INTRODUCTION

Purpose of Toolkit

The purpose of this toolkit is to provide individuals, local organizations and government agencies with the latest information on how to plan for, design, establish and maintain streamside forest buffers. It is intended particularly for groups that rely on volunteers who may not have a technical knowledge of trees or stream ecosystems and need guidance on how to go about a stream-side planting project.

Why Reforest Pennsylvania's Streamsides?

Although 63 percent of Pennsylvania is covered by forest, today's mature woods are not evenly distributed. Most of the forests have vanished in agricultural areas and rapidly developing urban centers, particularly in southcentral and southeastern Pennsylvania.

Trees that once hugged the shores of streams and rivers in these areas are no longer present to filter surface runoff and, in many landscapes, groundwater flow. Riparian forests have an ability to filter water that is often comparable to wetlands. They provide shade, temperature control and food for many aquatic and terrestial species of wildlife. A s a result, streamside forests are heralded as a way to partially mitigate the loss of forest over much of the remaining landscape. Streamside areas are the link between land and water, and trees are a vital component of a healthy stream ecosystem.

In Pennsylvania, the USDA Forest Service estimates that over one-third of the streams and rivers have had their riparian areas converted or degraded. In the Chesapeake Bay basin, as much as 60 percent of the streamside forests have been removed or severely impaired. Within the Susquehanna River basin, about 36 percent of the streams do not have forest buffers, a number that rises to 50 percent in the lower Susquehanna basin.

What is a Streamside Forest or Riparian Forest Buffer?

A riparian buffer is an area of vegetation that is maintained along the shore of a water body to protect stream channels and banks. Buffers can reduce the pollutants entering a stream, lake or pond by trapping, filtering and converting sediments, nutrients and other chemicals in runoff from surrounding lands.

Forested riparian buffers (or streamside forests) are riparian buffers with a functional forest ecosystem. Forested buffers are the most beneficial type of buffer because they provide water quality and ecological benefits, including food, cover and protection from temperature changes for fish and wildlife.

What Counts?

A set of criteria has been developed to track progress towards Pennsylvania's 600 mile restoration goal for the Chesapeake Bay drainage.

- *Buffers must average at least 35 feet wide from the top of the streambank to the buffer's uphill edge (a width of 50 to 100 feet should be strongly encouraged).*
- *Buffers must contain at least two species of trees or shrubs, or a combination of trees and shrubs.*
- *Natural regeneration is acceptable where nearby trees native to the area can provide a natural source of seeds and where invasive plant species can be controlled.*
- *Buffers established around wetlands, lake and pond shores may also count towards the goal.*
- *Conservation of existing forested streamside areas should occur within a corridor at least 100-feet wide.*
- *Progress will be measured in number of streambank or shoreline miles along which buffers are restored and conserved.*

To make sure your restoration project counts toward Pennsylvania's 600 mile goal, see Appendix VI for a tracking sheet.

Pennsylvania's Stream ReLeaf Initiative

In 1996, the Chesapeake Bay Program shed new light on the role of forest buffers along streamside areas. Acting on a two-year study that revealed the broad range of water quality and wildlife habitat benefits that forest buffers provide,Pennsylvania, Maryland, Virginia, Washington, D.C., and the Environmental Protection Agency pledged to further voluntary efforts in both conserving and restoring streamside forest buffers. They adopted a goal to increase the use of all riparian buffers, to conserve existing forest buffers, and to restore riparian forests on 2010 miles of stream and shoreline in the Chesapeake Bay watershed by the year 2010.

Pennsylvania is committed to reaching its share of the total restoration goal, or 600 miles of buffer, within the Chesapeake Bay drainage area, which includes the basins of the Susquehanna, Potomac, Northeast and Gunpowder rivers, and the Elk creeks (Figure 1). Under the leadership of Pennsylvania's Departments of Environmental Protection, and Conservation and Natural Resources, Pennsylvania's Stream ReLeaf Plan provides the vision and framework for accomplishing this goal. The plan identifies objectives for streamside buffer restoration, conservation, education and outreach, public relations and tracking progress.

Governor Ridge took the Chesapeake Bay commitment one step further and decided to expand Pennsylvania Stream ReLeaf statewide. The plan promotes the use and conservation of all types of streamside buffers, not only forested; it encourages the use of grasses or buffers narrower than 35 feet where landowner goals would preclude restoration of wider forested buffers.

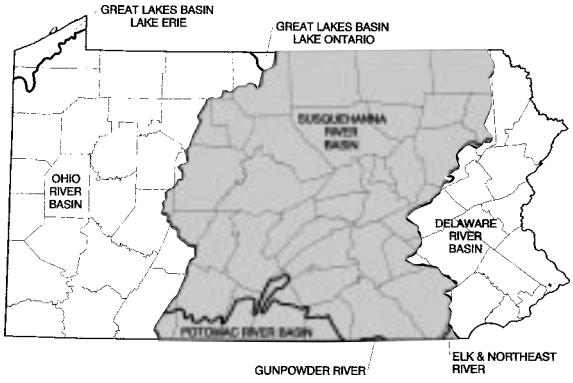


Figure 1. Shaded areas represent Chesapeake Bay drainage area in Pennsylvania.

Over 36,000 miles of streams drain the Chesapeake Bay basin in Pennsylvania.

The Importance of Headwater Streams

The quality of water (nutrients, sediment, and temperature) is affected most by the condition of headwater streams. Therefore, groups working to replant trees along smaller, headwater tributaries are doing a great deal for water quality in their watersheds.

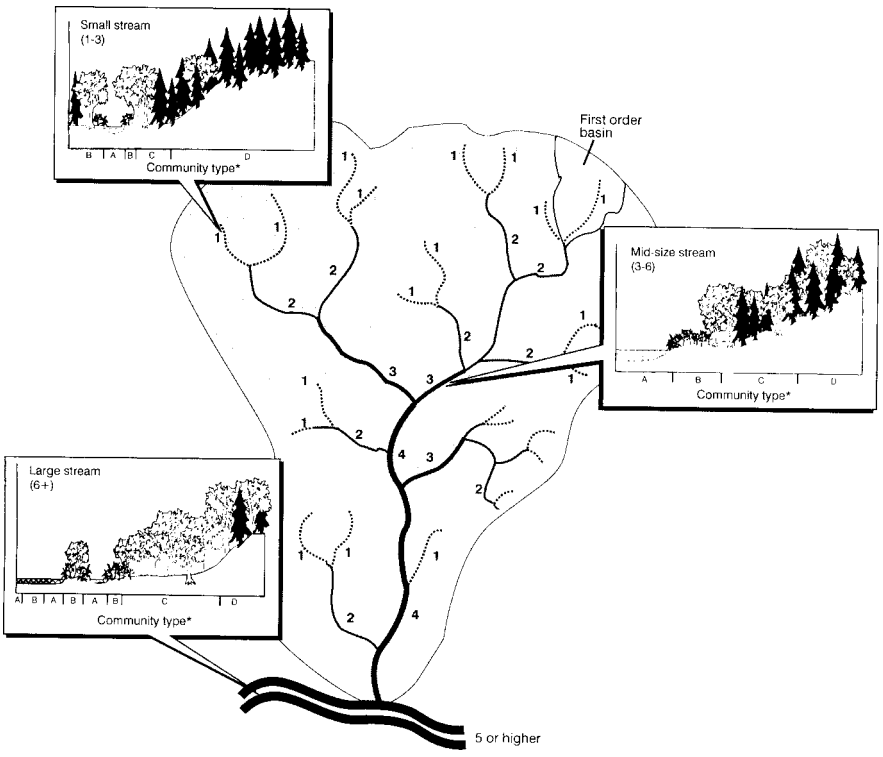
Headwater streams are otherwise known as order 1 through 4 streams. Stream orders are a simple numbering system used to classify the drainage network of a watershed. Order 1 streams are the first channels in the headwaters to exhibit a defined bed and banks. Most are only 1-2 feet in width. Two order 1's join to form an order 2 and so on. See Figure 2.

Riparian forest buffers may exert their greatest influence in headwater streams (order 1-4) as the majority of water flows through these parts of a watershed.

In most watersheds, over 90 percent of stream miles are order 1 through 3 headwater streams. Patterns of drainage vary due to geology, slope and climate.

Riparian forests may provide the greatest opportunities to enhance fish habitat on mid-order streams (3-6) and shorelines where there is sufficient large woody debris, stream structure and flow to support fish and other aquatic life.

Larger streams and rivers (order 6+) are often characterized by well-defined floodplains or adjacent wetlands. Wider buffers may be needed here to allow meandering, as well as improve channel stability, water quality and wildlife corridors.



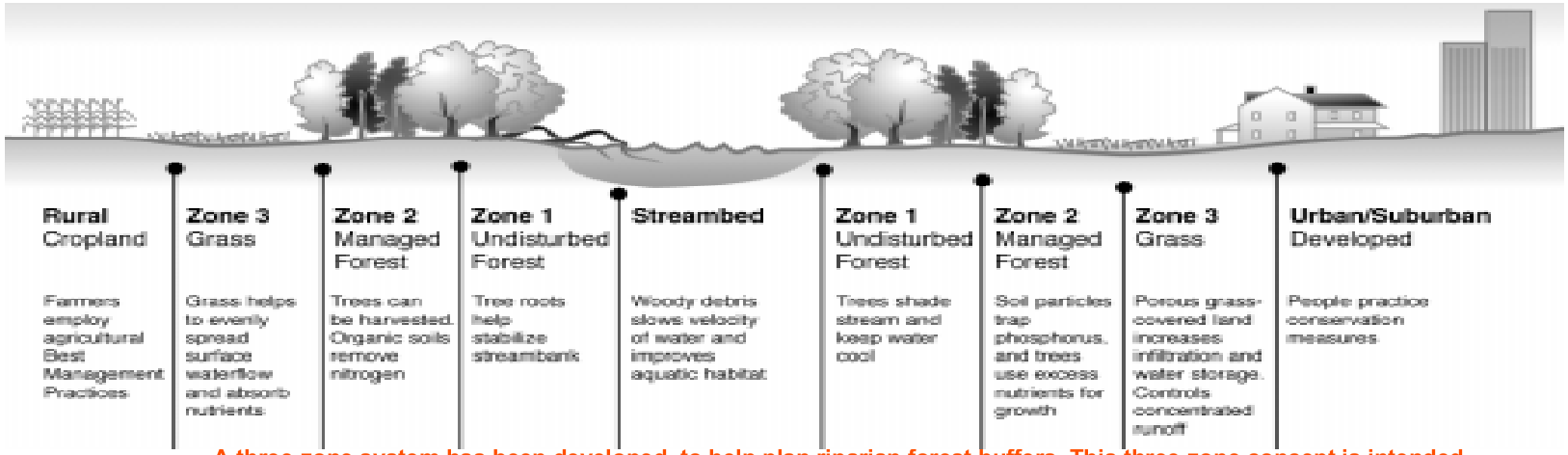
***Key**

A - Active channel or water body
B - Stream banks and adjacent area flooded on an annual basis.
C - Riparian zone of influence-zone of vegetation, directly affecting or affected by the stream or water body
D - Uplands

(Note that A, B and C make up the complete riparian zone. In some cases, portions of D may be included in a riparian buffer.)

Figure 2. Stream Orders

Figure 3. **FUNCTIONS OF STREAMSIDE FORESTS**



A three-zone system has been developed to help plan riparian forest buffers. This three-zone concept is intended to be flexible in order to achieve both water quality and landowner objectives. Use this framework for thinking about and grouping types of plantings — see page 15 for plant groupings.

ZONE 1: Undisturbed Forest

Water Quality Functions

❒ ***Sediment Control*** - The roots of trees in Zone 1 hold together the soil to resist the erosive force of flowing water. This keeps sediments, and any nutrients bound to it, out of the stream.

Ecological Functions

❒***Habitat Biodiversity***- Roots and fallen logs slow stream flow and create pools that form unique microenvironments. Pools support species of macro-invertebrates different from those in riffles only a few feet away. Fallen debris also traps leaves, twigs, fruit seeds and other material in the stream, allowing it to decay and be used by stream-dwelling organisms.

ZONE 2: Managed Forest

Water Quality Functions

❒ ***Nutrient and Sediment Control*** - Where shallow groundwater flows through the root zones of trees, large amounts of nitrate can be removed before the water enters a stream — on the order of 90 percent. In areas where groundwater flows deeper, much of this benefit will be lost as most of the water bypasses the root zone.

Debris from trees slows and traps sediments in the runoff, giving the nutrients they carry time to infiltrate into the ground where they may be stored or removed through natural processes. Studies have shown that Zone 2 can remove 50-80 precent of the sediment in runoff from upland fields.

ZONE 3 : Grass Filter Strip

Water Quality Functions

❒ ***Nutrient and Sediment Control*** - A grass filter strip or other control measure upslope from Zone 2 helps to slow runoff, filter sediment and its associated chemicals, and allows water to infiltrate into the ground. Grass filter strips protect the wooded areas by spreading the flow from adjacent land uses which might otherwise cut channels into the forest buffer. Zone 3 can range from suburban lawns to stormwater management measures to pasture.

Grass filter strips can reduce sediment runoff at rates of 50 percent or more. They can be effective at remove sediment-bound phosphorus, but less effective at removing dissolved nutrients.

❒ ***Food*** - The two primary sources of food energy input to streams are litterfall (leaves, twigs, fruit seeds, and other organic debris) from streamside vegetation and algal production. Recent studies have shown that in a healthy stream leaf litter is trapped and consumed in a relatively small area, rarely moving more than 100 yards; therefore, an upstream forest does little to "subsidize" an unforested area downstream.

