide assistance to local governments in the administration of the buffer modification provisions of the Chesapeake Bay Preservation Act Regulations. This manual primarily focuses on buffer modifications (alteration of buffer vegetation) rather than development-related buffer encroachments. The Department has published several guidance documents that cover permitted development in Resource Protection Areas, buffer encroachments, and expansion of non-conforming uses.

There are 84 different local governments in Tidewater Virginia, each with its own means of implementing the Bay Act. The intent of this manual is to provide guidance that is general enough to accommodate various settings and situations, but specific enough to be useful to local staff. The "Recommended Procedures for Local Government" sections found in the chapters provide suggested guidance on administrative procedures for handling buffer modifications. The information in this manual represents the minimum standards for consistency with the Regulations, although there are other alternatives available to local governments that would satisfy the intent of the Bay Act. Before implementing procedures or policies that may conflict with this official Department guidance, the local government should contact DCR to determine if such alternatives are a consistent application of the Regulations.

As you read through this manual, you will notice that there are no in-depth discussions of buffer encroachments for silviculture, agriculture, or development. These topics are covered in other DCR guidance documents that are available on the Department's website, which is located at www.dcr.virginia.gov under Chesapeake Bay Local Assistance. You may also contact the Department at 1-800-CHES-BAY or (804) 225-3440 if you would like copies of guidance documents mailed to you.

2 - Riparian Buffer Functions and Values

Vegetated riparian buffers are one of the most functionally beneficial and biologically diverse systems that also provide services of great economic and social value. Benefits derived from vegetated riparian buffers, especially forested buffers, include water quality enhancement, stormwater and floodwater management, stream bank and shoreline stabilization, water temperature modification, wildlife habitat protection, and absorption of airborne pollutants. These benefits can translate into increased quality of life and real savings for the community.

Riparian buffers are complex hydrologic and ecological areas that are transitional zones between the surface waters and the upland areas. Although initially thought of as agricultural best management practices, or BMPs, their multifunctional abilities are becoming better appreciated. Traditionally, BMPs were primarily used to control the quantity and quality of stormwater runoff for erosion and sediment, but did not necessarily address issues related to the effects of infiltration and the quality of ground water. A buffer's value lies not only in the ability to moderate erosion and sedimentation, but also in the ability to improve water quality in ground water and surface water runoff, increase the base flow of streams, and provide a biologically diverse habitat.

Buffers may also serve as attractions for tourists and community members, becoming greenways and recreation areas for hikers, birders, photographers, fishermen, picnickers and other outdoor enthusiasts. The influx of visitors to the community can spur an expansion of the local economy from tourism and accessory businesses. These corridors increase the aesthetic appearance of a community, enhance property values, and increase local tax revenues.

Water Quality Benefits

Riparian buffers are noted for their ability to protect or enhance water quality. A vegetated riparian zone can trap sediment, and reduce or remove nutrients and other chemicals from precipitation, surface waters and ground waters. The percentage of removal of these contaminants depends upon the width of the buffer, the composition of the vegetation in the buffer, the type of soil present,

the topography, the geohydrologic setting and climatic variables within the region.

Erosion and sediment control

A small amount of erosion and sedimentation occur naturally within any hydrologic system, but when land is developed upland of a Resource Protection Area (RPA), it can intensify, causing damage to all areas of the ecological system. A riparian buffer, while not capable of preventing upland erosion, can mitigate the effects on water quality from upland sources of sediment.

Sediment can come from either upland sources or from the stream itself. In general, the greatest sources of sediment are row crop agricultural fields and construction activities. Livestock that are permitted direct access to streams can cause bank destabilization and erosion, adding to the sediment load, as can some timber harvesting practices, especially when a site is clear-cut or forest roads are poorly maintained. Instream dredging activities for mineral resources can also contribute to channel degradation and downstream turbidity.

Sediment that reaches surface waters is a pollutant that can be hazardous to the aquatic plant and animal life. It increases the turbidity of the water, increases the scouring effect of moving water and can transport sediment-bound chemical pollutants, such as phosphorus. The increased turbidity can have a direct effect on fish that are too sensitive to survive the excess suspended sediment. When suspended sediments settle to the bottom of the channel, critical habitat for fish and other species may be degraded. Benthic organisms can suffocate, depleting the food supply for many fish, and reducing the abundance of filter-feeding organisms that help clean the water. The turbidity also prevents sufficient light from reaching submerged aquatic vegetation (SAV) and benthic algae necessary as food for the various forms of aquatic life.

Buffers can reduce the quantity of surface runoff reaching a stream by enhancing infiltration and ground water recharge, which in turn reduces peak streamflows and helps to prevent increased velocity within the channel bed. Channel erosion occurs when the velocity of the water in the stream causes it to cut into the banks and channel. This is a major source of stream sediment.[1] The water and suspended sediment scours the stream channel and undercuts banks making them unstable and causing them to slump into the stream. In urbanized areas, intensified streambed flow

results from decreased infiltration in the watershed due to increased impervious area and the concentration of flow off impervious surfaces into man-made channels before reaching streams. Channelization increases stream velocity causing greater scouring ability.

Riparian buffers help to reduce the stream sedimentation in several ways. A buffer may keep the land disturbing activity far enough back from the water feature that the disturbance does not directly affect the banks. Buffers can also reduce the speed and volume of overland runoff through enhanced infiltration. The vegetation, roots, leaf litter and detritus can trap sediment from surface runoff before it reaches the water. The vegetation, particularly their roots, helps stabilize stream banks preventing their failure, and also provides woody debris within the stream that helps trap sediment. During floods, the buffer moderates the velocity of the storm flow that surges onto the floodplain, reducing scouring, and allowing the sediment to settle out and be deposited on land.

The width of the buffer is the primary determining factor for its effectiveness. However, soil and slopes can vary the efficiency of the buffer for removing sediment. In Virginia, a buffer width of 100-feet has been deemed sufficient to protect water quality through the removal of sediment and nutrients. Additionally, on-site sediment control is important in source areas such as agricultural fields and construction sites to prevent excessive loadings from reaching the buffer.

In order for vegetation to be effective at retaining the stream or shore bank, it should have a strong, deep root structure to hold the soil. Woody vegetation with its spreading roots is best for stabilizing banks and deep-rooted warm-season grasses are effective for shore bank erosion control. Structural solutions such as riprap or concrete may halt the erosion on site, but may increase erosion downstream. Such solutions also lack the ecological benefits that wooded solutions have for habitat both in and out of the stream, lake or other water body. (See Chapter 3.4 for more information on shoreline management).

The effectiveness of the buffer also requires that it be continuous along streams and rivers. It is also important for these buffers to be maintained so that rills, gullies or gaps do not develop, allowing runoff to bypass the sediment trapping ability of the buffer. Maintaining a shallow sheet flow into and through the buffer is imperative for its effectiveness. Riparian buffers are especially important on headwater and small streams that have the greatest amount of water-land interaction and, therefore, have the most

opportunities for gaining and transporting sediment. Once that sediment has entered the system it can be continually re-suspended as it travels downstream.

Nutrient and Chemical Control

Nutrients such as phosphorus and nitrogen and chemicals such as pesticides can lead to many changes in the ecology of the water features as well as degrade the quality of potable water used by humans. Although there are natural sources of nitrogen and phosphorus, human activity has accelerated the rate and amount of nutrients reaching ground and surface waters. In rural areas, agriculture is generally the leading contributor of nutrients, from row crops and livestock operations, but residential lawn fertilization and on-site sewage systems contribute a significant amount of nutrients and pathogens. In urban areas the runoff from turfgrass and impervious areas are the principles sources of nutrients. Pesticides entering the system can be toxic to organisms at either lethal levels or at levels that cause sub-lethal deleterious effects.

Nitrogen and phosphorus are two major contributors to the degradation of the aquatic environment in the Chesapeake Bay. Both contribute to eutrophication, a condition resulting from the overabundance of algae. The algal blooms have several consequences. The algae itself consumes oxygen and nutrients that could have been used by other organisms and may release toxins that are directly harmful to other aquatic life. The increase in algae diminishes the amount of light available to submerged aquatic vegetation for photosynthesis, so the SAV declines. The subsequent loss of SAV beds eliminates habitat and food for numerous other species. As the algae die the excess amount of decaying organic matter consumes oxygen so that it is not available for other organisms.

Non-point sources of phosphorus and nitrogen include agricultural and urban fertilization, atmospheric deposition, animal waste from pastures and feedlots, and sewage from septic system drainage fields and leaking sewer pipes.

Phosphorus

Phosphorus is essential to plants for the conversion of sunlight into energy for their use. It has long been known to be the principle cause of eutrophication in lakes and other freshwater

systems, and was removed from laundry detergent for that reason. In estuarine waters, typically affected by nitrogen, seasonal shifts have shown phosphorus to be a factor. Continued phosphorus input from erosion, fertilizer, manure applications and other waste-water sources still disrupts aquatic environments by promoting algal blooms.

Much of the surface application of phosphorus that is not taken up by crops or turfgrass enters surface waters attached to sediment and organic material and is transported in runoff after storm events.[2] Because riparian buffers can act to remove sediment from runoff, a buffer that is effective in removing sediment should also remove the majority of total phosphorus. Indeed most phosphorus is retained in a buffer, and the retention percentage increases with the width of the buffer, assuming the inflow is shallow and uniform.

However, long-term retention of phosphorus may be limited. Unlike nitrogen, which can be released into the atmosphere through denitrification, phosphorus is used by vegetation, adsorbed by clay particles, precipitated with metals or exported into the groundwater.[3] Soils can become saturated with phosphorus, unable to retain additional soluble phosphorus, and vegetation may reach a limit to what it will retain. At a minimum, a riparian buffer can keep the phosphorus producing activity away from the stream. With other tools aimed at reducing the source of phosphorus, a buffer will help regulate the flow of phosphorus that does reach it.

Nitrogen

Non-point sources of nitrogen are the same as those for phosphorus. There are various organic and inorganic forms of nitrogen, some of which can readily change to another form under the right conditions, nitrate and ammonium being two forms that have potential for harm. Nitrate is potentially toxic to infants (mammals, including humans) if it reaches a 10 mg/L concentration, and ammonium is toxic to many aquatic organisms. Both can be difficult and expensive to remove from drinking water in treatment systems.[4]

Nitrogen is generally the principle nutrient causing eutrophication in brackish waters such as the Chesapeake Bay. An over abundance of nitrogen entering the water contributes to algal blooms that block light to underwater plants, absorb nutrients and

release toxins. As the algae die, the decaying matter depletes the water of oxygen causing eutrophication. Dense mats of dead organic matter can sink to the bottom suffocating the bottom-feeding organisms that are the source of food for other aquatic life.

Riparian buffers can have a significant impact on the removal of nitrogen, especially if they have a mix of plants including trees, shrubs and tall native grasses. A vegetated buffer is important for both the control of surface runoff and subsurface flow. Nitrate, a highly soluble form of nitrogen can readily move into ground water and be transported to surface waters. Most nitrogen enters the buffer dissolved in the ground water. According to studies done by the U.S. Geological Survey's Chesapeake Bay Ecosystem Program, "…about half of the water flowing into the Bay originates from groundwater, which carries about half of the nitrogen that enters the Chesapeake."[5] Trees, shrubs and tall native grasses that have significant deep roots extending into the sub-surface waters are important for protecting ground water that has traveled from great distances. So, even if stormwater systems circumvent the buffer, the buffer remains important for subsurface nitrogen removal.

There are several ways that a buffer can remove nitrogen passing through it: uptake by vegetation and denitrification are the primary mechanisms. Nitrogen can also be used by some soil microbes or adsorbed by soil particles. If the nitrogen flows through the root zone of a forested buffer, significant nitrogen removal can occur, primarily from denitrification. However, there are seasonal variations and different levels of removal depending on the vegetation, type of soil and degree of saturation.

Plants can take up a large amount of nitrogen when they are producing new growth, but a significant amount is returned to the soil when leaves die and decay on the ground. However, this nitrogen is available for further processing within the buffer system. Under certain circumstances denitrification is the primary process for permanent nitrogen removal in buffer areas. Denitrification is the conversion of nitrate to nitrogen gas that is released into the atmosphere. It requires a high or perched water table, anaerobic conditions alternating with aerobic conditions, available carbon and denitrifying bacteria.[6] Forested buffers supply both carbon, through leaf litter and detritus, and the denitrifying bacteria. Perched or seasonal high water tables can create the proper anaerobic conditions for denitrification to occur. A forested buffer will also continue processing nitrogen during the winter, unlike some types of vegetation that may go dormant.

While an herbaceous buffer can do significant good by slowing surface runoff and trapping sediment, the most significant gains for removal of nitrogen come from a mixed forested buffer of woody plants. The deep roots entering the ground water supply the necessary carbon and harbor bacteria in the soil for denitrification, so nitrogen can be permanently removed from the system. Much of the nitrogen in a system has entered the ground water quite a distance away from the surface waters. These underground aquifers then slowly carry the nitrogen and other contaminants to surface waters. So, even in an urban situation where most of the stormwater from adjacent properties is piped through a buffer, it still has an important role in pollutant removal. Woody vegetation in these buffers can be of significant value in removing ground water contaminants before they reach surface waters.

Other contaminants

Other contaminants such as pathogens, pesticides, heavy metals, and excessive organic matter can cause degradation in aquatic systems as well. Animal and human waste can supply pathogens and organic matter to surface water. Pesticides, like fertilizer, are applied to agricultural fields and residential lawns. Heavy metals are usually associated with transportation systems and industrial activities, but can enter systems through surface runoff from urban areas.

Pathogenic (bacteria, protozoans, viruses, etc.) contamination is a major pollutant whose survivability increases with high nutrient levels and suspended solids. Pathogens may die off quickly when they enter surface water, but they may become adsorbed by sediments or organic matter in the water and survive longer. These disease-producing pathogens can either harm aquatic life, be passed onto humans when contaminated fish and shellfish are consumed, or by direct contact with the water.[7] Buffers can trap waste from surface waters, preventing it from reaching water features.

Toxins may have immediate effects if present in large amounts, or may cause non-lethal disruptions in the life cycle of organisms such as increasing susceptibility to disease, or disruption of the reproductive or neurological systems. Humans can be affected by toxins in drinking water, fish or shellfish, or by direct contact in water. Pesticides, heavy metals, and hydrocarbons are all examples of toxins that may reach waters and persist in sediment for years. Once they are in the system, floods, boating, dredging,

or construction can release them from the bottom causing continuous environmental disruption.

Riparian buffers help minimize pesticide problems by keeping pesticide application away from the water feature, preventing direct contamination and reducing the risk of drift. They can be useful for the reduction of toxins from surface runoff as well. Many pesticides and herbicides are retained in the buffer decomposing over time, and many heavy metals can be bound to soil particles. As with nitrogen and phosphorus, the dense vegetative cover and litter layers encourage infiltration of pesticides. The dense root biomass and layers of organic matter support a rich soil capable of transforming dissolved chemicals through enhanced microbial activity.[8]

Hydrologic Benefits

The urbanization of a watershed has several effects on the hydrology of an area. The development of an area alters the natural drainage pattern as roads and buildings are fit onto the landscape. This also increases the amount of impervious surface that then amplifies the quantity of stormwater runoff that is concentrated before being released into the existing drainage system. In addition to augmenting the runoff quantity, the concentration of water boosts the speed at which it travels, multiplying the scouring power in surface streams and rivers. Additionally, as most of the existing natural vegetated areas are denuded, local rises in the water table can stress existing deep-rooted trees.

The rapid transport of water away from the land surface by stormwater conveyance systems reduces the amount of water that seeps into the soil and recharges the ground water system. An important function of the riparian buffer is to slow the rate of runoff, increasing the potential for infiltration. The recharging of the ground water is important for maintaining wells and supplying the baseflow waters that feed streams. The vegetation is important for maintaining a uniform flow of water through the buffer allowing longer detention times for pollutant transformation or removal. A uniform flow also helps protect stream and shoreline banks from erosion. During floods, the trunks, stems, twigs, and woody debris within the forested buffers provide a further advantage by modifying the speed of water flow through the floodplain. This reduction in the speed of water flow helps to encourage the settling of sediment and associated contaminants.

HABITAT BENEFITS

Forested buffers provide benefits to habitat both instream and on land. Aquatic habitats are affected most profoundly by excess sediment, as discussed earlier. A primary benefit of riparian buffers is their preventative ability in limiting sediment, nutrients, and toxins from reaching the water and degrading aquatic habitat. A forested buffer can provide additional habitat enhancements to the aquatic system by providing food, shade, and woody debris or snags for shelter. On land, the terrestrial habitat benefits from the ready availability of water, the abundant food supplied by riparian vegetation and the variety of cover provided by trees and shrubs to support a diverse selection of organisms.

Healthy aquatic habitats depend upon clean water. Certain microorganisms and invertebrates at the bottom of the food chain require a high quality of water to survive. As water quality declines and these organisms disappear, valuable resources dependent upon those organisms for food or ecological services also decline.

When the temperature of a stream rises due to the lack of shade provided by a forested buffer, it may no longer support valuable resources. The smaller tidal and non-tidal freshwater streams in the Tidewater area are important breeding grounds and nursery habitat for economically and ecologically important species of shad and herring. These resources depend upon an intact riparian corridor and the benefits, such as lower water temperatures, that a riparian canopy provides.[9]

Other resources such as SAV or oysters depend upon an adequate buffer to prevent sediment, nutrients, and other toxic chemicals from reaching the water and degrading their habitat to such an extent that they cannot thrive. The water quality functions of a vegetated riparian buffer can help maintain a supply of clean water vital for a healthy habitat.

Aquatic habitats

Terrestrial inputs to small streams are the predominant source of food for aquatic organisms. Microorganisms that form the bottom of the food chain break down the leaves, twigs, fruits, nuts, flowers and insects that fall into the stream. The nutrients derived from detritus contributed by the forest provide food for aquatic plants as well. The invertebrates that depend on organic debris and microorganisms are in turn important sources of food for

fish. The seasonal increase in organic material in spring and fall coincide with the increase in insects and with fish reproduction and growth.[10] If the woody vegetation were removed from the buffer it would affect the abundance and types of insects, thereby affecting the species of fish present. In large rivers and streams, the edge of the channel provides habitat for the smaller fish. They depend on the insects and debris, which falls from the riparian area, for food.

A forested buffer provides environmental enhancements as well, through moderating stream flow and velocity, providing shade, and large woody debris. As discussed earlier, the buffer reduces the velocity of runoff and absorbs much of the runoff water. Natural seasonal flow patterns have an affect on the life cycles of many aquatic organisms and water levels can affect breeding activity. Velocity affects the amount of oxygen and organic material that is present and whether or not a species can move up and down the stream.[11] Forested buffers, because of their absorptive capacity, moderate the effects of flooding as well as the consequences of drought. During flooding they may also provide habitat for breeding populations. Floodwaters may pick up debris, organic matter and small organisms. These nutrients return to the stream channel when the water recedes, providing food for aquatic plants and microorganisms that in turn feed the larger fish.

Trees dropping large woody debris into a stream promote a variety of habitat for a diverse number of aquatic organisms. Large logs help create pools, riffles, or still backwaters that function as places for fish to rest and juveniles to seek shelter. They supply cover from overhead predators and sunning spots for reptiles and amphibians. Logs also provide surface habitats for invertebrates to colonize. Woody debris can capture twigs, leaves, and other organic food items, such as seeds, or provide surface areas for invertebrates to colonize. Benthic populations are greater in areas with ample woody debris and snags to create habitat for reproduction.

The canopy of a forested buffer has a direct affect on the light and temperature of the stream water. The amount of light that reaches the stream is important for the rate of plant and algae growth. Sunlight hitting a stream raises the water temperature with many biological consequences. A higher temperature can increase decomposition, decrease the amount of oxygen in the water and increase the amount of nutrients released from suspended sediments.[12] The higher temperature and greater amount of light can encourage the growth of algae and parasitic bacteria while creating an environment that supports a less diverse community. Many

species of fish can only survive within a specific range of temperatures. Higher temperatures will prevent some species from thriving and stress others beyond survival.

Terrestrial Habitat

The plant communities of riparian areas are highly productive and typically contain a wide diversity of species. The regular input of nutrients and organic material, combined with the typically rich, moist soil supports a wider variety of both plants and animals than the surrounding lands upland of the riparian area. They also provide a variety of edge conditions along both the stream and adjacent land providing multiple habitats for wildlife.

Riparian buffers can provide habitat for an equally diverse animal community depending on the surrounding land uses. The complex plant community of a natural buffer provides water, food and shelter for both permanent and migrating species. The availability of food from seeds, fruits, buds and twigs to insects and small mammals makes the buffer an important source of food. The variety and complexity of wooded buffers supplies numerous opportunities for shelter for birds and small animals. Riparian areas provide corridors of habitat within agricultural settings and may provide the only natural areas in urban landscapes.

The particular mix of vegetative species may determine the density and diversity of animals within the buffer, but a greater diversity of wildlife is present in forested buffers because of the more complex habitat. In landscapes lacking large forests, a forested buffer may provide habitat for large mammals such as deer or other mammals such as beaver, raccoon, and muskrat. As areas surrounding urban development expand, the importance of riparian forested buffers increases. The remaining riparian forests may be the only vegetated corridors remaining for wildlife to travel for food or to find a mate.

Small mammals such as squirrels, mice, voles, shrews, and chipmunks are more likely to favor a riparian forested buffer than adjacent uplands because of a greater diversity of trees and shrubs for food and shelter. Reptiles and amphibians also favor riparian buffers, especially along smaller streams where many spend their entire lives. Birds in agricultural areas favor forested buffers for habitat. The diversity of bird species increases in the buffer even when a bottomland forest area is adjacent to existing forests.[13] Wider buffers (164 ft to 328 ft.) are more likely to provide breeding habitat for neo-tropical migratory birds as well.[14]

OTHER BENEFITS

Many of the advantages that natural systems derive from riparian buffers are equally important for the economic, health, aesthetic or recreational benefits that humans can receive from them. One obvious benefit is the retention of floodwaters within a flood plain, preventing the loss of property and life. The reduction of stormwater runoff can translate into millions saved in stormwater management structures and erosion control measures. An intact, forested buffer can also hold soil in place and help retain the natural hydrology behind a shoreline bank. This can be invaluable in the prevention of shoreline erosion and failure, which might otherwise necessitate an expensive structural solution.

In addition to providing aesthetic value to property, wooded lots have a higher resale value. Summer shade from deciduous trees can reduce cooling costs up to 50%, while blockage of winter winds by evergreens can save heating costs up to 20%.[15] A forested buffer has additional value for air quality since trees can remove many pollutants from the atmosphere as well. Pollutants such as carbon monoxide, sulfur dioxide, ozone and nitrogen dioxide are introduced into the air from burning fossil fuels. These chemicals can be deposited on the water adding to the pollutant load, but trees can be an important tool in their removal as well.

Fish streams require surface shading provided by forest buffers, otherwise the fish populations diminish. Anglers drawn to productive streams provide millions to the state and local economies as do game hunters after deer, waterfowl and other small game that inhabit buffer corridors and the waters they protect. The quality of water directly affects the breeding grounds and habitat of many of our commercial fin and shellfish that support a large commercial fishing industry. In Virginia, the water quality standards include a strict fecal coliform limit for its shellfish waters. The economic benefits may also include the use of the buffer as managed forest to produce lumber or other products such as nuts, berries or mushrooms.

The qualities of a buffer that increase the quality of life for residents in an area may also increase tourist visitation bringing tourist dollars. Recreational possibilities increase with abundant forested riparian buffers. The higher quality habitat of a forested buffer ensures the presence of a greater and more desirable amount

of sports fish. A wider forested buffer brings an increase in the diversity of birds for bird watchers, a fast growing segment of recreational tourists. Farmers have come to appreciate the diversity of small game that increases as forested buffers are restored or expanded.

Riparian buffers offer opportunities for the development of community greenway trails connecting parks or other neighborhood open areas. Paths for hikers, bicyclists, skaters, or even equestrian trails can add to a community's quality of life. Safe paths may connect neighborhoods to schools and provide educational opportunities for science classes and nature clubs. Just the aesthetic qualities alone can add value to property providing seasonal changes, shade in summer, flowers and birds in spring, and fall color.

SUMMARY

Riparian buffers fulfill many functions on several different levels. While required by the Chesapeake Bay Preservation Act for water quality benefits, the advantages realized by a natural or established forested buffer go well beyond clean water, erosion control and control of runoff. The presence of properly vegetated buffers provides biologically diverse habitats both in the water and on land. They are complex ecological systems that connect the upland areas with surface waters providing a transitional area through which both the surface and ground waters flow. Protecting riparian buffers protects human health and welfare by protecting water supplies, and may create economic advantages through increased property values.

The ability of the buffer to reduce the speed and volume of stormwaters and floodwaters encourages their retention in the soil helping prevent the loss of property and lives. In slowing the progress of the floodwaters, the buffer also reduces the velocity of the stream, allowing sediment and attached nutrients and toxins to filter out and settle. The woody vegetation with associated litter slows stormwater runoff, reducing erosion and permitting infiltration of water to recharge the ground water system. Detention within the buffer of both surface and ground waters allows the retention or transformation of pollutants before they can reach open waters. The vegetation along streams and coastal shorelines hold the banks in place with their roots, minimizing the addition of further sedimen-

tation through bank failure.

As part of greenways and open space within a community, riparian forest buffers provide numerous opportunities for recreation and education. Hikers, birdwatchers, and bicyclists can all enjoy the variety of landscapes and habitats in a buffer. Sporting enthusiasts also enjoy the fishing and small game opportunities available in forested buffers. As part of the quality of life in a community, a system of buffers may add to the economy of an area as well through aesthetics and land value.

Riparian forest buffers add a variety of benefits to a watershed and its adjacent communities. While its primary value is derived from its water quality, flood control and erosion control functions, fortunate side effects of a functioning buffer are the benefits to fisheries and wildlife and to the quality of life for communities' citizens.

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[1] Wenger, S. (March 5, 1999) *A review of the scientific literature on riparian buffer width, extent and vegetation. Rev.* Office of Public Outreach, Institute of Ecology, University of Georgia. p.18.

[2] Klapproth, J.C. & Johnson, J. E. (2000). *Understanding the science behind riparian forest buffers: Effects on water quality.* Virginia Cooperative Extension Service Publication Number 420-151. p.3.

[3] Wenger. p. 22.

[4] Wenger. p. 24.

[5] The Bay Journal. (June 1998). "Lag time of groundwater dampens hope for fast Bay cleanup." Dec. 17, 02. p.1.

[6] Klapproth, J. C. & Johnson, J. E. (2000). *Understanding the science behind riparian forest buffers: Effects on water quality.* Virginia Cooperative Extension Service Publication Number 420-151. p.4.

[7] Klapproth.*Effects on plants.* p.6.

[8] Brinson, M. M. (2002). *Riparian Areas: Functions and strategies for management.* National Academy Press. *p.74.*

[9] Dr. Greg C. Garman, e-mail to author, May 20, 2003.

[10] Klapproth, J. C. & Johnson, J. E. (2000). *Understanding the science behind riparian forest buffers: Effects on plant and animal communities.* Virginia Cooperative Extension Service Publication Number 420-152. p. 8.

[11] Klapproth. *Effects on plants.* p.9.

[12] Klapproth. *Effects on plants.* p.9.

[13] Wenger. p. 37.

[14] Wenger. p.38.

[15] Bay Journal. May 1999. "Forests offer tree-mendous benefits." Vol.9 Number 3. p.1.

CHAPTER 3 - PERMITTED BUFFER MODIFICATIONS

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3.1 - Sight Lines and Vistas

Purpose:

This chapter examines the circumstances under which removal or alteration of vegetation is allowed and the extent to which it can occur in order to achieve reasonable sight lines and vistas. The intent in providing a sight line or vista is to allow the property owner an enhanced view of an adjacent water body, but to do so in such a way as to retain the water quality functions provided by the buffer.

Regulations:

§9 VAC 10-20-130.5.a states that:

"In order to maintain the functional value of the buffer area, existing vegetation may be removed, subject to approval by the local government, only to provide for reasonable sight lines, access paths, general woodlot management, and best management practices, including those that prevent upland erosion and concentrated flows of stormwater, as follows:

(1)"Trees may be pruned or removed as necessary to provide for sight lines and vistas, provided that where removed, they shall be replaced with other vegetation that is equally effective in retarding runoff, preventing erosion, and filtering non-point source pollution from runoff."

A sightline is a filtered view to the water.
Woody vegetation is retained.

