MARYLAND COOPERATIVE EXTENSION
UNIVERSITY OF MARYLAND
COLLEGE PARK•EASTERN SHORE

Fact Sheet

Fact Sheet 725

RIPARIAN BUFFER MANAGEMENT

RIPARIAN FOREST BUFFER DESIGN, ESTABLISHMENT, AND MAINTENANCE

INTRODUCTION

Maintaining a forested buffer along creeks, streams, and rivers provides more than just a beautiful landscape. The combination of trees, shrubs, and native grasses can improve water quality by removing sediment and chemicals before they reach the waterway. A properly cared for buffer area can moderate flooding, help recharge groundwater, prevent soil erosion, and preserve or improve certain types of wildlife habitat. Trees in the buffer strip can provide landowners with valuable timber and alternative income sources, such as nuts and mushrooms.

A well-designed buffer system may include not only a multispecies buffer area established on land next to the stream, but also plantings that stabilize the streambank and wetlands constructed to absorb storm runoff. This publication discusses how to design, plant, and maintain a riparian forest buffer—an important part of the riparian ecosystem.

DESIGN

The Three-zone Concept

The most effective riparian buffers contain three different categories, or zones, of plantings as one moves away from the water's edge (see Figure 1). Closest to the water is Zone 1, consisting of trees. The middle zone (Zone 2) can be trees with a combination of shrubs. Farthest from the stream and next to another land use (for example crops, pasture, or homes) is Zone 3. This zone is best planted with native grasses and forbs (broad-leaved herbaceous plants and wildflowers).

The "Three-zone Concept" provides a framework for planning and grouping types of plantings. Combining fast- and slow-growing trees, shrubs, grasses, and forbs helps protect the waterway and provide a diverse habitat for wildlife. Trees and shrubs provide perennial, deep-reaching root systems to hold the soil and absorb nutrients into the woody biomass for long-term storage. Forbs and grasses provide a high density of stems to slow surface runoff, trap sediment, and absorb nutrients. The riparian buffer stabilizes the soil, removes nutrients from both surface and sub-surface water flow, slows rainwater runoff velocity, and traps sediments. This reduces the amount of nonpoint source pollutants entering our rivers, streams, and lakes.

Zone 1. The trees in this zone help provide streambed and streambank stability. Deadwood and leaf litter falling into the stream help regenerate the streambed, which is constantly changing and eroding. This regeneration is very important to the health of the stream and to all life in the stream. The tree species nearest the water's edge also provide shade and are selected for their ability to quickly develop deep roots that can increase bank stability. Native riparian tree species are preferable because they coevolved with the stream's inhabitants. Bottomland species, such as silver maple, black willow, eastern cottonwood, green ash, and sycamore, are best suited for Zone 1 in most locations throughout the Chesapeake Bay watershed. These species tolerate wet conditions, grow quickly and, while the main trunks are flex-

ible and sturdy, the branches are brittle. This fast growth rate and brittleness help these species withstand the periodic trauma of heavy flooding. Instead of washing away and exposing unstabilized banks to erosion, these trees will "shed" branches, which causes little damage to the main trunk stem.

In the drier portions of Zone 1, hardwoods such as black walnut, red and white oak, and white ash can be planted. If the water table is at least 3 feet below ground for most of the growing season, plant hardwood species that require good drainage. If the site has poor drainage, select hardwood species that are more tolerant of wet conditions. Some examples are river birch, black ash, bitternut hickory, and hackberry. Table 1 lists other recommended species.

The large hardwood tree species mentioned above provide a canopy as they mature. Understory trees and shrubs should be interplanted among these canopy species to provide stability for the streambank and shading next to the water. Table 2 lists shrub species tolerant of flooding and wet soils.

Table 3 lists understory species recommended for the Chesapeake Bay watershed. On sunny banks, shade-intolerant species will thrive until overshadowed by the canopy. On wide streams, south- and west-facing banks receive more sun. North-facing streambanks receive less solar exposure. Fewer species thrive in these shadier conditions, so plant selection is more limited. Swamp leucothoe (fetterbush), pinxterbloom azalea, spicebush, rosebay rhododendron, and mapleleaf viburnum are good choices for shady conditions.