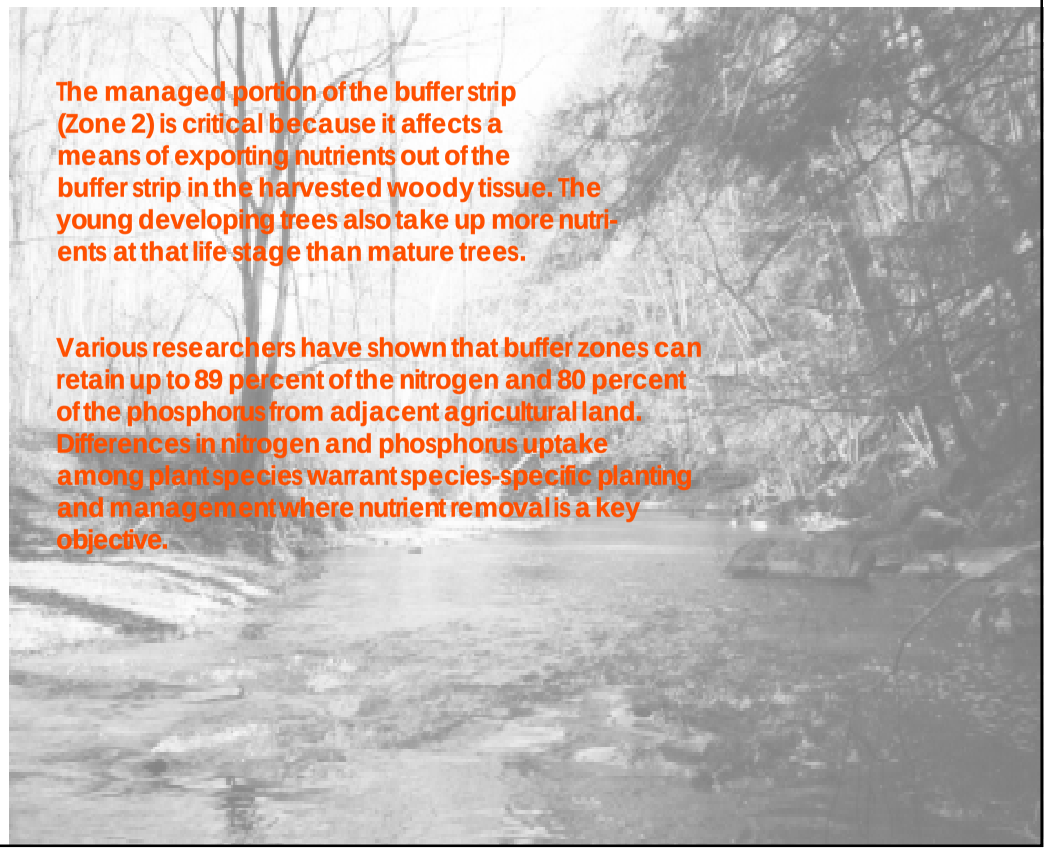
❒ ***Temperature control*** - The leaf canopy of the trees provides shade that helps to control water temperature. Maximum summer temperatures in a deforested stream may be 10-20 degrees warmer than in a forested stream. Temperature changes of only 4-10 degrees usually alter the life-history characteristics of macroinvertebrates that form an important part of the food web.

In addition, shaded streams support algal communities dominated by diatoms — a type of algae favored by many species — throughout the year while areas getting more direct sunlight are dominated by filamentous algae. While crayfish and a few insects will consume filamentous algae, most macroinvertebrate species cannot because they have evolved as specialists for scraping diatoms from the bottom.

Where the tree canopy completely covers the water surface, Zone 1 will have the greatest impact on improving habitat along the stream, providing maximum control over light and temperature conditions.

Two processes are at work: 1) trees convert available nutrients to biomass in leaves, stems, trunk and roots, and 2) bacteria that thrive in organic, carbon-rich forest floors convert harmful nitrates to nitrogen gas that is released into the atmosphere, a process called denitrification.

Over time, the removal efficiency decreases as grass is smothered by deposited sediment; therefore, grass filter strips require periodic maintenance. **Generally, the narrower the filter strip, the shorter its effective life.**



NINE STEPS TO A STREAMSIDE FOREST SITE PLAN

Planning will go a long way to making your group's streamside buffer project a success in the end. It's critical that you know your site conditions, understand the objectives of the landowner(s), and match your project goals and site conditions with the right plants.

When completed, a site plan should include:

1) *a map of the site with appropriately marked planting zones,*
2) *a plant species list,*
3) *planting directions,*
4) *equipment/tool list,*
5) *site preparation directions, and*
6) *a maintenance schedule.*

A sample site plan is provided on page 24.

Below is a nine step process that will help you arrive at a final site plan. Your group might want to form a buffer planning committee to share the tasks so that all of the planning doesn't fall on the shoulders of only one or two volunteers. In Appendix 4 , a checklist for success can be photocopied for use by all those involved in your local project.

The Virtues of a Streamwalk

A simple walk along the stream targeted for restoration is an excellent diagnostic technique. A field visit will aid you in analyzing the physical and vegetative features of your site as described below.

When you walk your stream segment, the following tools will help with your investigation:

- field guide to identify native trees and shrubs
- clipboard with pad of paper and pencil to sketch a map of the site
- a USGS topographic map that includes your streamwalk area
- tape measure
- camera and film
- waterproof boots
- thorn-proof clothing
- work gloves

No matter what the scale of your project, a map of some type is necessary for proper planning and sharing information about your project with others. A map showing how your project fits into the larger geographic area may be required in order to obtain funding from existing grant programs. A good map to start with are the 7.5 minute USGS topo maps, which are available from county planning offices, sporting goods stores, or engineering/survey supply stores.

1 OBTAIN LANDOWNER PERMISSION AND SUPPORT

If your site is privately owned, contact the landowner and enlist his/her approval and support of the project. Walk along the stream with the landowner and discuss his/her goals and wishes. The landowner's commitment is essential for the project's success. On publicly owned land, it is also necessary to obtain permission and the cooperation of the public agency that has land ownership responsibilities.

2 MAKE SURE YOUR PROJECT SITE IS SUITABLE FOR RESTORATION

Consider areas where streamsides lack shrubs or trees, or where bare soil is exposed to erosion along the shore. If streambanks are extensively eroded, you should obtain professional help in evaluating the need for streambank restoration before buffers are planted. Look for evidence of instability, such as vertical, eroded banks, excessive sediment deposition, and signs of frequent flooding. Rapidly eroding streambanks can undermine seedlings before they become established. Extensive streambank restoration will require additional time, professional advice and funding.

3 ANALYZE YOUR SITE'S PHYSICAL CONDITIONS

a) Evaluate the soil -- Soil moisture, seasonal high water table, flooding potential, topography, soil pH, and soil texture (proportion of clay, silt and sand) are all important physical characteristics of a site's soil that affect plant viability. For instance, most streamside plants tolerate a wide variety of soil textures, although certain species do not tolerate excessively sandy or clayey soils.

A soil survey will give you basic, background information about these characteristics, which you can then match with specific species of trees and shrubs. Soil surveys are available at your county conservation district or regional Natural Resources Conservation Service offices. Professionals at these offices can help you understand the soil survey symbols and how they apply to your specific site.

To obtain accurate information on the soil's organic content, pH levels, and nutrient composition, test the soil at various locations within the streamside area. Soil test kits are available from your local Cooperative Extension Service office, private nurseries, and private laboratories. An extension agent can tell you how many samples are needed for your project's area.

Did You Know...

Prior to the arrival of white men, virgin stands of Eastern White Pine contained an estimated 900 billion board feet of lumber. It is an excellent tree for reforestation projects and landscaping.

Eastern White Pine

b) Give your site the "shovel test" -- With shovel in tow, dig up a small area to see how compacted the soil is and how easy it will be to dig. If possible, take a soils specialist with you to help identify any special soil characteristics, such as the presence of a hardpan, shallow soil, or high water table that can interfere with the function of tree roots. Keep in mind that volunteers will come back if the work is made as pleasant as possible.

c) Identify the hardiness zone --Tree species are designated to particular hardiness zones based on their tolerance to winter cold. In Pennsylvania, the hardiness zones range from 5 to 7. Nearly all the plant species listed in Appendix 1 are classified as being hardy in the zone listed. However, caution must be exercised when specifying plants near the northern limit of their hardiness zone. Streamside areas typically lie in frost pockets that effectively reduce the regional zone by at least one increment. Microclimate is also affected by solar exposure.

The term "native" refers to a plant species that has originated in a particular region where it will perform better, have fewer insect and disease problems and is adapted to surrounding growing conditions.

4 ANALYZE YOUR SITE'S VEGETATIVE FEATURES

While physical features control plant selection, existing vegetation in a streamside area will dictate the choice of strategy for buffer establishment. Depending on whether the site is presently a pasture, an overgrown abandoned field, or a mid-succession forest (halfway between field and forest), different approaches are needed to properly establish the desired vegetation. An area's present condition affects conditions such as competition for light, water, and nutrients. Different plant species will respond differently to these conditions.

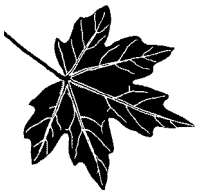
In addition, the upper soil layers will also determine the plant community likely to emerge during buffer establishment. This area includes not only the seeds of the plants in the immediate vicinity, but also the substantial extent of the root biomass from which new vegetation can sprout.

The first step is to look around at what is already growing in the vicinity. You might find that soils derived from limestone best support hardwoods like walnut, beech, ash, elm, red cedar, red oak and shagbark hickory; pines, on the other hand, do well in sandstone-based soils.

Identify Desirable Species

Retaining native tree and shrub species that thrive in riparian areas will provide substantial benefits for the stream ecosystem. Appendix 1 lists native species along with their buffer functions and values. Carefully examine the site to locate the seedlings of these species. While certain species may be inappropriate as part of the final stand (for example, black locust where nitrate reduction is a goal -- this species takes nitrogen from the air and fixes in the soil), they should be retained during buffer establishment to provide shade for tolerant species and to protect the stream environment.

TREE TIP



Sugar maple, red oak, and hickory trees indicate well-drained soils. Sycamore and yellow poplar grow well in moist soils; tupelo, willow and swamp white oak grow in wet, poorly-drained soils.

In addition to those listed, there are also several pioneer tree species that can be found colonizing a streamside area. Although they are short-lived, shade intolerant, upland species, these plants provide shade and structural diversity in a young riparian forest and their presence will benefit the establishment of a buffer. Pioneer riparian species include gray birch, bigtooth-aspen, black cherry and sweet cherry (high wildlife value), staghorn sumac, black locust (a nitrogen fixer, useful for canopy establishment), and sassafras.

Several native shrub and vine species also thrive in the transitional disturbed conditions found in streamside areas. Common species include blackberry, greenbriar, poison ivy, wild grape, Virginia creeper, and spicebush. While less desirable as components of a riparian forest, these native species can provide an effective ground cover during establishment of the buffer and also provide many wildlife benefits. It is important to note that some of these species can and will grow up and over newly planted trees. Therefore, they should be selectively controlled if this occurs. Eventually, forest canopy species will shade out the intolerant species.

Identify Undesirable Species

Since the introduction of exotic plants for landscape and reclamation purposes over the last century, many exotic species have aggressively invaded streamside areas in Pennsylvania. In many areas, these plants have completely taken over the riparian areas to the exclusion of desired native species, effectively stalling the natural progression of native plant communities. Most invasive species reproduce heavily from ground root systems, as well as by seeds. (See box.)

These plants are so aggressive when established that it is preferable to control them as much as possible before the buffer planting. If present in adjacent upland areas, these plants should be controlled to reduce the seed source in the streamside zone. In pasture conditions, sod forming cold season grasses are also undesirable in the streamside area since they compete with tree seedlings and confine streams, causing narrow incised channels.

Identify Sensitive Species or Habitats to Protect

The Pennsylvania Natural Diversity Inventory (PNDI) is a collection of data that describes the state's rarest and most significant ecological features, including plant and animal species of special concern, rare and exemplary natural communities and outstanding geologic features. Since riparian zones in particular are rich in wildlife habitat and wetland plant species, it's important to consult the PNDI to be aware of any rare, threatened or endangered species of plants or animals in the vicinity of your project. Some information about the PNDI can be accessed through DCNR's website at www.dcnr.state.pa.us/(choose "Wild Resources"). You can also request that a local agency representative check the PNDI for your site, perhaps from the Bureau of Forestry or County Planning Commission.

Did You Know...

How to tell a maple from a sycamore tree? Maple leaves grow opposite one another and sycamore leaves alternate along a branch.

Some Noxious/Invasive Plants in Pennsylvania

- *Canada thistle*
- *Multiflora rose*
- *Mile-a-minute*
- *Musk (Nodding) thistle*
- *Purple loosestrife*
- *Norway maple (disturbed woods)*
- *Autumn olive (old fields)*
- *Privet (woods, thickets)*
- *Japanese knotweed (streambanks, floodplains)*
- *Japanese barberry (woods, thickets)*
- *Dame's rocket (moist open sites, alluvial woods)*
- *Oriental bittersweet (hedgerows, woods)*
- *Bush honeysuckles (fields and woods)*
- *Stilt grass (moist disturbed woods)*

To check whether any PNDI-listed species might occur in your project area, contact DCNR's Bureau of Forestry, Forest Advisory Services, PO Box 8552, Harrisburg, PA 17105-8555; phone (717) 787-3444.

5 DRAW A MAP OF THE SITE

Don't be afraid to take too many photos or draw too many pictures. These will help you remember what you saw and aid in your next step -- designing the buffer.

As you collect the information noted above, sketch a map of the site that shows the stream width and length, streambank condition, existing stream-side vegetation, width of desired buffer, and adjacent land uses. Other conditions may also be worthwhile to note, such as stream activities (live-stock or recreational access sites), discharge pipes or other obstructions to digging, or conditions of the stream such as evidence of algae or scum floating or covering rocks.

Also, note any access areas near the site where plants and materials can be delivered and volunteers can park. Telephone or restroom access should be noted. These minor amenities will ease planting day in little but important ways.

6 CREATE A DESIGN THAT MEETS MULTIPLE OBJECTIVES

The three-zone system explained on pages 4 and 5 was developed to help plan riparian forest buffers. This three-zone concept is intended to be flexible in order to achieve both water quality and landowner objectives.