DEFINITIONS

SIGHTLINE*: a line extending from an observer's eye to a viewed object or area

VISTA*: a distant view through or along an avenue or opening

TROPHIC LAYER: a level or group of vegetation sharing similar characteristics such as size: i.e. the canopy layer, the shrub/sapling layer, or the groundcover layer

*according to Merriam-Webster Dictionary online <http://www.merriamwebster.com/cgi-bin/dictionary>

DISCUSSION:

Vegetated riparian buffers are the last defense in preventing non-point source pollution from reaching the Chesapeake Bay and its tributaries. Not only does the buffer mitigate runoff from the upland but, if forested, it also removes nutrients and pollutants from ground water that originates from areas further away from the surface water. The roots of trees and shrubs and their associated microbes can help remove nitrogen and convert some pesticides and other toxins to harmless substances before they reach ground water and surface waters. Roots and leaf litter also help slow stormwater runoff, allowing infiltration into the soil where pollutants may be removed and the ground water recharged.

The desire to view the water is a major reason for development along rivers and shorelines. Understandably, owners often prefer to have an open, unobstructed view of the water. However, excessive removal of buffer vegetation can reduce the effectiveness of the buffer functions.

In order for the buffer to function as intended, it should contain the full complement of vegetation that includes all trophic layers: shade trees, understory trees, shrubs, and ground cover, whether the groundcover is vegetation, leaf litter, or mulch. Therefore, should trees or other vegetation be removed to provide a view, they must be

A GOOD SIGHTLINE CLEARING

- √ Achieves a filtered view through vegetation.
- √ Retains all trophic layers.
- √ Replaces any removed vegetation with woody vegetation of equal value.
- √ Uses appropriate native vegetation.

Alli Baird - CBLAD

THIS!

Example of a good sightline towards the water. All trophic levels are retained, yet a clear framed view of the water is acheived.

replaced with material that provides an equivalent level of water quality protection. The Vegetation Replacement Rates table, found in Appendix D, is considered to provide an equivalent level of water quality protection and may be a useful reference for local governmants.

An entire trophic layer should not be removed.

Alli Baird - CBLAD

NOT THIS !!

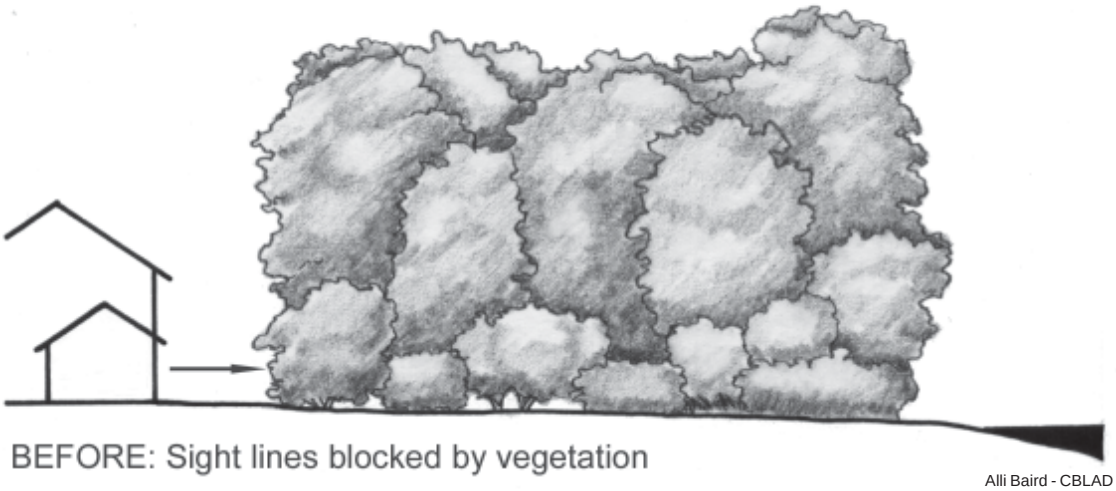
Entire understory and groundcover has been removed. The woody vegetation has not been replaced.

✖UNACCEPTABLE PRACTICES

- ✖ Clear-cutting any area within the buffer.
- ✖ Removal of a complete trophic layer.
- ✖ Removal or disturbance of groundcover, be it vegetation, mulch, leaf litter, or woody debris.
- ✖ Conversion of groundcover plants or leaf litter to lawn.

An existing forested buffer, containing shade trees, understory trees, shrubs, and groundcover, may not allow a reasonable view of the water, so a combination of pruning and judicious removal of a reasonable amount of vegetation may be permitted. ***There should be no reason to remove any leaf litter or groundcover to achieve sight lines or vistas.*** Appropriate native woody vegetation must replace trees and shrubs that have been removed so that the buffer will still achieve the requirement for retarding runoff, preventing erosion, and filtering non-point source pollution as set forth in §9 VAC 10-20-130.3.

Once the preferred sight lines are chosen for views through a dense existing buffer, the most desirable solution would be to prune trees and shrubs to enhance the view. This will maintain the functional integrity of the buffer while allowing filtered views of the water body. A clear-cut or removal of too many trees and shrubs prevents the buffer from maintaining its water quality functions. ***Clear-cutting of any area is not permissible to achieve sight lines or vistas.*** Pruning can open up what appears to be dense, impenetrable vegetation and will often provide extensive, pleasing, and interesting water views. Shrubs may also be pruned down for views over them, and tall shrubs may be limbed up to



BEFORE: Sight lines blocked by vegetation

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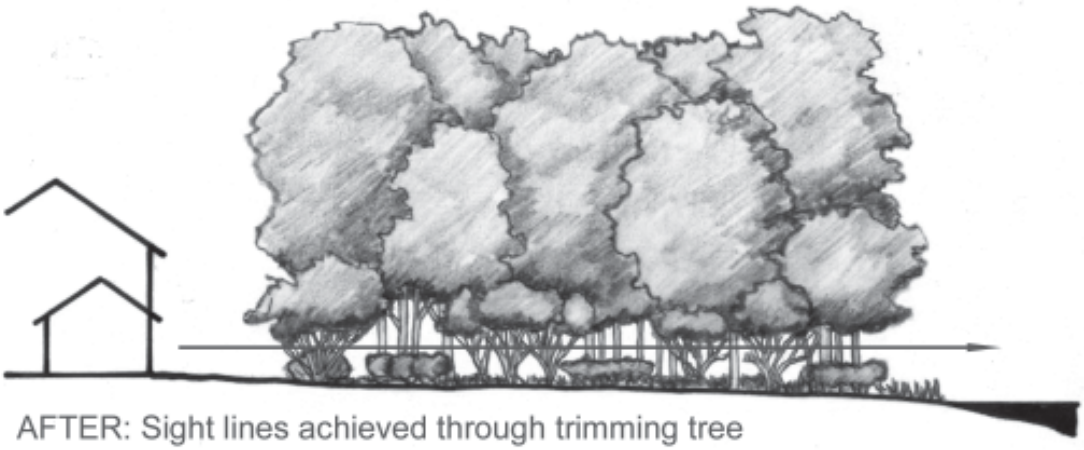

AFTER: Sight lines achieved through trimming tree branches, pruning shrubs and limbing up large shrubs.

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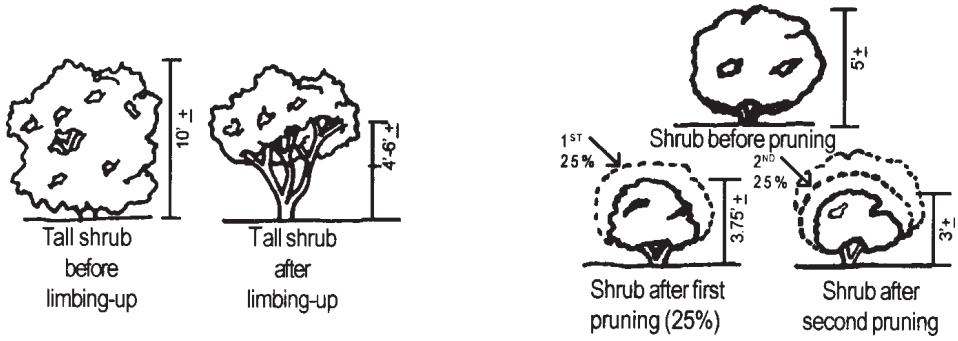


PRUNING

- Prune shrubs down to a minimum of 3' or limb up
- Do not remove more than 25% of any plant at one time to assure plant survivability.[1]

[1] Judy Okay, Virginia Department of Forestry. e-mail. October 1, 2002.

Alli Baird - CBLAD

Colin Cowling-CBLAB

A vista may be created by the judicious removal of vegetation to achieve a framed view to the water. Woody vegetation is retained on either side, at the top of the bank and on the bluff below.

Landowner Steps to Create Sightlines

- Choose sight lines and/or vista from the house to the water.
- Select vegetation for pruning.
- Prepare plan for pruning, removal and restoration.
- Mark vegetation proposed for pruning or removal.
- Notify local government for site visit.
- Receive local government approval prior to any action in the buffer.
- Prune or limb up trees and shrubs per approved plan.
- Remove approved vegetation.
- Replace woody vegetation as described in Chapter 5 - Buffer Establishment.

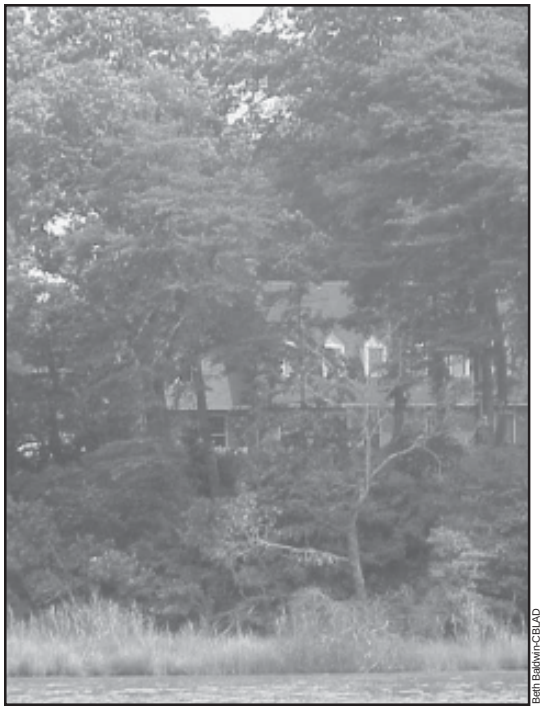
create a tree form that allows views under the canopy.

Always consider pruning and retaining existing buffer vegetation before deciding to remove of any vegetation. However, circumstances may preclude the preservation of all trees and shrubs in the buffer if a view is to be achieved. In this situation, a combination of pruning and removal with replacement may be used to create a vista.

Vegetation on and at the top of a stable bank or slope should be retained. Woody vegetation is valuable for reducing the speed and erosive ability of runoff as well as holding soil in place with deep fibrous roots. The ability of this portion of the buffer to prevent runoff from running down the slope face is invaluable in preventing erosion of the bank and bank failure. The roots also absorb ground water from the soil reducing the potential for slumping. Failure of a bank is hastened by removal of vegetation. Consideration should be given to retaining as much existing woody vegetation on the slope as is feasible to prevent the future need for expensive shoreline remediation.

The local government should have the applicant identify preferred sight lines from the house or other area from which a view is desired and provide photographs from those positions. Ideally, thinly vegetated or open areas should be identified for any vistas or sight lines rather than areas that require modification of an intact buffer. Sight lines should be established after the house has been constructed, so the sight lines will relate to the house, patio or other desired standpoint.

Dead or diseased vegetation should be given priority for removal. Then consideration may be given to to removing pruned shrubs or understory trees that interfere with the sight line. Limit this to removing the fewest feasible. Finally,



Beth Baldwin-CBLAD

Vegetation on the bank is retained, while sightlines were achieved through pruning and limbing up of trees.

canopy and understory trees may be considered for removal to create a framed view towards the water, again limited to the fewest feasible..

Multi-family

In multi-family, apartment, condominium or townhouse developments, each individual unit should not expect to have vistas of the water created through removal of vegetation, since that would potentially diminish the function of the buffer beyond what is required by the regulations. Pruning and limbing should be used to provide views. A vista to the water may be provided from a common area, rather than creating multiple individual views.

REMOVAL RATES

Some counties have chosen removal rates based on the following criteria:

- A % square feet within the buffer to a maximum total square footage.
- A % of the number of trees within the buffer (stem count)
- A % of the basal area within the buffer.
- A % of canopy coverage within the buffer.

Properties with impacted buffers

For properties where encroachments have already been alowed in the buffer, reducing the woody vegetation to less than the 100-foot width, local governments should carefully evaluate requests to remove additional vegetation for a sight line. Since a portion of the vegetated buffer has already been impacted, further removal of woody vegetation could compromise the function of the buffer for pollutant removal. When starting with a diminished buffer, removal of more vegetation should be the last alternative. Pruning and limbing up of vegetation through the most

Landowners with structures encroaching upon the buffer should limit removal of any additional vegetation to achieve sightlines. Pruning may be sufficient.

open or thinly vegetated areas of the buffer may provide an acceptable filtered view to the water.

Replacement planting

Any trees or shrubs removed should be replaced within the buffer with native trees, shrubs, groundcover shrubs, vines, or native perennial, ornamental herbaceous material . (See Appendix A for suggested vegetation for replacement and Appendix D for suggested replacement rates.) Woody vegetation, such as native trees and shrubs, is preferred for replacement plantings, since they have the greatest ability to survive and fulfill the water quality goals of the Chesapeake Bay Preservation Act.

Some local governments that have the authority to do so, require some type of performance guarantee to ensure that the plantings will be established and survive for a reasonable period of time (two years has been suggested), subject to a final inspection by local government staff. These localities typically require that dead or dying plants be replaced and continue the guarantee to ensure the survival of the newly replanted material.

CONCLUSIONS:

- The intent of the Regulations is to retain a functioning vegetated buffer, preferably a naturally forested one, while allowing filtered views to the water.
- Providing sight lines through the buffer should be accomplished with the least amount of disturbance to the existing vegetation.
- All attempts should be made to retain a forested buffer that mimics an undisturbed existing native forest.
- Removal of any vegetation within the buffer requires local approval.
- Open or sparsely vegetated areas should be selected for sight lines before considering undisturbed areas that would require modification and replanting.
- No vegetation should be removed, nor should sight lines be chosen, until construction on the site is finished.
- Groundcovers of woody or herbaceous vegetation, leaf litter, humus or mulch should not be disturbed or removed.
- The first step in creating a sight line should be pruning carefully selected tree limbs and shrubs to allow views through the vegeta-

tion.

- Dead or diseased trees should be considered first for removal to create a sight line.
- After the pruning, if removal of any additional vegetation is deemed necessary, replacement of the removed woody vegetation is required within the buffer to retain the buffer functions.

RECOMMENDED PROCEDURE FOR LOCAL GOVERNMENTS:

Steps to evaluate a request for sight lines or vistas:

1) The local authority should require an applicant to submit plans for creating sight lines or vistas.
   a) The plans should indicate the onsite location of existing trees and shrubs, and indicate the species and size of trees proposed for removal in the area of the proposed sight line.
   b) The plan should identify the location, size, and species of proposed replacement plantings.
   c) The plan should show the house and indicate the location from which a view is desired.
   d) Preference should be given to using existing views and open areas or thinly vegetated areas within the buffer for a sight line.
2) A local government staff member should meet with the applicant on site to evaluate the existing vegetation and determine what is the least disruptive method for providing requested sight lines or vistas.
   a) The applicant should flag all trees and shrubs proposed for pruning or removal for inspection by the local government staff

PLAN ELEMENTS FOR A SIGHTLINE REQUEST

All plans should contain the following information:

- Property owner's name and address
- Property boundaries
- The structure from which a sight line is desired
- Location of existing trees and shrubs
- Location, size and species of trees or shrubs to be pruned or removed
- Location, size and species of replacement trees, shrubs, and groundcover
- Maintenance schedule for replacement planting

before any vegetation is removed.

b) Preference should first be given to dead or diseased trees for removal before considering removal of healthy vegetation .

3) The first option for achieving a view should be the pruning of shrubs and limbing up of trees.

4) Modifications to the submitted removal and replacement plan, reflecting any agreements at the time of site visit, should be resubmitted to staff for final approval before any vegetation is removed.

5) After the chosen solution has been approved and implemented, staff should inspect the site to assure that only the approved pruning and/or removal has taken place.

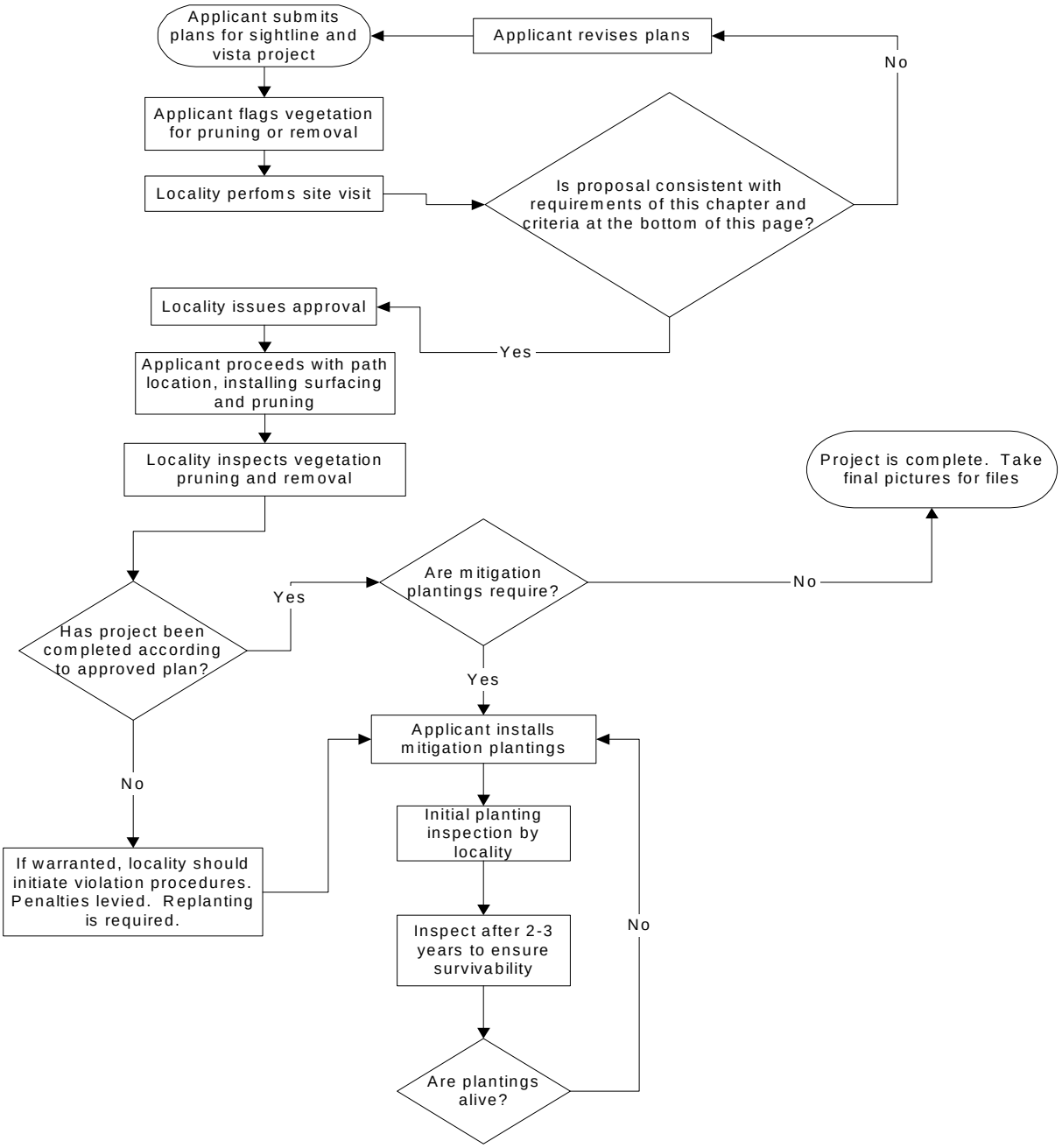
   a) Should violations be found at the inspection, the locality should require replacement plantings and other penalties as appropriate. (See Chapter 5.3 for a discussion on violations and Appendix D for suggested replacement planting options).

LOCAL GOVERNMENT OPTIONS

Local governments, that have the authority and exercise it as a matter of course, have found that the use of a performance guarantee is helpful in assuring that replacement plantings are installed and cared for until they are established.

1. A performance guarantee may be part of the approval process.
2. Such performance guarantee typically has two parts.
   a. Part 1 assures initial installation according to plans.
      (1) Part 1 is usually not released until an inspection has occurred after planting.
   b. Part 2 assures replacement of plants that do not survive.
      (1) Part 2 is usually not released until inspection (usually after two or more years, as specified in the guarantee) to assure survival of the planted material.
3. If the activity has occurred outside of the fall or spring planting season, the performance guarantee should assure planting during the next planting season.

Recommended local review and approval process for sightline and vista projects



Suggested review criteria for sightline and vista clearing projects:

1. Has pruning been considered before removal of vegetation?
2. Is there an opportunity to remove dead, diseased, or non-natives species to provide a sightline?
3. Does the proposal include clear-cutting or the removal of an entire trophic layer?
4. Does the mitigation plan provide for the required buffer function?
5. Are the proposed clearing and/or pruning methods consistent with the recommendations in this chapter?
6. If replacement plantings are required, is a performance guarantee being applied?
7. Is the proposed sightline "reasonable" or is it excessive?

3.2 - Access Paths

Purpose:

The purpose of this chapter is to provide guidance for evaluating plans for access paths to water bodies and will primarily address residential access. On private lands, removal of vegetation is allowed for an owner to walk to the shoreline of their property. Any path should be appropriately designed so as to preserve the functions of the buffer, especially with respect to the prevention of erosion.

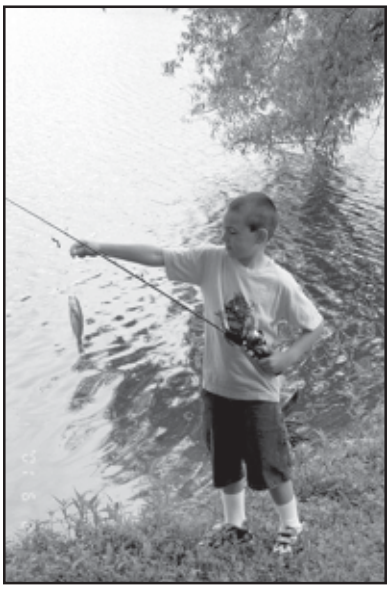
Regulations:

§9 VAC 10-20-130.5.a states that:

"In order to maintain the functional value of the buffer area, existing vegetation may be removed, subject to approval by the local government, only to provide for reasonable sight lines, access paths, general woodlot management, and best management practices, including those that prevent upland erosion and concentrated flows of stormwater, as follows:

(2) "Any path shall be constructed and surfaced so as to effectively control erosion."

Discussion:



The desire humans have to reach water for simple viewing, fishing, crabbing, swimming, or boating, is natural. The Regulations allow the removal of vegetation to create an access path to the water. For the purpose of this manual, an access path means a reasonably narrow pathway through the buffer to provide access to the water. Access for wheelchairs, motorized or not, is included in this definition. Bike paths or bridle paths would be considered "passive recreation facilities" and are dealt with in Chapter 4. Driveway access to put in a boat may be considered under 9 VAC 10-20-130.1 and is subject to the development criteria stated therein.

In order to reach the water, landowners will either create a path by constant trampling or by planning a path to be constructed in such a way as to limit the likelihood of erosion. Depending upon the degree of use, different materials and construction techniques can be used to minimize the erosion effects of a path through the buffer. A private

Alli Baird, CBLAD

This residential community path curves to avoid big trees, is only a couple of feet wide and has a porous gravel paving.

residential property would not typically require a path of the same width or material as a community access path would, since it would not see the same amount of daily use.

Access paths should be sited to fit into the character of the land. Existing open areas should be used and the path should wind around any large vegetation. The path should avoid disturbing the groundcover, leaf litter and mulch within the buffer as well as the existing woody vegetation. While it may be easy to site a residential footpath to avoid big trees and shrubs, there may be some plant removal in order to site the path in the least disruptive location.

Placing a path along banks, bluffs and sloping areas requires greater consideration and may require steps to protect the shoreline. Boardwalks, stairways or banking the path along the slope may be part of the design. However, should banking a path into the slope require significant removal of vegetation, an alternative should be considered. Removal of a quantity of vegetation would increase erosion and not be consistent with the General performance criteria that states that:

"...indigenous vegetation shall be preserved to the maximum extent practicable, consistent with the use or development proposed."

Should a large amount of vegetation have to be removed, best management practices may dictate that replacement planting should be included in the plans to maintain the function of the buffer.

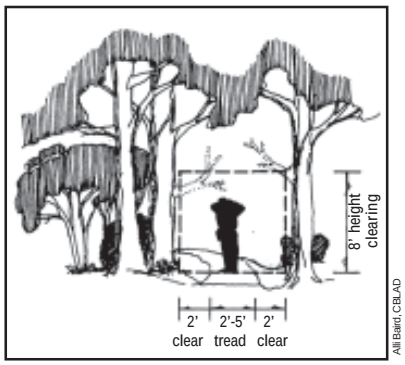
SOLUTIONS:

Access

An existing forested buffer on a residential property should be able to accommodate an access path without much disturbance to the vegetation. As noted above, the path should be located to avoid the majority of the existing vegetation and should wind around existing large trees and shrubs. On some occasions an access path to the water on a residential site may require some judicious removal of shrubs and small understory saplings.

Pruning of trees and shrubs should be the preferred method of clearing an access path through the buffer. Preferably, pedestrian paths should be kept to a 2-foot wide single lane. Wheelchair paths will need to be wider. Pruning of tree branches should not exceed 8 feet in height.[1] When some clearing is required, it should be limited to the pathway area and a maximum width 2 feet on either side of the path.

To minimize the effects of erosion on the sides of paths, native vegetation, or additional mulch, should be used to cover exposed soil. Herbaceous material or additional shrubs may be planted downslope of a path to help retard runoff and prevent erosion.



Path tread and height clearing standards.

Paving

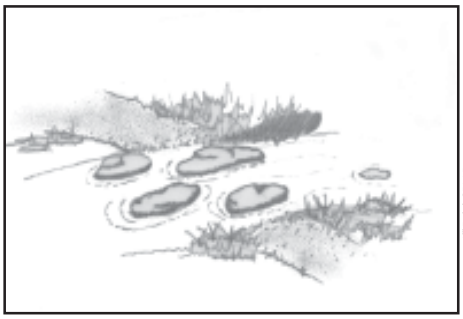
If a significant amount of leaf litter (2”- 4”) is present and can be left in place, no other paving material may be necessary. Should frequent use be expected, some additional material may be required. If a paving material is needed to protect exposed soil, mulch, shell, gravel, stepping stones or other permeable material should be used. Three to four inches of mulch would be the first choice of material, since it is very permeable and does not compact into a hard surface. It is inexpensive, easily replaced, holds water, and adds organic material to the soil, enhancing the denitrification potential of the buffer.

Impervious paving material should not be used for residential pedestrian paths, except for stepping stones. Even paths designed for those with disabilities can be made from semi-permeable granular stone compacted to an accessible surface. Paths subject to more frequent use, such as in residential communities may also require paving to prevent erosion, but pervious surfaces should be used where possible.

A wooden stairway may be the only feasible means of getting down a high bluff or steep slope.

Slopes

While slopes of 5% or less may not be subject to much erosion and can handle relatively straight paths towards the water, steeper slopes may require better planning to minimize potential impacts. Paths on slopes of 5% or greater should be located so as to take advantage of the terrain rather than running perpendicular to the slope. A sloping path cutting straight through the buffer towards the stream bank or shoreline is more likely to concentrate the overland flow. The increased speed and concentrated flow of water keeps the buffer from fulfilling its function of reducing runoff and erosion and preventing pollutants from reaching the water.



Stepping stones can provide a suitable crossing.

Porous paving or surface materials, such as mulch, crushed shell or gravel, should be considered for paths on increasing slopes that may be more prone to erosion. Paths on sloping terrain above 10% should follow the contours of the slope, slowly descending to the water, taking advantage of natural land features and vegetation. However, complete, or even excessive, removal of vegetation to acheive a ramped slope should not be allowed. A solution that does not promote erosion must be found. For slopes of 15% or greater, the path may be designed with a combination of ramping and wooden steps for steeper slopes, or a wooden stairway if descending a bluff to the shore. Such steep sloping paths may also require additional surfacing material.

Stream crossings

Stream crossings should be kept as compatible with the existing stream condition and surroundings as possible. The crossing should take place where there is little disruption of the bank. Ideally the crossing would take place on a well-defined stream channel, at the point of minimal channel width, and a flat stream gradient. There should be stable, gradual slopes on either side of the stream crossing.[2] If in an area where there is infrequent use of a crossing, stepping-stones may provide the least disruptive, most effective solution.

NOTE:

Stream crossings may require permits from :

- **Army Corps of Engineers** (ACOE)
- **Department of Environmental Quality** (DEQ)
- **Virginia Marine Resources Commission** (VMRC)

or other federal, state, local agencies or boards depending upon the location and nature of the project.

