Where the Land and Water Meet

A Guide for Protection and Restoration of Riparian Areas

FIRST EDITION

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USDA Natural Resources Conservation Service

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FOREWORD

People need available clean water to live. This is one of many environmental reasons why protection of surface water resources, such as streams and lakes, is important.

The areas adjacent to surface water, also known as riparian areas, play a significant role in water quality, water quantity, and ecosystem health. As a result, riparian areas have been the focus of much research, regulation, and conservation work.

The USDA Natural Resources Conservation Service (NRCS) in Connecticut recognizes the importance of riparian areas and considers them a valuable natural resource. NRCS has produced this *do- it-yourself* handbook on how to protect and restore riparian areas in an effort to meet the high demand for information and technical assistance on riparian areas.

For additional copies, contact

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1.1 How to Use this Handbook

The purpose of this handbook is to provide land managers with the tools to identify riparian areas, identify opportunities for preservation or restoration of riparian areas, plan and design riparian buffers, install riparian buffers, and manage riparian buffers.

This handbook is not a stream corridor restoration handbook, as it does not include information on stream restoration techniques such as streambank stabilization, nor does it address watershed management issues.

The information presented in this handbook is not intended for regulatory purposes. For guidelines on regulatory setback distances from watercourses and wetlands, see the Connecticut Department of Environmental Protection's (DEP) *Guidelines for Upland Review Area Regulations Under Connecticut's Inland Wetlands and Watercourses Act*. A copy of this publication may be obtained from DEP offices. (*See Appendix 1*.)

1.2 What are Riparian Areas?

Connecticut has over 8,400 miles of streams and over 13,000 lakes and ponds. These natural resources provide drinking water and recreational opportunities for the more than 3.2 million Connecticut residents. Clean water is also critical for fish and wildlife needs.

Riparian area is a term used to describe the land adjacent to water, where the interaction between water and land is important for the creatures and plants that live in these habitats. Typical examples of these areas are floodplains, streambanks, and lakeshores.

The vegetation in riparian areas performs many functions important to watercourses and water bodies. Riparian vegetation provides shoreline and streambank protection, water quality protection, fish and wildlife habitat, flood control, and scenic beauty. Human land uses within riparian zones often cause a reduction or loss of riparian vegetation, which frequently also results in the degradation of the adjacent water resource.

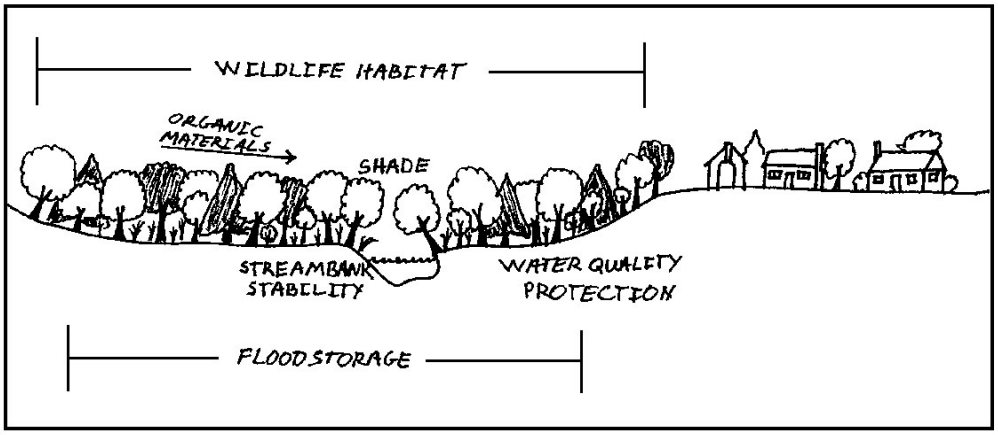


Figure 1.2-a Common Functions of Riparian Areas

A riparian buffer is a section of a riparian area, which is kept undisturbed or vegetated in order to protect the adjacent water resource. A riparian buffer also maintains valued ecological attributes of the riparian area. The Natural Resources Conservation Service is promoting the use of riparian buffers to improve and protect water quality and wildlife habitat. DEP also encourages the protection of riparian resources and the use of riparian buffers (*Appendix 3*).

Riparian buffers provide a green edge along our blue water. The natural functions most commonly associated with riparian zones and riparian buffers are:

Moderation of Stream Temperatures - During the summer, streamside vegetation shades the stream. During winter, streamside vegetation insulates the stream to reduce formation of thick ice sheets.