Consider Landowner Objectives

Designing a streamside buffer involves more than applying scientific criteria. Constraints imposed by land use do not always allow for an "ideal" 3-zone buffer design; in these cases, modifications must be made to meet as many objectives as possible. Determining the landowner's goals and wishes is critical to the success of your project. Answers to questions like those listed here will guide your determination of how wide a buffer to plant and what species to include.

Questions to ask...

- What is the landowner's current use of the riparian zone?
- What is the landowner's need for an economic return from the riparian area?
- What is the owner's interest in conserving the site in perpetuity?
- What is the owner's interest in harvesting timber or other forest products from the riparian area?
- What is the owner's ability to carry out management responsibilities?
- What is the owner's interest in recreational pursuits or wildlife enhancements?
- What is the owner's interest in maintaining a view of the stream from his/her private residence?
- Is the landowner interested in linking his/her riparian site to a planned greenway or recreational trail?
- Would the landowner be interested in participating in any government or privately funded conservation programs to help restore or conserve

his/her existing streamside property? Is the land currently enrolled in any existing conservation program?

- Are there any legal limitations currently placed on the riparian site by existing federal or state regulations, deed restrictions, and or municipal zoning?
- Does the landowner have any objections to volunteers maintaining the site once it is planted?
- Is the landowner able and willing to maintain the plantings to ensure that they become established?

As you discuss options with the landowner, specific objectives will evolve and need to be considered in choosing the appropriate width and native plant species for the buffer.

In agricultural settings, many farmers have conservation plans developed in cooperation with the USDA Natural Resources Conservation Service and county conservation districts. A conservation plan usually addresses the total resource concerns of the landowner, so it is important to integrate plans for a riparian buffer into the overall farm conservation plan.

Match Your Buffer Width to Scientific Objectives

There is no ideal buffer width for all applications in all areas. Buffer width is site specific and dependent on both scientific criteria and landowner objectives. When a scientifically-derived buffer width is reduced because of land use constraints, it's important to recognize that compromises are being made to the long term ecological function of the buffer. For example, when a decision is made to choose warm-season grasses over forest as the target buffer vegetation, reductions in stream stability, flood mitigation, groundwater nutrient removal, and aquatic/terrestial habitat should be recognized.

The function of the buffer, that is, the reason for installing a riparian buffer, should be the overriding criterion in determining buffer width with other factors influencing the final decision to a greater or lesser degree.

Generally, the narrower the buffer strip the shorter its effective life.

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 because they do not contain a "critical mass" or sustainable width that is essential for long term sediment and nutrient reductions. Buffers that are larger than needed may unnecessarily restrict use of a portion of the land and may burden resources available for establishment and maintenance.

From a scientific standpoint, you should consider the facts about your stream with regard to 1) its resource value, 2) its soil and hydrogeologic characteristics, 3) the intensity of adjacent land use, and 4) the desired buffer functions. The function of the buffer, that is, the reason for installing a riparian buffer, should be the overriding criterion in determining buffer width with other factors influencing the final decision to a greater or lesser degree.

Some situations that might influence the decision to design a smaller buffer include:

- a lower order stream (headwater) where a smaller buffer may be adequate to maintain the desired level of protection
- a stream system where it's a high priority to achieve contiguous buffers where wildlife habitat goals are important
- a stream where there's a low potential yield of nutrients, sediment, chemicals and runoff from adjacent land use

Conversely, other situations may warrant the decision to go with a wider width, such as:

- a stream within a watershed providing municipal water supply
- an area where steep slopes add a greater risk of runoff pollution
- a site where buffer width is expanded to incorporate sensitive landscape features such as floodplains and wetlands

TREE TIP

Forests provide as much as 40 times the water storage of a cropped field and 15 times that of grass turf.

Of all the scientific criteria that can be applied to making buffer width determinations, the most important are the specific functions that a buffer needs to provide under site-specific conditions. Some judgment and setting of priorities is nearly always necessary to attain a desired minimum buffer width for a desired set of functions.

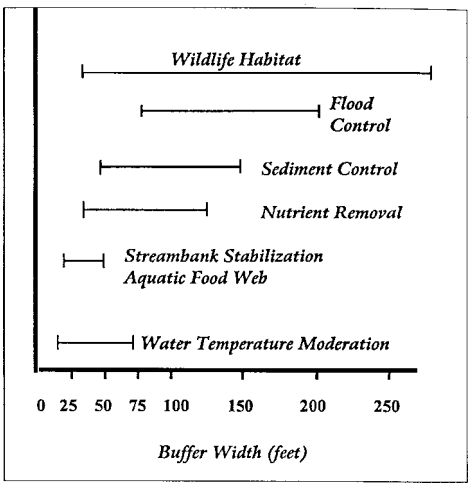


Figure 4. Range of minimum widths for meeting specific buffer objectives.

To provide an array of functions, buffers should be a minimum of 35 to 100 feet in width under most circumstances. Buffer widths toward the lower end of the range provide some physical and biological benefits, while buffer widths at the upper end of the range are likely to provide protection of physical, chemical and biological characteristics of the aquatic resource. Streamside buffers narrower than 35 feet can provide some limited benefits but may require long term maintenance since their ability to trap sediments is reduced and the lack of shading invites more invasive species.

Consider the Costs

Establishment and maintenance costs should be considered up front in the plan design. Although every project is site-specific, the following estimates provide realistic per acre costs on which to base your own budget figures.

One tool that can be used for establishment planning is the riparian forest buffer specification developed in 1990 by the USDA Forest Service. That specification, as described in this guide, outlines three distinct zones.

Zone 1 is nearest the streambank, has a recommended fixed 15-foot width, and is a no harvest zone to achieve streambank stabilization.

Zone 2 is recommended to be at least 60-feet wide; harvested trees promote nutrient removal as newly planted trees take up more nitrogen for early growth.

Zone 3 is recommended to be 20-feet wide and consists of dense grasses and forbs to convert concentrated water flow to uniform sheet flow.

Below are the associated costs.

Table 1. Riparian Forest Buffer Installation Costs Per Acre Estimated Costs

	Establishment	
Preparation	Light site preparation -- mow, disking	$ 12.00
Planting	Tree Seedlings 8x8 spacing, 430 trees/acre (Hardwoods - $1.15/seedling) 12-18" seedlings with labor included	$495.00
Subtotal		**$507.00**
	Maintenance	
Reinforcement Planting	Seedlings 50/acre Year 2 after establishment	$ 58.00
TOTAL COST	**Planting and Establishment**	**$565.00**
	Optional Costs	
Establishment	Shelters ($5.00/tree installed) Fencing (1 acre = 282 feet)	$2150.00 $ 564.00
Maintenance	Competition control -Herbicide treatment -Mowing	 $ 54.00 $ 12.00

Costs include labor estimates.

➪ With this basic outline we can begin to plan establishment costs, and then, estimate maintenance cost for a 10-year period. The costs shown in Table 4 are derived from USDA Forest Service, *Stewardship Incentive Program (SIP) cost-share rate structure guidance for SIP Practice 6 - Riparian and Wetland Protection and Improvement for Various States within the Northeastern Area.* All costs shown are the price of practices installed - that is including labor.

➪ NOTE: One mile of 35 foot wide buffer contains about 4 1/5 acres.

➪ NOTE: Volunteer labor can reduce costs signficiantly.

Pick the Right Plants

An important step in planning and establishment is the Plant Schedule, which lists the plant species, quantity, size and type. Planting specifications should detail the installation procedures, protection measures, and maintenance practices to be followed.

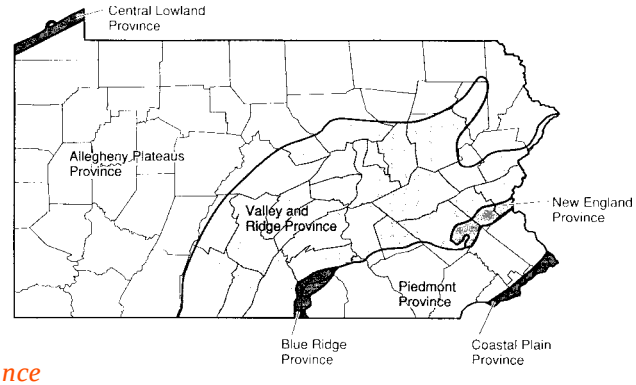
Which Species?

Designing the planting plan starts with selecting the best plants for each particular combination of hardiness, moisture, flooding and soil pH. Your streamwalk and up front research will give you this basic information.

Species Range

If species native to the area in which you are working are planted, they are more likely to establish and grow with less need for maintenance and water. The physiographic regions in which each species is most likely to occur (Piedmont, Valley and Ridge, and/or Appalachian Mountains) are listed in Appendix 1. This information will help to determine regional limitations.

Physiographic Regions of Pennsylvania

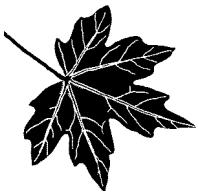


Flood Tolerance

Although all of the shrubs and trees in Appendix 1 are commonly found in Pennsylvania's riparian areas, some species are not able to survive frequent or prolonged flooding. Trees that are planted closest to the waterway are more likely to be flooded and should be able to withstand a high water table. More flood-tolerant trees should be planted in any site that tends to be very wet as well. *Figure 6* on the opposite page provides some examples of tree species that fit into the typical moisture conditions of a streamside area. Species not suited for reasons of pH, moisture, or flooding will be excluded from certain areas of the riparian zone.

The remaining species are selected according to wildlife value, price, economic value,availability and other landowner objectives. Appendix 1 lists native riparian plants and their tolerance and preference levels for growth and wildlife characteristics. Appendix 2 lists nurseries in Pennsylvania that have responded to a 1997 survey by the Alliance for the Chesapeake Bay in an effort to collect information on native stock. The Pennsylvania Landscape and Nursery Association can also direct you to local nurseries that stock native trees and shrubs.

TREE TIP



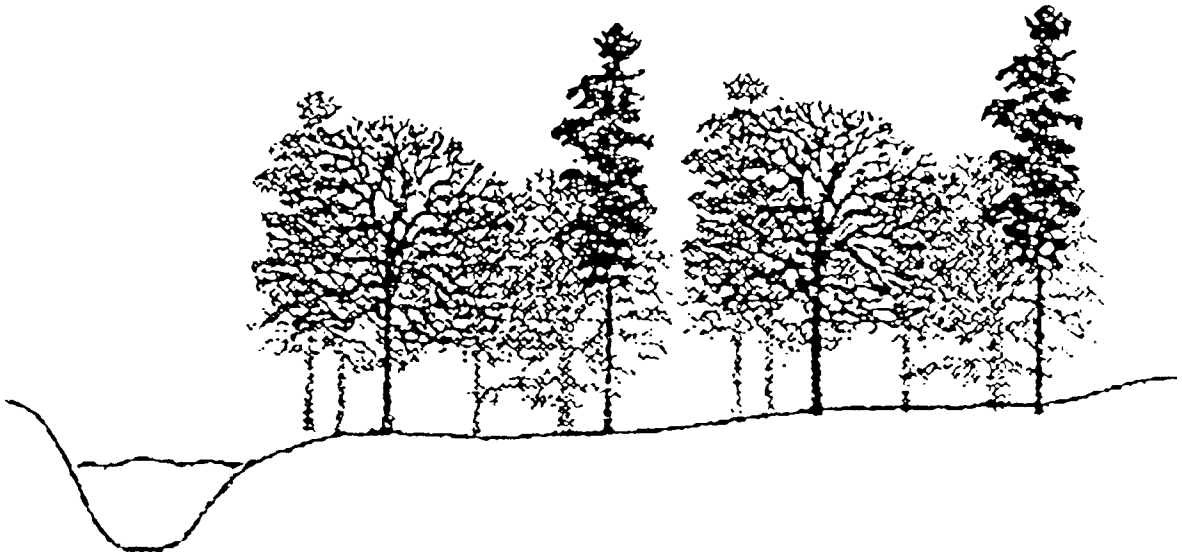
In establishing a new riparian forest buffer, it is usually both economical and practical to select a group of no more than 6 to 12 species.

Zone 1 provides detritus and shade to the stream and should consist solely of hardwoods. As it is located along the streambank, Zone 1 is likely to be flooded and should therefore be dominated by flood tolerant species. Hardy shrub species, such as dogwoods and willows, can also be planted along the streambank to provide stabilization.

Zone 2 contains a managed forest and may include hardwoods and conifers that have more intermediate flood tolerances.

Zone 3, if needed, may contain grasses or other features helpful in slowing and infiltrating water. Shrubs and small trees may also be desirable in Zone 3 to provide a diversity of habitats for birds and wildlife.

Figure 5. Sample Planting Recommendations According to Moisture Conditions



WET ---------- DRY

TREES

Silver Maple
Box Elder
Persimmon →
Black Ash
Red Ash
Pawpaw →
Sweet-bay Magnolia
Sycamore →
Cottonwood
Swamp White Oak
Oak,Willow →
Willow, Sandbar & Black

SMALL TREES/SHRUBS

River Birch
Smooth Alder
Chokeberry, Red
Chokeberry, Black →
Groundselbush
Dogwood, Red Osier & Silky
Summersweet →
Winterberry →
Inkberry →
Swamp Rose
Swamp Azalea
Meadowsweet →
Highbush Blueberry →
Witherod →
N. Arrowwood

TREES

← Maple, Red →
Bitternut Hickory →
← Redbud →
Hackberry →
American Beech →
← Ash, White →
← Honey Locust →
Kentucky Coffee Tree →
← Sweet-gum
Tuliptree →
Black-gum →
← Large-toothed Aspen →
← Oak, Pin →

SMALL TREES/SHRUBS

← Black/Sweet Birch →
Mountain Laurel →
← Hornbeam →
Yellow Birch →
← Shadbush (A.arborea & canadensis) →
← Dogwood, Gray & Flowering →
Fringe Tree →
American Hazelnut →
← Black Huckleberry
← Common Spicebush →
← Rosebay Rhododendron
← Southern Arrowwood
← Ninebark
← American Elder →
Bayberry →
← Highbush Cranberry →
Red Elm

TREES

White Pine
Black Cherry
Sassafras
Canada Hemlock
Oak, White
← Oak, Red
Oak, Chestnut
Hickory, Shagbark
Maple, Sugar
Black Walnut

SMALL TREES/ SHRUBS

Hop-hornbeam
Witchhazel
Staghorn Sumac
Nannyberry
Blackhaw

Arrows denote that certain species can tolerate either a wetter or drier environment.