Community access paths

Private access paths through subdivision buffers, or multi-family complexes, owned and maintained by a homeowner's association would be used more frequently, so greater thought must be given to location and paving. Slopes, topography and soils should be taken into consideration as well as the intensity of use.

A path in a small subdivision might not see heavy use. A thick layer of leaf litter or mulch may be sufficient to prevent erosion along a pedestrian path, as long as it is well planned and fits on the site. Frequent use, unstable soils or slopes greater than 5% may require packed shell, gravel or other pervious paving to prevent erosion. The least pervious surfacing should be used that will sustain the intensity of use expected.

CONCLUSIONS:

- Access paths should be limited to the minimum width necessary for the use (pedestrian, wheelchair, etc.) in order to preserve as much vegetation as is feasible.
- Ideally, the path should wind around existing trees and shrubs rather than remove vegetation. Removal of large shrubs or trees should be avoided. However, pruning may occur to create a passage through the vegetation.
- Paving material or other path surfacing should be pervious. Mulch should be the first choice of surfacing material. Shells, gravel, stepping stones, or other porous paving material may be used where frequent use, slopes or other factors would result in erosion otherwise occurring.
- Plantings along the side of paths should be used to mitigate the effects of runoff and prevent soil erosion.

RECOMMENDED PROCEDURE FOR LOCAL GOVERNMENTS:

Residential

1) The local authority should require the applicant to request a permit to create a path if:
   a) The path location will require any tree or shrub pruning or removal.
   b) The applicant proposes any paving material.
   c) The path (including any steps) is on a 5% or greater slope, or drops down a bank or bluff.
2) The application for a permit should include a plan that shows:
   a) The proposed location of the path through the buffer.
   b) Existing trees or shrubs to be pruned or removed.
   c) The location, name, and size of replacement plantings for vegetation removed.
      i) Replacement ratio should be a one to one replacement of the same type of plant: i.e. a large shrub should replace a large shrub removed, an understory tree replace an understory tree, or a canopy tree replace a canopy tree; or consider the Vegetative Replacement Standards table in Appendix D.
3) A locality staff member should meet with the applicant on site to evaluate the existing vegetation, soils and slope to determine the least disruptive solution to path placement and paving materials.
   a) Adjustments to the path location to avoid sensitive areas

(such as wet soils or valuable vegetation) should take place at the visit.

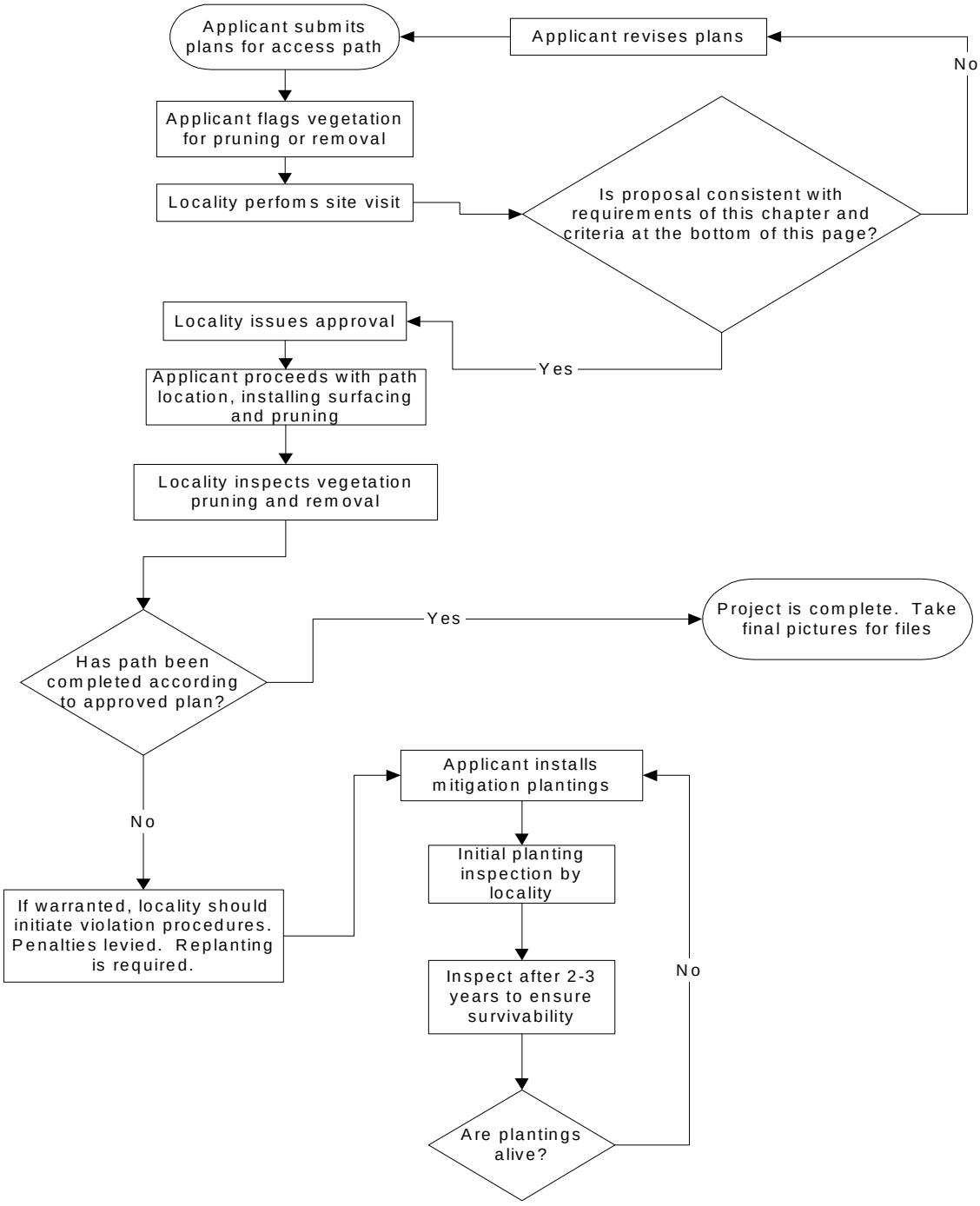
b) Any trees and shrubs to be pruned or removed should be evaluated to see if an alternative location for the path might be chosen.
   i) Any plants that are to be pruned or removed should be flagged or otherwise marked at this time.

c) Location of replacement plantings should be identified at this time, to encourage even coverage of vegetation within the buffer.

4) The locality should issue a permit based on a plan showing the agreed upon solution.
   a) If it has the authority and it is considered feasible for the specific application, the locality may require a performance guarantee of some type to assure replacement should the plants not survive.

5) If extensive modifications are required to locate the path, a staff member should inspect the site after path location and replacement plantings have occurred to assure that the agreed upon plan has been followed.
   a) Staff should inspect the site after a year to assure that the plantings have survived.
      i) If the plants look healthy at that time, the surety may be released.
      ii) If the plants have not survived, replacement plants must be installed and a new performance agreement could be issued to cover the new plantings.

Recommended local review and approval process for access paths



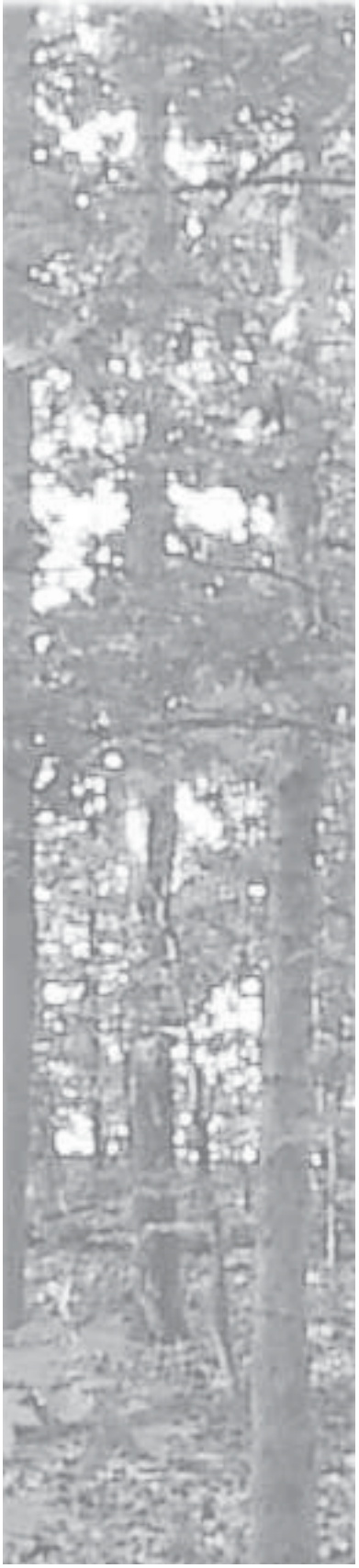
Suggested review criteria for sightline and vista clearing projects:

1. Has pruning been considered before removal of vegetation?
2. Is there an opportunity to remove dead, diseased, or non-natives species to provide a path location?
3. Are the proposed clearing and/or pruning methods consistent with the recommendations in this chapter?
4. Is the proposed path location "reasonable?"

[1] Parsons Harland Bartholomew & Associates, Inc. (Oct. 2000). *The Virginia Greenways and Trails Toolbox: A how-to guide for the organization, planning, and development of local greenway and trails programs in Virginia.* Virginia Department of Conservation and Recreation. p. 4-37.

[2] US Forest Service. *Trails Management Handbook.* FSH 2309.18. Section 3.12d Stream Crossings. <http://www.fs.fed.us/im/directives/fsh/2309.18/2309.18,3.txt>

3.3 - General Woodlot Management


Alli Baird, CBLAD

Purpose:

The purpose of this chapter is to provide general horticultural guidance for local governments to help property owners maintain a healthy, functioning buffer. Management of the riparian buffer is often necessary to maintain the vegetation in the best health so that it can continue to function properly and provide the required water quality benefits. A riparian buffer is a living resource that changes over time. In order for property owners to manage their buffers, reasonable activity is allowed to the extent that it is necessary to assure the health of the forest.

This chapter is intended primarily for the residential homeowner, and for those whose property includes a wooded forest not intended for silvicultural activity. For legitimate silvicultural activities refer to Virginia Department of Forestry *Virginia's Forestry Best Management Practices for Water Quality,* 4th ed. for appropriate management techniques.

Regulations:

§9VAC 10-20-130.5.a states that:

"In order to maintain the functional value of the buffer area, existing vegetation may be removed, subject to approval by the local government, only to provide for reasonable sight lines, access paths, general woodlot management, and best management practices, including those that prevent upland erosion and concentrated flows of stormwater, as follows:"

(3)"Dead, diseased or dying trees or shrubbery and noxious weeds (such as Johnson grass, kudzu, and multiflora rose) may be removed and thinning of trees may be allowed, pursuant to sound horticultural practice incorporated into locally-adopted standards."

Alli Baird - CBLAD

A forest of mixed vegetation will help stabilize a bank by:

- retaining runoff
- preventing channelization
- increasing infiltration
- increasing soil strength
- maintaining sheet flow
- preventing erosion

DISCUSSION:

"A healthy forest can be defined as one with a majority of living trees that are a part of a functioning ecosystem."[1]

That ecosystem is a complex mix of trees, understory shrubs and groundcover. Over time the process of natural succession causes a change in species composition and structure. Small saplings are developing into the next generation of trees as the older ones die out, and understory trees add valuable functions between the larger dominant species. Despite the fact that fire, insects, disease, and natural disturbances such as ice and wind are a normal part of that successional process, in an urban setting, the effects of these natural forces may need to be monitored and controlled where necessary.

Alli Baird, CBLAD

Fine organic debris and leaf litter is essential for retarding runoff, and providing carbon for denitrification.

A riparian, forested buffer may require some degree of maintenance to retain its health and function. Since a forest is a dynamic ecosystem, change is inevitable as vegetation grows and dies. Active management should, however, be based on sound horticultural practice to assure that unwarranted thinning or removal does not occur. The removal of noxious weeds, or dead, dying and diseased vegetation should only be done as necessary to maintain the health of the forest or to prevent fire fuel buildup problems. (For information on reducing fire risk, contact the Virginia Department of Forestry about their

Firewise Program: www.firewisevirginia.org). Removal of any material in the 25 feet closest to a stream should be avoided since the vegetation in this area provides the shade and organic material necessary to maintain the health of the aquatic habitat.

One of the important functions of this area of the buffer is that the roots of permanent woody vegetation helps to maintain the stability of a stream bank, minimizing bank erosion that contributes to instream sediment loading.[2] A wooded buffer with porous soil from leaf litter, fungi, twigs and associated bacteria, increases the ability of the bank to resist failure by enhancing infiltration, helping to decrease surface water runoff that can cause erosion.[3]

The root mass of woody vegetation also has value for nutrient retention, pollutant degradation, and denitrification aided by microbes associated with the roots. These functions cannot be entirely duplicated by herbaceous material such as turfgrass. Additionally, the deeper woody roots are more likely to intercept groundwater carrying pollution from inland sources and remove or convert nutrients, metals, and toxins before they reach surface waters.

In a forested area the roots, twigs, associated leaf litter and detritus are important for slowing stormwater runoff and trapping debris and sediment. The tree canopy is beneficial for attenuating the force of raindrops hitting soil and causing erosion. Raindrops that are intercepted are more likely to evaporate or infiltrate the soil, thereby reducing runoff quantity and rate of flow, producing potentially 30-50 percent less runoff than lawn areas.[4] "In addition to attenuating erosion, another advantage of the increased soil strength that roots impart is that surface soils become more resistant to channelization."[5] Maintaining sheet flow through the buffer is extremely important to gain the greatest value from the buffer. Sheet flow rates are generally lower which increases the probability of infiltration and allows sediment to filter out of runoff.

A forested buffer can help stabilize a steep bank. By helping to curb runoff and encouraging infiltration, erosive channels are less likely to develop and disturb the stability of the bank. Interlocking networks of woody roots provide significant value for soil stabilization, especially on sloping sites, as the roots extend deep into more stable subsurface soil layers. In older trees, the root system can extend as much as two or more times beyond the canopy of the tree, or the "drip line."[6] Before any tree is cut, all alternatives to removal should be explored. "…the practice of removing a majority of trees on a slope can greatly increase the probability of a slope failure in the future as the tree roots decompose and their soil-

CBLAD Staff

Decaying debris provides organic material for aquatic life, and creates instream habitats.

binding capacity declines."[7] The mass of roots, and associated bacteria and fungi that are part of a complex soil food web, improve the soil structure so that infiltration and water-holding capacity is increased and the soil maintains its structure. "…the overwhelming conclusion is that in the vast majority of cases, vegetation (especially well-rooted, mature trees) helps to stabilize a slope."[8]

Dead, diseased and dying Trees

Chris Schnepf, University of Idaho Extension, www.bugwoodimages.org

Rotting logs and other detritus provide nutrients, carbon and other organic enrichments to the soil.

In natural stands, dead and dying trees are a natural part of forest succession as it moves from pioneer to climax forest. Dead standing trees and logs on the ground provide food and shelter to many organisms and provide nutrients to the young forest vegetation as it grows. The carbon contained in the decaying material is a necessary part of the denitrification process, helping to remove nitrogen from the groundwater system. Leaf litter, twigs, and branches are an essential part of the buffer, functioning to retard run-off and return nutrients to the soil.

In the 25 foot area of the buffer next to the water, where dead or dying trees are the result of natural or physical causes (damage to roots, compaction of soil, toxins, wind or lightning), they should not be removed, unless they threaten to undermine the integrity of the stream bank or shoreline. If, for the health of the buffer, they must be removed, the stump and roots should be left in place to help bind the soil. For damaged trees that are otherwise healthy, leaving the stump may encourage new growth and regeneration, or "coppicing", to occur.

Robert F. Wilson, Oklahoma State University, www.bugwoodimages.org

Shortleaf pine coppicing after fire.

Another important function of the area next to the water is to provide woody debris for habitat and decaying detritus that provides nutrients for plants and aquatic organisms. Woody debris that falls into a stream is one of the major factors in aquatic biological diversity promoting a variety of habitats as well as providing a source of slowly decomposable nutrients.[9]

Snags, or dead standing trees, offer nesting and perching sites for

many wildlife and bird species. If they are located where they won't be a danger to life or property, they should be left in place. However, in some instances, the dead or dying woody plants may be harboring insects or disease that require control before they invade other weakened plants in the buffer. Safety may dictate that dead trunks and logs need to be removed where they pose a fire or falling hazard.

Trees that are diseased or infested may have to be removed if the disease or insects threaten other trees and other control methods, such as chemical application, are likely to damage the adjacent waterway. An assessment by a certified arborist, degreed horticulturalist or forester would determine the severity of the problem and whether or not mechanical or chemical treatment might rid a tree or shrub of infestation, or if removal is the only option. Chemical use should be avoided within 25 feet of the water, since use in this area is more likely to result in the chemicals reaching the water.

All tree removal is subject to approval by the local government.

CBLAD Staff

Snags are preferred nesting site for some species of birds.

Noxious weeds

Noxious weeds may be of concern when trying to promote a natural healthy native forest buffer. For the purpose of this section of the Regulations, "noxious weed " encompasses any invasive species that has gotten out of control and has become harmful to the health and survival of the woody vegetation in the buffer. This can include trees such as ailanthus or shrubs such as privets, as well as vines. Noxious does not mean "undesirable" or "obnoxious" plants. Control of non-native, exotic species, or even invasive native species, may be justified when they threaten to over-run or out-compete native trees and shrubs. Some common noxious species are Japanese honeysuckle, kudzu, mile-a-minute, multi-flora rose, English ivy, all privets, and winged euonymus. (For additional lists of invasive species see Appendix B: *Invasive alien species*)

JIM. Swearingen, USDA Forest Service, www.forestryimages.org

Ivy choking a tree

Not all alien plants are invasive all the time. If the noxious weed does not out-

DEFINITIONS

Noxious weeds - vegetation that is physically harmful or destructive to living vegetation, especially to native species

Alien species - non-native species, differing in nature so as to be incompatible with native species

Invasive - tending to spread uncontrollably, overwhelming other, especially native, species; a native species may qualify as an invasive

Exotic - introduced from another country, not native to the place where found

JIM, Sveamingen, USDA Forest Service, www.forestyimages.org

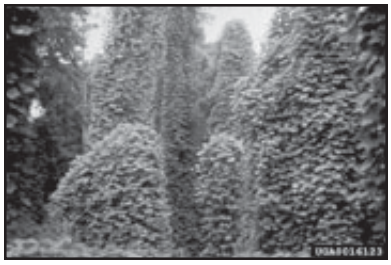
Japanese honeysuckle may be invasive, damaging existing vegetation, but in some instances, such as on a bank where it is preventing erosion, it should not be removed without being replaced with appropriate erosion controlling vegetation.

compete the existing native species, does not alter the ecosystem, does not overtop existing species, adds rather than decreases diversity, or does not change the presence or density of existing species, then intense management or removal may not be necessary. If an invasive species is performing a desirable function such a preventing erosion on a bank, it should not be removed without replacing it with vegetation of at least equal value for erosion control and water quality functions.

The significance of impact on the site and the feasibility of control should dictate the management decisions. Careful planning and research may be required to develop the appropriate management tool for an invasive species. A variety of methods may have to be used depending upon the severity of the infestation. Mechanical control methods, such as pulling or cutting are the least disruptive to the environment. However caution is needed to prevent damage to valuable native species.

Doug Wetmore, CBLAD

Poison ivy choking a tree



Kerry Britton, USDA Forest Service, www.forestyimages.org

Kudzu is an aggressive alien invasive and requires severe measures to remove it from a site. If not removed by hand as soon as it is found, it may overtop and kill the existing vegetation. Removal and replanting of all vegetation may be necessary.

Preferrably, herbicide should be avoided to prevent damage to the underlying native vegetation. However, occasionally the tenacity of an invasive species may require chemical treatment. The choice to use herbicide treatment demands diligence in researching the appropriate product and method of application, for safety and effectiveness. Because of the dangers of unintended damage to non-target species, chemical use should be the choice of last or extreme resort. If it is determined that chemicals are necessary, owners are encouraged to consult with their county extension agent or other knowledgeable source to assure use of the appropriate

David J. Moorhead, The University of Georgia, www.forestyimages.org

Over-crowding in a naturally regenerated stand may require thinning for the vegetation to develop into a healthy woodlot.

chemical at the correct rate. All manufacturers' recommendations and best management practices must be followed to assure the safety of the nearby surface waters.

Thinning

The use of the word thinning was to address the needs of silvicultural landowners to manage timber stands to maximize harvest. If a landowner has a buffer being managed as part of a timber stand, it is recommended that they contact a professional for advice on the best management practices to acheive this purpose.

Forested buffers in residential areas are generally not being retained as lumber stock for economic purposes, so thinning practices should reflect the value of individual trees and other woody vegetation as part of a functioning buffer, rather than as timber grown for economic gain. Thinning is distinct from pruning or removing vegetation to create a sightline or vista and is not the appropriate method to acheive those results. Residential thinning should only be done to improve the health and vitality of a wooded buffer to improve its water quality functions. It does not mean clear-cutting, removal of an even-aged class of trees, or removal of all trophic layers leaving only trees above a certain size.

Many woodlands have grown up after an open property has been abandoned, or after intense logging or clear-cutting, resulting in an even-aged stand that does not necessarily have plenty of young trees to grow and replace those that might die or be removed. Often trees in these naturally regenerated forests are poorly distributed, growing too closely together. This may result in overcrowding and competition for sunlight, water and nutrients, producing slow-growing, weakened trees that could be more susceptible to insects and disease. Additionally, years of neglect or poor

Excessive removal of trees and all understory trees, saplings and shrubs is not acceptable and impairs the buffer functions. This should be considered a violation requiring replanting of understory shrub and groundcover layers.

BEFORE THINNING CONSIDER THIS

Health: Dead, diseased, dying or weakened trees are preferred removal targets.

Age: A tree past maturity is a better candidate for removal than one in its prime.

Natives: Native species are more desirable and should be retained. Target non-natives and invasive species for removal.

Understory: Understory trees and shrubs are a significant part of a healthy self-regenerating forest and should not be removed. Native shade-loving understory trees and shrubs may decline if the canopy is removed, allowing invasives or other undesirable brush to flourish.

TREE CLASSIFICATIONS

In a typical unmanaged, even-aged stand of trees there will be six different classifications of trees:

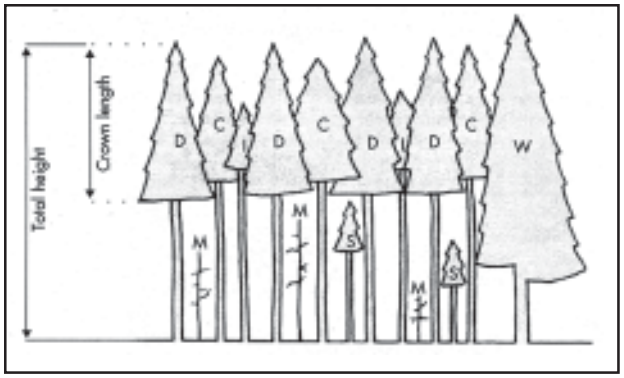
1) **dominant** are those that reach above the general level of the canopy and receive full sun from above and some on the sides;
2) **co-dominant** are those that form the general layer of crown cover, or canopy, receiving full light from above, but little on the sides;
3) **intermediate** are those that have crowns that extend into the general crown layer, but are crowded, receiving little light from above and none on the sides;
4) **suppressed** (or overtopped) are those that have crowns below the level of the crown canopy, receiving no light from above or on the sides;
5) **wolf** are trees that receive light on a full crown canopy and on two or more sides, usually in a mostly open space such as the edge of a forest.
6) **mortality** are dead trees within the stand; these are usually supressed trees or trees attacked by insects or disease.

management may have left only poor quality or undesirable species and a lack of young vigorous trees to replace those lost over time.

An evaluation of a woodlot may determine that thinning or an improvement cut may be a valid method for improving the health, distribution and species mix of a neglected stand. ***It is important to note that, in the practice of silviculture, harvesting or thinning trees is not planned in advance of the woodlot evaluation; the evaluation of the woodlot stocking determines the need for harvesting or thinning.***[10]

Response to thinning

Thinning of young dense forests may increase the growth of remaining young trees and allow selection of the most desirable mix of species. Most thinning is done for commercial purposes of encouraging rapid diameter growth in crop trees for timber harvesting. If the buffer is a dense forest of mixed-aged young trees, between 5-30 years old, and the crown ratio (length of crown in relation to height of tree) is 30 percent or more, thinning may improve the strength and growth of existing trees if they are currently crowding each other. This will release more of the light, water and nutrients for use by the remaining trees, so they should grow faster. It may also help to reduce insect and disease vulnerability by increasing tree vigor, as well as remove broken, deformed or otherwise weakened trees.[11] However, it does not mean remov-



Crown type classifications of trees in even aged stands. D= Dominant, C= codominant, I= Intermediate, W= Wolf, M= Mortality. The "crown ratio" is the proportion of total tree height that is occupied by live crown. In this illustration, the dominants have a 50 percent crown ratio: the wolf tree has an 80 percent crown ratio.*

*Emmingham, W. H., and N. E. Elwood. August 1983. Thinning: An important timber management tool. PNW 184. Pacific Northwest Extension, Oregon State University. p.4.

ing all understory trees, saplings and shrubs. They add significant value to the buffer and are not detrimental to the canopy trees in a buffer being maintained for water quality. The removal of understory trees and saplings will prevent the buffer from continually regenerating naturally over its lifetime.

> ***"A cardinal rule when thinning is to improve the stand's condition for future growth."***[12]
> ***Future growth should include regeneration within the buffer so that the woodlot is sustainable.***

It should be noted that stands that have not been actively managed before they are 15-20 years old generally do not respond to thinning with a significant increase in growth. If the remaining trees have less than 30% crown ratio or are shade-intolerant species, they may not respond positively to thinning and may even decline. Since timber harvesting would not be a goal of residential buffer thinning, the same standards for evaluation should not be used.

Another consideration may be the consequences of removing overstory trees. Understory shrubs that have been stunted in the shade may thrive when the overstory is removed and interfere with views as the shrubs grow higher and need frequent trimming. Other native shade-loving shrubs may become overstressed by excessive sunlight and give way to less desirable or weedy species if the adjacent protective overstory is removed. Non-native invasives that have been suppressed by overstory shelter may become prolific if the shelter is removed.

Competition within a stand

As an even-aged stand grows, some trees grow faster and out-compete the others: some become dominant while others fall behind to become co-dominant. The intermediate trees never managed to compete or are co-dominant trees that have weakened. The intermediates often become overtopped and die. On some poor sites the stand may become stagnant exhibiting slow growth and containing many suppressed trees. In an unmanaged stand the dead trees may remain in place to rot.

If a forest is managed early in its development, competition will be reduced and the majority of the trees will grow quickly into large trees with fewer becoming intermediates or suppressed trees.

Diameter limit*

Setting a minimum diameter, or caliper, for cutting is a poor woodlot management practice.

Cutting everything in a size class will include trees that are just beginning their optimal growth and may leave a woodlot without good quality trees for future seed sources.

A lack of reference to stocking rates in an evaluation of the stand may result in thinning that opens up the forest so much that regeneration may not result in a good growing stock for decades.

The best way to manage thinning or harvesting of timber is to measure the present stocking and compare to the ideal; then cut, or thin, trees from all size classes to bring the remaining stand as close to the ideal as possible.

Hilts and Mitchell.*The woodlot management handbook*. Firefly Books, Inc. 1999., pp. 126-127.

If the forest has been left to develop on its own, competition will cause all crown classes to develop, eventually. Removing only suppressed and intermediate trees will not have a big effect on the growth of the dominant and co-dominant trees, since suppressed and intermediate trees do not offer significant competition with the larger trees. Removal of some dominant trees may open the canopy and release some of the younger trees to growth. However, good quality trees should be left to provide seed for future generations. Even when thinning of some dominant trees is recommended, most of mature and aging trees should be left in the 25 feet adjacent to a stream to help maintain the health of the stream habitat.[13]

Patrick H. Brose, Clemson University, www.forestryimages.org

A typical natural forest will have a mix of 25% canopy trees, 25% subcanopy trees and large shrubs and 50% shrub/saplings.

Typical Tidewater forest composition

A typical forest in the Tidewater region has a mixed composition of tree classifications as well as a mix of trees, saplings, shrubs and groundcover. Proportionally, an undisturbed forest will have approximately 25% canopy trees (at ≥10 inch diameter breast height or dbh), 25% subcanopy trees and shrubs (at 4-10 inch dbh) and 50% shrub/saplings (at 1-4 inch dbh). While the total count of stems per acre varies from riverine to estuarine stands, the basal area remains similar at approximately 228.7 square feet per acre.[14] Young trees and seedlings, in the understory / subcanopy, are an indication that a forest is healthy and growing vigorously. A lack of these understory saplings indicates a forest that is not able to regenerate over time.