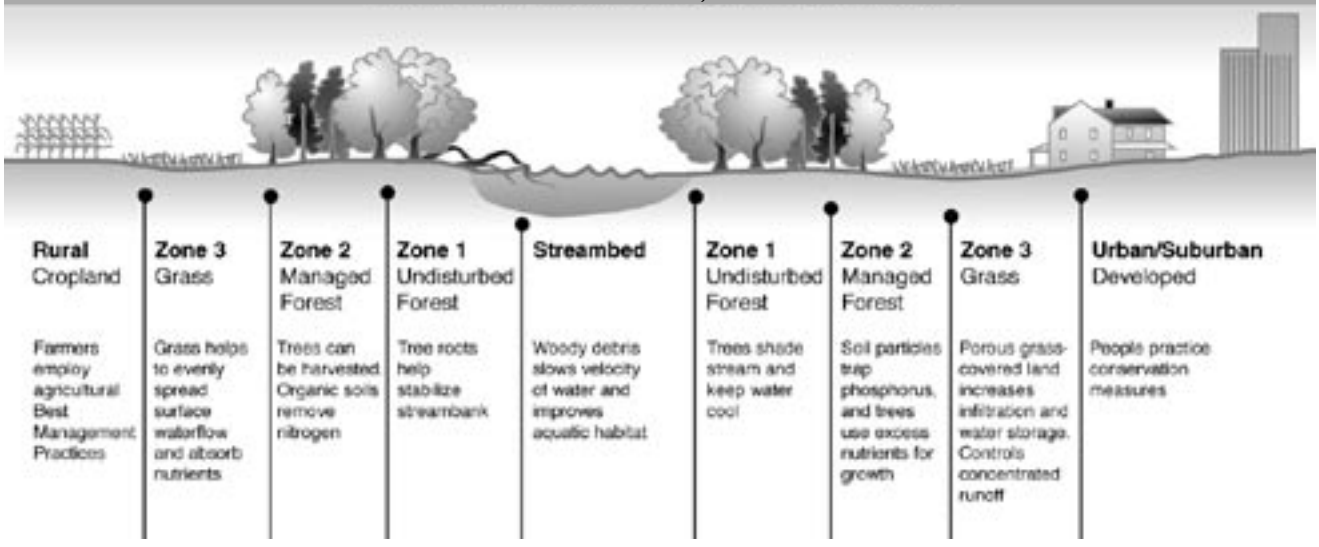
Zone 1 is an undisturbed forest area where logging is generally not recommended. Livestock should be excluded from this zone. Stream crossings, watering sites, and any streambank stabilization work must be carefully planned to minimize negative impact on water quality.

Zone 2. This zone allows the water to infiltrate or percolate into the soil so that waterborne nutrients/pollutants are absorbed and cleansed through vegetation and other natural ecological systems. Zone 2 also provides long-term storage of nutrients in the woody biomass of trees and shrubs. Large trees dominate Zone 2, which has an understory of smaller trees and shrubs. This zone can tolerate some disturbance. Where site conditions permit, commercially viable species can be planted for possible future logging. A wide range of forest management options can be used in Zone 2. Other nontraditional agricul-

Figure 1.

The three-zone buffer concept provides a framework for the establishment and maintenance of a long-term riparian buffer.

The width of a riparian forest buffer is site specific and dependent on the landowner's objectives.



tural products can be grown in this area (for example, Christmas trees, nut crops, shade-loving wildflowers, and ginseng).

Select species adapted to the specific site and soil conditions. Look at adjoining areas for the types of native species that grow in that locale. Shade-tolerant shrub species such as winterberry, Virginia sweetspire, and mapleleaf viburnum generally do well in this zone. Planting a variety of tree and shrub species increases diversity and improves wildlife habitat. Also, planting a mix of species prevents loss of all benefits if one species does not thrive or fails to grow completely. In areas with heavy deer browsing, spicebush and maple-leaf viburnum are good choices (see Tables 1, 2, and 3).

Zone 3. Zone 3 is the transition zone between the forested areas in Zones 1 and 2 and adjacent land. When carefully designed, this zone filters sediments, increases water absorption capacity, converts nutrients into green biomass, takes in nutrients, and prevents erosion by spreading the concentrated surface water flow to a uniform sheet flow. Zone 3 also provides valuable food and cover for certain wildlife species. A dense, herbaceous cover with no trees or shrubs works best to slow and filter runoff. Warm and/or cool season grasses are recommended in this zone. Switchgrass is preferred because its dense, stiff stems remain upright throughout the seasons. This slows the overland flow of water, allowing the water

Table 1.