What Size Plants?

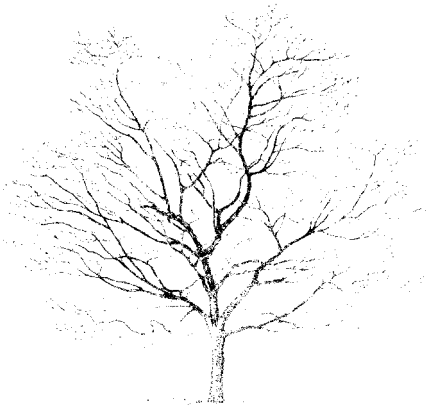
Your choice of planting stock, which ranges from seeds to large caliber nursery stock, depends to a large extent on available funding resources. Larger plant material, such as balled and burlapped (B&B) trees or large container stock (> 2 gallons), will cost more, although they will attain the desired goals more rapidly. Alternatives include bare root seedlings and seeds and plugs.

Where funding is limited, least expensive material can be widely used, while the most expensive material can be used sparingly in high visibility locations or in other high priority areas where, for instance, you may want faster results or ease of maintenance over the first few years. Where cost differential is not a factor, plants remaining on the list should be used in roughly equal proportions within each combination of physical conditions to provide the greatest diversity and resistance to plant diseases.

Also, consider the planting rate that it will take for a three-person crew to install a buffer. The following chart is a conservative estimate of planting rates for a trained three-person crew with adequate soil conditions. It includes digging holes, fertilizing, planting, back filling, and flagging the site.

Trees and Shrubs	Quantity Per Hour
Bare Root Stock	100
Containerized Seedling	50
1 Quart Pot	45
1 Gallon Pot	40
2-3 Gallon Pot	20

Herbaceous material in bare root, plugs or peat pots can be installed considerably faster but, as for woody vegetation, factors like soil conditions, spacing, terrain of the site, weather and age of the volunteers can influence planting rates.



Flowering Dogwood

Did You Know...

The bark of flowering dogwood has been used instead of quinine as a remedy for fevers? The flowering dogwood is also useful for its rapid decomposition, contributing calcium and other minerals to enrich the soil.

Balled & Burlapped and/or Container Stock

The most expensive approach is to plant the canopy, midstory and understory in the final locations, using B&B and large container stock. In mature riparian forests, canopy tree stem density is roughly 150 stems per acre, indicating a tree spacing of 16 to 18 feet. B&B material will attain a higher canopy height in the shortest time. Large material is most appropriate in riparian forests where intensive multiple uses are anticipated, as in urban development or part of an urban park system.

The typical plant cost for B&B material with roughly 1.5 inch diameter stems is about $35 and up. Five-foot tall B&B material costs from $8 to $20, depending upon source and species. Installation costs are about $10 to $30 per plant, depending upon method, size of plant, and source. The installed cost ranges from $18 to $50 (or higher), or $2700 to &7500 per acre. Since it is relatively expensive, this approach is inappropriate for use in most riparian sites.

Bare Root Stock

A more cost-effective approach is to use bare root material. Planting density should be higher than the final stem density desired, to allow for losses due to competition, stress and deer. At a survival rate of 75 percent, roughly 200 plants are needed per acre. A spacing of 14 to 16 feet is appropriate for larger material at least several feet high and around 3/4 " in diameter. Bare root material can grow relatively rapidly after the root system is established, reaching canopy closure soon after similar size B&B material. Bare root plantings are best in situations where visible plantings are desired after riparian forest buffer planting.

Bare root material ranges in price from $2 to $6 per plant for five-foot plants, less than half the price of B&B for the same height. Hand planting with mattocks is the least expensive, but root spread may be compromised. Using power augers to dig the planting holes, installation costs should run from $0.40 to $0.50 per plant, or an installed cost from $2.40 to $6.50 per plant. At 240 stems per acre, installed costs would run from $575 to $1500 per acre.

Bare-root seedlings are usually shipped in bundles which must be kept moist prior to planting

Seedlings

Seedlings can be purchased as container grown seedlings or bare root seedlings. Container grown seedlings are often grown in paper pots that disintegrate and allow for both seedling and pot to be planted. This increases survival rate because the plant never loses contact with the soil and suffers less stress. Plastic containers work well for producing plugs that are pulled out of the container before planting.

In situations where a longer time to attain canopy closure is acceptable, smaller bare root seedlings are used. They are the least expensive type of plants. Seedling stock is either lifted directly from the nursey bed and

shipped or is shipped as transplants (two years in the nursery and one year in a transplant bed).

TREE TIP

Rules of Thumb:
Spacing and Density Recommendations

Seedlings.....6 - 10 feet spacing or roughly 700 seedlings/acre

Bare Root Stock.....
14 to 16 feet spacing or roughly 200 plants/acre

Balled & Burlapped and Large Container Stock.....
16 to 18 feet spacing or roughly 150 plants per acre

Depending upon plant condition, species, and site stresses, the survival rates range from less than 30 percent to over 90 percent. At an average survivial rate around 50 percent, the plant spacing should be 6 feet by 6 feet, or 1,210 stems per acre. Assuming a 50 percent survival rate, the site will have over 600 seedlings per acre.

Seedlings and two-year transplants are considerably less expensive than larger stock, varying from $0.30 to $1.50 per plant according to source and type of plant. With experienced personnel, at least 60 to 80 plants can be planted per hour. At $10 per hour, this results in installation costs from $0.10 to $0.15 per plant, or an installed cost of $0.40 to $1.65 per plant. Given a planting density of 300 trees per acre, the installed cost ranges from $120 to $495 per acre. Herbaceous control is more extensive, though, requiring at least several years of control.

Tree shelters accelerate growth and increase the survivability of seedlings but add to the installation costs (approximately $3-$4 per plant). Where shelters are used, the density can be decreased and the results improved. See page 31 for more information on tree shelters.

Formula for Estimating Number of Trees and Shrubs

Number of Plants Equals:

$$\frac{\text{Length x Width of Corridor (ft.)}}{\text{50 (square ft.)}}$$

This formula assumes:

- Each tree/shrub will occupy an average of 50 square feet.
- Trees/shrubs will be randomly placed. The trunks of the plants will be approximately 10 feet apart.
- With a density of a tree/shrub every 50 square feet, mortality of up to 40% can be absorbed by the growing forest system. Replanting would not be necessary unless all 40% occurred in an isolated area.

Source: Lancaster County Conservation District

Seeds and Plugs

For certain riparian species with large seeds, such as walnut and oak, planting of the seed is a viable alternative. While the planting material may be the least expensive, tree shelters are required to obtain acceptable survivability. Given the absence of transplant shock and the favorable conditions inside a shelter, growth rates from seed can be surprisingly fast. Walnut seedlings in shelters have grown up to 4 feet within the first growing season. For grasses and forbs, seed is the material of choice.

7 DRAWING A PLANTING PLAN

Given the planting density and a conceptual plant mix, drawing up the planting plan is straightforward. The plan can be a simple line drawing of the site with areas denoted for tree and shrub species with appropriate notes on spacing and buffer width.

The opposite page provides an example of a riparian forest buffer in an agricultural setting. On this site, an average width of 35 feet is planned for a mixed hardwood buffer within a streamside fence.

Figure 6. Sample Planting Plan

Spacing: *All hardwood and shrub species will be planted at a more or less random 8'-10' spacing. Sandbar Willow and Red-osier Dogwood will be planted immediately along the stream in flagged out areas. White Pine will be planted in groupings at a spacing of 8' and a minimum of 15' from any hardwood.*

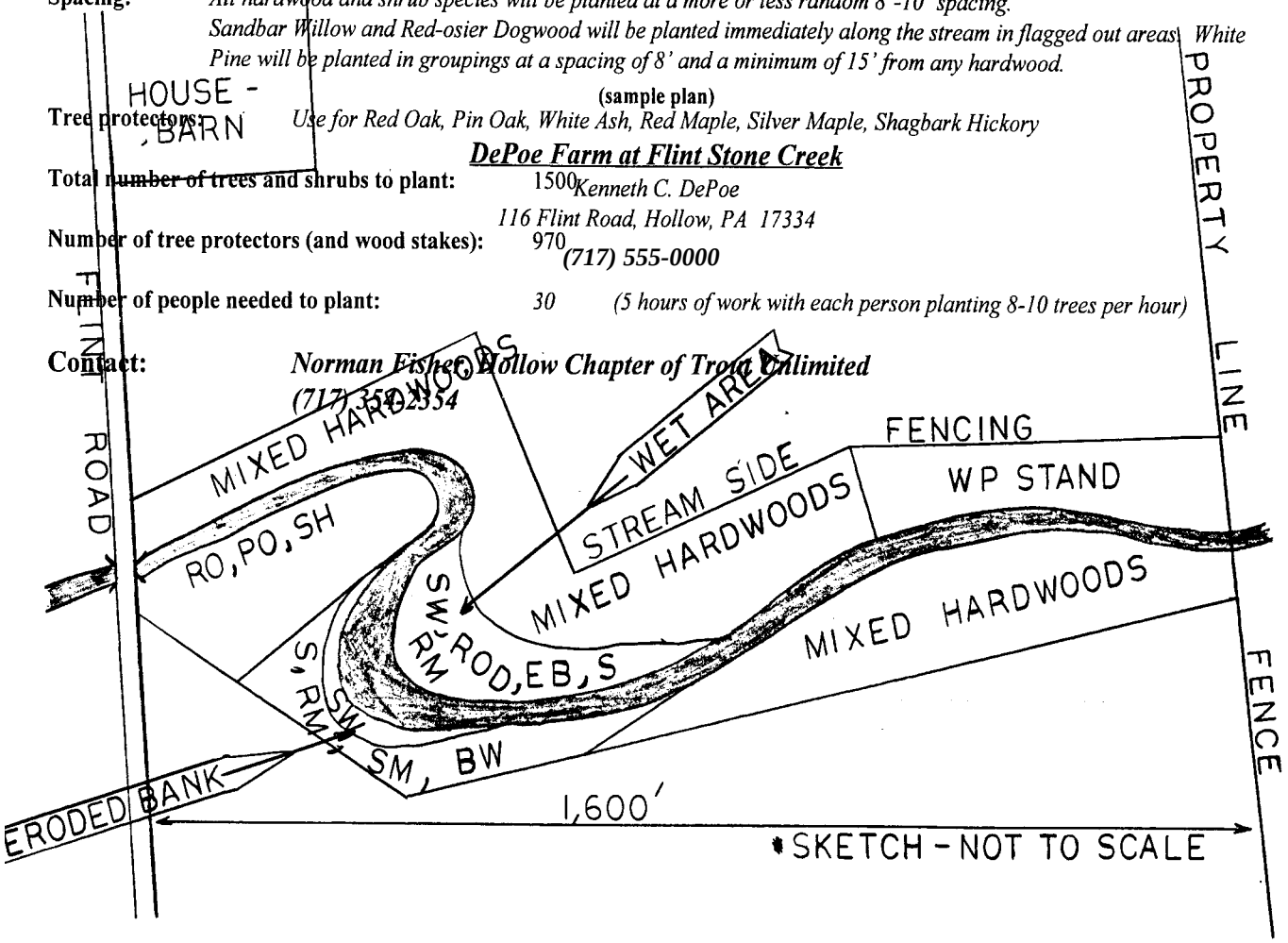
Tree protectors: *Use for Red Oak, Pin Oak, White Ash, Red Maple, Silver Maple, Shagbark Hickory*

Total number of trees and shrubs to plant: 1500

Number of tree protectors (and wood stakes): 970

Number of people needed to plant: *30* *(5 hours of work with each person planting 8-10 trees per hour)*

Contact: ***Norman Fisher, Hollow Chapter of Trout Unlimited***
(717) 352-2354



Tree/Shrub	Number	Symbol	Tree/Shrub	Number	Symbol
White Pine	*60*	*WP*	*Red Oak*	*150*	*RO*
Pin Oak	*170*	*PO*	*White Ash*	*180*	*WA*
Red Maple	*140*	*RM*	*Silver Maple*	*70*	*SM*
Sycamore	*100*	*S*	*Black Willow*	*100*	*BW*
Shagbark Hickory	*60*	*SH*	*Sandbar Willow*	*150*	*SW*
Red-osier Dogwood	*170*	*ROD*	*Elderberry*	*150*	*EB*

Your drawing can be a more detailed depiction as illustrated on the next two pages for another project site. Below is a sketch of the site before the symbols were added. The opposite page shows the conceptual planting.

Canopy plantings are delineated with graphic symbols of a diameter representing the spacing and random arrangement throughout the streamside area. (If mowing is not used for herbaceous control, an artificial grid pattern is not necessary.) Understory plants are similarly arranged, using symbols of smaller diameter. Typically, there should be at least three or four understory trees for every canopy tree. This will provide structural diversity similar to mature forests. Shrub species are most intensively arranged at the margins of streamside forest buffers, where edge effects are the greatest. To avoid clutter and provide more graphic clarity in the dense plantings of the buffer, complete names can be omitted from the plan. Instead, species can be listed by initials generally representing the genus and species, with the key listed on the planting plan..

Many riparian plant species have a wide degree of tolerance in soil moisture, pH, and shade. Therefore, these species can be used effectively in many locations through the streamside area.

Where site conditions permit a wide choice of material, the individual species selection is not as important as the overall mix in a particular area. Overall, the planting plan should appear random; the crucial issue being that all plants are native and are located where they will thrive.