Woodlot evaluation

The local government must determine whether or not the proposed thinning is appropriate for a residential woodlot to improve the health of the stand. Consultation with a professional arborist or forester is recommended before approving any thinning activity. The arborist or forester should be able to examine a stand and determine whether or not a thinning will have any significant

benefit to the buffer. If thinning will not actively benefit the stand, then natural succession should be allowed to select the growth of the most vigorous trees. An evaluation should include an analysis of existing understory trees and shrubs, as well as subcanopy and canopy trees, since these are also important layers of a functioning buffer. The analysis should include the seedlings and saplings of understory and canopy trees so that species desirable for regeneration can be protected during management activities. Understory trees such as dogwood or redbud and a sapling and shrub layer are a natural component of a healthy forest that do not compete with the dominant trees. As part of a healthy, self-regenerating forest buffer, this understory layer offers other benefits as well for nutrient removal, soil stabilization and habitat.

Alli Baird, CBLAD

A healthy forest has a mix of trees and shrubs, and a variety of ages within the stand. This mix allows a constant renewal of the stand over time.

Under no circumstance should a complete understory layer be removed under the claim of thinning for management.

Healthy regeneration

In order for forested buffers to remain healthy, tree regeneration must be promoted through protection of existing understory trees. "…an undisturbed understory and forest floor should provide the next generation of overstory trees. In areas to be maintained as a light forest cover, the regeneration of shade tolerant species should be selectively promoted and protected when understory thinning operations are undertaken."[15] In a small residential buffer, individual trees should be identified as replacement for the overstory and protected during maintenance activities. A few high quality large seed trees should also be left as sources for future regeneration within the buffer. A mixture of native species should be encouraged, both understory and overstory, for a healthy future stand of trees.

James Solomon, USDA Forest Service, www.bugwoodimages.org

Damage from woodlot management may be more harmful than beneficial to the woodlot if damage like this occurs.

Tree protection

Protection of the remaining trees is an important part of any plans for activity in the buffer. "Light thinnings may do more harm than good unless the logging crew is very careful."[16]

Hardwoods are quite susceptible to insect and disease when bark is knocked off during thinning processes. This leaves the trees susceptible to bacteria, fungi and insects. "Removal of trees from a dense stand without damaging those remaining can be difficult and expensive, but the extra care required is a good investment in maintaining the health of the [remaining] trees…"[17]

Robert L. Anderson, USDA Forest Service, www.forestimages.org

Trees left behind after a severe thinning may be more susceptible to wind throw.

Stability

On slopes, larger trees will have the more extensive deeper root systems that are better for soil retention and slope stabilization. Removing the majority of healthy, well-rooted trees from a slope is more likely to increase the probability of slope failure. As mentioned in the section about dead and dying trees, the roots also help slow runoff, encouraging infiltration, so erosion is less likely.

Assessment of the stability of a tree in relation to surrounding trees and vegetation should also be taken into account. In a mature forest with trees growing within ten feet of each other with intermingled crown canopies, the trees generally function as a group. Removal of one or more trees, that are part of an interdependent group, may compromise the stability of the remaining trees.[18] Excessive tree removal within the stand may also subject the remaining previously stable trees to unusual wind stresses,[19] especially when on a bluff or other exposed situation.

CBLAO staff

Stream temperature is maintained by the surrounding buffer, helping to support aquatic organisims.

Stream temperatures

Another important function of the riparian buffer is the maintenance of stream temperatures that are necessary for the survival of aquatic species. However, the removal of 50% of the canopy cover over a stream may cause temperature fluctuations for four years in a first order stream adjacent to a cleared area such as a subdivision, meadow or agricultural field. The temperature of the groundwater effluent that enters a stream alters the temperature in the stream, so the loss of a forest adjacent to the buffer may have a greater effect if the density of a forested buffer is reduced.[20] In the area of the buffer adjacent to water, thinning should also be severely

restricted to removal of only those trees absolutely necessary to maintain the health of the forest.[21]

CONCLUSIONS:

- The goal of woodlot management should be to develop a self-sustainable, uneven-aged stand of mixed trees, shrubs and groundcover with a floor of either leaf litter and debris, or mulch.
- It is best to have a professional arborist, forester or other knowledgeable person evaluate the stand before any plans for removal of vegetation are developed for thinning or for removal of large infestations of pests.
- Should a woodlot be large enough that timbering is considered a legitimate silvicultural activity, the Virginia Department of Forestry should be notified before any activity takes place and operations should adhere to the *Virginia Forestry Best Management Practices for Water Quality*, Fourth edition.
- Thinning for woodlot management should only be considered as a management measure when:
    1) the buffer is a young forest that is a tangled jungle of dense vegetation, and an opportunity exists to encourage a selection of vigorous native species;
    2) the buffer is a degraded stand or an older stand that has been poorly managed or grazed in the past, and a thinning may be used to influence species composition, age and quality to achieve sustainability in the buffer.
- Thinning should only be done according to an approved plan based on recommendations of a professional arborist or forester, or as part of a Department of Forestry approved Forest Stewardship Plan.
- Under no circumstances should a complete age or size class, or trophic level of vegetation be removed under the claim of "thinning" or to achieve sight lines and vistas.
- The removal of noxious plants, which includes all plants on the Virginia Department of Conservation and Recreation's list of Invasive Alien Plants (found at http://www.dcr.state.va.us/dnh/pdflist.htm or in Appendix B

of this manual), is limited to those that have overrun an area becoming invasive, or are otherwise out-competing, or choking native plants.

- On first and second order streams, consider leaving dead trees, logs and other large woody debris within the 25 foot area closest to the stream. The availability of woody debris in this area is a major factor in aquatic biological diversity, providing slowly decomposable nutrients and a variety of habitats.
- Removal of leaf litter, groundcover or humus is not permitted.
- Removal of underbrush should be permitted only when it is dead, dying, diseased or infested, or if the material is a noxious weed.

RECOMMENDED PROCEDURE FOR LOCAL GOVERNMENTS:

Woodlot management may require anything from removal of a single dead tree to a complete removal of invasive and noxious species and replacement with native woody species. The procedure may vary depending upon the extent of the request.

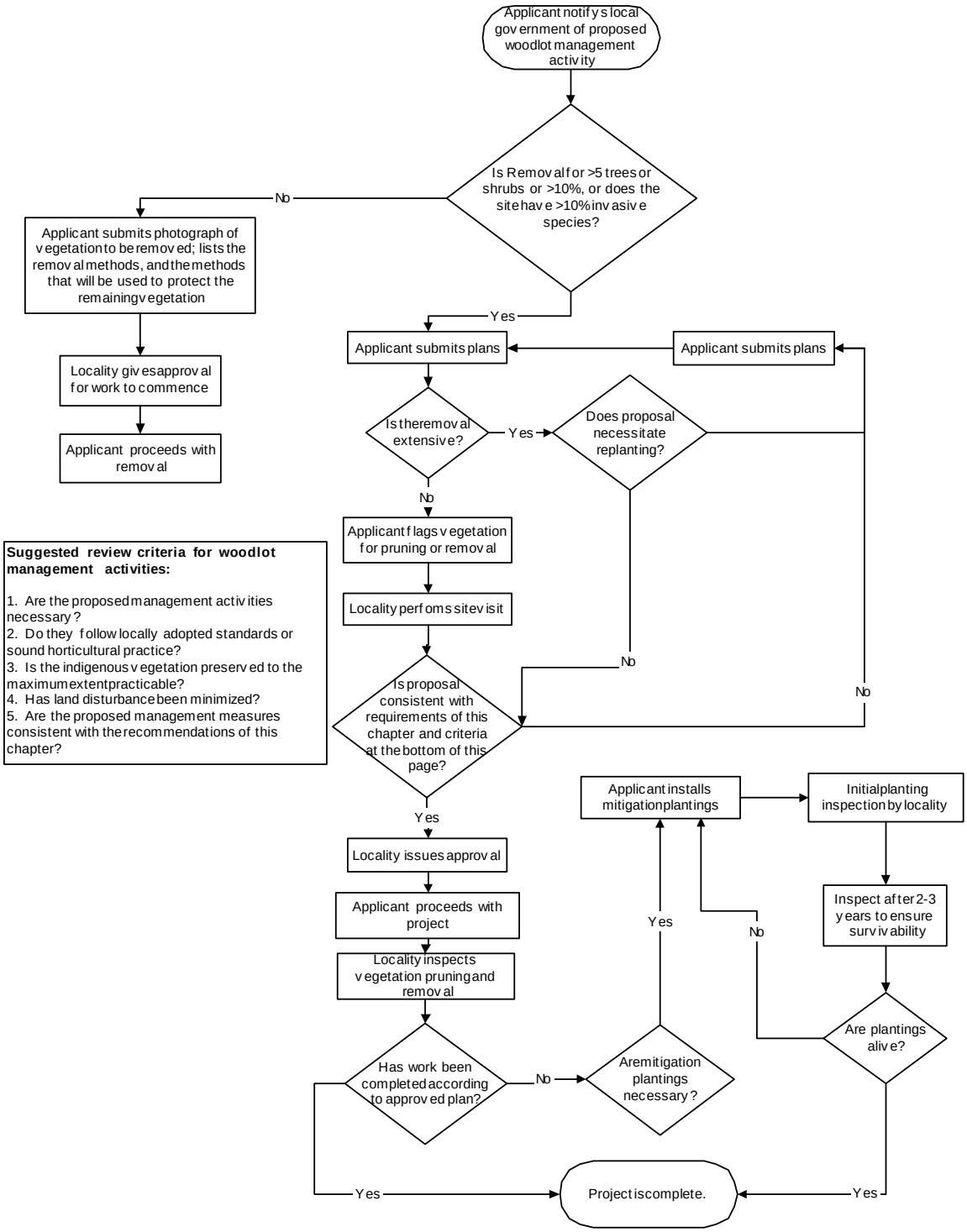
1) A simple administrative approval, without a site visit, may be appropriate for the removal of 1-5 dead, dying, diseased or storm damaged trees and/or large shrubs or removal of an invasive species such as honeysuckle if it covers less than approximately 10% of the site.
   a) Pictures showing the tree(s) or shrub(s) to be removed and the location within the buffer should accompany the request.
   b) Methods for removal should be discussed as part of the application to minimize disturbance within the buffer.
   c) Methods for preserving the remaining vegetation should be discussed as part of the application.
   d) A written approval should be issued specifying the particular tree(s) or shrub(s) to be removed
2) A site visit by local government staff is advised before any request to remove more than five trees or shrubs, or large areas of invasives, from the buffer is approved.
   a) The application should include a plan that shows the name and location of plants to be pruned or removed.

b) Protection methods for the remaining vegetation should be included in the plans for removal.
c) All plants that are to be removed should be flagged before the site visit.
d) The visit should verify the condition of the plants to be removed (that they are dead, dying, or diseased).
    i) Protection plans should be evaluated prior to any vegetation removal to assure the survival of the remaining vegetation.

3) After removal of the approved vegetation, staff should make a site visit to assure that the plans have been followed.
    a) For those local governments that have the authority to require a performance guarantee, and do so as a matter of practice, one may be required to assure the implementation of replacement plantings in the next planting season, when the removal takes place outside of the planting season.
4) For thinning operations, the local government staff should verify that thinning is the only viable method to maintain the health of the forested buffer. Evaluation by a professional arborist or forester is recommended.
    a) An application should include the size, type, and location of all trees to be removed.
5) If the buffer is overrun with invasives and a complete removal and restoration is proposed, the application should include a restoration plan. See *Chapter 5: Buffer Establishment* for restoration procedure.

For additional information on suggested native plants, and planting techniques, see Appendices *A* and *C*. For information on suggested vegetation replacement standards, see *Appendix D*.

Recommended local review and approval process for woodlot management activity



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[20] Lowrance, R., et al. (1995). *Water quality functions of riparian forest buffer systems in the Chesapeake Bay watershed.* EPA 905-2-95-001 CBP/TRS 134/95. Annapolis, MD p. 9.

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3.4 - Shoreline Erosion Control

Purpose:

The purpose of this chapter is to provide regulatory and procedural guidance for reviewing proposed shoreline erosion control projects for consistency with the Regulations and ensuring that the water quality functions of the buffer are preserved or restored.

Regulations:

§9VAC 10-20-130.5.a (4):

"For shoreline erosion control projects, trees and woody vegetation may be removed, necessary control techniques employed, and appropriate vegetation established to protect or stabilize the shoreline in accordance with the best available technical advice and applicable permit conditions or requirements."

§9VAC 10-20-130.1.a:

"A Water Quality Impact Assessment…shall be required for any proposed land disturbance [within a Resource Protection Area]."

§9VAC 10-20-130.1.b:

"A new or expanded water-dependent facility may be allowed provided that the following criteria are met: (1) it does not conflict with the comprehensive plan; (2) it complies with the

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performance criteria set forth in §9VAC 10-20-120; (3) any non water-dependent component is located outside of Resource Protection Areas; and (4) access to the water-dependent facility will be provided with the minimum disturbance necessary. Where practicable, a single point of access will be provided."

DISCUSSION:

Section 9VAC 10-20-130.5.a (4) of the Bay Act Regulations permits the removal of buffer vegetation to allow the installation of shoreline erosion control projects. However, a locality must verify that all aspects of the proposed erosion control project meet the requirements of the Regulations before allowing land disturbance or removal of vegetation within the Resource Protection Area (RPA). This should be done through the review of a Water Quality Impact Assessment (WQIA), concurrent with the local wetlands board review. It is extremely important that the local review be done as early in the process as possible to prevent the wetlands board from approving a project that is inconsistent with the local Bay Act program.

The Regulations require that localities review all shoreline erosion control projects that involve land disturbance in the RPA or removal of buffer vegetation. In reviewing shoreline erosion control projects, the local government must make a determination that:

- Any proposed shoreline erosion control measures are **necessary**
- The erosion control measures will employ the **best available technical advice**
- **Indigenous vegetation** will be **preserved** to the maximum extent practicable
- Proposed **land disturbance** will be **minimized**
- Appropriate **mitigation plantings** are proposed that will provide the required water quality functions of the buffer area
- The project is **consistent with** the locality's **comprehensive plan**

- **Access** to the project will be provided with the **minimum disturbance necessary**

- The project complies with **erosion and sediment control requirements**

If any of these criteria are not met, local governments should not allow removal of vegetation from the RPA buffer, regardless of whether or not wetland permits have been issued for construction of shoreline erosion control structures. In this case, the only recourse for property owners would be to request a formal exception to the local Bay Act program requirements. This would entail a public hearing and findings issued by a locally designated board or committee.

Another issue that has complicated the process is the misconception that shoreline erosion control projects are exempt from the Regulations and that localities are not required to review these types of projects. This has resulted in the loss of riparian buffers, unnecessary hardening of the shoreline, and destruction of RPA wetlands. The Regulations provide the local government with the authority to oversee shoreline erosion control projects to ensure that they are correctly approved, engineered, and constructed, and that all necessary mitigation measures are installed. If implemented correctly and consistently, the Bay Act Regulations should promote necessary shore erosion control measures while protecting the required water quality functions of the buffer.

The following sections provide guidance on how localities can determine if a project is consistent with the applicable sections of the Regulations.

Determining if the project is necessary

The Regulations allow the removal of buffer vegetation for shore erosion control devices only if the project is actually necessary. Even though the wetlands boards are charged with approving the type of erosion control structure allowed, the local government must confirm that the project is necessary before issuing any land disturbing permits or allowing any removal of vegetation. This requirement stems from language in the *Wetland Guidelines* manual prepared by the Virginia Institute of Marine Science (VIMS) and the Virginia Marine Resources Commission (VMRC) pursuant to

Active detrimental erosion was not observed on this site; therefore, an erosion control structure was not necessary and was not approved.

§28.2-1300 of the Code of Virginia (The Tidal Wetlands Act). This manual contains criteria for the evaluation of shoreline erosion control projects. Page 44 of the *Wetlands Guidelines* manual states that "shoreline protection structures are justified only if there is active, detrimental shoreline erosion which cannot be otherwise controlled" and that "needless shoreline modification is therefore discouraged." If a property were determined to have active, detrimental erosion, then it would seem appropriate to permit the landowner to remove buffer vegetation only as necessary for the installation of an erosion control measure. In determining if an erosion control measure is necessary, local government staff should work closely with the members of the local wetlands board, VIMS, and the Virginia Department of Conservation and Recreation (DCR).

If site visits and historical research do not indicate the presence of active, detrimental erosion, the local government should not permit the removal of buffer vegetation or land disturbance within the buffer. In these situations, the landowner should be encouraged to use non-structural methods of shoreline protection such as establishing a marsh fringe and/or planting native shrubs and tall grasses in the riparian buffer area.

Best available technical advice

In order to be consistent with the Regulations, a shoreline erosion control measure must be based on the "best available technical advice." The applicant should seek the advice of a shoreline engineer or some other erosion control specialist such as staff from the Department of Conservation and Recreation. While there is no one source for this information, the local government must ensure that the applicant has selected the erosion control method that is consistent with the nature and severity of the erosion problem on the site. For example, if the applicant applies for approval to construct a seawall, but, as the State's technical experts in the review of tidal wetland and shoreline erosion control permit applications, DCR and VIMS were both to recommend that a stone revetment is an appropriate remedy, the locality should give

serious consideration to such recommendations prior to determining whether or not to approve the application.

For guidance on selecting the proper method of shore erosion control based on site conditions, local governments and wetlands boards should use the various VIMS publications on shoreline erosion control BMPs. One very useful source of information, which is based on research provided by VIMS, is the Hampton Roads Planning District Commission's *Regional Shoreline Element of Comprehensive Plans*. This document provides information on how to select the most appropriate shoreline erosion control alternative based on the wave climates and erosion rate. This ranking system is also supported by the results of several VIMS studies and guidance documents.

Note: Alternative #1 is the preferred control method with subsequent methods being listed in descending order of preference.

Areas with Low Erosion Rate (< 1 ft/yr.)
(low energy shorelines with an average fetch exposure of <1 nautical mile)

1. Vegetative stabilization with/or bank regrading
2. Revetment
3. Bulkhead

Areas with Moderate Erosion Rate (1- 3 ft/yr.)
(medium energy shorelines with an average fetch exposure of 1-5 nautical miles)

1. Vegetative stabilization with/or bank grading
2. Beach nourishment
3. Revetment
4. Breakwaters
5. Groins
6. Bulkheads

Areas with Severe Erosion Rate (> 3 ft/yr.)
(high energy shorelines with an average fetch exposure of > 5 nautical miles)

1. Relocation (of threatened structures)
2. Beach Nourishment
3. Revetments
4. Breakwaters
5. Groins
6. Seawall

Before selecting or approving an erosion control alternative, it is suggested that a "reach assessment" be performed by the applicant or his/her agent. This should be done based on the information provided in the VIM's publication entitled *Shoreline Erosion Guidance for Chesapeake Bay Virginia* by Scott Hardaway. Section IV of this document provides details on how to perform the technical assessment of a reach.

A REACH ASSESSMENT INCLUDES, AMONG OTHER ELEMENTS:

1. Determining the limits of the reach the project lies in
2. Determining the historical rates and patterns of erosion and accretion
3. Determining the source and volume of the sand supply
4. Determining the effective wave climate, direction of littoral drift, and estimating the potential impacts of the project on adjacent properties
5. Estimation of other erosion causing factors (groundwater discharge, surface runoff, etc.)

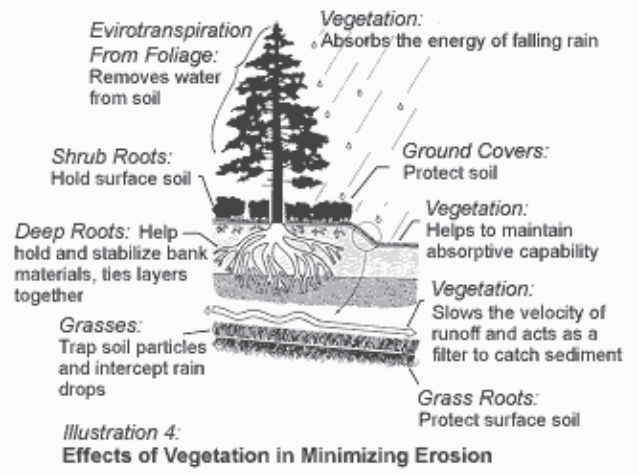
At the very least, the locality should require that the applicant provide this basic assessment so that the local Bay Act program coordinator and the wetlands board members will have an accurate evaluation of the erosive conditions of the site. The results of the reach assessment and the best available technical advice should be included in the required WQIA for review. This information will assist the decision makers in determining which control method is most appropriate to the severity of the erosion problem on the site.

Preserving indigenous vegetation

In order to protect the integrity and water quality functions of the riparian buffer, it is essential to preserve existing vegetation within the RPA. That is the reason for inclusion of the preservation of vegetation as one of the General Performance Criteria listed in the Regulations (§9VAC 10-20-120.2). In reviewing shoreline

erosion control projects, the locality must confirm that the applicant has made a reasonable effort to avoid and minimize the removal or disturbance of woody vegetation associated with the access and installation of the erosion control measure. ***It is much easier and cheaper to preserve buffer vegetation than it is to remove vegetation and replace it with new woody vegetation.*** The WQIA should include a site plan indicating the species type, size, and location of all woody vegetation on the site and what vegetation will be impacted or removed. The local government should review the plan to ensure that the project will not cause excessive disturbance or removal of buffer vegetation.

Often, landowners want to remove buffer vegetation as a method of preventing further erosion of the shoreline. As demonstrated in the following graphic, trees and other buffer vegetation actually contribute to the stability of the slope.



Graphic reprinted from Manashe, Elliott. 1993. *Vegetation Management: A Guide For Puget Sound Bluff Property Owners.* Shorelands and Coastal Zone Management Program, Washington Department of Ecology, Olympia.

If the applicant is proposing to remove trees in the buffer as a preventative measure, the locality should ensure that tree removal is warranted. The removal of well-rooted, healthy, mature trees should be discouraged because this can actually decrease the stability of the slope and accelerate slope failure. Even if the stumps are left in the ground, the roots of the dead tree will decay over a three to nine year period.[1] As a result, eroding slopes may still fail after removing mature trees. ***Therefore, only trees that are in immediate danger of falling over should be removed.***

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The project in these photos would be considered in violation for excessive land disturbance and clearing of vegetation.

Minimizing land disturbance

The minimization of land disturbance is the first of the General Performance Criteria listed in §9VAC 10-20-120 of the Regulations. It is required for all developments in Chesapeake Bay Preservation Areas, including shoreline erosion control projects. The local Bay Act Coordinator should review the grading and access plan to verify the minimization of land disturbance. The images above are an example of excessive clearing during the installation of a bulkhead.

Requiring mitigation plantings

After the project is completed, the local government must ensure that appropriate vegetation is established to protect and stabilize the shoreline. As discussed in previous chapters of this manual, a buffer area that provides the best water quality functions is composed of several layers of vegetation, including canopy trees, understory trees, shrubs, and groundcover. Once the project is completed, the locality must require that the buffer be re-established (suggested vegetation replacement rates are located in the *Appendix D* in this manual). ***Replanting the buffer with a lawn grass is not acceptable.*** Turf grass does not provide the full range of buffer functions and the maintenance of the lawn may actually contribute to nutrient pollution of the adjacent water features. Rather than

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Re-establishment of the buffer as a managed lawn is not consistent with the intent of the Bay Act. Regulations.

a lawn, the landowner should replant a combination of native woody plants.

During the installation of devices such as revetments or bulkheads, it is common for the shoreline contractor to grade the slope and align the structure to achieve a 2:1 or 3:1 slope, per the accepted practice. An example of this can be seen in the picture below.

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Steep slopes should have woody vegetation replanted.

This practice often results in steep sloping terrain landward of the structure. While it may not be sensible to plant large canopy trees in the area adjacent to the structure, the Regulations require that this area be planted in vegetation other than a maintained lawn.

Small trees, low-growing shrubbery, and native groundcovers are an excellent choice for planting in these sloped areas. The WQIA must include a planting and maintenance plan to ensure that the buffer vegetation will be established and that it will survive. No local permits should be approved without the submittal of an approved planting and maintenance plan. Some local governments have authority to require a performance guarantee to assure the establishment and survival of the required plantings. Please refer to the plant lists in Appendix A for examples of suitable vegetation for planting in riparian buffer areas.

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Low growing juniper can be an effective woody groundcover.

Comprehensive plan consistency

Another requirement for shoreline erosion control projects is that they are consistent with the local comprehensive plan requirements. All Tidewater localities are required to have elements in their comprehensive plan that provide mapping of critically eroding areas and policies to address erosion control or shoreline management. Prior to approving erosion control projects, the locality must

determine if the proposal is consistent with all the goals, objectives, and strategies in the comprehensive plan. Some examples of comprehensive plan policies are regional shoreline erosion management, provisions for giving priority to vegetative erosion control methods, and retention or establishment of riparian buffers. The local WQIA review process must verify that the project is consistent with the comprehensive plan policies for shoreline erosion control.

Examples of Comprehensive Plan policies for shore erosion control

1. Regional shoreline erosion management measures
2. Giving priority to vegetative erosion control methods
3. Retention or establishment of riparian buffers

Minimizing disturbance for construction access

This requirement is very similar to the above requirement for minimization of land disturbance. The local government should review the project to ensure that access to the project site is provided with the least amount of land disturbance. Applicants must demonstrate that he/she has explored all reasonable options for access to the site. Where feasible, access to the project must be provided with a single construction entrance only. The WQIA should include a site plan that indicates the preferred method of access and the limits of clearing and grading.

Compliance with erosion and sediment control requirements

All land disturbances in CBPAs over 2,500 square feet, including shoreline erosion control projects, are required to comply with local erosion and sediment control regulations. During the 2003 General Assembly session, the Erosion and Sediment Control Law (Title 10.1, Chapter 5, Article 4 of the state code) was amended to remove the exemption for shoreline erosion control projects. This means that **all upland land disturbances associated with shoreline erosion control projects are no longer exempt from the E&S requirements.** Therefore, local governments must review projects that disturb more than 2,500 square feet for consistency with the local E&S laws.

CONCLUSIONS

- Shoreline erosion is a natural process and should only be controlled when there is potential threat to structures or a significant amount of annual property loss.

- All shoreline erosion control projects must submit a WQIA and receive approval of the local government prior to any removal of buffer vegetation.

- The locality must ensure that the WQIA addresses all of the requirements for consistency that have been discussed in this chapter.

- The local government should coordinate its review with the wetlands board in order to prevent the board from approving projects that are inconsistent with the local Bay Act program.

- Localities should designate a local staff person to attend the wetlands board meetings to ensure that all parties involved know the requirements of the Bay Act and the implications of inconsistency with the Regulations. This staff person should contact VMRC to ensure that he or she receives copies of all Joint Permit Applications (JPA) prior to the meeting of the wetlands board.