Recommended Tree Species for Zones 1 & 2

American beech	Green ash	Silver maple
Bald cypress	Hackberry	Sweetgum
Basswood	Loblolly pine	Swamp white oak
Bitternut hickory	Persimmon	Sycamore
Blackgum	Pitch pine	Tulip poplar
Black walnut	Red maple	White ash
Black willow	Red oak	White oak
Cottonwood	River birch	Willow oak

Table 2.

Recommended Shrub Species for Zones 1 & 2

Arrowwood	Inkberry	Spicebush
Bayberry	Maple-leaf viburnum	Swamp azalea
Buttonbush	Pinxterbloom azalea	Swamp leucothoe
Common ninebark	Pussy willow	Sweet pepperbush
Elderberry	Red chokeberry	Virginia sweetspire
Grey dogwood	Rosebay rhododendron	Winterberry
Highbush blueberry	Silky dogwood	

Table 3.

Recommended Understory Woody Plants for Zones 1 & 2

American holly	Flowering dogwood	Redbud
Blackhaw	Hornbeam	Shad-bush
Boxelder	Paw paw	Sweet bay
Common alder	Possumhaw	Witch-hazel

to infiltrate the buffer, and also allows sediment carried by the water to be deposited in the buffer area. In addition, switchgrass produces an extensive and deep root system, much of which is replaced annually, providing large amounts of organic matter to the soil. Organic matter improves soil quality by increasing infiltration rates and microbial activity. Switchgrass takes approximately 3 years to become fully established.

Where surface runoff is not a major problem, other permanent grasses such as Indiangrass, big bluestem, and little bluestem can be used. Black-eyed Susan and purple- and gray-headed coneflower also can be planted with grass to intercept surface runoff. Other grasses may be combined with the switchgrass to promote wildlife diversity within this zone.

Native forbs also may be part of the mix, especially if they are seeded in clumps with other native grasses. Cool season grasses, such as bromegrass and fescue, are not appropriate for Zone 3 because they do not tend to remain upright under the flow of water and they provide limited value as wildlife habitat. They also produce up to eight times less root mass than native grasses and, therefore, do not improve soil quality as quickly or as much as the same planting of warm season grasses. However, in areas where soil erosion is a serious problem, cool season grasses are recommended to establish vegetation cover quickly. In some cases, cool and warm season grasses can be planted to provide wildlife habitat and also help prevent serious soil erosion problems.

Other Planting Strategies

The combination of plantings already described provides the most effective buffer system, but the three zones are not the only approach to improving water quality, habitat, and flood control. Site conditions, surrounding land use, owner objectives, and cost-share program requirements should be considered in determining combinations of species for a buffer.

The following strategies also provide some reduction of nonpoint source pollution:

- Plant the entire buffer area to warm season grasses and forbs. Some soil stabilization may be needed, such as growing willow stakes along the streambank. This system does not provide as many benefits as a multispecies design (three zones) and is best suited where streambanks are not very high or steep.
- In urban areas, plant warm season grasses over the entire area and small groups of shrubs and/or trees to provide a diverse, natural look. Recreational facilities such as hiking or bike trails can be incorporated into the system. Careful design will help avoid erosion problems often associated with runoff from trails.
- Accelerate succession by overplanting with seedlings of fast-growing, shade-intolerant species at a high enough density to provide canopy closure relatively rapidly. Tulip poplar, box elder, and silver maple are among the fastest growing trees appropriate for the riparian zone. Seedlings of shade-tolerant canopy species, such as red oak, interplanted among these pioneer species can be selectively released after canopy closure to become the eventual dominants. That is, once the species intended to be the dominant trees are well-established, the protective, fast-growing, shade-intolerant species are removed. Canopy overplant-ing will also reduce deer browsing on the future dominant species. This strategy also provides more wildlife habitat and deadwood in the riparian zone. The decision to use this strategy is largely determined by the existing vegetation in the riparian zone. Where many indigenous seedlings exist, the planting approach should attempt to capitalize on this.

ESTABLISHMENT

Buffer Width

There is no ideal buffer width for all applications in all areas. Many factors including slope, soil type, adjacent land uses, floodplain, vegetation type, and watershed condition influence what can be planted. The function of the buffer, that is, the reason for installing a riparian buffer, should be the overriding criteria, with other factors (such as those listed above) influencing the final decision to a lesser degree.

The most commonly prescribed minimum buffer widths for use in water quality and habitat maintenance are approximately 35 to 100 feet. Buffers of less than 35 feet cannot sustain long-term protection of aquatic resources. (Figure 2 associates a range of buffer widths with some specific buffer benefits.)