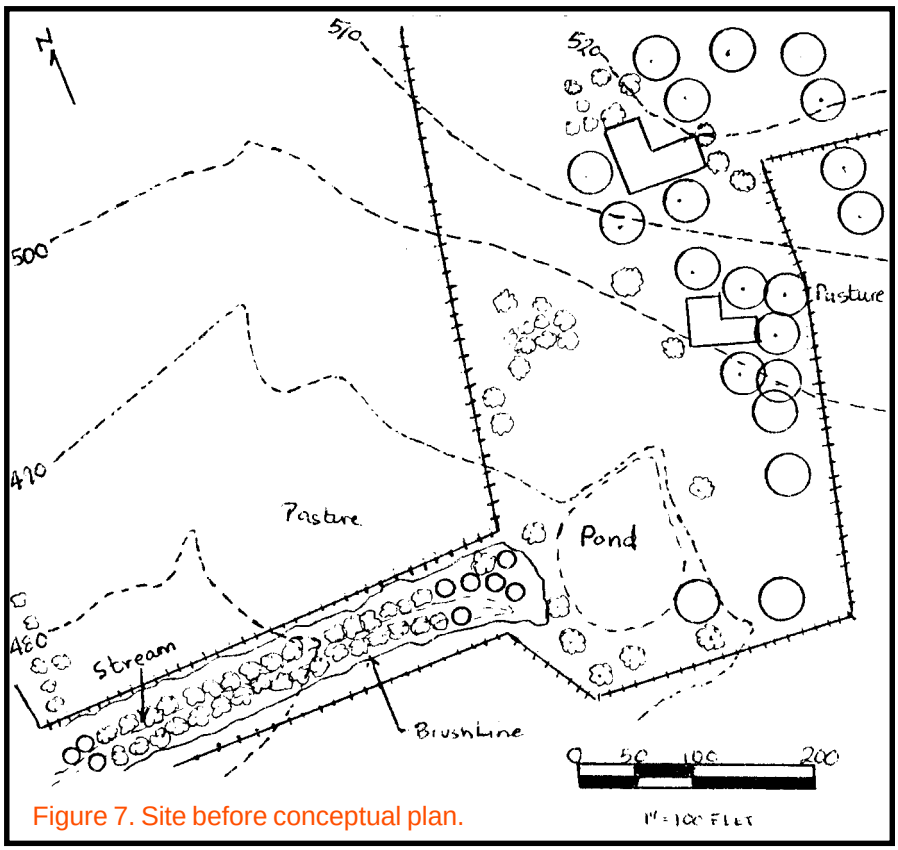
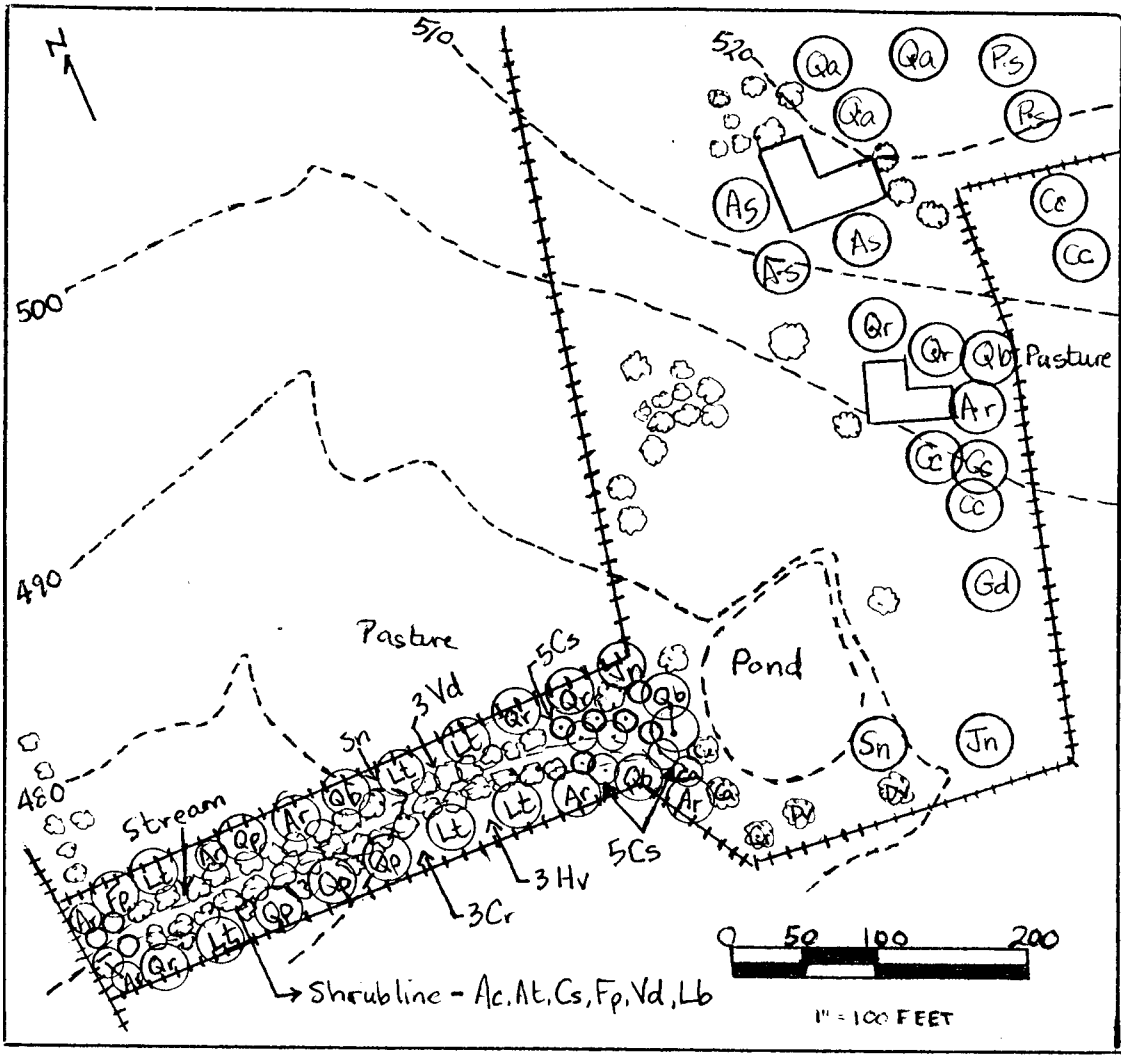


Figure 7. Site before conceptual plan.

On this site, the relatively small scale precludes a wide buffer, so control of the aquatic environment is the primary goal. Removal of sediment and nitrates is a lesser objective. Shrubs are concentrated along the external edge of Zone 3 to provide more shade and structure. Shade tolerant species are specified on the north-facing edges.

Figure 8. Sample Planting Plan



KEY

Serviceberry, Amelanchier canadensis	Ac	Black walnut, Juglans nigra	Jn
Red maple, Acer rubrum	Ar	Common spicebush, Lindera benzoin	Lb
Sugar maple, Acer saccharum	As	Tuliptree, Liriodendron tulipfera	Lt
Paw paw, Asimina triloba	At	Eastern white pine, Pinus strobus	Ps
Summersweet, Clethra alnifolia	Ca	White oak, Quercus alba	Qa
Redbud, Cercis canadensis	Cc	Swamp white oak, Quercus bicolor	Qb
Grey dogwood, Cornus racemosa	Cr	Pin oak, Quercus palustris	Qp
Red-osier dogwood, Cornus sericea	Cs	Northern red oak, Quercus rubra	Qr
Persimmon, Diospyros virginiana	Dv	Black willow, Salix nigra	Sn
Red/Green ash, Fraxinus pennsylvanica	Fp	Arrowwood, Virburnum dentatum	Vd
Kentucky coffee-tree, Gymnocladus dioica	Gd		

8 PREPARE YOUR SITE AHEAD OF TIME

Tool & Equipment List for Site Preparation:

- brush ax
- bush hog
- weed whacker
- herbicide
- backpack sprayer
- lopping shears
- pick axe or mattock
- mower
- tractor with disk & seeder

Herbicides Suitable for Riparian Areas

"Most Preferred"
- Glyphosate (Roundup, Accord, Rodeo, and Campadre)

"Preferred"
- Metsulfuron (Escort)
- Gluphosinate (Finale)
- Fosamine (Krenite)
- Triclopyr (Garlon)

"Acceptable"
- Imazapry (Arsenal)
- Sulfometuron (Oust)
- Dicamba (Banvel)
- 2,4 D (Generic)

Highly mobile or toxic herbicides to avoid within riparian areas:
- Hexazinone
- Picloram
- Atrazine
- Fluazifop

Source: Chesapeake Riparian Handbook - A Guide for Establishing and Maintaining Riparian Forest Buffers, USFS.

Often, a streamside buffer area to be reforested will have a mixture of undesirable species, pasture, overgrown fields and a line of pioneer species of trees along the stream requiring a combination of site preparation techniques. Wetlands and streams should not be exposed to herbicides if it can be avoided. In stubborn situations, a variety of physical and herbicidal methods will be effective in manipulating the plant composition to control undesired species.

It's best to acquire the help of a professional in determining whether chemical controls are absolutely necessary to prepare a site for planting. Site-specific hydrology and soil conditions will dictate what types of herbicidal applications can be done without detriment to surface water quality. Even though aquatic insects and fishes seem to be unaffected by the "Most Preferred" herbicides, diatoms (a type of single-celled algae) are likely to be affected. Notwithstanding the apparently low toxicity of such herbicides to aquatic organisms, timing application after peak diatom activity in early spring should result in lesser effects upon stream ecosystems. Where invasive species are a problem, consult a professional. *Important reminder: Before using an herbicide, read the label and follow instructions carefully. Do not use a "restricted use" pesticide unless you are a formally trained, certified pesticide applicator.* "Highly mobile or toxic" herbicides usually fall under the "restricted use" category.

In some situations, site preparation can require up to a year of vegetative control prior to planting. Any necessary streambank stabilization needs to be included in the planting plan so work can proceed in a logical order.

Pasture Conditions

Experts offer two approaches to preparing a former pasture for forest establishment. The first approach involves no herbicide -- simply plant young trees and seedlings at a higher density directly into the grass cover and mulch around the plant stems to control weed and grass growth. With this approach, mowing and weeding will be necessary until the trees mature and provide their own natural weed control by shading out underneath growth. Some thinning may be required as the trees compete for space .

The second approach requires the use of herbicides. In pasture where concentrated runoff is less likely to occur, the sod should be plowed and disked in early spring followed by an application of Oust, Escort and Arsenal to control turf grasses. (Apply Oust in upland areas only, away from surface waters.) Immediately seed the site with an appropriate warm-season and cover crop grass mixture to stabilize the soil. In this case, site preparation essentially overlaps with the establishment of the riparian forest buffer.

In pasture where erosion is likely, plowing is not recommended. Instead, a combination of Roundup and Oust should be applied in a four-foot diameter circle at each planting location to control sod forming grasses. Apply Oust only in upland sites; not near surface waters.

Abandoned Fields

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 (spraying the base of plant) during the dormant season, cutting large shrubs and vines 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.

Undesirables Species

Other problem species such as multiflora rose and honeysuckle will still need to be controlled by cutting, pulling and/or herbicides.

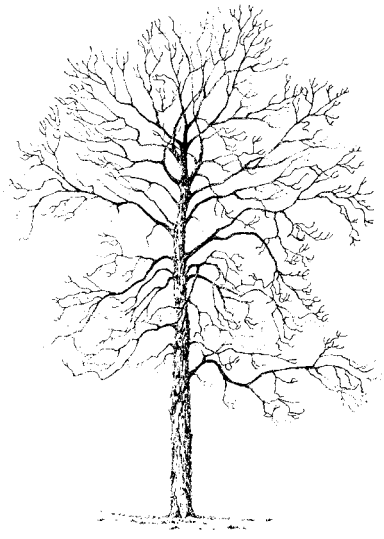
9 DETERMINE MAINTENANCE NEEDS

Before the actual establishment of the streamside buffer, serious consideration must be made as to maintenance needs and long-term monitoring of the site. Often times this issue is overlooked in the planning process but is an important key in the longevity and sustainability of the forest. It's advisable to develop a schedule that identifies the commitments of each party in maintaining the site. Make this schedule a part of the site plan so that everyone is familiar with the assigned responsibilities. Groups that may be able to assist with maintenance include service corps, high school and college students, and scout clubs. A detailed overview of maintenance and monitoring considerations is covered on pages 33-35.

TURN THE PAGE FOR A SAMPLE SITE PLAN.

Did You Know...