Streambank Stabilization - The roots and stems of streamside or shoreline vegetation help stabilize banks by binding and shielding soil and by reducing the velocity of flowing water.

Source of Organic Matter to Streams – Leaves, fruits, and woody debris that fall into streams are a major source of food and shelter for aquatic organisms.

Wildlife Habitat – Riparian vegetation provides food and cover for both aquatic and terrestrial animals, and may provide travel corridors for wildlife.

Filtering of Pollutants – Riparian vegetation filters nutrients, sediments, and other pollutants that may otherwise reach water resources through surface and shallow subsurface flows.

Flood Control – Riparian areas are often subject to flooding, so they help store water during floods. Riparian areas also store water in the ground. This groundwater slowly flows into the stream during times of limited precipitation.

How Can I Help Restore and Protect Riparian Buffers?

(Adapted from the *Forest Buffer Toolkit*, published by the Alliance for Chesapeake Bay and Pennsylvania DEP, 1998)

If you are a land manger:
- *Plant native noninvasive species of trees and shrubs.*
- *Stop mowing to the stream's edge.*
- *Join your local watershed organization.*

If you are a farmer:
- *Build fences to keep livestock from streams.*
- *Enroll riparian areas in conservation programs.*
- *Partner with local watershed and recreational organizations.*
- *Consider alternatives to commodity crops that would provide economic returns while preserving buffers.*

If you are a developer:
- *Avoid removing streamside trees and shrubs.*
- *Preserve existing riparian areas.*

If you run a business or industry:
- *Plant native species of plants and shrubs.*
- *Sponsor a school or community organization that wants to plant trees.*
- *Consider alternatives to current business practices that negatively impact streams and riparian areas.*
- *Use environmentally friendly products.*

1.3 The Importance of Riparian Areas

Riparian areas are an important ecological component of the landscape. They are also transition zones between upland communities and aquatic communities. Transition zones, also known as ecotones, often have higher species richness because they represent both communities. The linear nature of riparian areas along streams provides travel routes for wildlife. Aquatic biodiversity is often dependent on the quality of the riparian area.

Riparian areas are often considered valuable recreational resources. These areas are often used for hiking trails and for access to water for activities such as canoeing and fishing.

Riparian areas are the connection between the uplands and the water resource. Surface runoff, sub-surface flows, and shallow groundwater flows must pass through riparian zones before reaching open water. Therefore, riparian areas can influence the quantity and quality of water in streams and lakes.

In Connecticut, nonpoint source pollution is a problem that threatens the quality of water resources such as wetlands, watercourses, lakes, and Long Island Sound. Nonpoint source pollution occurs when water becomes contaminated as it falls through contaminated air as rain, or as it flows over the land surface. Water flowing over agricultural fields, parking lots, industrial sites, roads, and lawns picks up nutrients, sediments, and other pollutants that often reach streams and other surface waters. Protecting and restoring riparian areas can help reduce the impacts from nonpoint source pollution on our water resources.

Other practices that can help reduce nonpoint source pollution are:

- Reducing the use of fertilizers and pesticides
- Properly disposing of hazardous wastes such as auto fluids and household chemicals (contact your municipality for more information)
- Recycling
- Disposing of pet waste by burying or flushing down the toilet
- Adopting environmentally friendly development practices such as reducing impervious (paved) surfaces and installing storm water treatment practices
- Preserving natural areas