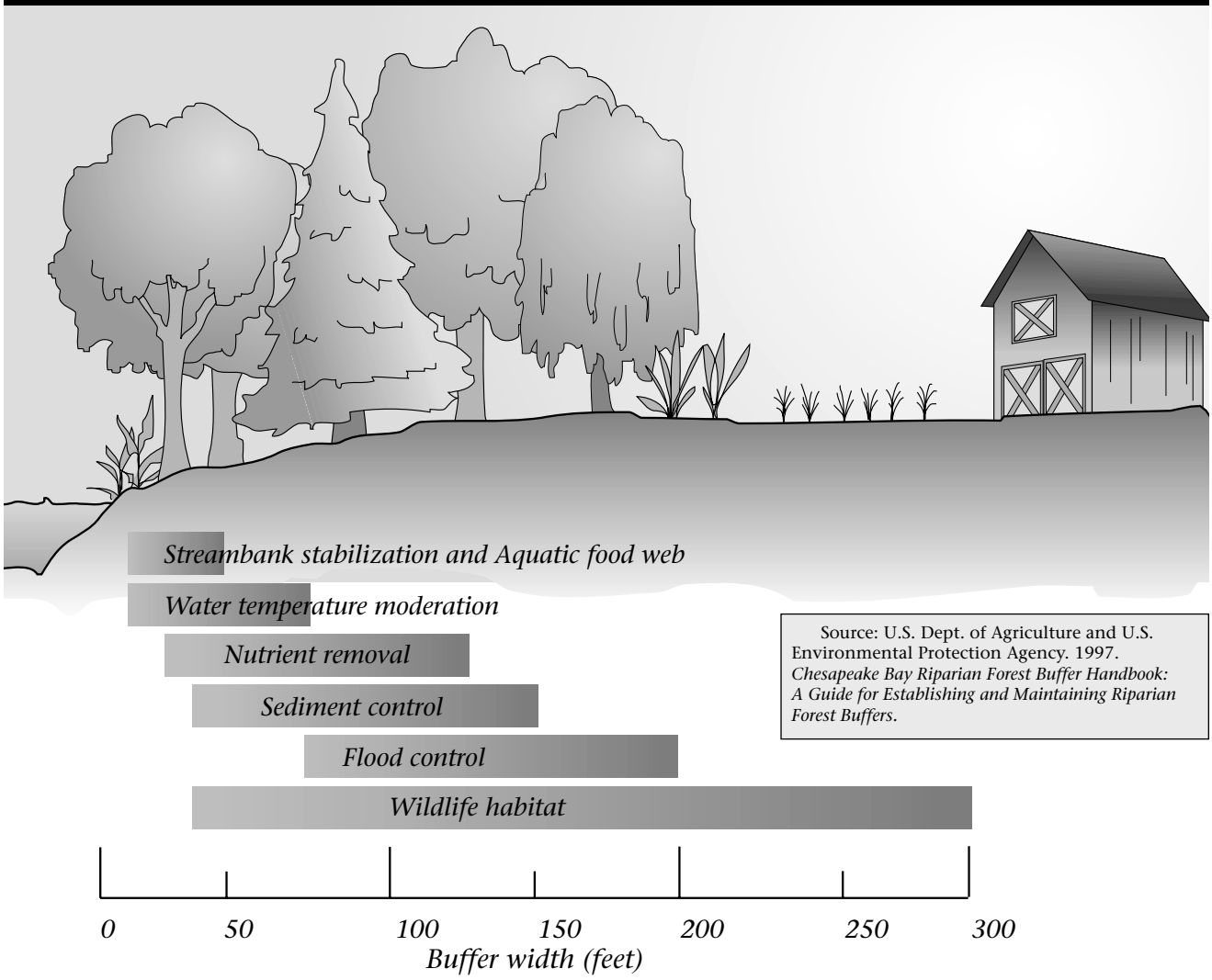
Site Preparation

Often, a riparian area will have a mixture of pasture, overgrown fields, and a line of branchy, poor quality trees along the stream. This requires a combination of site preparation techniques. In all situations a combination of physical and herbicidal methods will be most effective and efficient. Site preparation should begin the fall prior to planting. In some situations site preparation can require up to a year of vegetation control prior to planting. Any necessary streambank stabilization needs to be included in the planting plan so work can proceed in a logical order.

If the area has been used for row crops, disk the ground in the spring and seed the area where the woody material will be planted with a cover crop, such as annual rye grass or cereal rye. Since a good cover is essential, cool season grasses such as field bromegrass and tall fescue are often appropriate. These grasses are not invasive, do not require mow-

Figure 2.