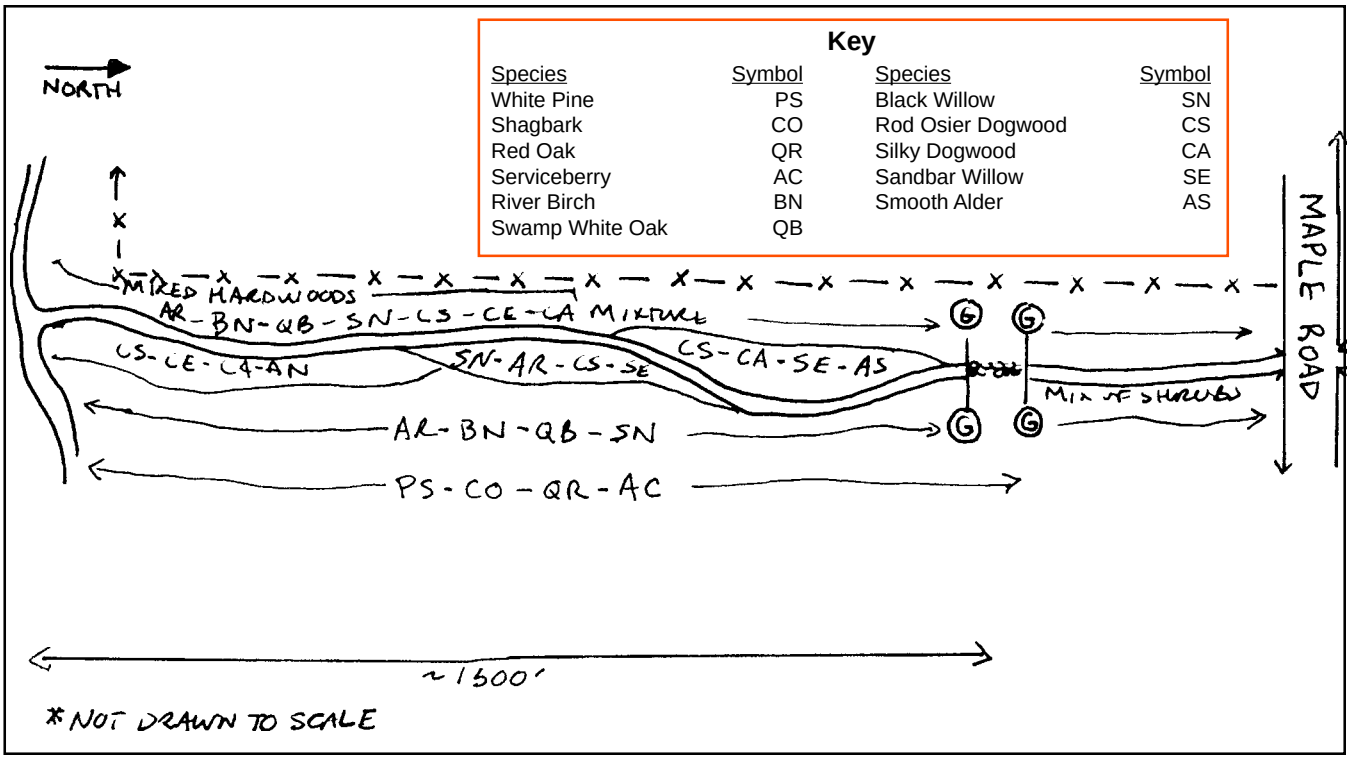
Shagbark hickory has the highest fuel value among all American woods. One cord equals one ton of anthracite coal. This hickory produces high-quality charcoal. Nuts of this species were a staple among the fall foods consumed by many tribes of the Native Americans.



Shagbark Hickory

Figure 9. SAMPLE FOREST BUFFER SITE PLAN

Contact: John Boxelder **Phone Number:** 555-xxxx



Location: 999 Maple Road, Quercusville, PA

Species	Latin Name	Size	Quantity	Pattern/Spacing
White Pine	Pinus strobus	bareroot	95	6 - 8 feet random spacing for all trees and shrubs
Shagbard Hickory	Carya ovata	container	45	
Red Oak	Quercus rubra	container	50	
Serviceberry	Amelandrier canadensis	bareroot	50	
Red Maple	Acerrubrum	container	70	
River Birch	Betula nigra	bareroot	70	
Swamp White Oak	Quercus bicolor	container	40	
Black Willow	Salix nigra	bareroot	70	
Red Osier Dogwood	Cernus sericea	bareroot	170	
Silky Dogwood	Cernus amomum	bareroot	200	
Sandbar Willow	Salix exigua	bareroot	220	
Smooth Alder	Alnus serrulata	bareroot	120	

Equipment/Tools:

shovels
auger
buckets
trees
mulch
gloves
flagging

Site Preparation:

Remove invasives, mow site, mark planting areas and pre-dig holes (if needed).

Maintenance Responsibilities:

Regular mowing; mulch if needed; replace dead trees if mortality is over 40 percent in one area.

Number of volunteers: 35

Directions to site: Route 700 South; right on Bobcat Road; 7 miles to Maple Road; left and go approx. 2 miles; planting area on right; look for big cow in pasture.

BUFFER ESTABLISHMENT

Purchasing Plants

It is important to consider purchasing plants native to the area. This is due to the fact that locally evolved species have better vigor and hardiness and are better able to compete. These "natives" also provide food to aquatic insects, some of which have mouths adapted to feed only on these local species of plant materials.

In recognition of the merits of native material, many nurseries now stock native plants. Where available, this stock should be used, although much of the plant material may have to come from more distant genetic sources. Nursery stock from large or distant suppliers often comes from a biotype far removed from the site of installation. Where stock from remote sources differs substantially in hardiness, it is a less desirable option, even though its cost may be slightly more competitive. Local sources may be a little more expensive, but the better quality control and reduced shipping and handling costs can offset initial price disadvantages. Listed in the Appendix 2 are suppliers of native plants in Pennsylvania. This list is by no means exhaustive; other suppliers will have suitable material as well. When purchasing plants from a nursery, ask the source of the plant and/or if it is propagated onsite.

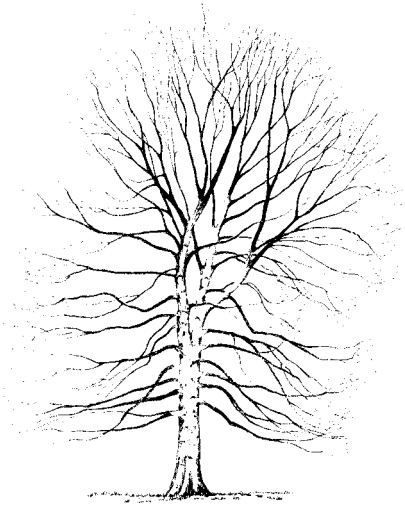
It is important to note that plant species should not be dug and transplanted from the wild. In many cases the species are site specific to the growing conditions and some have a deep taproot which if severed will kill the plant. Seeds may be collected; however, seed planting has its drawbacks and requires a knowledge of specialized techniques. Also, it's important to leave enough seeds for wildlife and survivability of plant populations.

During formulation of the plan, likely sources of plant materials will have to be identified, contacted and visited to check on the condition of the stock. The size, condition, and health of the plants should be examined before ordering. Specimen material can be tagged at this time, and arrangements for delivery, payment, and guarantee conditions are drawn up. When ordering plants, it is important to provide as much lead time as possible to ensure the best selection. Prior to early spring is the best time to place orders, as the best trees are shipped first. Consider ordering 10 to 15 percent more trees and shrubs than what you think you will need. The additional plants can be planted in a nearby “holding” area and used for replacement plantings.

In most cases, plants should not be paid for until delivery and unloading. This ensures that delivered material meets the specifications stipulated, and that the plants arrive in good condition. Plants that do not meet specifications should not be accepted and sent back to the supplier with arrange ments for replacement or refund. The material should be examined for the following criteria at delivery:

Did You Know...

Because of its elastic properties, American Beech was used to make most of the older all-wood clothespins.



American Beech

Vigor - The plants should have well developed branches and adequate buds. Gently bend tree seedlings to check for pliability; if the seedling snaps, then it is too dry and should not be planted. Bark should be pliable and green when scratched, without shriveling or discoloring. Leaves should not be discolored or dessicated, or show spotting indicative of potential disease or nutrient stress.

Roots - B&B plants should have the specified root ball size. The root ball should be securely wrapped without any signs of looseness, or the roots are likely to be damaged and/or desiccated. The ball should be moist. Container plants should be upright and firmly rooted. Inspect for circling, kinked, or "J" roots that may girdle the tree. Rootbound plants often have roots protruding above the surface or through the drain holes, a leggy appearance, and/or they are unusually large for the container. Bare root material should be wrapped in burlap and packing. The roots should be damp, fresh, and flexible.

Wounds and Diseases - The trunk should be free of abrasions, cuts, scars, knots, and/or sunscald injury. There should be no insect egg masses or fungi on the branches or trunk.

Be sure to store delivered plants in a cool spot, out of direct sunlight, and water them adequately.

Planting Layout: Marking the Site

Prior to planting, the site may be marked so the volunteers can put the right plant in the right place. A specific marker is used to delineate each plant at each location. This approach may be helpful for inexperienced volunteers.

Where precise detail is not essential, zones can be marked for a particular mix of plant species. Volunteers can then be instructed as to which species they can randomly plant within a zone and what spacing to maintain. Crew leaders must provide necessary guidance along the way.

Tools for marking the site:

- colored flags
- spray paint
- 300 foot measuring tape
- wooden stakes & mallet
- auger to drill holes prior to planting

A variety of markers can be used. On mowed sites, lime can be rapidly applied to the ground and vegetation, but this method has minimal ability to convey species selection. Various colors of spray paint can be used to differentiate species, as well as color-coded flagged wires. Survey flagging can be used in a similar manner if enough vegetation is present onto which the flagging can be tied.

To mark the site, it is not necessary to conform rigidly to geometry set forth in the planting plan. If mowing is essential to control weeds, trees should be spaced evenly in rows across the planting area to prevent tree loss from lawnmower damage. Trees can be planted randomly or in clusters in mowed areas, but trees may be lost due to lawnmower damage. In random, mow-free plantings, trees are placed irregularly throughout the planting area, which is

converted to a "natural forest" by not mowing. Weeds should be periodically removed around individual seedlings until trees become established (generally three years after planting).

Plants should not be placed where roots, stumps, hummocks, depressions, and gullies will interfere or create less than optimal conditions. Plants should not be placed next to existing trees or shrubs. Knowing the average plant spacing, relative plant location is easily paced off, starting from the streambank and proceeding upslope. Landmarks from the mapping are used to ensure that spacing errors are not compounded as the planter proceeds along the stream.

In smaller sites where the buffer is not too wide, an experienced professional should be able to mark the plantings without even drawing up a detailed planting plan. Each plant or mix of species is placed as he/she proceeds through the streamside area, based upon judgment of site conditions and a knowledge of plant availability. The plantings are then counted, and the plant list is drawn up according to the actual layout. This is a more accurate method as to total number, and the total effort involved is reduced. A conceptual plan is still necessary to assist volunteers in staging.

For large sites or sites that have hard or heavy clay soil, you may want to predrill the planting holes prior to planting day. You can rent soil augers or ask for an in-kind contribution from a landscaping company to do the job. Predrilled holes speed planting tremendously and help the volunteers focus their energies on planting the trees and shrubs correctly. See *Planting Methods* on page 29 for more information.

Planting Tip

When planting seedlings, it's helpful to mark the plants with colored ribbons or flagging to make them easier to locate during maintenance tasks. Young plants can easily become "lost" in areas where weeds and other pioneer species are left to grow. You can also color-code the ribbons to mark plants that have died within the first year for replacement at a later date.

Planting Practices

Planting Seasons

Trees and shrubs can be planted during the spring or fall, with the preference in early spring between mid-March and May 1st. Deciduous species are best planted in the early spring before bud break in April. This ensures the longest season for root growth and gives the plant a chance to establish feeder roots prior to the moisture demands of the growing season. While less than optimal, planting can extend into late May in the moist conditions found in streamside areas. Evergreens can be planted with good results before the new growth is fully extended in May. Planting later in the growing season will subject plants to moisture stress, unless proper care is taken to ensure adequate moisture in the root zone.

In the fall, evergreens can be planted after the heat of summer has passed. Most deciduous trees and shrubs can be planted later in the fall after leaf drop, since their roots will continue to grow until the soil temperature falls below 45 degrees. However, the ground must have adequate moisture, or a severe winter will kill the trees. Many oaks are listed as fall hazard plants,

so they should be planted only in the spring.

Winter transplanting is possible if the soil around the tree to be transplanted is not frozen, and if the planting area is mulched enough to prevent freezing throughout the winter. Bare root material and seedlings should be planted in the winter to early spring while they are still dormant. Planting bare root material after leaf emergence is not recommended even if adequate shade and moisture are present.

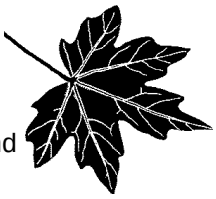
Storage Before and During Planting

After delivery, plant material should be stored on site in a moist, shaded location prior to and during planting. The root balls of B&B stock and the packing of bare root stock should be thoroughly watered and kept moist with a covering of peat moss, straw, or sawdust. Bare root stock can be stored for several weeks if "heeled in" by laying the plants in a trench of loose soil or mulch. The tops should face toward the south at an angle of 30 to 45 degrees.

Seedlings should be moist and cool upon receipt. Seedlings can be stored by stacking them in a circle with the roots facing inward in layers separated by packing material and kept moist at all times. Alternatively, they can be heeled in (Figure 10) or refrigerated if facilities are available. Container material is least susceptible to moisture stress and will store well if properly watered.

If you transport seedlings in an open truck or trailer, cover the seedlings with a tarp to prevent excessive drying from high winds. So that air can circulate, do not lay the tarp directly on the seedlings.

Planting Tip



Keep seedling roots moist and do not allow them to be exposed for extended periods of time. When planting, you can either dip the roots into water and cover them with a bag, or you can stand the seedlings in a bucket of water filled to the root collar. Volunteers can carry the bags or buckets to each hole to be planted.

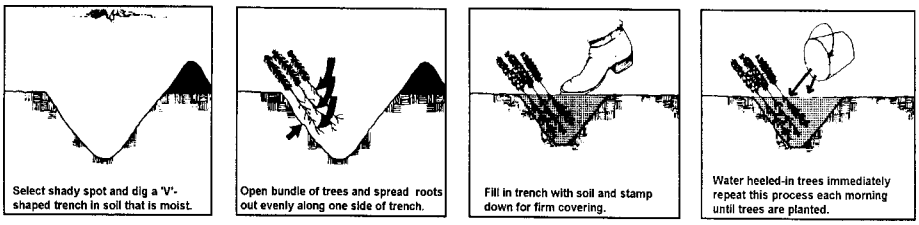


Figure 10. Heeling in Seedlings to Protect Roots
(Source: Tree Planting Notes, Minnesota Department of Natural Resources, Division of Forestry)

Planting Methods

B&B Trees

B&B stock should never be picked up by the trunk or dropped, as this will damage the root ball. To move B&B stock during planting, the root ball should be firmly cradled. The planting hole should be twice the width of the root ball, but no deeper. Soil amendments, such as the addition of organic matter, are not recommended since few roots will grow beyond the amended soils. All sod should be discarded. The root collar (the base of the plant stem) should be placed at the same level as the original soil; if the hole is overdug and backfill is necessary, the tree should be placed an inch or two higher to allow for settlement. After placement of the tree, completely remove any wire baskets and twine. Remove as much burlap as possible without damaging the root ball by cutting it down to where the root ball rests on the native soil. Work the backfill around the root ball, firmly compacting in place to avoid any air pockets. Fill up to original grade with the balance of the soil, compact, and water. Fill in any spots that settle, and place excess soil in a ring around the tree to retain water. A mulch of wood chips and/or geotextile fabric should be placed in a three-to-four-foot-diameter circle around the tree to inhibit grass and herbaceous competition. Avoid placing organic mulch directly against the trunk, as this will harbor insects and rodents that may damage the tree. (For more information on mulching, see page 35).