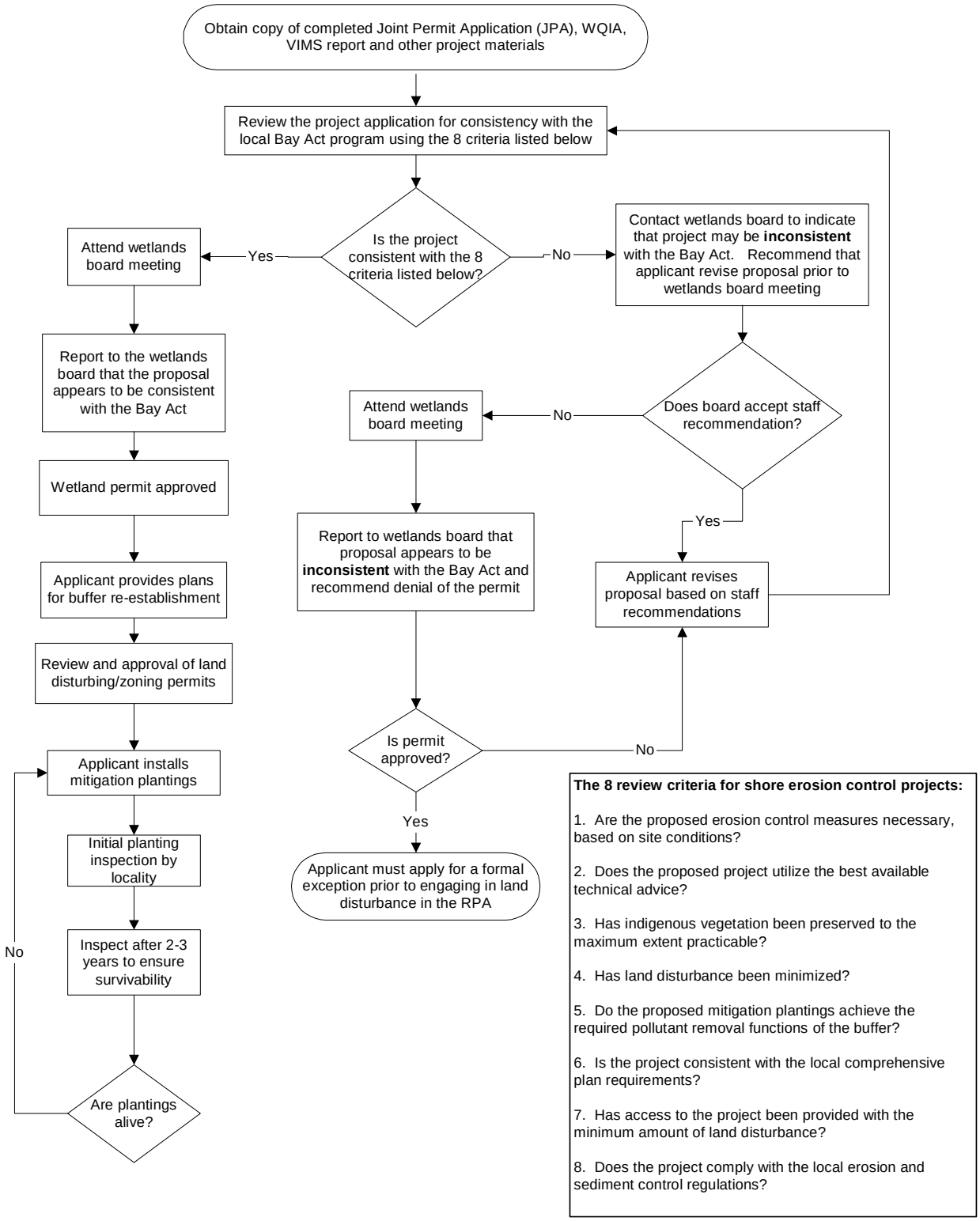
- **Approval of a wetlands disturbance permit does not constitute compliance with the local Bay Act regulations, nor does it require the locality to grant any land disturbing permits or allow the removal of any vegetation from the buffer.**

- The establishment of maintained lawns in the buffer is not permitted as mitigation for the disturbance of buffer vegetation caused by the installation of shore erosion control measures. The buffer must be established in native, woody vegetation as described in the buffer establishment guidelines in Appendix D.

- All shoreline erosion control projects disturbing more than 2500 square feet must comply with the local Erosion and Sediment Control regulations.

- Existing mature trees and other types of woody vegetation often provide significant erosion control benefits. Only trees that are in immediate danger of falling over should be removed.

Recommended local review and approval process for shoreline erosion control projects



[1]Manashe, Elliott. 1993. *Vegetation Management: A Guide For Puget Sound Bluff Property Owners.* Shorelands and Coastal Zone Management Program, Washington Department of Ecology, Olympia, Washington.

CHAPTER 4 - PASSIVE RECREATION FACILITIES EXEMPTION

4 - Passive Recreational Facilities Exemption

Purpose:

The purpose of this chapter is to provide guidance to property owners on the land disturbance exemption allowed in the 100-foot wide buffer for passive recreation facilities such as boardwalks, trails and pathways. Homeowner creation of trails and pathways generally do not have the potential for as great an impact on the buffer as do public facilities; therefore, this chapter primarily addresses projects, such as community parks and recreation facilities, that are likely to be used by large numbers of people on larger parcels, rather than individual residential properties. However, the design information is also appropriate for homeowner trails and pathways, which are also allowed by the Regulations.

Regulations:

§9 VAC 10-20-130.2 states that:

"The following land disturbances in Resource Protection Areas may be exempt from the criteria of this part provided that they comply with subdivisions a and b below of this subsection: (i) water wells; (ii) **passive recreation facilities such as boardwalks, trails and pathways**; and (iii) historic preservation and archaeological activities.

a. Local governments shall establish administrative procedures to review such exemptions.

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b. Any land disturbance exceeding an area of 2,500 square feet shall comply with the erosion and sediment control criteria in subdivision 6 of §9 VAC 10-20-120."

DISCUSSION:

Many public parks and recreational facilities are located in land adjacent to riparian features, as are some facilities owned by private, homeowner community associations. Since these land areas may have limitations for development, they are often donated by developers as public or community parks systems and are developed as public open space.

The Bay Act Regulations restrict recreational uses within the 100-foot wide buffer to passive recreation facilities, including trails, boardwalks and paths. The Department generally considers passive recreation to be non-motorized activities such as walking, bike riding, picnicking, hiking, sun bathing and bird watching. This includes motorized devices required by physically impaired individuals to access and enjoy any passive recreation facilities. Passive recreation does not include obtrusive activities that have significant adverse impacts to natural, cultural, open space, or agricultural values. Passive recreation would also not include organized sports facilities such as baseball diamonds, football fields, or soccer fields.

If a locality chooses to grant exemptions to the land uses listed in §9VAC 10-20-130.2, it must establish a review process to determine whether a proposed use or activity qualifies for an exemption from the local Bay Act program. This local review must also verify that any proposed uses in the buffer do not conflict with the spirit or intent of the Act and meet the performance criteria in §9 VAC 10-20-120 for:

Minimization of land disturbance
Preservation of indigenous vegetation
Maintenance of best management practices
Minimization of impervious cover
Requirement of a plan of development for land disturbing activity over 2,500 square feet, and compliance with the requirements of the local erosion and sediment control ordinance

Local review process

The Regulations require all local governments to develop an administrative procedure to review proposals to determine if they qualify for an exemption. The Department recommends that the local review procedure requires the submittal of an application that includes the following information:

- The limits of the 100-foot buffer
- The nature of the proposed land use
- The location of any proposed structures, trails, boardwalks, paths, etc.
- The existing and proposed topography of the site
- The limits of clearing and land disturbance
- Existing vegetation and proposed vegetation removal
- Area of impervious surface proposed
- Composition of surface materials used (mulch, gravel, concrete, planks, etc.)
- Dimensions of proposed paths, trails or boardwalks
- A water quality impact assessment for any land disturbing activity.
- Proposed erosion and sediment control measures for any land disturbing activity over 2,500 square feet.
- Proposed plantings or other mitigation measures

The locality should review the proposed facilities and determine whether or not an exemption is warranted. Because the term passive implies low impact and minimum disturbance to natural areas, the locality should not grant an exemption for a project that proposes excessive land disturbance, installation of large amounts of impervious surface, or the removal of a significant amount of buffer vegetation.

If the locality approves the exemption request and all other applicable regulations or permit conditions are satisfied, the applicant may proceed with construction of the project. If the locality concludes that the nature of the land use is not consistent with the definition of passive recreation or if the project has the potential to cause negative impacts to the buffer and the quality of the adjacent aquatic resource, the applicant must revise the project plan or the local government should deny the exemption request.

Passive recreation includes...	Passive recreation does not include...
Hiking	Organized sports facilities and ball fields
Biking	The use of motorized vehicles, such as golf carts, motorcycles, motor boats or all-terrain vehicles (ATVs)
Picnicking	Structures such as pools, decks or gazebos
Wildlife viewing	Boat ramps, docks, piers, or marinas
Public boardwalk or trail use	Any activity that contributes to erosion, causes significant vegetation loss, or involves the installation of excessive amounts of impervious surfaces
Fishing	

Pathways, trails and boardwalks

Citizens will use public open space, whether or not facilities exist to accommodate public use. Paths will be made towards a favorite fishing hole or bird-watching post. Best management practice requires planning for those uses and mitigating the effects of that development on the functions of the buffer through appropriate planning and design of facilities.

There are many fine publications that provide details on planning, designing, and constructing public trails, such as the Virginia Department of Conservation and Recreation's *The Virginia Greenways and Trails Toolbox, the U.S. Forest Service Trail Construction and Maintenance Notebook*, 2000 edition, and *Planning Trails With Wildlife In Mind*, Colorado State Parks – Trails Program, which can be found at the web site <http://www.parks.state.co.us/home/publications.asp>. Therefore, only aspects that are related to buffer issues will be discussed here.

> *"Well designed trails take advantage of the natural drainage features, and are low-maintenance trails that meet the needs of the user."*[1]

Paths and trails for passive recreation are exempt from the development criteria for RPAs, but they should be designed to minimize the disturbance to the vegetation, groundcover, and soils within the buffer to maintain water quality and protect shorelines and

stream banks. Careful planning based on an analysis of natural features and characteristics will determine the best location and design of trails and paths. Care should also be taken to avoid sensitive habitat such as breeding areas, habitats of local significance, threatened or endangered species, or natural heritage areas.

Placement and design of paths, trails, and walkways

> *"There are three factors to consider: environmental suitability of a particular use, the intensity of use, and the design and development of the trail tread."*[2]

Trails and paths through public parks serve many different purposes and users. A large natural area, such as a state park far from urbanized areas, may not have frequent, numerous visitors, whereas a path in an urban park may provide access to the shore, a pier or boardwalk and get constant use by large numbers of citizens. The variety of users and activities necessitate different types of paths.

Proper design and placement of paths is necessary to meet the needs of the user while maintaining the integrity of the riparian buffer. Placement of the trail or path is important to assure that it is located in the least sensitive areas. If a trail or path is not adequate for the use, failure of the path may compromise the buffer. The frequency of use and type of user should dictate the size of the path. Clearing should be minimized as much as possible, and pruning should be kept to only that necessary to maintain safe usage. Paving should be adequate to accommodate the quantity and frequency of use expected and appropriate for the level of maintenance that will be available to prevent or correct trail failure. Development should be accomplished with the least destructive equipment and construction methods feasible.

Environmental suitability

Location

Preferably, the majority of a public trail or path will be located outside of the 100-foot buffer. However, when the path does enter into the buffer to reach the shoreline or stream, it should

be located so as to minimize impact on the buffer. Soils, slopes, drainage and vegetation will determine the best location for the portions of a path that are located within the buffer.

When a trail must be placed within the buffer, the area 75-100 feet inland from the water's edge would be the best location for the majority of the trail. The path may reach the water through areas whose physical characteristics are less susceptible to adverse impacts. Sensitive soils and steep slopes should be avoided. The path should take advantage of features in the area between 25-75 feet landward, such as bluffs or rock outcroppings, that may provide views to the water without needing to remove vegetation or encroach into the 25 foot zone closest to the water, which is typically the most critical portion for stream protection.

The area from the water's edge to 25 feet inland should see only minimal use with occasional access to water, ideally in areas least likely to be adversely impacted. This 25 foot area is important for stream bank or shoreline stability. Roots of woody vegetation in this area help bind the soil while the canopy helps intercept raindrops from hitting the soil causing erosion. The leaf litter, twigs and duff supply organic matter for denitrification and for food to the smaller organisms on the forest floor and in the stream. The trees in the area help moderate stream temperature, encourage infiltration of runoff and remove or convert pollutants before they reach the surface waters.

Paths should be kept as short as is feasible within this portion of the buffer to give a direct access to the water. Minimize the impact by taking advantage of terrain, working with natural features and avoiding existing trees. Alternate routes should be carefully evaluated to determine the path location that would minimize impact to soils and vegetation in this portion of the buffer,

Soils

One of the most important structural factors, determining both placement and composition of a trail or pathway, is the nature of the native soil.[3] Soil analysis should be part of any planning process to determine the suitability of the soil for development. Load-bearing ability, permeability and soil composition are good indications of the ability of the soil to sustain trails or the need to devise alternative trail designs to overcome the difficulties.

Soft, waterlogged and unsuitable soils are frequently found in riparian buffers. It is preferable to avoid these types of soils, or limit the placement of paths in these areas to the shortest length and

width feasible. In areas where such soils cannot be avoided in locating a trail, the use of geotextile fabrics or the installation of a boardwalk may be appropriate to minimize the possibility of trail failure.[4]

In some areas flooding may have left a deposit of sand or other suitable material that is appropriate for trail development but is within the 25 feet closest to the water. An analysis of the potential advantages of using this area for trail development should be weighed against the potential for damage to the water quality by overuse and failure of the trail. If the intensity of the use or potential for misuse is high, the trail should probably be located elsewhere.

Slopes

Slope, or the amount or rise in elevation over distance, is also important in determining whether or not a path or trail may have a large or small impact on the buffer. It is better to locate a path to avoid steep slopes. Trails should follow the contours of the land rather than run perpendicular to the slope. A sloping path cutting straight through the buffer towards the stream bank or shoreline is more likely to concentrate storm runoff and develop problems. The increased speed of the concentrated flow prevents infiltration and stimulates erosion. This keeps the buffer from fulfilling its function of reducing runoff and erosion and preventing pollutants from reaching the water.

While paths on topography sloping 5 percent or less may withstand erosion on stable soil, paths located on steeper slopes should take advantage of natural land features and vegetation to minimize the potential impact. Paths with out-slopes can accommodate the intended user yet allow water to naturally drain off the path surface. Careful design should result in pathway surfaces and drainage solutions that will prevent negative impacts on water quality.

Stream crossings

Keep stream crossings to a minimum. Make crossings compatible with the existing stream condition and surroundings. The crossing should take place where there is as little disruption of the bank as possible. Ideally the crossing would take place (1) on a well-defined stream channel, (2) at the point of minimal channel width, (3) where there is a flat stream gradient, and (4) where there

NOTE:

Stream crossings may require permits from :

- **Army Corps of Engineers** (ACOE)
- **Department of Environmental Quality** (DEQ)
- **Virginia Marine Resources Commission** (VMRC)

or other federal, state, local agencies or boards depending upon the location and nature of the project.

are stable slopes on the uphill trail grades on both sides of the stream crossing.[5] If in an area where there is infrequent use of a crossing, stepping-stones may provide the least disruptive, most effective solution. Depending upon the types of users and the frequency of use anticipated, the crossing may require more structural solutions, from a simple shallow stream ford or log crossing to some type of bridge.

Shoreline access and wetlands

Access to the shoreline may include crossing marshes or other sensitive wetlands. Identification of sensitive areas such as unstable shorelines or bluffs should be part of any analysis, and those areas should be avoided. Limit access to areas that can handle the level of visitation proposed. If a sensitive shoreline is the only choice for access, boardwalks, overlooks or other structural solutions might provide appropriate protection for the area. Any access provided in a wetland, marsh or tidal area requires a permit from the local wetlands board.

Any walkway or boardwalk should be planned and designed to minimize impacts on shoreline stability and vegetation as well as on aquatic resources such as submerged aquatic vegetation or intertidal vegetation. Wetlands and marshes provide ample opportunities for education, so a carefully planned access gently placed in the landscape may be worth the extra expense to engineer and construct a suitable solution.

Intensity of use

Paving

In conjunction with soil characteristics, slopes and drainage patterns, the intensity of use is the major factor in determining the type of surfacing needed. A hiking trail in a natural area that is not intensively used may only require a natural surface, while a path in an urban park, or a well-used community recreational path may need some type of harder surfacing than native soil, leaf litter, or mulch. A community pedestrian path in a small subdivision might not be expected to have heavy use, so a mulch surface may be sufficient to prevent erosion. Ideally, the path should have the least impervious surfacing that will withstand the proposed level of use.

Paths that have frequent use, unstable soils, or slopes greater than 5 percent may require the use of additional material to prevent erosion. If a paving material is needed to protect exposed soil, use mulch, shell, gravel, stepping-stones or other permeable material. Paths with heavy pedestrian use or multi-use trails that may also accommodate bicycles or other uses may need more structural paving. ADA requirements may also indicate a harder surface for the path, such as a compacted granular stone, which is less obtrusive than asphalt. Again, the path should have the least impervious surfacing that will withstand the proposed level of use.

Design and development of trail tread

Clearing

Keep clearing for paths, trails or walkways to the minimum necessary to develop and maintain them. Ideally, paths and walkways should wind around existing mature trees rather than requiring their removal. Try to locate paths through existing open areas, or areas where undesirable, invasive vegetation may be removed, (e.g. Japanese honeysuckle, ivy, or tree of heaven). Limit vertical clearing and pruning of branches and other obstacles from the pathway to only that necessary for the safety and comfort of users.

For a mile of trail, a ten-foot wide swath of clearing comprises almost one and a quarter acres of land and is ten percent of the vegetated buffer. Paths should be kept as narrow as possible to fulfill the need of the proposed user based on the carrying capacity of the terrain. If the proposed path will require a much wider clearing for construction than the path itself requires, consider keeping the path outside of the buffer, or changing that portion that encroaches into the buffer to less intensive use or smaller size that requires less intrusive construction methods. Should no alternative be possible, the clearing might be mitigated with additional vegetation in the portion of buffer remaining between the path and the water.

The following table represents standards recommended by the Virginia Department of Conservation and Recreation in *The Virginia Greenways and Trails Toolbox*. (2000).

Summary of Trail Corridor Clearing Standards

Type of Trail	Vertical Clearance	Trail Width	Horizontal clearance beyond trail width
Hiking	8 feet	2 feet single lane 5 feet double lane	2 feet
Biking	8 feet	4 feet single lane 8 feet double lane	1 ft trees/rocks 3 ft limbs/brush
Mountain Biking	8 feet	2 feet single lane 5 feet double lane	1- 2 feet single lane 2 feet double lane
Equestrian	10 feet	5 feet	1 feet trees/rocks 3 feet limbs/logs
Multiple Use	10 feet 8 feet if no equestrian	8 feet 10 feet if heavy use	2 feet

Size of paths

Paths, trails or walkways in the buffer should be no wider than necessary for the required use. When a path must encroach into the buffer, the plan should attempt to limit uses to those that are low-impact and will require the minimum width and associated clearing necessary for the proposed use. Pedestrian paths could be made into one-way single use paths as they encroach into the 25 feet closest to the water and quickly return to the outer landward 50 feet of the buffer. Vegetation, groundcover, leaf litter or mulch should be added in the cleared areas to assure the stability of the disturbed buffer floor, help retard runoff, and prevent erosion. ADA requirements for paths (no less than 5 feet wide) may also apply to community facilities.

Any path or trail designed and intended for passive use within the buffer must be maintained to prevent failure and subsequent water quality impairment. The design of the path should be appropriate for the use or uses, and capable of handling the expected use. Should a more intense use, such as mountain biking, result in the failure of the trail and/or degradation of the water feature due to erosion, attempts should be made to: (1) prevent such use, (2) provide a suitable trail for such use elsewhere, or (3) if appropriate, upgrade the trail to withstand the more intense use.

A well-designed path or trail in and of itself should not be a detriment to water quality. However the impact on the buffer can be significant over long distances through the buffer, and water quality impairments may result.

The characteristics of the site should determine design

options. If vegetation is intact and dense in the 25 feet adjacent to the water, and leaf litter and groundcover are in sufficient quantity to prevent erosion, additional design measures may not have to be employed to assure adequate water quality protection. Sensitive soils, or other characteristics that may cause erosion, may require appropriate management measures to retard runoff, prevent erosion and filter non-point source pollution. An engineered solution may be necessary to assure that the trail will not cause deterioration of the buffer functions.

CONCLUSIONS:

- If a locality chooses to grant exemptions for the land uses listed in §9VAC 10-20-130.2, it must establish a review process to determine whether a proposed use or activity qualifies for an exemption from the local Bay Act program.
- Proposed facilities that do not meet the Board's interpretation of "passive recreation" should not be given exemptions from local Bay Act requirements.
- Recreation facilities that involve excessive land clearing, disturbance of vegetation, or large expanses of impervious cover are not considered passive and should not qualify for an exemption.
- All facilities that disturb more than 2,500 square feet of land must comply with the local erosion and sediment control ordinance.
- Passive recreation facilities should be located outside the 100-foot buffer, where feasible.
- Passive recreation facilities should accommodate all proposed users without straining the carrying capacity of the particular terrain, negatively affecting water quality, or impacting the nearby aquatic resources.
- Passive recreation facilities should be designed and located to avoid sensitive slopes, soils, and habitats. If a locality determines that a facility is causing erosion problems, the use may be stopped until the erosion is eliminated and the soil stabilized.
- Ideally paths should be located primarily within the outer 25 feet of the buffer (from 75-100 feet landward of the shore or stream bank) with occasional access to the water through carefully located corridors. Any path

located in the landward 50-100 feet of the buffer should only be in areas capable of handling the intensity of use proposed.

- Paths (including trails and boardwalks) within the 100-foot wide buffer should be kept to the minimum width feasible.
- Paths should blend into the landscape, taking advantage of the terrain and working with contours to minimize impacts to the 100-foot buffer and the potential for erosion.
- Paths should be located to minimize removal of vegetation and to conserve the forest canopy. Paths should meander around existing mature trees rather than displacing them.
- Ideally, native trees, shrubs and groundcovers should be planted along the sides of paths to control runoff, provide shade, and prevent soil erosion.

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[1] U.S. Forest Service. Trail construction and maintenance handbook, 2000 edition. P. 9.

[2] Flink, Charles A. and Robert M. Searns. *Greenways: A guide to planning, design and development.* The Conservation Fund. 1993. Island Press, Washington, D.C., p.201.

[3] Flink, p.203.

[4] Flink, pp 203-204.

[5] US Forest Service *Trails Management Handbook.* FSH 2309.18.3.12d Stream Crossings. <http://www.fs.fed.us/im/directives/fsh/2309.18/2309.18,3.txt>

CHAPTER 5 - BUFFER MANAGEMENT

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5.1 - Buffer Establishment, Replacement and Restoration

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Purpose:

The purpose of this chapter is to provide guidance for the establishment, replacement or restoration of the 100-foot wide buffer required by the Chesapeake Bay Preservation Act. This vegetation needs to be effective in performing the required functions of retarding runoff, preventing erosion, filtering non-point source pollution from runoff (assumed to achieve at least a 75 % reduction of sediments and a 40% reduction in nutrients). In order to best achieve these goals, a mixed community of vegetation, including trees, understory, shrubs and groundcover imitating an undisturbed riparian forest, is considered the appropriate vegetated buffer.

This chapter suggests procedures for establishing vegetation to replace or restore vegetation removed from a buffer or to establish a new, forested buffer. Different circumstances will require different responses. A buffer established on an existing agricultural or silvicultural parcel requires different methods than merely restoring a few plants that have been removed for purposes allowed by the Bay Act.

Regulations:

§9 VAC 10-20-130.3. states that:

"…a 100-foot wide buffer area of vegetation that is effective in retarding runoff, preventing erosion, and filtering non-point source pollution from runoff shall be retained if present and established where it does not exist."

§9 VAC 10-20-130.3.a. states that:

"The 100-foot wide buffer area shall be deemed to achieve a 75% reduction of sediments and a 40% reduction of nutrients."

§9 VAC 10-20-130.3.b. states that:

"Where land uses such as agriculture or silviculture within the area of the buffer cease and the lands are proposed to be converted to other uses, the full 100-foot wide buffer shall be reestablished. In reestablishing the buffer, management measures

shall be undertaken to provide woody vegetation that assures the buffer functions set forth in this chapter."

DISCUSSION:

There are several situations that require replacement plantings:

1) Conversion of agricultural or silvicultural land to another land use, requiring buffer reestablishment;
2) Restoration of vegetation in a buffer where forestry best management practices dictate the removal and replacement of vegetation (such as trees and shrubs overwhelmed by invasives like kudzu, or 50% or more of the existing plant material consists of invasive species) for the health of the buffer or for shoreline erosion control;
3) Replacement of vegetation that has been removed to achieve a sight line or access path or for woodlot management.
4) And for replacement of illegal excessive removal of vegetation (also see Chapter 5.3 for a discussion of violations).

Reestablishment of a forested buffer is required when an existing agricultural or silvicultural parcel of land is changed to another land use. Under the Bay Act, silvicultural activities in the Chesapeake Bay Preservation Areas are exempt, provided that the operations adhere to the water quality protection measures prescribed by the Virginia Department of Forestry. The Department of Forestry requires establishment of a Streamside Management Zone (SMZ) a minimum of 50 feet in width, measured from the top of the stream bank. The 50-foot SMZ can be a managed forest, which means that up to 50% of the basal area or up to 50% of the forest canopy area can be harvested.[1]

Land in agricultural use often has less than 100 feet of woody vegetation in the buffer. When converted to another land use, woody vegetation must be replanted.

Agricultural activities can encroach within the landward 75 feet of the 100-foot wide buffer area when best management practices are used to address erosion control, nutrient management and pest chemical control. This may leave as little as 25 feet of vegetated buffer. Under both agricultural and silvicultural land uses, the land may have less than 100 feet of buffer remaining in woody vegetation at the time of its conversion to other uses. Whatever area of the 100-foot wide buffer is not covered with woody vegetation at the time the use is converted, must be planted so as to

achieve the required buffer width and functions, returning the area to a condition that closely resembles a pre-disturbance state.

Restoration of a buffer may also occur when a large amount of vegetation has been removed to maintain vegetation health or for erosion control projects involving grading. Restoring a riparian forest buffer requires planting not only canopy trees, but the other trophic layers as well. A forest is a complex ecosystem incorporating canopy trees, understory trees and shrubs, a ground layer of herbaceous plants and leaf litter. Establishing a community of plants similar to those already existing in an area requires duplicating the density, spacing, and distribution of the particular species that naturally occur. The most important part of a restoration is establishing the canopy, since that is critical to the microclimate of the community.[2]

Replacement of vegetation must occur when individual trees, shrubs or groundcover are removed to provide a reasonable sightline, to create an access path, for general woodlot management or for forestry best management practices. Replacement generally should involve only small amounts of vegetation and provide for replacement of trees, shrubs and groundcover. A Vegetation Replacement Table, with suggested replacement rates may be found in this chapter and in Appendix D.

In order to understand the reasons for restoration, replacement or reestablishment of a buffer, it is important to understand what an undisturbed natural buffer is and does. The next section describes what characteristics are typical of a native forest community.

Native Forest Community

The best buffers are those that share the traits of natural, undisturbed, forested vegetative systems. A natural forest would contain a dense vegetative cover of native plants, groundcover and leaf litter, would have undisturbed soils and would sustain a healthy microbial community.[3] "Forests provide the greatest range and number of potential environmental benefits…"[4]

Benefits that are either enhanced by or require a forest are; (1) protection from stream bank erosion, (2) protection of associated wetlands[5] (3) increased removal of nitrogen, (4) Ground water recharge (5) reduced downstream flooding, (6) thermal protection, (7) enhanced potential for stream restoration, (8) reduced watershed imperviousness, (9) food and habitat for wildlife, (10) food

and habitat for fish and amphibians, (11) provision of corridors for habitat conservation, (12) foundation for present or future greenways, and (13) increased urban/suburban property values.

When evaluating the effectiveness of a buffer, the soils, slopes, hydrology, and vegetation all play a part. An increase or decrease in any of the factors comprising an effective pollutant removing buffer may compromise its ability to fully accomplish its role in maintaining water quality. "The key to maintaining good forest watershed conditions lies in proper management of the forest floor. Even when disturbed, forest litter effectively reduces soil movement and excessive surface runoff. With time, more water will soak into the soil as organic matter blends into the surface soil. Of course, the forest floor must be protected from additional disturbances to accomplish these improvements."[6]

A natural forest community buffer, one that effectively retards run-off, prevents erosion, and filters non-point source pollution would have the following characteristics:

A. Forest cover would be dense and contain shade trees, understory trees, shrubs and either groundcover or a deep layer of leaf litter and humus.
B. Soil would be permeable with high organic content, not highly sandy.
C. Slopes would be less than 5%.
D. Overland flow would be less than 150 feet before reaching the buffer.
E. Velocity of run-off would be less than 1.5 ft/sec.
F. Water would pass into the buffer in sheet flow, not concentrated flow.
G. There would be a high water table.[7]

Not all riparian buffers have each of these preferred characteristics, yet not all of the characteristics have to exist to achieve a reduction in sediment and pollutants. Modifying some characteristics, such as slope and distance of overland flow, may not be possible, but other factors may be mitigated. Adding vegetation and mulch can help increase soil permeability. Over time, roots with their associated microbes and insects break down leaf litter and other debris adding the organic material to the soil. A thick layer of mulch on top of the soil can add organic matter as well.

One aspect of a forested buffer that can be replicated is the density and proportions of the types of plant materials found in a typical riparian or estuarine situation. The following table shows the typical mean densities of three classes of mid to late successional stands in the forests of the Coastal Plain and a total basal area found in both riparian and estuarine forest stands from an unpublished data gathered by the Department of Conservation and Recreation, Division of Natural Heritage. The mean densities of the different materials may be used as a guide when establishing goals

TYPICAL STOCKING RATES OF VIRIGNIA FOREST STANDS			
	All Stands **MEAN**	Riparian Stands **MEAN**	Estuarine Stands **MEAN**
Shrub/Sapling[a] Density (stems/acre)	269.6	199.2	340.0
Subcanopy[b] Density (stems/acre)	110.4	83.3	137.5
Overstory[c] Density (stems/acre)	100.8	94.2	107.5
Total Density (stems/acre)	480.8	376.7	585.0
Basal Area (ft^2/acre)	228.7	239.5	217.9
a - shrub/sapling stems range from 1 to 4 inch dbh (diameter breast height - 4.5 ft.); **b** - subcanopy stems range from 4 to 10 inches dbh; **c** - overstory stems are equal to or greater thatn 10 inches dbh.			