Buffer widths (in feet) for specific objectives.



Source: U.S. Dept. of Agriculture and U.S. Environmental Protection Agency. 1997. *Chesapeake Bay Riparian Forest Buffer Handbook: A Guide for Establishing and Maintaining Riparian Forest Buffers.*

ing, and will be shaded out (eventually eliminated) by the woody plants.

In pasture-type situations, eliminate competing perennial vegetation with herbicides in 3- to 4-foot-wide circles or strips where trees or shrubs will be planted. Problem species, such as multiflora rose and honeysuckle, will still need to be controlled by cutting, pulling, and/or herbicides.

Abandoned fields of varying ages already have tree saplings, shrubs, and vines. In this situation, site preparation focuses on releasing the desired saplings and other plants from competition by undesired species. Release methods vary according to the target species and extent of infestation by invasives. Techniques include spraying basal bark herbicides during the dormant season, cutting large shrubs and vines and then treating the stumps to prevent resprouting, and mowing everything around the "keepers" after they have leafed out in late spring. Larger cut stumps may also require an application of an herbicide to control resprouting.

Plant Materials

One- to two-year-old seedlings of most tree and shrub species, or rooted or unrooted cuttings of willow can be obtained from various forest nurseries. Order plants early to get desired species and type of planting stock. Consider ordering 10 to 15 percent more trees and shrubs than you think you will need. The additional plants can be planted in a nearby "holding" area by the heeling-in method and used for replacement plantings (see Figure 3). Seeds should be ordered as PLS (Pure Live Seed) to ensure you are paying for and planting only live seed, not inert material.

Plant trees and shrubs as soon as possible after receiving them. If planting must be delayed, keep plants cool and moist, or heel-in as previously mentioned. Always use high quality stock with good root systems. Quality hardwood seedlings should have a minimum of four to five large lateral roots.

Trees and shrubs should be planted in early spring. A tree planter, auger, planting bar, or shovel can be used to plant seedlings and cuttings. Before planting, soak rooted cuttings in water for 2 to 4 hours and unrooted cuttings for 24 hours. Root collars of seedlings should be slightly below the soil surface. Make sure planting holes are closed and the soil around the root or cutting is firm. For unrooted cuttings, plant deep enough to leave only 1 or 2 buds above ground.

Grass and forb seeds may be broadcast planted using a spinner-type seeder or a drop-seeder. Because of the light, fluffy nature of the seed, broadcast seeding of warm season grasses can only be accomplished with clean seed. This means at least 75 percent PLS. Seed less than 75 percent PLS should be planted with a specialized warm season grass drill or planter.

Plant trees 8 to 12 feet apart. Depending on the species and desired results, leave 8 to 12 feet between trees in the row. Spacing will vary considerably depending on your objectives and on the species. Planting for timber production, biomass production, and wildlife management all have different recommendations.

MAINTENANCE

Weed control is essential for the survival and rapid growth of trees and shrubs in a buffer. Options include 4 to 6 inches of organic mulch, weed control fabrics, shallow cultivation, pre-emergent herbicides, and mowing. Nonchemical weed control techniques are preferred because chemicals can quickly enter the water system in riparian areas. Continue weed control until woody plants occupy the area, normally 2 to 3 years. For more information about weed control, contact your local forester or state extension forester.

During the first year, control annual weeds in Zone 3 by mowing to 6 inches. Do not let weeds get higher than 12 to 14 inches before mowing. Cutting down tall weeds can smother the small seedlings below. During the second year, mow to 12 to 18 inches in early summer if weeds are a problem. Mowing lower could harm plants and nesting animals.