Container Stock

For container material, the planting hole should be twice as wide and as deep as the soil in the container. Carefully cut the container away from the plant to expose the roots. After exposing the roots, look for circling roots. The small ones can be teased apart and spread out in the planting hole. Plants with large and extensive circling roots should be rejected. Backfill, water, and mulch as in B&B plants (see page 33 for more on maintenance).

Bare Root Seedlings and Year Transplants

Trees can be planted by hand or by machine. A correctly planted tree should have the following general characteristics:

1) Planted at about the same depth, or not to exceed one-half inch deeper than it was in the nursery. Use the root collar for depth judgment.
2) Have the main roots nearly straight and spread out, not doubled, or sharply bent.
3) Have the soil firm around the roots. Leave no air pockets.
4) Have the tree in an upright position, and have it nearly even with the general ground level, not sunk in a hole or raised on a mound.

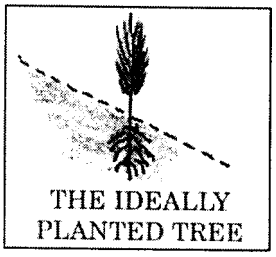
TREE TIP

Avoid these errors in planting:

Too deep.
Needles buried.

Too shallow.
Roots exposed.

"L," "J" or "U" roots. Hole too narrow and/or shallow.



THE IDEALLY PLANTED TREE

There are two methods of hand planting - slit method (using planting bar or dibble) and side-hole method (using mattock). Hand planting tools such as planting bars, dibble bars, mattocks, and hoe-dads are used for rapid planting of bare root stock and seedlings.

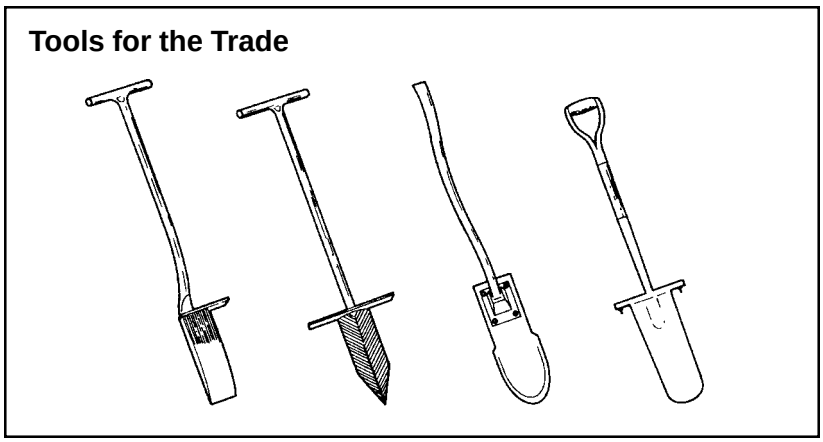


Figure 11: Tree-planting tools (left to right): planting bar, a pointed planting bar for stony soils, the Rindi grub-hoe (L-shaped) for making straight-sided holes, and a tile spade planting shovel for digging deep holes for large planting stock. (Source: The Practice of Silviculture, Smith, 1986).

The slit method consists of making a slit with a planting bar or dibble bar for smaller seedlings. It is much more rapid than the side-hole method. After placement, the bar is reinserted several inches away, rocked away from the seedling to kick in the soil at the bottom of the roots, and then rocked toward the plant to compress the soil around the base of the plant. Where water is not available to settle the soil, it is important to firmly compress the soil around the plants.

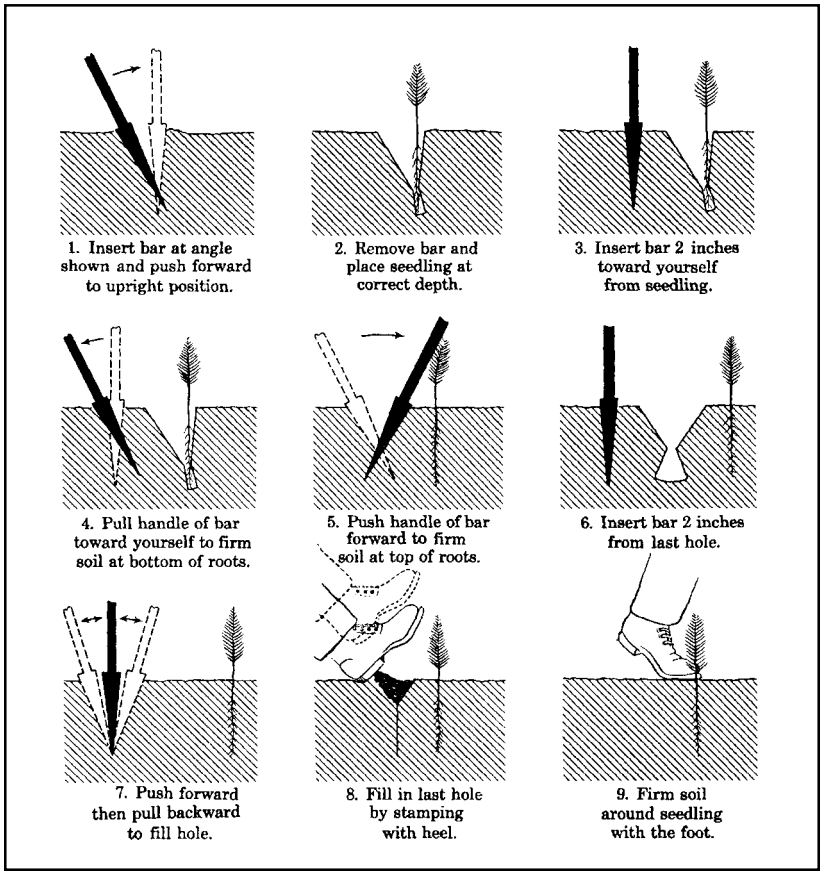


Figure 12: Slit Method of Planting (Source: US Forest Service)

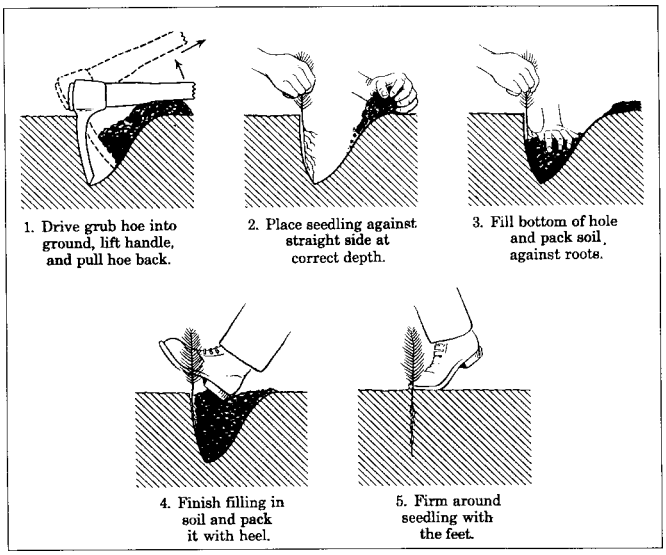


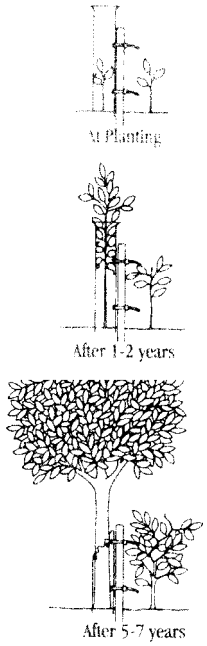
Figure 13: Side-hole method of planting
(Source: US Forest Service and The Practice of Silviculture, Smith, 1986)

The side-hole method consists of digging a hole deep enough with a mattock or grub hoe to hold the roots of the tree. Mattocks and hoe-dads are suitable for larger seedlings and most bare root stock.

Tree Shelters

In areas where deer browsing is a substantial problem or where you want rapid growth, tree shelters , plastic tubes that fit over the trees, have been used with considerable success. With shelters 4-feet high, seedlings are protected until the root system is well established. Five-foot shelters should be used where browsing is very heavy. Shelters also prevent rabbits and rodents from girdling the base of the tender trunks. Where deer browsing is light, shorter tree shelters (2 or 3 foot lengths) will provide protection at a lower cost. Over-planting other vigorous species is another method to sustain deer browsing without excessive pressure on the desired species.

Tree shelters enhance growth in early stage development.



Source: 1997 Native Plants for the Environment, Octoraro Wholesale Nursery Catalog

Other benefits of tree shelters are:

1) Provide a favorable microclimate for seedlings. When shelters are properly installed, moisture transpired from the leaves condenses inside the tube, resulting in more humidity and moister root zone.
2) Increased carbon dioxide levels, resulting in favorable growth. Tree shelters generally increase initial growth rates by a factor of two to four times that of unsheltered seedlings.
3) Protect against wind and drought, shelters increase seedling survivability in adverse circumstances. Red oak is particularly responsive to the benefits of tree shelters.
4) Management of competing vegetation after planting is much easier; mowing and weedwacker strikes are prevented, and herbicides are isolated from trunk contact.

There is some concern that shelters reduce rooting and trunk strength due to wind isolation during initial growth. However, once the sapling has emerged so the crown spreads, there is enough trunk movement to build stem and root strength. The tree then allocates resources toward stem growth. For this reason, tree shelters should be left on for two to three years after emergence. After this time, the tree shelter must be physically removed.

White tree shelters allow more light through them and are preferred in sites where shady conditions will occur over the four to five-year span that they are used. Brown shelters are less obtrusive in more open sites. Tree resistant stakes shelters should be staked with rot-resistant stakes such as white oak. The base of a tree shelter must be driven at least an inch into the soil to avoid a chimney effect, which increases moisture loss and to prevent rodents from girdling the tree. The shelters are then tied to a stake, located on the upwind side and protective mesh placed over the top to prevent entry of birds. Netting should be removed once the tree grows out of the top of the shelter. There are several types of shelters available.

The cost of installing tree shelters varies according to the product type and size used. As an example, a 1998 tree planting project in Pennsylvania paid $556 for 150 four-foot tree shelters (including stakes and delivery), which works out to $3.71 per plant.

Because of the cost involved, shelters would not be recommended for every seedling. They are most appropriate for the more expensive seedlings of species difficult to establish, such as red oak. However, reductions in maintenance costs and increased seedling vigor associated with tree shelters suggest that shelter plantings may be a more cost-effective approach than planting unprotected larger material.

Is it necessary to fertilize?

Generally, adding fertilizer at the time of planting is not necessary, especially if your plant species match your site's soil conditions. A soil test will, however, help you determine the need for any soil amendments.

When taking a soil test, it's important to dig deep to cover the depth of your average seedling root length (20 to 30 inches). Your local Cooperative Extension Service agent can give you the proper guidance in testing your site before planting begins.

If the soil has been seriously disturbed, such as on abandoned mine sites, then fertilizer and other soil amendments may be needed to recondition the soil for planting.

BUFFER MAINTENANCE AND MONITORING

The critical question should be asked-- can the site be maintained by the current caretaker? Does the caretaker understand what it will take to maintain the site? Has a maintenance plan been written for the specific site, gone over with the caretaker and agreed upon by all principal parties involved in the planning and planting process?

The most critical period during streamside forest buffer establishment is maintenance of the newly planted trees during canopy closure. Ongoing maintenance practices are necessary to ensure establishment of a thriving buffer, particularly where smaller seedling plant material has been used. Even where large plants are involved, deer browsing, invasion by exotic species, and competition by herbaceous forbs and grasses will be a continuing problem. Therefore, maintenance practices are necessary to ensure the long-term effectiveness of the buffer.

Maintenance & Monitoring Tools:

- watering
- fertilizing
- fence maintenance (usually on agricultural sites)
- habitat structures (brush piles, tree swags, bird boxes)
- signage
- periodic photos of buffer

In many cases, existing grasses and forbs are mowed once or twice per year to control their height. This method maintains a vigorous herbaceous layer, even though the species mixture may shift away from cold season grasses to other perennial forbs. Mowing also requires that the plants be spaced in a grid pattern, resulting in an artificial aspect to the buffer. The requirement for mowing also inhibits the establishment of understory species and shrubs until canopy closure. Mower strikes on the trunks are often unavoidable if no protective measures such as mulches or tree shelters are used.

During the first year, control annual weeds in zone 3 by mowing to 6 inches. Do not let weeds get higher than 12-14 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.

Non-chemical weed control techniques are preferred because chemicals can quickly enter the water system in streamside forest areas. If herbicides are needed, use wisely and sparingly. Weed control should be continued until woody plants occupy the area, normally within two to three years.

An alternative to mowing is the use of biodegradable mulches to control weed and forb growth (see page 35). Because annuals and perennials easily root within such organic mulches as they decompose, an option is to lay heavy cardboard beneath the mulch for added protection against herbaceous competition. The cardboard will eventually decompose.