Stocking rates in 24 forest stands of riverine and estuarine buffers.[8]

for restoration, replacement or establishment of riparian buffers.

The above table indicates that, proportionally, an undisturbed forest will have approximately 25% canopy trees, 25% subcanopy trees and shrubs and 50% shrub/saplings. While the total count of stems per acre varies from riverine to estuarine stands, the basal area remains similar.

DEVELOPMENT OF A BUFFER ESTABLISHMENT OR RESTORATION PLANTING PLAN:

Analysis

An analysis of the existing site characteristics, vegetation and land use may be necessary to choose the best method of buffer establishment and appropriate plantings. An analysis of the site should include the following information:

Vicinity map

Shows location of property; relationship to adjacent water body and natural resources.

Soils classifications

Soil survey information can be obtained from the local Natural Resources Conservation Service office or local Soil and Water Conservation District offices. The classification of the soils on site will give information regarding slopes, soil color and texture, soil horizon, depth to bedrock, permeability, runoff potential, moisture capacity, and other information related to woodland management. (For a more in depth explanation of soils see Section IV of *The Chesapeake Bay Riparian Handbook.*)

Seasonal High Water Table

Information on the typical depth to the Seasonal High Water Table can be found in the soil survey, however a soil probe can give a quick determination to depth by observation of soil wetness or soil mottling. This is important for choosing plants that will thrive in the existing moisture conditions.

Soil chemistry (from soil test)

Soil samples can be analyzed by by the Virginia Tech Soil Testing Laboratory to determine the available nutrients in the soil. Call your local Virginia Cooperative Extension Office for instructions and a Soil Sample Box. A routine soil test kit will cost $7.00 (as of Spring 2003) and the results include recommendations for soil improvement, if necessary.

Topography

Topography will give the slope and aspect of the parcel within different areas of the buffer. Slopes facing south or west with more sun exposure are

more likely to have lower moisture levels, while north and eastern slopes and stream reaches are less exposed and likely to have a higher moisture content. Local topography can create anomalies in the soils and moisture particular to a site.

Floodplain

Those areas of the buffer that are within the flood-plain need to be identified so that plants tolerant of periodic inundation can be chosen for that area.

Location of water features, rock outcroppings, steep bluffs, existing vegetation and other significant features.

These features will affect the location of plantings. Significant rock outcroppings will prevent plantings. A bluff may require herbaceous as well as woody plantings to prevent erosion. A significant or noteworthy canopy tree, or forest grouping should be shown so the planting plans can take them into consideration.

DEFINITIONS:

Canopy tree: a tree that reaches 35 feet in height or larger when mature

Sub-canopy: can be an immature canopy tree, a stunted canopy tree, or other co-dominant tree or an understory tree

Understory tree: a tree that matures to a height of 12 feet to 35'

Large shrub: a shrub that reaches 10 feet of height or greater at maturity

Small shrub: a woody plant that can reach up to 10 feet of height at maturity

Planting plan

A planting plan should be included in any application for approval, clearly delineating the location of plants removed and plants to replace them. The plan should be at a large enough scale to be legible.

The planting plans should have the following information:

- Vicinity map, scale, north arrow
- Property owner and address & contact name and number for the person who prepared the plan, if different from owner
- Existing vegetation remaining
- Proposed location of new plant material
- Species, size, root condition (B&B, container, bare root) See Appendix C for an example of a plant list
- Planting specifications and details on installation procedures, and protection measures
- Maintenance plan & schedule

REPLACEMENT PLANTING:

Replacement planting occurs when small amounts of vegetation have been removed in accordance with The Chesapeake Bay Preservation Act, Section 9 VAC 10-20-130.5.

"Permitted modifications of the buffer area.

(1)Trees may be pruned or removed to provide for sight lines and vistas, provided that where removed, they shall be replaced with other vegetation that is equally effective in retarding runoff, preventing erosion, and filtering non-point pollution from runoff."

And

"(4) For shoreline erosion control projects, trees and woody vegetation may be removed, necessary control techniques employed, and appropriate vegetation established to protect or stabilize the shoreline in accordance with the best technical advice and applicable permit conditions or requirements."

Although the preferred method for developing sight lines or vistas is pruning out the lower branches of trees and trimming shrubs to a height of 3.5 feet (as discussed in *Chapter 3.1)*, occasionally the removal of a few shrubs or trees may be necessary to achieve the desired sightline. Access paths should also avoid trees and shrubs, but may require the removal of vegetation. Under these circumstances, the vegetation must be replaced with woody vegetation or a combination of woody and herbaceous material.

When shoreline erosion control projects result in the removal of vegetation (see *Chapter 3.4*) to install erosion control measures, "…marshes are the natural shoreline vegetation for many of those areas. At sites where marshes are not the natural shoreline, forest buffers can help stabilize the banks."[9] Replacement of vegetation is a necessary part of the shoreline stabilization process and will help keep the shoreline from eroding in the future. Planting woody vegetation on 2:1 slopes is acceptable. However, large species should be kept away from shoreline hardening and BMPs. Trees should also be kept back from shading shoreline marsh vegetation or submerged aquatic vegetation (SAV). Shoreline erosion control projects may involve the removal of large amounts of vegetation as a result of regrading. Should that be the case, the Restoration Tables should be used rather than the Vegetation Replacement Rates table.

Site preparation and ground disturbance for replacement plantings in an existing forested buffer should be minimal. Existing

vegetation should be protected from disturbance during planting of new material. Only the area receiving the new planting should be disturbed. Invasive vegetation should be removed by hand for a circle of at least three feet in diameter for the planting pit. Leaf litter may be raked and redistributed on site. All plantings should be mulched with 3-4 inches of mulch that is kept away from the base of the plant. Mulch group plantings as a single bed.

The replacement material should have the same functional value as the material that has been removed. Since research suggests that forested buffers have a greater pollutant removal capability than grass buffer strips, woody vegetation is the preferred choice for buffer replacement, restoration or establishment.[10] Native plants are preferred for any replanting and should be similar to those in neighboring sites. The plant selection should include all three trophic layers; canopy trees, sub-canopy trees/shrubs and shrub/groundcover.

For small areas where the number and type of plants removed is known, such as removal for sight lines or vistas where pruning and trimming are the first option, the replacement rate may be derived from the Vegetation Replacement Table below. The removal of vegetation should be minimal, and the applicant can determine in advance the cost of replacement materials. A single small tree cannot be expected to be as effective as a large tree with an expansive root system in retarding runoff, preventing erosion and

NOTE!!

Plant materials planted in the buffer **do not** have to be specimen quality plants.

To minimize expense, "B Grade" plants, either containerized or bare root may be allowed.

VEGETATION REPLACEMENT RATES

Vegetation removed	Preferred replacement vegetation	Acceptable alternative vegetation
1 tree or sapling ½"-2 ½" caliper	1 tree @ equal caliper or greater	**Or** 2 large shrubs @ 3'-4' **Or** 10 small shrubs or woody groundcover *@ 15"-18"
1 tree ≥ 2 ½" caliper	1 tree @ 1½" - 2" caliper,or 1evergreen tree @ 6' min. ht., per every 4" caliper of tree removed (ex: a 12" cal. tree would require 3 trees to replace it)	**Or** 75% trees @ 1½" - 2" and 25% large shrubs @ 3'-4' per every 4" caliper of tree removed. (ex: a 16" cal. tree removed would require 3 trees and 1 large shrub) **Or** 10 small shrubs or woody groundcover @ 15"-18" per 4"caliper of tree removed (ex: a 8" caliper tree removed requires 20 small shrubs)
1 large shrub	1 large shrub @ 3'-4'	**Or** 5 small shrubs or woody groundcover @ 15"-18"

* Woody groundcover is considered to be a woody, spreading shrub that remains close to the ground, to 18" high, such as a shore juniper, *juniperus conferta*. Vines may not be considered "woody groundcover" for the purpose of vegetation replacement.

Vegetation Replacement Rates

filtering non-point source pollution from runoff. Therefore, the table reflects replacement values that will begin to achieve equivalent functioning.

RESTORATION

Restoration will occur when large amounts of vegetation have been removed illegally or, as part of shoreline erosion control projects, as mentioned above. Restoration may also occur when, for woodlot management purposes, the majority (50% or greater) of the existing vegetation has been removed because of damage by insects, disease or other factors important to the health of the buffer.

Restoration may also be necessary when fifty percent or more of the vegetation in a woodlot is invasive material that has out-competed or over-run the existing native trees and shrubs. If the invasives cannot be removed by hand, leaving healthy woody vegetation in place, and complete removal of all vegetation is

RESTORATION/ESTABLISHMENT TABLE A

A. ¼ acre or less of buffer

(Up to 10,890 square feet or less of buffer area.)

For every 400 square-foot unit (20'x20') or fraction thereof, plant:

one (1) canopy tree @ 1½" - 2" caliper or large evergreen @ 6'
two (2) understory trees @ ¾" – 1 ½" caliper or evergreen @ 4'
or *one* (1) understory tree and *two* (2) large shrubs @ 3'-4'
three (3) small shrubs or woody groundcover @ 15" – 18"

Example:
A 100-foot wide lot x 100-foot wide buffer is 10,000 square feet.
Divide by 400 square feet (20'x20' unit) to get:
25 units

Units	x	plant/unit	Number of plants
25 units	x	1 canopy tree	25 canopy trees
		2 understory trees	50 understory trees
		3 small shrubs	75 small shrubs
			150 plants

RESTORATION/ESTABLISHMENT TABLE B

Greater than ¼ acre of buffer

More than 10,890 square feet

A. Plant at the same rate as for ¼ acre or less.

B. <u>The waterside 50% of the buffer (from the waterline inland for the first 50 feet):</u>
For every 400 square-foot unit (20'x20') or fraction thereof plant:

one (1) canopy tree @ 1½" - 2" caliper or large evergreen @ 6'
two (2) understory trees @ ¾" – 1 ½" caliper or evergreen @ 4'
or *one* (1) understory tree and *two* (2) large shrubs @ 3'-4'
three (3) small shrubs or woody groundcover @ 15" – 18"
<u>AND</u>

<u>The landward 50% of buffer (from 50 feet inland to 100 feet inland):</u>
either plant
Bare root seedlings or whips at 1,210 stems per acre[1] , approximately 6'x6' on center (Minimum survival required after two growing seasons: 600 plants)
or
Container grown seedling tubes at 700 per acre approximately 8'x 8' on center (Minimum survival required after two growing seasons: 490 plants)

C. If the applicant is willing to enter into a five year maintenance and performance guarantee: 100% of buffer planted with:
Bare root seedlings or whips at 1,210 per acre, approximately 6'x 6' on center (Minimum survival required after two growing seasons: 600 plants)
or
Container grown seedling tubes at 700 per acre approximately 8'x 8' on center (Minimum survival required after two growing seasons: 490 plants)

1 acre or more of buffer

With an evaluation from an arborist or forester or other professional, natural regeneration may be an acceptable method of buffer establishment, however, a forestry management plan must be in place prior to any vegetation being removed. A minimum of 35 feet next to the water must be left in forest and protected prior to any vegetation being removed. If over 20 percent of the vegetation must be removed for the health of the woodlot, within the 35 feet closest to the shoreline, vegetation must be reestablished by seedling plantings at the rates above.

[1] Palone, Roxanne S., and Al Todd, *Chesapeake Bay riparian handbook: A guide for establishing and maintaining riparian forest buffers.* May 1977. p. 7-20.

necessary to eradicate the invasives, then restoration of woody vegetation is necessary to maintain a functioning buffer.

For restoration of areas that have been so overgrown with invasives that the original underlying vegetation is unknown, part A of the Restoration Table is recommended as a reference to determine replacement amounts. Replacement planting plans should include a maintenance schedule. Some local governments have the authority to require performance guarantees, and as a matter of practice require them to assure survivability of the plants. The scientific literature suggests that two years may be needed to assure plant survival.

Reestablishment of a buffer must occur when a parcel of land that was in either agricultural or silvicultural use is converted to another use. Part B of the Restoration Table is a recommended reference for reestablishing the 100-foot wide buffer. Alternatively, a regeneration plan may be prepared by an arborist or other qualified professional.

For areas over one (1) acre that have been evaluated by a professional and meet the criteria, natural regeneration may be allowed according to the procedure outlined in the following section.

Natural Regeneration

If regeneration is the desired method of reforestation on a parcel that is currently in silvicultural use, but will change to another use after timber harvesting, a reforestation plan must be in place prior to the timber being cut. This will allow the assessment by a trained forestry professional to evaluate the regeneration capability of the buffer areas and suggest the best timber harvesting methods to produce that result. They will also be able to assist in developing a plan for the appropriate site preparation for hardwood establishment after timber harvest.

Planting Season

The best time for planting trees and shrubs is the spring or fall while the plants are dormant. The preferred time for deciduous species is spring, (late February / early March to May1st before bud break). Fall planting can take place after the leaves have fallen off deciduous plant material. Generally, evergreen plant material can be planted during the same period of time, although their dormancy period is a bit shorter. However, fall plantings should be well

watered and mulched to prevent winter desiccation. Frozen ground is the major obstacle to planting during the winter months.

MAINTENANCE

Maintenance of a newly planted buffer is necessary to assure survival of the vegetation. Included in that is the need to control invasive species, grasses and vines. These need to be kept away from new plantings by mulch, geo-textiles, mechanical means, chemical application, tree shelters or other means as necessary until the plantings are established. The ground around and between the plantings requires cover to prevent erosion. Native plants should be well adapted to the area and require no additional fertilization. The area should have signs or fencing to prevent mowing within the buffer while the new plantings establish and volunteer vegetation germinates from seed or sprouts from remaining roots.

A maintenance schedule should outline the timing and methods for maintenance activities, from watering to control of competing vegetation. The second most important issue related to the success of the planting is "…the care the plantings receive during the first year, watering at regular intervals being especially important."[11]

Over time as volunteer plant materials enter the buffer, thinning or removal of undesirable and invasive species may be necessary to assure the health of the buffer. A professional arborist or forester should include a maintenance plan in his/her forest management plan or forest stewardship plan.

Some local governments that have the authority to require performance guarantees to assure the survivability of the plantings, may choose to require such a guarantee. Research suggests that, generally, the larger sized replacement plantings should be established within one growing season. For restoration or regeneration planting, a minimum of two years or, more realistically, five years may be necessary to evaluate the survival rate of the plantings.

CONCLUSIONS

When reestablishing a woody buffer the following criteria should be met:

- The hydrology of the site should be evaluated and necessary measures taken to assure the dispersal of

concentrated flows into sheet flow before runoff reaches the riparian buffer area.

- Best management practices for erosion and sediment control should be employed during restoration activities to protect adjacent wetlands and shorelines of water bodies.
- Site preparation shall be sufficient for the establishment and growth of the selected plants and done at a time to insure their survival and growth.
- Plant stock should come from properly certified and inspected nurseries.
- Species planted should be non-exotic strains of native plants, (non-hybrid, non-invasive), indigenous to the area, and adapted to the site conditions.
- The mix of species chosen should reflect the ecological community in adjacent or nearby parcels following the composition and mix of trophic layers.
- A mixture of container grown or B&B species with no less than 1 canopy, 2 understory, and 3 shrub species per 400 square feet, is recommended for a buffer restoration site of a quarter of an acre (10,890 square feet) or less.
- The location and density of the plants should complement the natural features of the site. Random spacing and clustered groups of mixed species should be used rather than evenly spaced rows of plants.
- Mulching, tree shelters (at a rate of 100 per acre), grass mats, or other methods should be used where necessary to ensure the survival of the selected plant material.

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[1] Virginia Department of Forestry. (July 2002). *Virginia's Forestry Best Management Practices for Water Quality.* 4th ed. Charlottesville, VA.: Department of Forestry. p. 44.

[2] Harker, et.al. *Landscape Restoration Handbook.* New York Audubon Society. Lewis Publishers. p. 66.

[3] Palone, R. S. & Todd, A. H. eds. (1997). *Chesapeake Bay Riparian Handbook: A Guide for Establishing and Maintaining Riparian Forest Buffers*. USDA Forest Service. NA-TP-02-97. Radnor, PA. p. 6-5.

[4] Palone, p 6-5.

[5] Palone, p 6-5.

[6] Virginia Department of Forestry. *Watershed Management*. Online. Internet.

[7] Palone, p.6-3.

[8] DCR – Division of Natural Heritage. (2002). Unpublished data on stand structure and stocking in forests of estuarine and riparian buffers.

[9] Alliance for the Chesapeake Bay. (January 1996). *Riparian forest buffers.* White Paper.

[10] Schueler, Thomas. (1987) *Controlling urban runoff: A practical manual for planning and designing urban BMPs.* Washington, D.C.: Metropolitan Washington Council of Governments, in *The Chesapeake Bay Local Assistance Manual*, (1989). p.IV-56.

5.2 - Buffer Land Use Activities

Purpose:

The purpose of this chapter is to provide local governments with guidance on what non-development related activities are prohibited within the 100-foot buffer and to provide visual examples of these uses and activities.

Regulations:

§9VAC 10-20-130.3 states that:

"The 100-foot wide buffer area shall be the landward component of the Resource Protection Area as set forth in subdivision B.5 of §9 VAC 10-20-80. Notwithstanding permitted uses, encroachments, and vegetation clearing, as set forth in this section, the 100-foot wide buffer area is not reduced in width. To minimize the adverse effects of human activities on the other components of the Resource Protection Area, state waters, and aquatic life, a 100-foot wide buffer area of vegetation that is effective in retarding runoff, preventing erosion, and filtering nonpoint source pollution from runoff shall be retained if present and established where it does not exist."

§9VAC 10-20-130.3.a that:

"The 100-foot wide buffer area shall be deemed to achieve a 75% reduction of sediments and a 40% reduction of nutrients."

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DISCUSSION:

Although the buffer is protected from most development activities, there are certain land uses and activities that have the potential to impede the water quality functions of the buffer. Activities such as clearing for the establishment of a lawn, wholesale application of pesticides, the use of heavy equipment, and excessive storage of materials would not be consistent with the Regulations. These types of activities clearly limit the buffer's ability to retard runoff, prevent erosion, and filter nonpoint source pollution. Local governments should consider these types of activities as violations of the local Bay Act program.

EXAMPLES:

The following images are examples of land uses activities in the buffer that are not consistent with the intent of the Regulations.

Tree damage from heavy machinery use.

Heavy equipment use

These photos demonstrate the effects of the use of heavy machinery in the buffer area. The picture on the left shows scarring of a tree trunk, a common occurrance with heavy machinery use. Bark damage or other cuts can easily lead to disease and death of the tree.

The image below shows land disturbance and soil compaction that results from the use of heavy machinery. Because the majority of a tree's roots are in the top 18" of the soil, compaction can easily crush the root system and kill the tree. Where construction is authorized within the buffer, such as for

Heavy machinery compacts roots, and disturbs the soil.

shoreline erosion control or water dependent facilities, clearly marking the limits of land disturbance can help prevent damage to trees in the buffer.

Boat storage is not allowed in the RPA.

Storage of equipment and materials

This picture is an example of buffer area that is not functioning properly because of boat storage in the buffer area. In order for riparian buffers to provide adequate water quality protection, they must be properly managed to promote the growth of natural vegetation. Section 9 VAC 10-20-130.1.a. (3) requires that any non-water dependent component of a water dependent use, such as boat storage at a marina, be located outside of the RPA. Since they are an accessory use, permanent storage structures are not permitted in the 100-foot buffer area. Other examples would be storage of construction materials and equipment. Local governments have the authority under §9VAC 10-20-130.3 to require that the 100-foot buffer be established and retained in natural vegetation that performs the required water quality functions.

Clearing all woody vegetation to create a lawn is not consistent with the intent of the Regulations.

Lawn fertilization adds additional nutrients to the Bay

Clearing to establish a lawn

Clearing woody vegetation in the buffer to establish a lawn is not permitted by the Regulations. Maintained lawns do not

provide all of the required buffer functions and may actually contribute to nonpoint source pollution through the application of fertilizers and pesticides associated with maintaining a lawn.

Lawn Care Activity

While new lawns may not be created within buffer area, it is recognized that many properties have existing lawns that extend into the buffer. Property owners are encouraged to convert such lawn areas to woody vegetation or native cool season grasses that are not mowed. However, with proper and diligent maintenance, based on sound horticultural practices, an existing lawn may provide some of the required buffer functions. However, the use of nutrients and pesticides (including weed preventers) should be based on an accurate analysis of existing soil conditions and correct identification of weeds or pests before application. Soil test kits can be obtained through county extension offices to determine the need for chemical application and assure use of the proper chemicals and application rates.

Local governments should encourage programs to educate the public on proper lawn care to prevent over-fertilization and unnecessary pesticide use that can add to water quality problems. Extension agents and Master Gardeners can provide information on proper turf management, through programs such as *LawnKnowers* in Henrico County or *Water-wise Gardener* in Prince William County, to help minimize improper lawn care practices. Education in Integrated Pest Management (IPM) practices can also help minimize the use of pesticides.

Generally, a healthy forest buffer will not require the application of nutrients in the form of fertilizers, especially a buffer composed of native plants. The continuous recycling of nutrients through the growth, death, decay and reuse of organic material in the soil assures the proper nutrient level in most natural forests.

Equally important is the proper identification of insects, pests or diseases in the woodlot, prior to any pesticide use. Homeowners should be encouraged to consult an extension agent or other professional to examine any insect or disease problem. A professional can identify the pest, determine the need for chemicals and, if necessary, educate the property owner on the proper dosage and method of application. Often what may seem like a devastating infestation to a homeowner may be a natural cycle that will balance

out through natural ecological controls. A small area of infestation may be controllable by hand and not require potentially damaging chemical application. The correct identification of a problem and appropriate solution suggested by a knowledgeable person can help to avoid practices that contribute to water quality problems.

CONCLUSION:

- Any land use in the100-foot buffer that prevents the buffer from performing the required functions of retarding runoff, preventing erosion, and filtering nonpoint source pollution, should be considered inconsistent with the Regulations.
- Land uses that are authorized within the RPA should be conducted with care to avoid harmful impacts to buffer vegetation that will remain in place.
- Local governments should develop programs, or encourage use of those they have, to educate property owners about the proper care of their vegetation to prevent improper practices that may contribute to nonpoint source pollution.

5.3 - Buffer Area Modification Violations

Purpose:

The purpose of this chapter is to provide guidance on how to address violations, such as illegal clearing activities. The guidance includes a discussion of some causes for violations, how they may be prevented, and a local government may address the violations that do occur.

Regulations:

§9 VAC 10-20-130.3 states:

> "To minimize the adverse effects of the human activities on the other components of the Resource Protection Area, state waters, and aquatic life, a 100-foot wide buffer area of vegetation that is effective in retarding runoff, preventing erosion and filtering nonpoint source pollution from runoff shall be retained if present and established where it does not exist."

§9 VAC 10-20-130.5.a states:

> "In order to maintain the functional value of the buffer area, existing vegetation may be removed, ***subject to approval by the local government***, only to provide for reasonable sight lines, access paths, general woodlot management, and best management practices, including those that prevent upland erosion and concentrated flows of stormwater, as follows…"

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DISCUSSION:

In order for the buffer to be effective in preventing erosion, filtering nonpoint source pollution and retarding runoff, existing vegetation must be preserved. The value of the various layers of vegetation of the buffer in protecting water quality has been discussed in other chapters of this document. The buffer is best left undisturbed in its natural state. Modifications (vegetation removal activities) within the buffer should always be reviewed and approved by the local government according to their locally adopted ordinance.

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Improper removal of existing buffer vegetation is one of the more serious issues associated with maintenance of the buffer area. When property owners and/or developers remove excessive amounts of vegetation from the buffer area without local government approval, or in some cases despite local guidance, the clearing is considered in violation of the regulations. Some examples of buffer violations include removal of trees and other woody vegetation for yard areas, expansive unrestricted vistas, or other buffer uses such as permanent boat storage.

Some property owners have replaced the woody vegetation with a turf-grass lawn, which does not provide the pollutant removal and retardation of runoff that a woody buffer, with an undisturbed groundcover of leaves, twigs and duff provides. While an un-mowed meadow may provide some of the buffer functions, a mowed lawn does not meet the same level of functioning as a forested buffer. In addition, fertilizers and weed control chemicals used to support a residential lawn may be washed into adjacent waters,

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Common Reasons for Violations:

There are many reasons that violations may occur, but the following are the more frequent reasons that excessive vegetation is removed:

Lack of knowledge

Many homeowners are unaware of the Chesapeake Bay Preservation Act, or do not think it applies to them. They may not understand the purpose of buffers or the requirements that do apply to them. People who move in from out of state are especially unlikely to be aware of the Bay Act. Consequently, they may remove vegetation without consulting the local government for guidance and approval.

Invisibility

The location of the buffer boundary is usually not marked or visible on the ground, so its location is assumed and the buffer is treated more like a setback line than an edge beyond which activity is limited. This may result in the yard gradually encroaching into the buffer diminishing the width of the buffer over time.

Deliberate destruction:

Some homeowners are aware of the buffer requirements, but chose to eliminate all woody vegetation, believing that replacement with turfgrass is equally effective and acceptable.

Aids to prevention of buffer destruction:

Including the buffer limits on all construction drawings could help clarify the limits for those involved in construction activity.

Some local governments require permanent markers or signs to show the limits of the buffer. This helps prevent inappropriate impacts to the buffer.

Education of owners, developers, contractors and realtors about the Bay Act and the importance of buffers could help eliminate unintentional buffer removal.

Some local governments have decided to enact additional setbacks to provide further protection from construction impacts or gradual yard encroachments.

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adding to the pollutant load.

Local governments often have difficulties in tracking and responding to buffer violations. In many instances it is difficult, after the fact, to ascertain what type and amount of vegetation was cleared; therefore, determining restoration quantities based on what was originally there is not feasible. Use of an established vegetation replacement standard would help in such instances, and would assure consistency among projects.

Discovery of violations

Violations are usually discovered when a citizen or neighbor calls about removal of vegetation in the buffer, or when a local inspector, such as an erosion and sediment control or zoning inspector, notes the violation as part of their site inspection. Most local governments do not have staff exclusively dedicated to investigating buffer violations and most rely on citizen calls or local inspectors to identify violations.

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Procedural issues

Localities process confirmed violations in a variety of ways. Many localities do not currently have a formal, established process for buffer violations, but rely on informal meetings and conversations with the property owner or contractor to develop acceptable mitigation or remediation solutions. Other localities send a Notice of Violation or other zoning violation letter to the property owner with a follow-up visit to the owner on site to discuss remediation requirements and enter into a restoration agreement. Some localities clearly stipulate mitigation and remediation requirements in the violation letter. Some localities now require a letter of agreement or other performance guarantee to assure plant replacement survival.

When a violation cannot be resolved through the types of measures outlined above, local governments have used both crimi-

nal and civil processes to address the violations. Some local governments have indicated that criminal cases are more difficult for them, because some criminal judges are not familiar with the Bay Act program and the intricacies of its regulatory requirements. However, at least one local government has had success in criminal cases because the locality has urban foresters on staff who can effectively prepare court case materials and testimony.

Although not used extensively by local governments, civil cases can result in fines that can then be used by the local government for restoration projects on public lands or to help fund their water quality improvement programs. Civil cases may go to local elected bodies for decisions that may establish a fine or levy civil charges in addition to requiring restoration of buffer vegetation.

Local ordinance language needs to be in place to allow for either civil or criminal proceedings to be used. When a local government has included the Bay Act requirements as a zoning overlay district, civil penalties included in the local zoning code may be applied. Other localities have adopted the civil penalties clause from the Bay Act itself to support assessing civil penalties for violations of Bay Act requirements, including buffer area violations.

Buffer violation mitigation

Localities normally require the re-establishment of vegetation in the buffer area to remediate the improper removal of vegetation; however most do not have consistent buffer restoration standards. Local governments currently use a variety of options for addressing vegetative replacement when violations occur. Some of these options include:

- Requirements that trees and sometimes shrubs must be replaced at a one-to-one or two-to-one ratio.
- Specific vegetation replacement standards in their ordinance.
- Requirements that replacement be based on the sampled density of species in adjacent undisturbed buffer areas.
- Reliance on staff judgment to decide vegetation replacement ratios on a case-by-case basis.

Suggested standards for vegetative replacement ratios can be found in Appendix D. Chapter 5 and the Appendices contain

additional information on suggested vegetative replacement standards, plant lists and planting details. Local governments are encouraged to develop replacement policies appropriate for their jurisdictions.