Long-term Management

Buffers must be monitored and managed to maintain their maximum water quality

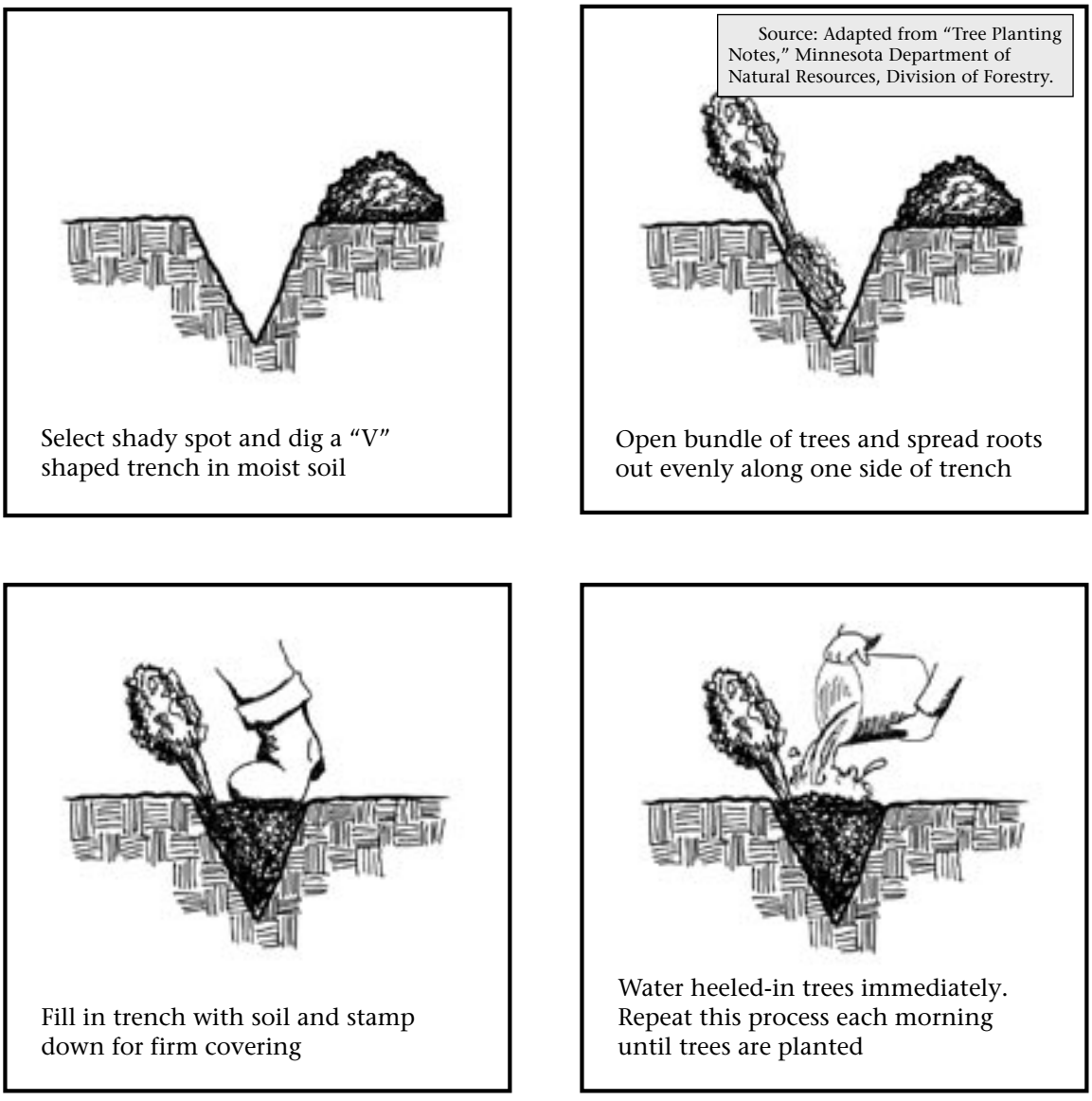
and wildlife habitat benefits. They should be inspected at least once a year, and always within a few days of severe storms for evidence of sediment deposit, erosion, or concentrated flow channels. Repairs should be made as soon as possible.

Grasses should be harvested, burned, or in some instances, can be control grazed. The use of fast-growing tree species ensures rapid growth and the effective removal of nutrients and other excess chemicals that could pollute waterways. Harvesting fast-growing trees as early as possible removes the nutrients and chemicals stored in their woody stems. Periodic harvesting also promotes continued vigorous growth. If harvested in winter, these species will regenerate from stump sprouts, thereby maintaining root system integrity and continued protection of the streambank.

Finally, if possible, avoid working in the riparian area between April 15 and August 15. During this time period, disturbance can be detrimental to a variety of wildlife, because of mating and newly born wildlife.

Figure 3.

Heeling-in method to protect roots.



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Other Fact Sheets in the Riparian Buffer Series:

FS 724	An Introduction to the Riparian Forest Buffer
FS 726	Trees for Riparian Forest Buffers
FS 727	Understory Plants for Riparian Forest Buffers
FS 728	Grasses for Riparian Buffers and Wildlife Habitat Improvement
FS 729	Soil Bioengineering or Streambank Restoration for Riparian Forest Buffers
FS 733	Riparian Buffer Systems

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