Tree mats also reduce the rooting ability under organic mulches. A tree mats is a geotextile fabric (roughly 3' x 3') with a slit in the middle to allow it to be placed over the seedling, and four large staples to secure the corners. Mats are used in areas of light deer browsing and a turf grass setting or an area that is heavily maintained to ensure that vines and grasses do not over grow the seedlings. The down-side is that tree mats are highly labor intensive to install and must be removed once the trees have developed a canopy that will naturally shade out competitive weed growth.

Long-term Management and Monitoring

Buffer strips must be monitored and managed to maintain their maximum water quality and wildlife habitat improvement. They should be inspected at least once a year, and always within a few days of severe storms (if possible) 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 cases, may be control grazed. The use of fast growing tree species ensures rapid growth and 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 streamside forest area between April 15th and August 15th. During this time period disturbance can be detrimental to a variety of wildlife.

Depending on the objectives of the buffer project, baseline monitoring of the stream's physical, chemical and biological characteristics may be warranted to evaluate the success of the buffer over the long run. For more information on water quality monitoring, contact the Pennsylvania Department of Environmental Protection's webite Citizen.Monitoring@a1.dep.state.pa.us .

Watering

Watering at many reforestation sites is difficult. Typically, water is not readily available from a public water supply or it may be difficult to haul from the stream's banks. Frequently, plants rely on rain events for watering. For this to be successful, plantings must be timed to coincide with seasonal rains. Rainfall must be monitored well in advance of the planting date to ensure that the surface soil has received adequate moisture and that there is time for additional rainfall in the post-planting period. Although this method seems somewhat precarious, the success rates are higher than might be expected. This is one reason why the timing of plantings discussed earlier is so critical. Success is contingent on having plant root-balls (container grown or B & B plants) or root mats (for seedlings) sufficiently moist at the time of planting. Coordinate with the plant supplier to ensure that plants will be watered a day or so before delivery. As an added assurance, on-site during the planting, store the plants in a 5 gallon bucket with water.

Occasionally, local sources may be helpful in providing initial or post installation watering. Deep water regularly throughout the first growing season.

Mulching

Mulch the soil surface around the plants with two or three inches of a course slow-decomposing media, such as shredded bark, compost, leaf mulch, or wood chips. Organic mulches retain moisture, retard evaporation, moderate soil temperatures, control weeds, and improve appearance. Uncomposted mulches, such as grass clippings and sawdust, decompose rapidly and require more frequent applications resulting in reduced benefits. They are not recommended. Do not place mulches directly against the tree trunk as this creates a moist area that can provide a favorable environment for boring insects or fungus growth.

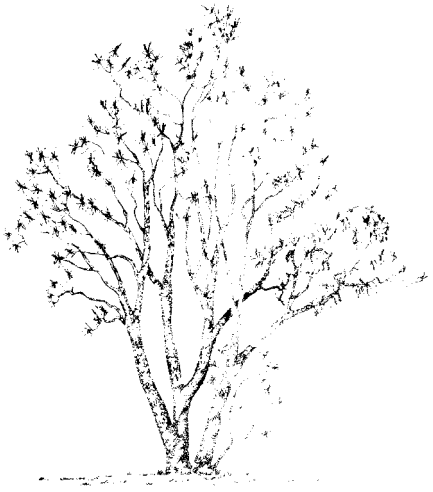
Mulch is considered by many to be a cosmetic top dressing. However, the proper type of mulch can have many benefits. Research results suggest that height growth and trunk diameter increase significantly if the ground near the tree base is kept free of grass. Besides the clear advantage of preventing turf competition to young trees, expect fewer tree injuries caused by mowing equipment.

In general, shredded hardwood mulch has good moisture retention and weed control benefits and is relatively unaffected by wind and rain. Shredded mulch is marketed in coarse, medium, and fine grinds. The more course the grind, the greater the moisture retention and weed control benefits. Coarse ground mulch is also less susceptible to dispersement by wind and rain. Whichever mulch type is selected for use, make sure that it has been properly composted before use to minimize the ensuing leachate. Uncomposted yard waste, such as grass clippings, twigs, branches, and leaves can be harmful to plants when used as mulch, because they compete with the plant for soil nitrogen to continue decomposition. Improperly composted wood chips can be harmful to plants because the decomposing microorganisms haven't been neutralized. When the chips are stored in large piles, sufficient amounts of alcohol and/or acetic acid can accumulate and kill plants when the chips are later used as mulch. Another concern of using this freshly chipped waste is that the composition is unknown. If the material being chipped was dead, diseased, or insect infested, and not properly sterilized, these problems can be spread by using this material as mulch.

Not surprisingly, the mulches used most frequently on reforestation sites are a combination of wood chips/leaves/twigs because it is readily available and may at most require a nominal delivery fee. If possible, try to stockpile this type of mulch for six months to a year before use or reserve monies in the budget for obtaining composted mulch.

Did You Know...

Rosebay Rhododendron and mountain laurel were used for the bowls of briar pipes made out of the burls (hard tumor-like growths in the wood).



Rosebay Rhododendron

USING VOLUNTEERS AND SECURING TOOLS

After the initial planning stages, the reforestation plan is ready to be implemented. Several key issues need to be addressed to ensure an effective implementation of the planting plan. They include: volunteer support, tools, watering, mulching, and long-term maintenance of planted areas.

A Few Notes on Volunteers

The involvement of volunteers in riparian reforestation projects is highly recommended. Volunteers offer a ready source of labor, bring enthusiasm to the effort, and provide excellent publicity opportunities. They, in turn, learn the importance of riparian forest buffers and become potential advocates for the cause and better stewards of their watersheds.

Some good sources of volunteers include:

Watershed Associations	Schools
Boy/Girl Scouts	Service Organizations
Service Corps	(Kiwanis, Rotary...)
Sporting Groups	Youth Conservation Corps
Senior Citizens	Colleges/Universities
Environmental Groups	Neighborhood Associations

Partnering with area businesses is equally valuable. When they donate dollars and/or in-kind goods, equipment and services to your project, it's a win-win situation for all involved. Don't underestimate the latent interest these businesses may have in your project and remember: it never hurts to ask!

Regarding liability, it's recommended that you have each volunteer sign a waiver form that releases your organization of any liability claim related to a volunteer's participation in a tree planting activity. Create a brief job description for the volunteers, read it to them on planting day, and have them sign the waiver of liability form before the planting begins. Appendix 3 provides a sample waiver statement and job description.

Volunteers plant seedlings along a stream on a farm in Lancaster County.

10 tips for engaging volunteers and business partners:

1. Create a list of potential partners and volunteers.
2. Send them a cover letter with the details of the project (where, when, directions, what to bring, etc...). Include a description of the project (what and why).
3. Contact businesses with a wish list of your needs ($, materials, equipment, food, etc...).
4. Involve volunteers in all phases of the project - site preparation, planting, maintenance, and monitoring.
5. Contact the media and invite them to your event.
6. Confirm the participation of volunteers with a letter or phone call. Send a packet of information on time and place to meet, items to bring and liability waiver form.
7. Allow time for training (on the workday or before). Provide a brief orientation on the workday, divide volunteers into appropriate teams or groups and then get your hands dirty. One group leader per 15 volunteers is a good ratio.
8. Take good care of your volunteers - provide food, beverages, water, and restrooms. Keep the work day to a reasonable length and monitor their energy level.
9. Recognize your volunteers - praise them on the job, send thank you letters, give souvenirs,etc... Make sure they know that their participation is valued.
10. Keep a list of past volunteers. It's likely that they will help again.

Securing Tools

Listed below are some suggestions for locating and obtaining tools:

- Contact participating local government agencies for help. They may be willing to lend equipment for a one-day weekend event if the tools are retrieved and returned in a timely manner.
- If funds are available, some essential tools could be purchased and used for subsequent projects provided that adequate transportation and storage are available. Check with local businesses who may donate and/ or contribute monies or equipment,
- Sponsor an event with an established restoration group that has access to the necessary equipment. Long-term restoration goals are often more successful when they include other community organizations and groups with similar goals.
- Request volunteers to bring their own tools for the event.

Whatever option or combination of options is chosen, tag or mark tools with the owner's name or identification number to ensure their return. Table 2 below lists some of the tools that will prove helpful contingent on the type and scope of the project.

Signage informs the public about the benefits of streamside restoration projects and credits landowners and cooperating agencies and organizations.

Table 2. Types of Tools Needed for Reforestation Projects

Tool/Materials	Use
Scissors/pruners	Cutting containers off of trees; cutting string & burlap
Shovels	General planting activities
Dibble Bars (planting bars)	Tool for planting seedlings easily
Pickax(es) or Mattock(s)	Cutting through sod or backfill material
5 Gallon Buckets	For carrying water and mulch (if needed). Also to contain the bare root seedlings in water.
Wheelbarrow(s)	For carrying large quantities of mulch and planting stock
Mallet & Stakes	For marking site boundaries and tree shelter installation.
Weed Mats/Sod Staples	Self explanatory
Tree Shelters	" "
Mulch	" "
Planting Stock	B&B, Containerized, Bare Root, etc.
Flagging,Lime,Paint	To ease locating plants for maintenance activities and to mark site boundaries
Signage	For public notification of the site location.

WORKING WITH THE MEDIA… GETTING THE WORD OUT

In order to convey the importance of your work to the general public, it's necessary to work with the media — newspapers, television, and radio — to get the word out about your local tree planting project.

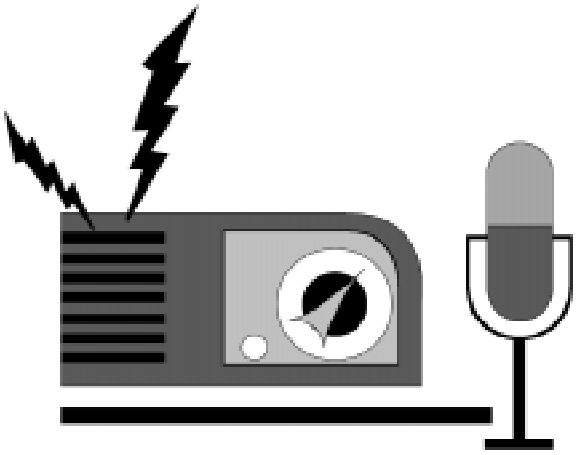
A good pro-active tool to use is the news release, but use them only when there is something truly newsworthy to announce. The opposite page provides a sample news release for projects that meet the criteria of Pennsylvania 's Stream ReLeaf program.

The following are guidelines to follow in writing a news release:

- Make sure the announcement is newsworthy and of wide interest.
- Decide what media should receive it.
- Limit the length to one or two pages.
- Write in an "inverted pyramid" style. The most important information goes in the first paragraph, followed by progressively less important material.
- Use only one topic of information per paragraph.
- Use the past tense.
- Remember to address the "5 W's" and "H." Who, what, when, where, why and how.
- Every news release should have a title, date and location of announcement.
- Use some direct quotes, after seeking permission from the speaker.
- List a contact and phone number for further information.
- If the news release is going to a TV or radio station, consider an audio or video clip to accompany the release.

When talking to a reporter, follow these general guidelines:

- Be polite, and never lose your temper.
- Use a helpful, informative demeanor.
- Know what you're talking about; be sure the information you give is accurate.
- Be honest about not knowing the answer to a particular question; offer to find out.
- Always tell the truth. If you are not allowed to give information, state why.
- Stick to your area of expertise and responsibility.
- Answer questions, but always return to your main theme.
- Ask the reporter to repeat a question if you are unclear about it.
- Put the event or issue into proper context. If you accomplished a "first" in the watershed, say so.
- Stick to the facts, and keep your opinions to yourself.



- Anticipate the reporter's needs, and bring along fact sheets.
- Repeat messages. Each time a message is repeated, the chances of it being in the final story increase.
- Respect the reporter's time and deadlines.
- Call back when you promised.
- Keep track of what was said during the interview.

SAMPLE NEWS RELEASE

N E W S R E L E A S E

Name of Organization/Group
Address

FOR IMMEDIATE RELEASE

CONTACT:
(XXX) XXX-XXXX

XXXXXXX WATERSHED GROUP TO PLANT TREES ALONG XXXX WATERWAY AS PART OF PENNSYLVANIA STREAM RELEAF

CITY/TOWN (DATE) – (Name of Organization/Group) will be planting (# of trees) along (Name of waterway) in (Municipality), (County) on (Date).

The tree planting is part of Pennsylvania Stream Releaf, a cooperative initiative to replant Pennsylvania's streamsides with forest buffers. Buffer plantings next to streams filter out sediments and nutrients that run off the land and help to keep the water shaded and cool.

(One or two paragraphs here with information about how many volunteers will be participating, what trees are being planted, that it's part of a larger watershed restoration initiative, etc. May include quote from someone in organization.)

"We are hoping that streamside buffer planting is the next wave of environmental volunteerism," state Department of Environmental Protection Secretary (DEP) James M. Seif said. "Trees along waterways are important in urban, suburban and rural areas. Someone from any walk of life, the old and the young — anyone can plant a tree."

Stream Releaf is being implemented statewide. A planning committee was established after Gov. Tom Ridge, as a member of the Chesapeake Bay Executive Council, agreed in 1996 to establish a goal of 2,010 miles of forest buffers along shorelines in the Chesapeake Bay watershed. Pennsylvania's goal is 600 miles.

"Pennsylvania Stream Releaf — A Plan for Restoring and Conserving Buffers Along Pennsylvania Streams" is a report on how to undertake the buffer restoration and conservation effort, as well as to educate citizens about the benefits of buffers along waterways, and to collect and report data on the plantings.

The Stream Releaf report and additional information about forest buffers is available on DEP's website at http://www.dep.state.pa.us (choose Information by Subject/Stream Releaf).

Pennsylvania Stream Releaf is working in cooperation with American Forests Global Releaf 2000.

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(Note: This news release is a template that can be altered however you see fit. It's a good idea to send this out to your local newspaper/radio station/TV station about a week in advance. This release is available in an electronic format on DEP's website at www.dep.state.pa.us – choose Information by Subject/Stream Releaf/News Releases/Community Planting Template).