When considering buffer violations and remediation, the survival of replacement species should be part of the restoration agreement. Again, some local governments employ performance guarantees to ensure the viability of replacement vegetation. Withholding certificates of occupancy until plantings are installed has been used as well. However, this can be unreasonable if the house is completed outside of a planting season.

Experts consulted in the development of this guidance indicated that a minimum time frame to ensure survival of replacement species would be two years. However, one expert indicated that five years would be preferable to ensure plant viability when smaller seedling and bare-root stock has been planted.

Educational efforts

Given that one of the greatest threats to a riparian forested buffer is removal of vegetation resulting from a lack of understanding of buffer functions and benefits for water quality, local governments should have educational materials about buffers available for their citizens. Educating local homeowners on the importance of the buffer area and the activities allowed within it will help prevent many violations. Clarity about what may or may not be removed and what requires local government approval should be included. Realtors should also be educated about the buffer so that they can learn to market the positive aspects of a forested buffer and make accurate statements about what can be removed from the site.

Most local governments do not have sufficient staff to conduct frequent site visits to assure that the buffer is protected during construction. Additional training for erosion and sediment control, zoning and building inspectors may be a cost effective way to better track buffer area violations.

Localities should contact the Department for information on what educational programs other Tidewater localities have developed. Some localities have produced informational videos and

brochures addressing buffer issues. CBLAD is also producing a small buffer brochure that can be distributed by localities.

CONCLUSIONS:

- In addition to showing the limits of the 100-foot wide buffer on property boundary plats, the local government should require the limits to be clearly marked on all site plans, construction drawings, grading plans and planting plans and indicate limits of construction outside of the buffer.

- Pre-construction meetings with the owner and contractor should include a discussion of buffer protection measures during construction.

- Local governments need to establish a consistent process for dealing with buffer violations, including consistent and appropriate vegetation replacement standards.

- Procedures should be codified where possible to ensure consistent application of mitigation and replacement standards.

- Civil charges may be helpful to augment buffer restoration and other water quality improvement efforts of a local government and could serve as a deterrent to future violations.

- Criminal charges may be necessary in extreme cases, as a last resort, provided adequate case preparation provides reasonable expectations of success in court.

RECOMMENDED PROCEDURES FOR LOCAL GOVERNMENTS:

- Local governments should first conduct a site visit to determine whether a violation has occurred. Documentation should include a written report and corroborative

photographs.

- Local governments should send a notice of violation when a buffer violation is confirmed. If the site is under active construction, localities may have the authority to issue a stop-work order to assure that no additional land disturbance or removal of buffer vegetation occurs until the violation is resolved.

- Local governments should require the property owner to develop a mitigation plan based on local vegetative replacement standards applied consistently.

- Local governments should have a list of approved plants for replacement vegetation to ensure that exotics and invasive plant materials are not used. A suggested list of native plants can be found in *Appendix A* of this manual.

- Although native grasses may be a component of a successful buffer restoration plan, lawn grass should never be the predominant replacement vegetation. Clearing woody vegetation and replacing it with a maintained lawn is inconsistent with the Regulations.

- As with buffer establishment, a three tiered approach for buffer mitigation and replacement should be applied for buffer area violations. Localities should refer to *Chapter 5 - Buffer Establishment*, for information on buffer replacement.

- Some local governments may have the authority to require a performance guarantee to ensure the survival of replacement vegetation. An inspection should be made after at least two years prior to release of the guarantee.

APPENDICES

Appendix A - Lists of Recommended Plants for Riparian Buffers.....A-1

Appendix B - Invasive Alien Species.....B-1

Appendix C - Planting Details.....C-1

Appendix D - Vegetative Replacement Standards.....D-1

Appendix E - Native Plant Nurseries.....E-1

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Appendix H - Glossary.....H-1

Appendix I - Contributing Members.....I-1

Appendix A - Plant Lists

These lists are suggestions for recommended plants and are not to be construed as exclusive lists. There are many other suitable plants for riparian buffer planting. These lists are a place to start.

MEDIUM TO LARGE DECIDUOUS CANOPY TREES

Red maple - Acer rubrum
Acer saccharum - Silver maple
Betula lenta - Black birch
River birch - Betula nigra
Shagbark hickory - Carya ovata-
Mockernut hickory - Carya tomentosa
Hackberry - Celtis occidentalis
Washington hawthorn - Craetagus phaenopyrum
Persimmon - Diospyros virginiana
American Beech - Fagus grandifolia
White ash - Fraxinus americana
Green ash - Fraxinus pennsylvanica
Water locust - Gleditsia aquatica-
Black walnut - Juglans nigra
Sweetgum - Liquidamber straciflua
Tulip poplar - Liriodendron tulipifera
Water tupelo - Nyssa aquatica
Black gum - Nyssa sylvatica
Sourwood - Oxydendron arboreum
Sycamore - Platanus occidentalis
Cottonwood poplar - Populus deltoids
Swamp cottonwood - Populus heterophylla
Black cherry - Prunis serotina
Swamp white oak - Quercus bicolor
Shingle oak - Quercus imbricata
Laurel oak - Quercus laurifolia
Overcup oak - Quercus lyrata-
Swamp chestnut oak - Quercus michauxii
Water oak - Quercus nigra
Pin oak - Quercus palustris
Willow oak - Quercus phellos
Shumard oak - Quercus shumardii
Swamp willow, Black willow - Salix nigra
Weeping willow - Salix babylonica
American basswood - Tilia Americana

SMALL CANOPY/UNDERSTORY TREES

Red buckeye - Aesculus pavia
Smooth alder - Alnus serrulata
Serviceberry - Amelanchier canadensis
Devil's walkingstick - Aralia spinosa
Pawpaw - Asimia triloba
American hornbeam- Carpinus caroliniana
Sugar hackberry - Celtis laevigata
Redbud, Judas tree - Cercis canadensis
Fringetree - Chionanthus virginicus
Dogwood - Cornus florida
Cockspur hawthorn - Crataegus crus-galli
Green hawthorn - Crataegus viridis
Parsley hawthorne - Crataegus marshalli
Swamp cyrilla - Cyrilla racemosa
Two-winged Silverbell - Halesia diptera
American holly – Ilex opaca
Possumhaw - Ilex deciduas
Spicebush - Lindera benzoin
Sweetbay Magnolia - Magnolia virginiana
Eastern hophornbeam - Ostrya virginiana
Sourwood - Oxydendron arboreum
Elderberry - Sambucus canadensis
Sassafras - Sassafras albidum
Sparkleberry - Vaccinium arboreum
Nannyberry - Viburnum lentago

EVERGREEN TREES

American holly - Ilex opaca
Eastern red cedar - Juniperus virginiana
Southern magnolia - Magnolia grandiflora
Shortleaf pine - Pinus echinata
Pitch pine - Pinus rigida
Eastern white pine - Pinus strobus
Loblolly pine - Pinus taeda
Virginia pine - Pinus virginiana
Darlington oak - Quercus laurifolia
Darlingtonia
Live oak - Quercus virginiana

EVERGREEN SHRUBS

Inkberry holly - Ilex glabra
Common juniper - Juniperus communis
Shore juniper - Juniperus conferta
Southern wax myrtle - Myrica cerifera
Bayberry - Myrica pennsylvanica
Swamp azalea - Rhododendrona viscosum
Farkleberry - Vaccinium arboreum

LARGE SHRUBS

Alder - Alnus serrulata
False indigo - Amorpha fruiticosa
Red chokeberry - Aronia arbutifolia
American beautyberry - Calicarpa americana
Eastern sweetshrub -Calycanthus floridus
Buttonbush - Cephalanthus occidentalis
Silky dogwood - Cornus amonum
Greystem dogwood - Cornus racemosa
Red twig dogwood - Cornus stolonifera
Witch hazel - Hammamelis virginiana
Wild hydrangea - Hydrangea arborescens
Oakleaf hydrangea - Hydrangea quercifolia
Winterberry holly - Ilex verticilata
Yaupon holly - Ilex vomitoria
Virginia sweetspire - Itea virginica
Fetterbush/ Sweetbells - Leucothoe racemosa
Fetterbush - Lyonia lucida
Male-berry - Lyonia ligustrina
Southern wax myrtle - Myrica cerifera
Bayberry - Myrica pennsylvanica
Common ninebark - Physocarpus opulifolius
Choke cherry - Prunus virigniana
Swamp azalea - Rhododendrona viscosum
Smooth sumac - Rhus glabra
Allegheny blackberry - Rubus allegheniensis
Pussy willow - Salix discolor
Silky willow - Salix sericea
Elderberry - Sambucus canadensis
American snowbell - Styrax americanus
Highbush blueberry - Vaccinium corybosum
Arrowwood viburnum - Viburnum dentatum
Swamphaw Viburnum - Viburnum nudum
Blackhaw viburnum - Viburnum prunifolium

SMALL SHRUBS

-
Obovate serviceberry - Amelanchier obovalis
Black chokecherry - Aronia melanocarpa
Sweet pepperbush - Clethra alnifolia
Sweet fern - Comptonia peregrina
Strawberry bush - Euonymus americanus
Fothergilla - Fothergilla gardenii
Black huckleberry - Gaylussacia baccata
Dangleberry - Gaylussacia frondosa
Wild hydrangea - Hydrangea arborescens
Oakleaf hydrangea - Hydrangea quercifolia
Mountain laurel - Kalmia latifolia
Staggerbush - Lyonia mariana
Shrubby cinquefoil - Potentilla fruticosa
Beach plum - Prunus maritime
Sand blackberry - Rubus cuneifolius
Bankers willow - Salix cottettii
White meadowsweet - Spiraea alba
Meadowsweet - Spiraea latifolia
Steeplebush - Spiraea tomentosa
Common snowberry - Symphoricarpos albus
Coralberry - Symphocarpos orbiculatus
Lowbush blueberry - Vaccinium angustifolium
Maple-leaved viburnum - Vaccinium acerifolium
Adam's needle - Yucca filamentosa

NATIVE GRASSES

Big Bluestem - Andropogon gerardi
Broomsedge - Andropogon virginicus
Indian woodoats - Chasmanthium latifolium
Coastal panic grass - Panicum amarum
Switch grass - Panicum virgatum
Little bluestem - Schizachyrium scoparium
Indian grass - Sorghastrum nutans
Easternn gama grass - Tripsacum dactyloides

HERBACEOUS PLANTS

Black-eyed Susan - Rudbeckia fulgida
Cardinal Flower - Lobelia cardinalis
Coralbells - Heuchera Americana
Creeping Phlox - Phlox stolonifera
Crested Iris - Iris cristata
Foamflower - Tiarella cordifolia
Goldenrod - Solidago Canadensis
Great Blue Lobelia - Lobelia siphilitica
Green and Gold - Crysogonum virginianum
Ironweed - Vernonia noveboracensis
Jack-in-the-Pulpit - Arisaema triphyllum
Joe-Pye Weed - Eupatorium purpureum
Mayapple - Podophyllum peltatum
Mistflower - Eupatorium coelestinum
Mouse-ear Coreopsis - Coreopsis auriculata
New York Aster - Aster novi-belgii
Pink Turtlehead - Chelone lyonii
Purple Coneflower - Echinacea purpurea
Small Solomon's Seal - Polygonatum biflorum
Swamp Milkweed - Asclepias incarnata
Sweet Flag - Acorus americanus
Tall Gayfeather - Liatris scarios
Three-toothed Cinquefoil -Potentilla tridentata
Tickseed - Coreopsis grandiflora
Virginia Bluebells - Metensia virginica
Virginia Blue flag - Iris virginica
Wild Columbine - Aquilegia Canadensis
Woodland Phlox - Phlox divaricata

SHADE TOLERANT PLANTS

Trees

Red maple
Sugar maple
Serviceberry, Shadbush
Pawpaw
Yellow birch
Hornbeam
American beech
White ash
Sweetbay magnolia
Hop hornbeam
American basswood
Canada hemlock

Small Trees & Shrubs

Dogwood
Redbud
Fringetree
Sweet pepperbush
Gray dogwood
American hazelnut
Witchhazel
Inkberry
Mountain laurel
Spicebush
Staghorn sumac
Elderberry
Highbush blueberry
Witherod
Southern arrowwood
Highbush cranberry
Virginia sweetspire

PART SUN (semi-shade intolerant)

Trees

Silver maple
Sweet birch
Bitternut hickory
Shagbark hickory
Hackberry
Tulip poplar
Easter white pine
Sycamore
White oak
Swamp white oak
Chestnut oak
Willow oak
Northern red oak
Slippery elm

Small Trees & Shrubs

Red chokeberry
Black choke berry
Black huckleberry
Winterberry
Swamp azalea
Meadowsweet
Nannyberry
Smooth alder
Pinxterbloom azalea

FULL SUN (shade intolerant)

Trees

Persimmon
Black ash
Red ash
Honey-locust
Kentucky coffee-tree
Black walnut
Sweet gum
Black gum
Eastern cottonwood
Black cherry
Pin oak
Black willow
Sassafras

Small Trees & Shrubs

Groundsel bush
Buttonbush
Silky dogwood
Red-osier dogwood
Bayberry
Wax myrtle
Ninebark
Rosebay rhododendron
Blackhaw viburnum

FLOOD TOLERANT

Trees

Red maple
Shadbush
Yellow birch
Black Ash
Red ash
Sweet gum
Sweetbay magnolia
Eastern cottonwood
Swamp white oak
Willow oak
Black willow
Slippery elm

Small Trees & Shrubs

Smooth alder
Red chokeberry
Black chokeberry
Groundsel bush
Buttonbush
Silky Dogwood
Red-osier dogwood
Inkberry
Winterberry
Bayberry
Ninebark
Rosebay rhododendron
Swamp azalea
Swamp rose
Meadowsweet
Highbush blueberry
Witherod
Southern arrowwood
Northern arrowwood
Highbush cranberry

SEMI-FLOOD TOLERANT
(good for wet sites)

Trees

Atlantic white cedar
Allegheny serviceberry
Bald cypress
Black gum
Bitternut hickory
Eldeberry
Grey birch
Green ash
Hackberry
Persimmon
White ash
Honey-locust
Kentucky coffee-tree
Black walnut
Tulip poplar
Black gum
Sycamore
Northern red oak
River birch

Shrubs
Serviceberry
Fringe tree
American hazelnut
Black huckleberry
Grey dogwood
Spicebush
Witchhazel
Mountain laurel
Staghorn sumac
Nannyberry viburnum
Blackhaw viburnum

SALT TOLERANT SPECIES

Serviceberry, Shadblow
Groundsel tree
Hackberry
American holly
Eastern red cedar
Sweetbay magnolia
Black gum
Pitch pine
Elderberry

Shrubs

Bearberry
Red cokeberry
Black chokeberry
Buttonbush
Sweet pepperbush
Inkberry
Spicebush
Southern wax myrtle
Bayberry
High tide bush
Beach plum
Winged sumac
Smooth sumac
Staghorn sumac
Rugosa rose
Arrowwood viburnum
Blackhaw viburnum
Highbush blueberry

APPENDIX B - INVASIVE ALIEN PLANT SPECIES OF VIRGINIA

This list was developed in a cooperative project between the Department of Conservation and Recreation, Division of Natural Heritage and the Virginia Native Plant Society Blandy Experimental Farm, 400 Blandy Farm Lane, Unit 2, Boyce, Virginia 22620 (540) 837-1600 *http://ww.vnps.org*

August 2002

Key

M = Mountains F = Full sun“P = Shade H = Hydric“M = Mesic“X = Xeric

COMMON NAME	SCIENTIFIC NAME	REGION			LIGHT			MOISTURE		
		M	P	C	F	P	S	H	M	X
Highly Invasive Species										
Tree-of-heaven	*Ailanthus altissima*	●	●	●	●	●			●	
Garlic mustard	*Alliaria petiolata*	●	●		●	●	●		●	
Alligator weed	*Alternanthera philoxeroides*			●	●	●		●		
Porcelain-berry	*Ampelopsis brevipedunculata*		●		●	●	●		●	
Asiatic sand sedge	*Carex kobomugi*			●	●	●				●
Oriental bittersweet	*Celastrus orbiculata*	●	●	●		●	●		●	
Short-fringed knapweed	*Centaurea dubia*	●			●	●			●	●
Spotted knapweed	*Centaurea maculosa*	●	●	●	●	●				●
Canada thistle	*Cirsium arvense*	●	●	●	●				●	
Chinese yam	*Dioscorea oppositifolia*	●	●	●		●	●		●	
Autumn olive	*Elaeagnus umbellata*	●	●	●	●	●			●	
Winged burning bush	*Euonymus alata*		●			●	●		●	
Hydrilla	*Hydrilla verticillata*			●	●	●		●		
Cogon grass	*Imperata cylindrica*			●		●	●		●	
Chinese lespedeza	*Lespedeza cuneata*	●	●		●				●	
Chinese privet	*Ligustrum sinense*	●	●	●		●	●		●	
Japanese honeysuckle	*Lonicera japonica*	●	●	●	●	●	●		●	
Morrow’s honeysuckle	*Lonicera morrowii*	●	●		●	●	●		●	
Standish’s honeysuckle	*Lonicera standishii*	●	●			●	●		●	
Purple loosestrife	*Lythrum salicaria & L. virgatum*	●	●	●	●			●	●	
White sweet clover	*Melilotus alba*	●	●	●	●	●			●	
Yellow sweet clover	*Melilotus officinalis*	●	●	●	●	●			●	
Japanese stilt grass	*Microstegium vimineum*	●	●	●	●	●	●	●	●	
Aneilima	*Murdannia keisak*		●	●	●	●		●		
Parrot feather	*Myriophyllum aquaticum*	●	●	●	●			●		
European water-milfoil	*Myriophyllum spicatum*	●	●	●	●			●		
Common reed	*Phragmites australis*		●	●	●	●		●	●	
Japanese knotweed	*Polygonum cuspidatum*	●	●	●	●	●			●	
Mile-a-minute	*Polygonum perfoliatum*		●		●	●	●		●	
Kudzu vine	*Pueraria lobata* (*P. montana*)	●	●	●	●	●	●		●	

Lesser celandine	*Ranunculus ficaria*			●		●	●		●	
Multiflora rose	*Rosa multiflora*	●	●	●	●	●			●	
Wineberry	*Rubus phoenicolasius*	●	●	●		●	●		●	
Johnson-grass	*Sorghum halepense*	●	●	●	●	●			●	
Moderately Invasive Species										
Norway maple	*Acer platanoides*	●	●	●	●	●			●	
Quack grass	*Agropyron repens*	●	●	●	●	●			●	
Rhode Island bent-grass	*Agrostis tenuis*	●	●		●	●			●	
Five-leaf akebia	*Akebia quinata*		●	●	●	●	●		●	
Wild onion	*Allium vineale*	●	●	●	●	●			●	
Mugwort	*Artemisia vulgaris*	●	●	●	●	●			●	●
Jointed grass	*Arthraxon hispidus*	●	●	●	●	●	●	●	●	
Giant reed	*Arundo donax*		●	●	●	●		●	●	
Japanese barberry	*Berberis thunbergii*	●	●	●	●	●	●		●	
Balloon vine	*Cardiospermum halicacabum*			●	●				●	
Musk thistle	*Carduus nutans*	●	●	●	●				●	
Sickle pod	*Cassia obtusifolia*		●	●	●	●			●	●
Brown knapweed	*Centaurea jacea*	●	●		●	●			●	●
Bull-thistle	*Cirsium vulgare*	●	●	●	●				●	
Field-bindweed	*Convolvulus arvensis*	●	●	●	●	●			●	
Cut-leaf teasel	*Dipsacus laciniatus*	●			●				●	
Common teasel	*Dipsacus sylvestris*	●	●	●	●			●	●	
Brazilian water-weed	*Egeria densa*	●	●	●	●	●		●		
Wintercreeper	*Euonymus fortunei*			●		●	●	●	●	
Tall fescue	*Festuca elatior* (*F. pratensis*)	●	●	●	●	●			●	
Fennel	*Foeniculum vulgare*		●	●	●			●	●	●
Gill-over-the-ground	*Glechoma hederacea*	●	●	●		●	●		●	
English ivy	*Hedera helix*		●	●	●	●	●		●	
Velvet-grass	*Holcus lanatus*	●	●	●	●	●		●	●	
Japanese hops	*Humulus japonicus*	●	●	●	●	●	●	●	●	
Ivy-leaved morning-glor	*Ipomoea hederacea*	●	●	●	●	●		●	●	
Common morning-glory	*Ipomoea purpurea*	●	●	●	●				●	
Yellow flag	*Iris pseudacorus*	●	●	●	●	●		●		
Shrubby bushclover	*Lespedeza bicolor*	●	●	●	●	●			●	
Blunt-leaved privet	*Ligustrum obtusifolium*		●	●			●		●	
Amur honeysuckle	*Lonicera maackii*	●	●			●			●	
Tartarian honeysuckle	*Lonicera tatarica*	●	●		●	●			●	
Moneywort	*Lysimachia nummularia*	●	●	●	●	●	●	●	●	
China-berry	*Melia azedarach*		●	●	●	●			●	
Princess tree	*Paulownia tomentosa*	●	●	●	●	●			●	
Timothy	*Phleum pratense*	●	●	●	●	●			●	
Golden bamboo	*Phyllostachys aurea*		●	●	●	●			●	
Canada bluegrass	*Poa compressa*	●	●	●	●	●	●		●	●
Rough bluegrass	*Poa trivialis*	●	●	●	●	●	●	●	●	

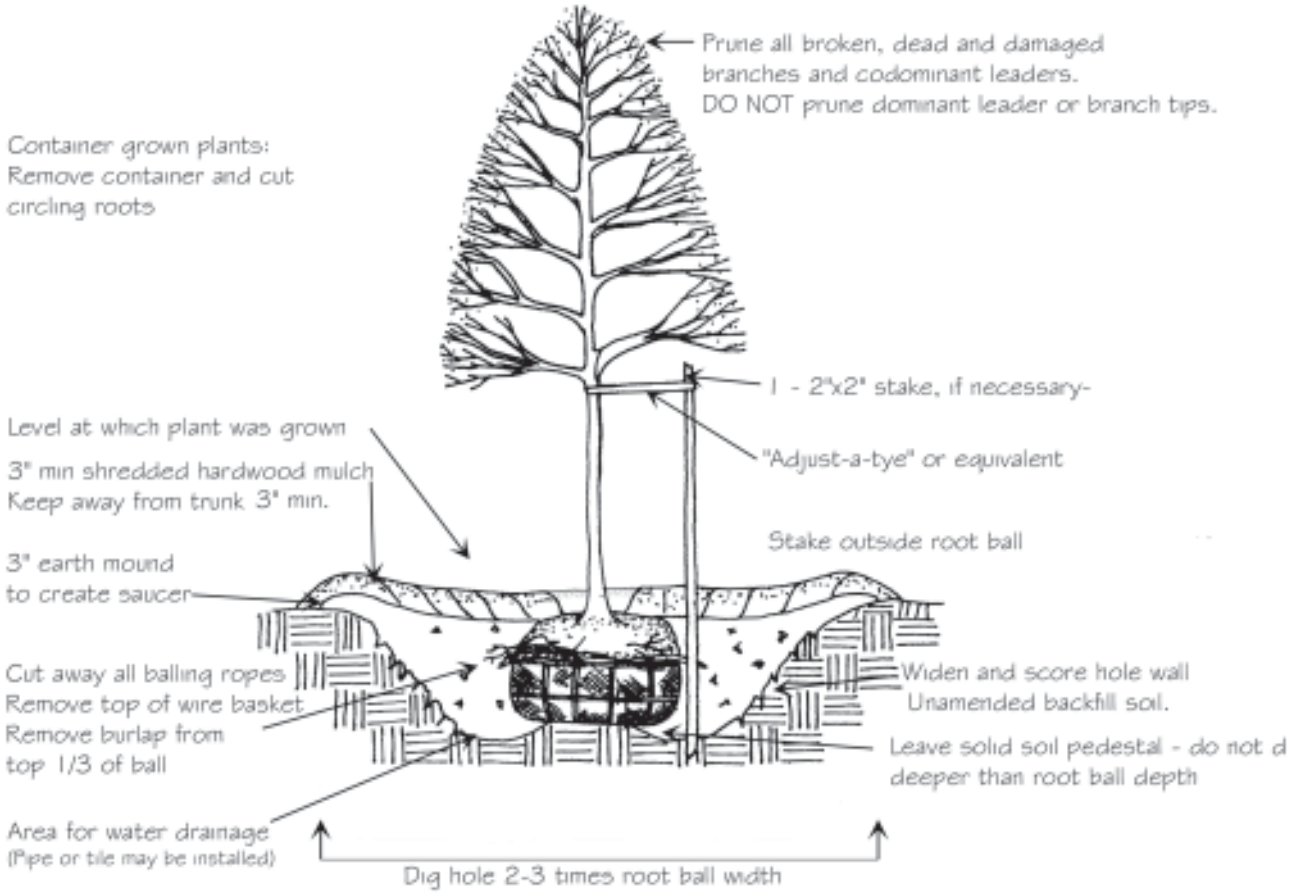
Bristled knotweed	*Polygonum cespitosum*	●	●	●	●	●	●	●	●	
White poplar	*Populus alba*	●	●	●	●	●			●	
Jointed charlock	*Raphanus raphanistrum*	●	●	●	●				●	
Red sorrel	*Rumex acetosella*	●	●	●	●	●			●	
Curled dock	*Rumex crispus*	●	●		●				●	●
Giant foxtail	*Setaria faberi*		●	●	●	●			●	
Japanese spiraea	*Spiraea japonica*	●	●			●	●	●	●	
Common chickweed	*Stellaria media*	●	●	●	●	●	●		●	
Ivy-leaved speedwell	*Veronica herderifolia*	●	●	●	●	●	●		●	
Chinese wisteria	*Wisteria sinensis*		●	●		●	●		●	
Common cocklebur	*Xanthium strumarium*	●	●	●	●	●			●	●

Occasionally Invasive Species

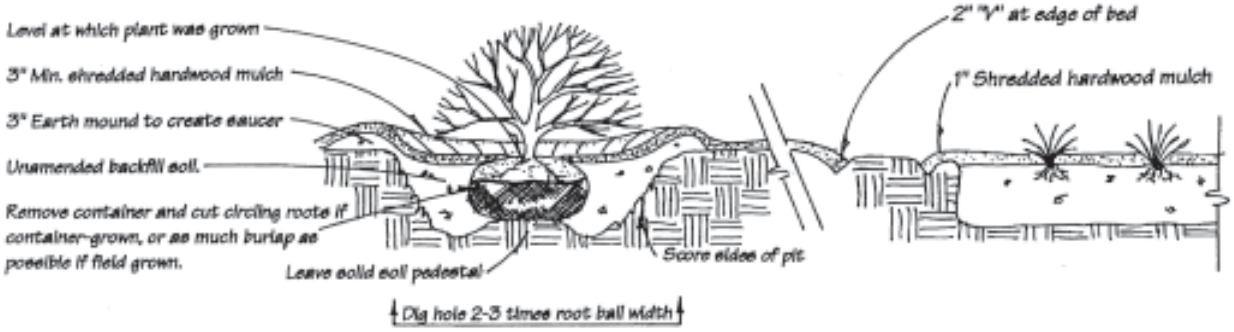
Redtop	*Agrostis gigantea*	●	●	●	●	●			●	
Bugleweed	*Ajuga reptans*	●	●	●	●	●			●	●
Mimosa	*Albizia julibrissin*	●	●	●	●	●			●	
Oatgrass	*Arrhenatherum elatius*	●	●	●	●	●			●	
Common dayflower	*Commelina communis*	●	●	●	●	●			●	
Poison hemlock	*Conium maculatum*	●	●	●	●	●			●	
Crown-vetch	*Coronilla varia*	●	●	●	●				●	●
Orchard grass	*Dactylis glomerata*	●	●	●	●	●			●	
Russian olive	*Elaeagnus angustifolia*	●	●	●	●	●			●	
Thorny elaeagnus	*Elaeagnus pungens*		●	●		●			●	
Weeping lovegrass	*Eragrostis curvula*	●	●	●	●				●	●
Leafy spurge	*Euphorbia esula*	●	●			●	●		●	
Red morning-glory	*Ipomoea coccinea*	●	●	●	●				●	
Nipplewort	*Lapsana communis*	●			●	●			●	
Sweet breath of spring	*Lonicera fragrantissima*		●		●	●			●	
Bell's honeysuckle	*Lonicera x bella*	●	●	●	●	●			●	
Birdsfoot trefoil	*Lotus corniculatus*	●	●	●	●	●			●	●
Silver grass	*Miscanthus sinensis*	●	●	●	●	●			●	
White mulberry	*Morus alba*	●	●	●	●	●			●	
Wild parsnip	*Pastinaca sativa*	●	●	●	●	●			●	
Beefsteak plant	*Perilla frutescens*	●	●	●		●	●		●	
Black pine	*Pinus thunbergii*			●	●	●			●	
Sawtooth oak	*Quercus acutissima*	●			●				●	
Water chestnut	*Trapa natans*			●	●			●	●	
Siberian elm	*Ulmus pumila*		●		●	●			●	
Linden viburnum	*Viburnum dilatatum*		●		●	●			●	
Periwinkle	*Vinca minor & V. major*	●	●	●	●	●	●		●	
Japanese wisteria	*Wisteria floribunda*			●		●	●		●	

"About the List" This advisory list is published by Virginia Department of Conservation and Recreation (VDCR) to inform land managers of potential risks associated with certain plant species know to exhibit invasive behavior in some situations. It should also be noted the list is not regulatory in nature, and thus does not prohibit the use of the listed plant species. VDCR Natural Heritage and Virginia Native Plant Society use detailed criteria to assess the invasiveness of a plant. Factors used to rank each species include: culmulative impacts on natural areas; potential to disperse and invade natural landscapes; distribution and abundance; difficulty to manage; and impacts on other species. The list is periodically reviewed and updated by land managers, nurserymen, landscape architects, horticulturalists, botantists, wildlife biologists, and other conservation partners. "**Invasiveness Ranking"** Each species on the list is assessed according to its cumulative effects on natural areas and native plant habitats where it typically occurs. The A-ranked species exhibit the most invasive tendancies in natural areas and native plant habitats. they may disrupt ecosystem processes and cause major alterations in plant community composition and structure. They establish readily in natural systems and spread rapidily. The B-ranked species exhibit moderate invasiveness in natural areas. They may have minor influence on ecosystem processes, alter plant community composition and affect community structure in at least one layer. They may become dominant in the understory layer without threatening all species found in the community. These species usually require a minor disturbance to become established. The C-ranked species generally do not affect ecosystem processes but may alter plant community composition by outcompeting one or more native plant species. They often establish in severely disturbed areas. The disturbance may be natural or human origin, such as ice- storm damage, windthrow, or road construction. These species spread slowly or not at all from disturbed sites. "**Regions**" For purposes of this list, the state has been divided into three regions. Coastal Plain and Piedmont follow conventional boundaries. Blue Ridge, Ridge and Valley, and Cumberland Plateau and grouped together into one region called Mountain. "**Habitat Requirements**" The categories for light and soil requirements are very broad and are meant only to give general indication of habitat adaptations for these plants.