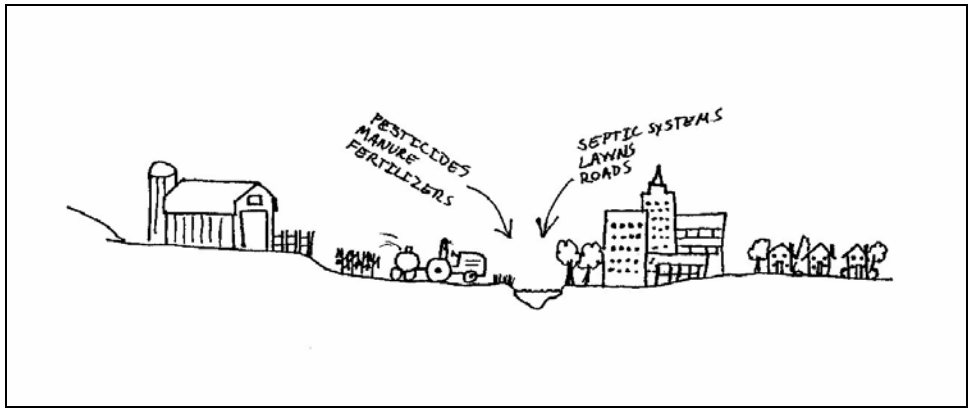


Figure 1.3-a Examples of Nonpoint Sources of Pollution

In addition to contributing to nonpoint source pollution, land use changes associated with urban and suburban development typically increase the amount of impervious or compacted surfaces such as roofs, roads, sidewalks, and parking lots. Therefore, rainwater cannot infiltrate into the ground through these impervious surfaces and becomes runoff; consequently, more water reaches the surface water resources faster than under natural conditions. The greater volumes of runoff associated with urban and suburban land uses can also increase erosion and flooding hazards along streams.

Chapter 2 -- Identifying Problems and Opportunities in Riparian Areas

Riparian buffer protection projects often begin after problems in the stream are discovered. Many streams in Connecticut have problems such as loss of fish and wildlife habitat, barriers to fish passage, water pollution, low water flows, erosion and sediment deposition, livestock grazing and hoof traffic, loss of streamside vegetation, and litter. Sometimes important riparian resources are identified before a land use change occurs. This section provides some useful tools to identify opportunities to preserve or restore riparian buffers.

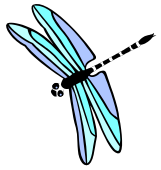
How Can I Help Restore and Protect Riparian Buffers? (Adapted from the *Forest Buffer Toolkit*, published by the Alliance for Chesapeake Bay and Pennsylvania DEP, 1998)

If you belong to a conservation or volunteer organization:

- *Plant native noninvasive species of trees and shrubs along streams.*
- *Partner with agricultural landowners and municipalities to promote buffers.*
- *Organize volunteers and work parties to help evaluate and maintain buffers.*

If you are a municipal official:

- *Adopt zoning that protects and improves stream corridors.*
- *Partner with agricultural landowners and municipalities to promote consistent stream buffer ordinances.*
- *Create recreational greenways.*
- *Provide tax incentives for open space areas.*



2.1 Using Maps and Other Resources

A picture is worth a thousand words, and sometimes it can save a lot of time and work. USGS topographic maps and aerial photographs are great tools for locating and evaluating streams and riparian areas. The maps can also be used to identify wetlands, ponds, lakes, and reservoirs. A topographic map shows the elevation of the land. From the topographic map one can make determinations about a stream's topography, order, flow pattern, and adjacent land cover. Aerial photographs show a bird's eye view of the land. This is a great tool for determining land use and nearby resources. Appendix 1 contains a list of natural resource information centers, many of which keep maps and aerial photographs.

Non-forested land uses adjacent to water resources could indicate degraded riparian areas. On a topographic map, forested land uses are colored green. Water bordered by only a narrow strip of green, or by non-forested land uses could be a site with a degraded riparian area. Topographic maps or aerial photographs can also be used to identify potential stream bank erosion sites by locating deep meanders, sharp turns, and sediment bars or islands in streams.

Although maps and photographs are useful tools, the information obtained from this type of assessment should be considered preliminary and it should be followed by field observations.

2.2 Surveying the Stream

A simple walk along the stream is an excellent diagnostic technique. The Natural Resources Conservation Service in Connecticut has developed a streamwalk process that has been used to survey many streams in the State, including the Quinebaug River, the Norwalk River, the Quinnipiac River, and the Pomperaug River. The primary objective of a streamwalk is to collect information on existing physical conditions of the streams, which could be used to identify resource needs and to plan conservation measures. However, the information collected through the stream survey will not be a complete assessment of the problems in or along the stream; therefore, other sources of information should be researched.

Another purpose of the streamwalk survey is to bring people in direct contact with the river so they can better understand the river system and the relationships between their communities and the river. This can be an important tool for getting community support for a riparian buffer project.

The information collected during a streamwalk should provide a general description of the stream, and also identify sites where the water quality and the life in the stream are threatened by pollution and habitat loss. Appendix 5 contains streamwalk survey sheets and instructions. Additional information on streamwalks can be found at the NRCS web site http://www.ct.nrcs.usda.gov.

After identifying an area of concern, a more detailed evaluation of the riparian area can be made. NRCS has developed a set of riparian area inventory sheets for this purpose. Appendix 6 contains copies of these sheets and other related information. These riparian area inventory sheets may be used in conjunction with, or in addition to, the Streamwalk worksheets in order to get a full description of the riparian area.