APPENDIX C - PLANTING DETAILS



Tree Planting Detail



Shrub and Groundcover Planting Detail

Bare Root Seedlings and Year Transplants

(Taken from Section VII of *The Chesapeake Bay Riparian Handbook.* Palone, Roxanne S. and Albert H todd, eds. 1998)

Generally, seedlings and year transplants should have the following characteristics when planted:

1. They should be at the same level that they were grown at the nursery. Look for the root collar to determine depth.
2. The roots should be straight doen or spread out, but not curved, bent or doubled back to form a "U" or "J" shape.
3. The plant should be firmly tamped in removing any air pockets around the roots.
4. The plant should be in an upright position, even with the ground, not ina hole or on a mound of soil.

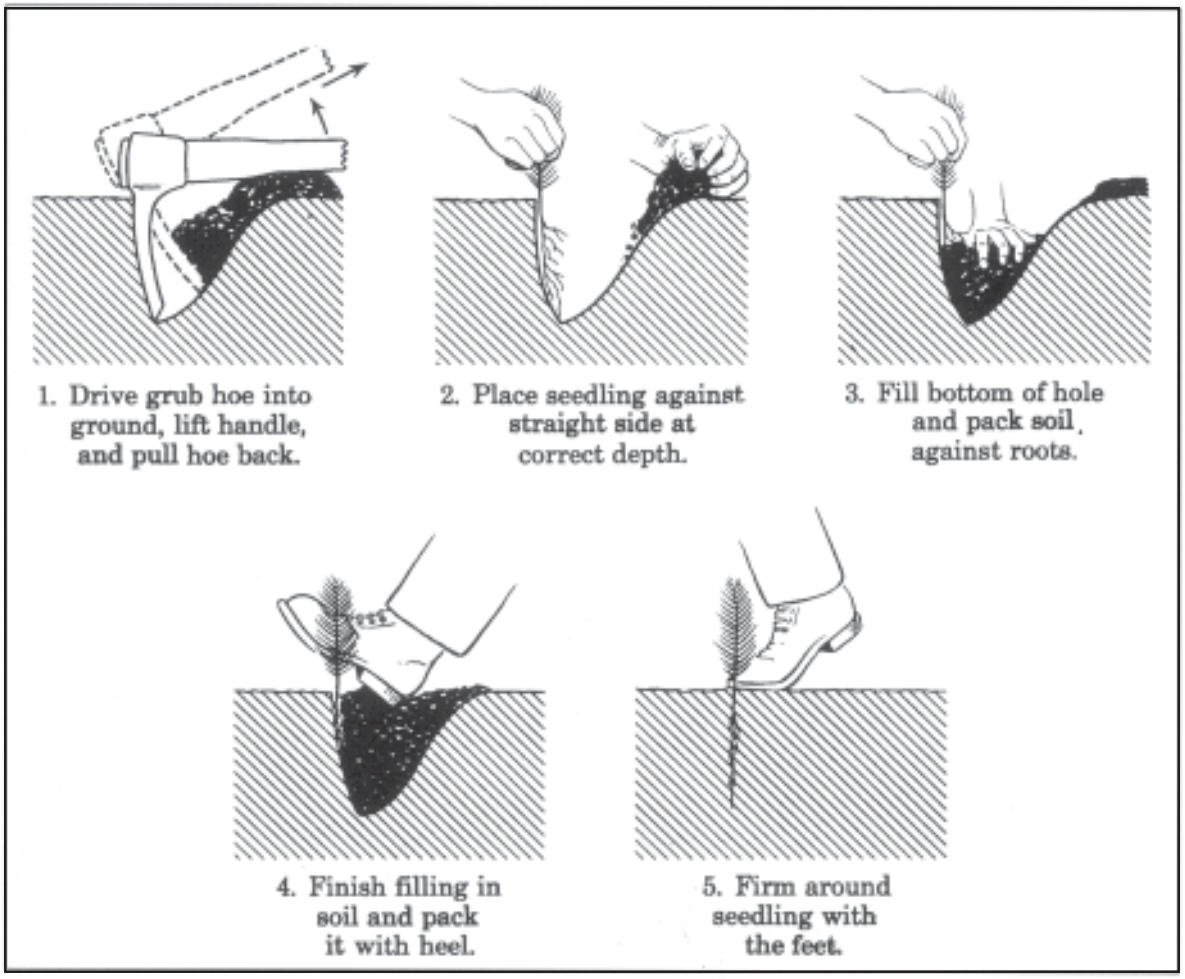


Figure 7 - 8. The Side-Hole Method of Planting. (Sketch adapted from U.S. Forest Service and The Practice of Silviculture, Smith, 1986.)

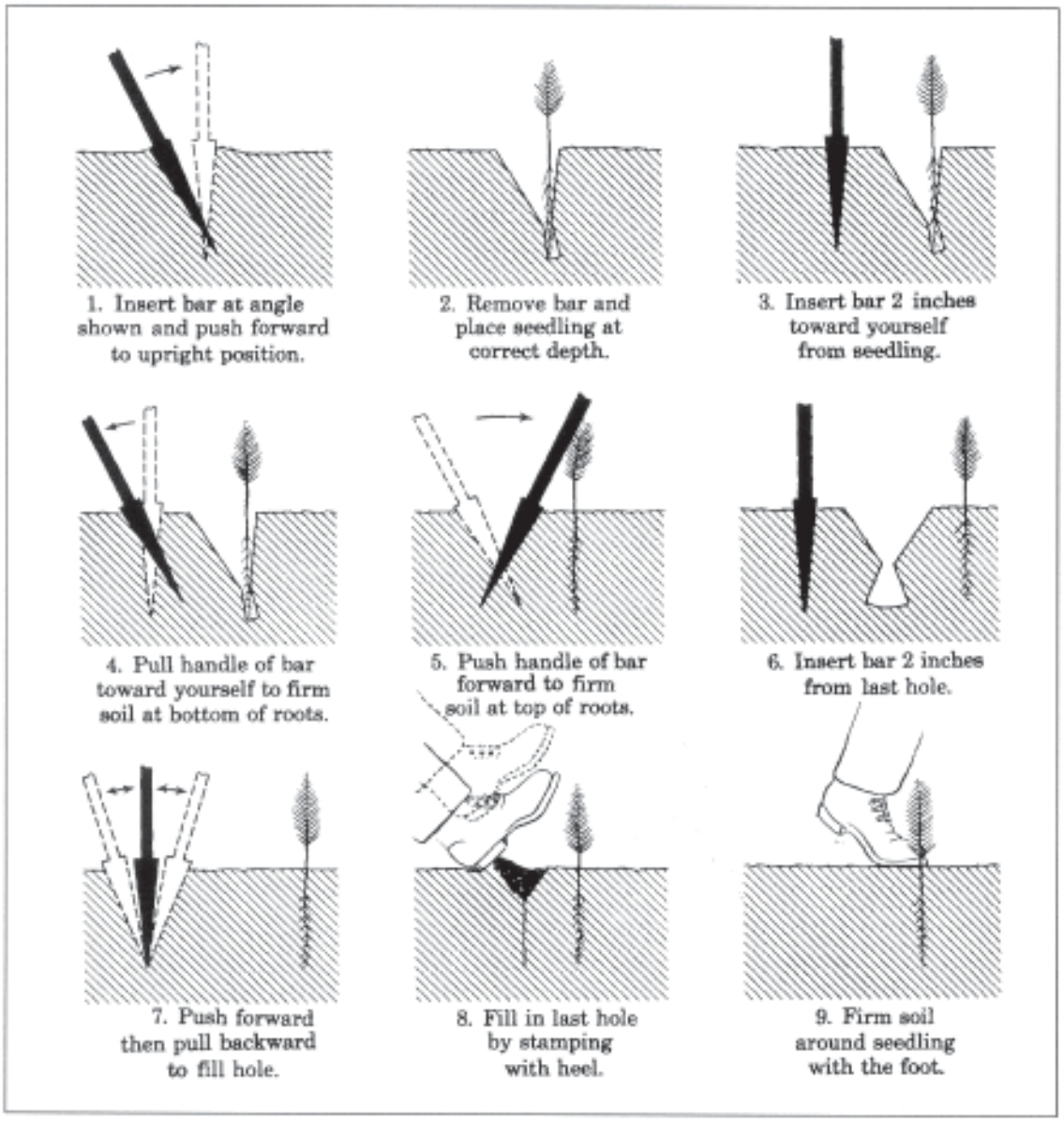


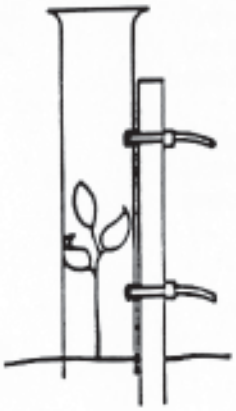
Figure 7 - 7. Slit Method. Steps in the use of the slit method of planting seedlings in sandy soil. (Sketch by U.S. Forest Service.)

Taken from *A Case Study of The Difficult Run Riparian Project: A Guide for Riparian Restoration Projects.* (December 1998) Judith A. Okay. Virginia Department of Forestry. Appendix C, p. 16.

Installing Tree Protectors

3) **The flared end of a Supertube is the top**. Gently guide the Supertube down over the seedling, making sure the seedling doesn't get caught under the ties.

4) Fasten the ties loosely around the stake. Do not tighten them yet.



5) Place your gloved hand over the top of the Supertube and push down until the base of the tube sits ½ - 1" deep in the soil.

This is easiest to do right after planting when the soil is loose, or when the soil is moist.

If the soil is packed or dry, try this: Place a board on top of the Supertube (the board should be at least 6" x 6"). Pound the board with a mallet or hammer, to push the base of the Supertube ½ - 1" into the soil.

It is critical that the base of every Supertube be well seated in the soil.

6) Cinch the ties tight.

Installing Protective Net

The plastic net included with your shipment of Supertubes (2' and taller) prevents birds from entering the Supertube and harming themselves or the tree.

The net breaks down over 18 months in the sun. It is designed to allow buds to grow through. However, buds can get caught on the net. Each time you are checking your trees, remove the net from those Supertubes where the tree is a few inches from the top or has already emerged. Bird entry is not a problem after the tree emerges.

1) Expand the bottom of the net.

2) Pull the net 7-8" down the Supertube.

3) Adjust the net so that the ends of the net are just touching.

APPENDIX D - VEGETATIVE REPLACEMENT STANDARDS

The vegetation replacement standards are a complilation of information from many sources. The following list reflects the major sources of information used to develop the replacement and restoration standards:

USDA :
- Natural Resources Conservation Service
- Forest Service

Virginia Department of Conservation and Recreation
Virginia Department of Forestry
Chesapeake Bay Local Assistance Department
Conversations and emails with members of the Technical Committee.
Maryland Chesapeake Bay Critical Area Commission
Maryland Department of Natural Resources Forest Service
Pennsylvania Releaf
Local governments in Virginia and Maryland

VEGETATION REPLACEMENT RATES

VEGETATION REMOVED	PREFERRED REPLACEMENT VEGETATION	ACCEPTABLE ALTERNATIVE VEGETATION
1 tree or sapling ½"-2 ½" caliper	1 tree @ equal caliper or greater	**Or** 2 large shrubs @ 3'-4' **Or** 10 small shrubs or woody groundcover *@ 15"-18"
1 tree ≥ 2 ½" caliper	1 tree @ 1½" - 2" caliper,or 1evergreen tree @ 6' min. ht., per every 4" caliper of tree removed (ex: a 12" cal. tree would require 3 trees to replace it)	**Or** 75% trees @ 1½" - 2" and 25% large shrubs @ 3'-4' per every 4" caliper of tree removed. (ex: a 16" cal. tree removed would require 3 trees and 1 large shrub) **Or** 10 small shrubs or woody groundcover @ 15"-18" per 4"caliper of tree removed (ex: a 8" caliper tree removed requires 20 small shrubs)
1 large shrub	1 large shrub @ 3'-4'	**Or** 5 small shrubs or woody groundcover @ 15"-18"

* Woody groundcover is considered to be a woody, spreading shrub that remains close to the ground, to 18" high, such as a shore juniper, *juniperus conferta*. Vines may not be considered "woody groundcover" for the purpose of vegetation replacement.

RESTORATION / ESTABLISHMENT TABLE A

Definitions:

Canopy tree: a tree that reaches 35 feet in height or larger when mature
Understory tree: a tree that matures to a height of 12 feet to 35'
Large shrub: a shrub that reaches 10 feet of height or greater at maturity
Small shrub: a woody plant that can reach up to 10 feet of height at maturity

¼ acre or less of buffer

Up to 10,890 square feet or less

For every 400 square-foot unit (20'x20') or fraction thereof plant:

one (1) canopy tree @ 1½" - 2" caliper or large evergreen @ 6'
two (2) understory trees @ ¾" – 1 ½" caliper or evergreen @ 4'
or *one* (1) understory tree and *two* (2) large shrubs @ 3'-4'
three (3) small shrubs or woody groundcover @ 15" – 18"

Example:
A 100-foot wide lot x 100-foot wide buffer is 10,000 square feet.
Divide by 400 square feet (20'x20' unit) to get:
25 units

Units x	plant/unit	Number of plants
25 units x	1 canopy tree	25 canopy trees
	2 understory trees	50 understory trees
	3 small shrubs	75 small shrubs
		150 plants

RESTORATION / ESTABLISHMENT TABLE B

Greater than ¼ acre of buffer

More than 10,890 square feet

A. Plant at the same rate as for ¼ acre or less.

B. The waterside 50% of the buffer (from the waterline inland for the first 50 feet):
For every 400 square-foot unit (20'x20') or fraction thereof plant:

one (1) canopy tree @ 1½" - 2" caliper or large evergreen @ 6'
two (2) understory trees @ ¾" – 1 ½" caliper or evergreen @ 4'
or *one* (1) understory tree and *two* (2) large shrubs @ 3'-4'
three (3) small shrubs or woody groundcover @ 15" – 18"
AND

The landward 50% of buffer (from 50 feet inland to 100 feet inland):
either plant
Bare root seedlings or whips at 1,210 stems per acre[1] , approximately 6'x6' on center (Minimum survival required after two growing seasons: 600 plants)
or
Container grown seedling tubes at 700 per acre approximately 8'x 8' on center (Minimum survival required after two growing seasons: 490 plants)

C. If the applicant is willing to enter into a five year maintenance and performance guarantee:
100% of buffer planted with:
Bare root seedlings or whips at 1,210 per acre, approximately 6'x 6' on center (Minimum survival required after two growing seasons: 600 plants)
or
Container grown seedling tubes at 700 per acre approximately 8'x 8' on center (Minimum survival required after two growing seasons: 490 plants)

1 acre or more of buffer

With an evaluation from an arborist or forester or other professional, natural regeneration may be an acceptable method of buffer establishment, however, a forestry management plan must be in place prior to any vegetation being removed. A minimum of 35 feet next to the water must be left in forest and protected prior to any vegetation being removed. If over 20 percent of the vegetation must be removed for the health of the woodlot, within the 35 feet closest to the shoreline, vegetation must be reestablished by seedling plantings at the rates above.

[1] Palone, Roxanne S., and Al Todd, *Chesapeake Bay riparian handbook: A guide for establishing and maintaining riparian forest buffers.* May 1977. p. 7-20.

Appendix E - List of Nurseries for Native Plants from the Virginia Native Plant Society

(Compiled by Nancy Arrington, former Horticulture Chair, Virginia Native Plant Society.)

Key: **C** Carnivorous Plants, **F** Ferns, **G** Grasses, **H** Herbaceous Plants, **O** Orchids, **S** Seed, **W** Woody Plants

[This is a list of nurseries whose stock is partially or entirely made up of native plants. It is not intended to be exclusive. There may be other nurseries stocking native plants as well. This is a list of suppliers and is not to be construed as an endorsement of those suppliers.]

Botanique
387 Pitcher Plant Ln.
Stanardsville, VA 22973
E-mail: botanique@pitcherplant.com
Catalog $1 (as a courtesy, not required); C, F, H, O

Edible Landscaping
361 Spirit Ridge Lane
Afton, VA 22920
434-361-9134
Free catalog; W

Meadowview Biological Research Station
8390 Fredericksburg Turnpike
Woodford, VA 22580
phone/fax: (804) 633-4336 / (804) 633-5056
E-mail: meadowview@pitcherplant.org
Catalog on-line; C

The Salt and The Earth
P.O. Box 560
Deltaville, VA 23043
804-776-6985, 804-776-6324
E-mail: alor@inna.net
Call for availability; G, H

Sassafras Farm
7029 Bray Rd.
Hayes, VA 23072
804-642-0923
E-mail: sasafras@3bubbas.com
SASE for list; F, G, H

Virginia Natives
P.O. Box D
Hume, VA 22639-0903
phone & fax:540-364-1665
E-mail: vanatvs@erols.com
Mailorder catalog $1.50
retail by appointment
C, F, G, H, W

Lists of plants suggested for conservation, restoration and landscaping in Virginia and lots of other relevant information can be found care of Virginia's Natural Heritage Program. < http://www.dcr.state.va.us/dnh/>

List of Nurseries for Native Plants from the Maryland Native Plant Society

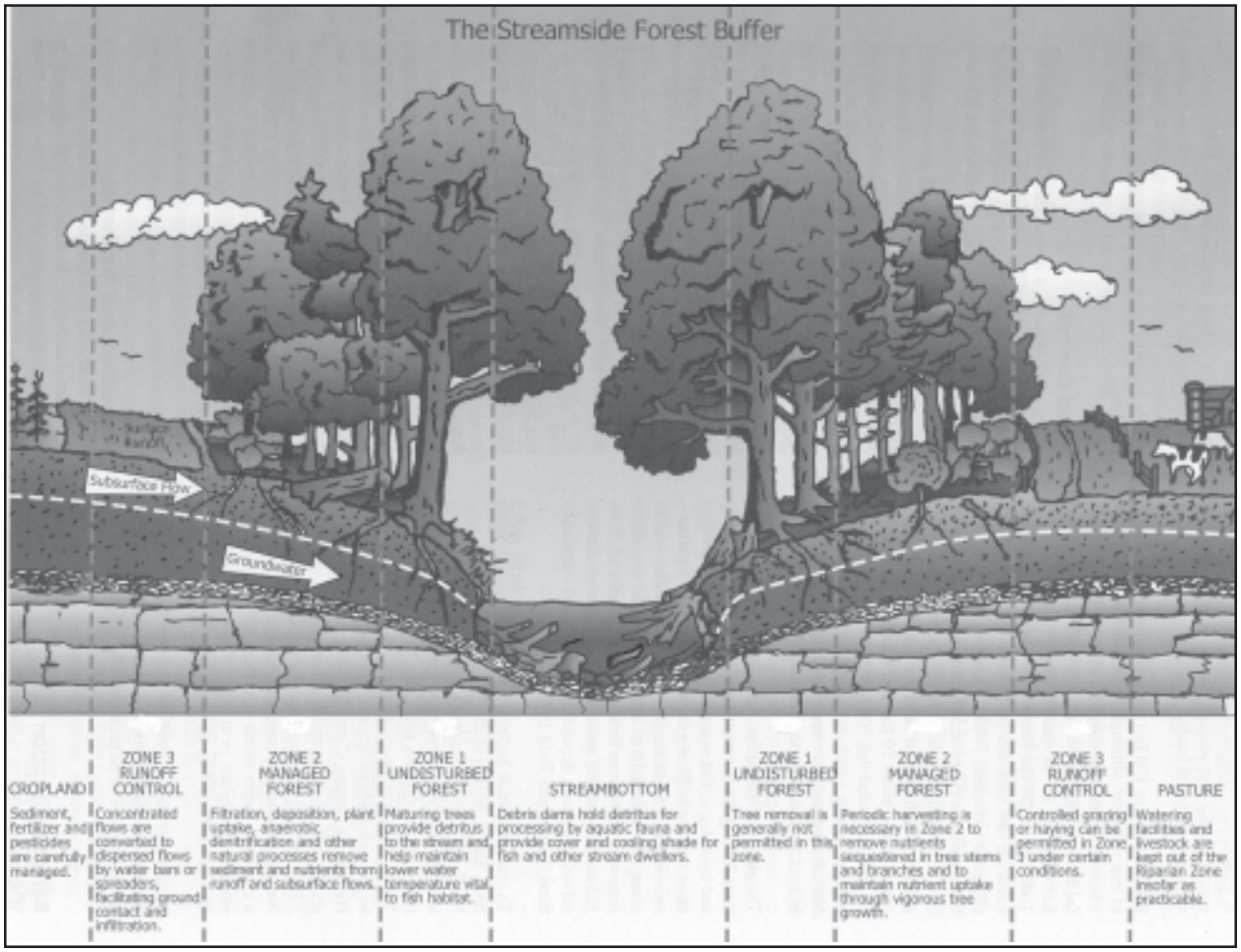
Bobtown Nursery
16212 Country Club Rd.
Melfa VA 23410
(757) 787-8484

Joseph Brown Native Seeds & Plants
7327 Hoefork Lane
Gloucester Point VA 23062
(804) 642-0736

Pinelands Nursery
8877 Richmond Rd.
Toano, VA 23168
(800)667-2729
Contact: Don Knezick
sales@pinelandsnursery.com
www.pinelandsnursery.com

WaterWays Nursery
Sally Kurtz, 13015 Milltown Road, Lovettsville, VA 20180
(540) 822-5994
http://members.aol.com/wwnursery/index.html
(herbaceous only)

APPENDIX F: BUFFER ZONES AND FUNCTIONS

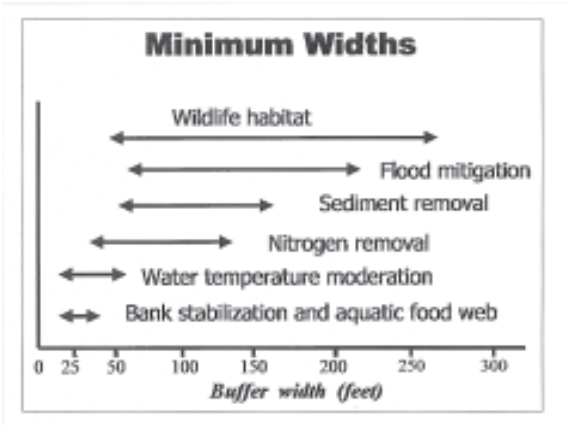


Schematic of the three zone Riparian Forest Buffer System

Riparian Forest Buffers:
% Reduction of Nutrients and Sediment*

Level	*Sediment*	*Nitrogen*	*Phosphorus*
High	85-95	68-92	70-81
Medium	65-85	45-68	50-70
Low	40-65	15-45	24-50

* General approximations for 100-foot forest buffer system. Actual levels will vary by land use and site conditions. Based on loadings from agricultural lands, performance in field studies rated as high removed total N in the range of 23-66 #/acre/year and total P in the range of 1-3 #/acre/year from adjacent fields. Expected level of function is based on mature forest in Zone 1 and 2.



Range of minimum widths for meeting specific buffer objectives

The above graphics were taken from: Palone, R. S. and Todd, A. H. eds.*Chesapeake Bay Riparian Handbook: A Guide for Establishing and Maintaining Riparian Forest Buffers.* USDA Forest Service, N. E. Area NA-TP-02-97. Radnor, PA, 1997.

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APPENDIX H - GLOSSARY OF TERMS

Access Path – A narrow pedestrian walkway through the buffer that provides access to the water.

Coppice – Trees or shrubs that have grown from sprouts or suckers rather than seed forming a thicket. A coppice usually results from human woodcutting activity.

Department – The Chesapeake Bay Local Assistance Department

Denitrification – The process by which denitrifying bacteria convert nitrogen in the form of nitrate to gaseous nitrogen and it is released into the atmosphere. The process requires available carbon, anaerobic conditions alternating with periods of aerobic conditions, a high water table and healthy populations of denitrifying bacteria. It is an important means of removing nitrogen from the riparian area.

Establishment - In reference to a buffer, establishment occurs when there is no buffer in existence.

Groundwater – Water within the earth that supplies wells and springs and contributes to surface waters.

Humus – Fine organic matter in soil, produced by the decomposition of plant and animal material.

Locality – A county, city, or town in Tidewater Virginia, as defined in §10.1-2101 of the Chesapeake Bay Preservation Act, or other local government that has developed and implemented a local Bay Act program.

Nonpoint Source Pollution- Pollution that occurs from many diffuse sources such as runoff from roads, agricultural fields, lawns and other surfaces or from failed septic tanks.

Noxious Weed – Any invasive species that has gotten out of control and has become harmful to the health and survival of the existing woody vegetation in the buffer.

Passive Recreation - non-organized, non-motorized activities including but not limited to walking, bike riding, picnicking, hiking, sun bathing, and wildlife viewing. Passive recreation does not include obtrusive activities that have significant adverse impacts to natural, cultural, open space, or agricultural values.

Regulations - The Chesapeake Bay Preservation Area Designation and Management Regulations (§9VAC 10-20-10 et seq.)

Resource Protection Area (RPA) – The component of the Chesapeake Bay Preservation Area (CBPA) comprised of lands adjacent to water bodies with perennial flow that have an intrinsic water quality value due to the ecological and biological processes they perform or are sensitive to impacts which may result in significant degradation to the quality of state waters. The 100-foot wide buffer area is one component of a RPA.

Replacement - In reference to a buffer, replacxement occurs when part of the buffer vegetation has been removed, such as to create a vista, and woody vegetation has to be put back into the buffer.

Restoration - In reference to a buffer, restoration will occur when a large amount of vegetation has been removed, such as to eliminate an invasive species or when a violation has occurred, and the buffer must be restored by the planting of woody vegetation.

Sheet Flow - The uniform flow of water across a surface; not channellized.

Silvicultural Activity – A forest management activity, including but not limited to the harvesting of timber, the construction of roads and trails for forest management purposes, and the preparation of property for reforestation that are conducted in accordance with the silvicultural best management practices developed and enforced by the State Forester pursuant to § 10.1-1105 of the Code of Virginia and are located on property defined as real estate devoted to forest use under § 58.1-3230 of the Code of Virginia.

Size Class - In silviculture: a group of trees all of which are the same general size, age and classification; such as all of the dominant trees in a woodlot, or all of the understory trees.

Stormwater – The runoff from a rain event

Stream Order – A numerical system used to designate the size and relative position of a stream or stream segment within the hierarchy of streams in a drainage basin from headwater to river mouth.

Trophic Layer, trophic level – A layer or level of vegetation sharing similar characteristics such as size: i.e. the canopy layer, the understory layer, shrub/sapling layer or the groundcover.

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Joan Salvati, Chesterfield County
Sandy Manter, Accomack County
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