Chapter 3 -- Take a Look at the Natural Resources

During the evaluation and planning of a riparian area, it is important to consider the different components of such habitats.

3.1 Soils

In Connecticut, riparian soils occur along flood plains, in depressions, or in areas adjacent to springs and seeps. They generally are either saturated with water for some period of time during the year, or are subject to periodic overflow from ponding or flooding. Soil information is crucial in a riparian buffer project, as it is needed to identify wetlands and floodplains, and to determine the plants that are well suited for the site. The USDA soils survey for the area can be used to obtain the basic soil information needed for the planning of riparian buffers. Soil surveys are available for review at Soil and Water Conservation District or Natural Resources Conservation Service offices (see Appendix 1).

Soil types differ in their ability to protect water quality. Some types of soils can help to neutralize acid rain before it enters a water body. Some soils can soak-up large amounts of storm water runoff. Other soils can help to tie up or filter potential pollutants.

Soils are often described by their texture. Coarse soils include sandy and gravelly soils. Fine soils include silts and clays. Soils that have a good mixture of coarse and fine materials are called loams. Sandy and gravelly soils do not hold water for long periods of time. During the summer, when water flows are low, these well drained areas may become dry and droughty. Fine soils take and give up water slowly. Fine soils tend to remain wet for long periods of time and may pond. Other important site considerations for plants to be grown in buffer areas are flooding frequency and duration, soil acidity, presence or absence of root restricting layers (bedrock), aspect (direction the slope faces), and organic matter content. A soil survey will give you basic, background information about most of these characteristics. Soil and site conditions can be matched with the requirements of specific species of trees and shrubs.

How Can I Help Restore and Protect Riparian Buffers? (Adapted from the *Forest Buffer Toolkit*, published by the Alliance for Chesapeake Bay and Pennsylvania DEP, 1998)

If you are a student or a teacher:

- *Conduct research to help better define buffer values and maintenance techniques.*
- *Incorporate buffer protection activities into lesson plans*
- *Establish a buffer on school premises if you have a stream or pond.*

If you work for a state or regional agency:

- *Develop new buffer information and act as a clearinghouse for existing information.*
- *Develop guidelines for establishing and maintaining buffers, and provide technical assistance.*
- *Establish incentives for participation in buffer programs.*

To obtain accurate information on the soil's organic content, soil acidity, and nutrient composition, a soil test should be conducted at various sites within the area that is being planted. Soil test kits are available from your local Cooperative Extension System office. Field examination by an experienced soil specialist may also be needed to identify special soil characteristics such as the presence of a hardpan, shallow soil, or high water table. For some projects, free technical assistance may be available though the local NRCS office.

Appendix 2 contains a soil evaluation form titled Soil Quality and Site Assessment Card. This methodology was developed to help people assess a potential planting site without the aid of technical or laboratory equipment.

3.2 Water

Water is a precious resource essential for many basic needs. In addition to domestic uses such as drinking and bathing, water is used for recreation, food production, transportation, and some industrial uses. In Connecticut we get most of our water from surface water resources such as streams and lakes, or from groundwater, through wells and springs. Streams and ponds are also important fish and wildlife habitats, and the water quality of these resources has a direct impact on the creatures that live in them or depend on them for drinking water.

The water quality of the resource is an important consideration, as it will be a major factor in determining riparian buffer needs. The Water Quality Classification Map of Connecticut, published by the CTDEP Environmental and Geographic Information Center, can be used to determine the current and intended water quality classification and designated uses for the water resources in the State. Appendix 1 contains water quality information resources.

Surface waters are also home for many aquatic creatures. To properly evaluate a riparian area it is important to understand and consider the different ways in which riparian vegetation interacts with different types of water resources.

Not all streams are created equal. Generally, a section of a stream system in Connecticut falls into one of these categories: small headwater streams, mid sized stream, and large rivers. Headwater streams are shallow and narrow enough to be almost completely shaded by adjacent trees. Steep slopes and rocky bottoms characterize these streams. Headwater streams are usually found flowing down steep hillsides. In these narrow streams (2 to 10 feet in wide) there is not enough sunlight for photosynthetic aquatic plants to be the major food source for the creatures in the stream. Organic materials such as leaves and twigs that fall into these streams become the major food source for the creatures in these streams. Small aquatic creatures that feed on organic materials are abundant in these streams, while populations of fish and other larger predators are small. Many of these streams are seasonal and dry up during the summer. The quality of water in a watershed can be significantly affected by the condition of headwater streams, as in most watersheds over 90 percent of stream miles are small headwater streams.

Mid size streams are wide enough (10 to 75 feet wide) to allow enough sunlight to penetrate so photosynthetic plants and algae are plentiful. Grazing aquatic creatures, such as water snails and insects that feed on aquatic vegetation, are abundant in these streams. There are also aquatic creatures that feed on organic materials that fall in the stream from the adjacent vegetation. In mid size streams fish are common. In Connecticut, these tend to be the cold water trout streams. The riparian zones of midsize streams support fish and other aquatic life by maintaining adequate water temperature, flows, and structural habitat.

Large streams are so wide (often over 75 feet wide) that streamside vegetation only directly influences the banks. Large streams are also deep (usually sufficiently deep for motorized boating), so photosynthetic production is not a major food source. These streams receive most of their organic material from the rivers upstream and from land runoff. Aquatic creatures that collect or filter fine particulate organic materials and large predators dominate these streams. These are the warmer water rivers frequented by bass. Well-defined floodplains or adjacent wetlands often characterize these streams. Wide riparian areas in large streams allow for meandering and flooding, improve channel stability, maintain water quality, and provide wildlife corridors.

In ponds riparian vegetation is an important component of the shoreline. Vegetation protects the shoreline from erosion that results from fluctuating water levels, ice damage, and wake action. Large woody debris such as fallen branches and trees provide valuable habitat for fish and other wildlife.

A dramatic increase in streamside vegetation may have an effect on floodwater flows. This is particularly important in sections of streams that have been manipulated for flood control purposes and that were not designed to have woody plants. There may be nearby properties or structures that could be impacted by increased floodwater depths. Potential effects on flood flows should be a consideration if the project involves plantings in flood control projects areas or if it will result in higher plant density than the surrounding areas.

3.3 Air and Wind

Trees are known to enhance air quality by producing oxygen and using carbon dioxide. Even in developed riparian areas, planting of trees can extend beyond the streambanks into city parks, sidewalks, parking lots, and yards. The shade provided by the trees prevents the ground from heating up, keeping these areas cooler during the summer.

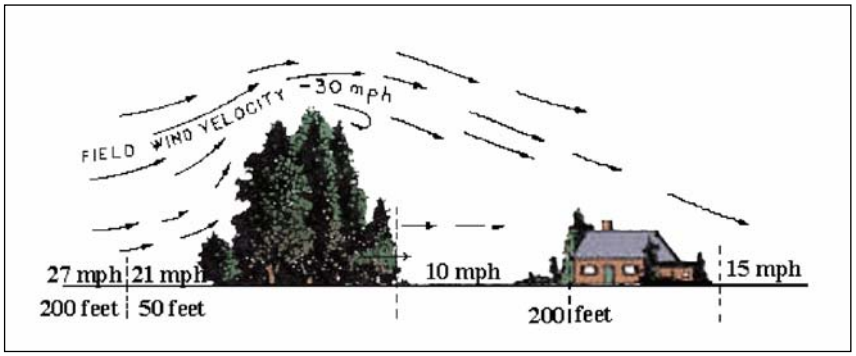


Figure 3.3-a Buffers as Wind Breaks

In open lands and lake shorelines, buffers can work as wind breaks. During cold weather, when high wind velocities result in very low temperatures, these windbreaks can help reduce wind-chill effect and reduce heating cost. Prevailing wind direction during winter months is an important consideration during the planning of windbreaks for energy conservation.

3.4 Plants

Analyzing the existing vegetation in the riparian area is an important planning step. Look at nearby vegetation to identify plants that grow successfully in the local area. Identify native tree and shrub species that thrive in riparian areas and provide substantial benefits to streams. Adjacent communities of native plants can serve as seed sources for natural regeneration or as harvesting sites for transplants and cuttings.

Invasive plants should also be identified. Invasive plants are nonnative plants that displace native plants, or through rampant growth cause undesirable changes in natural areas. Invasive plants are a serious problem in Connecticut and elsewhere, reducing agricultural production, impairing recreation, and causing the loss of biological diversity. If invasive plants are identified, a control strategy may be needed for the restoration site and adjacent areas. Appendix 4 contains a list of plants considered non-native and invasive in Connecticut. Appendix 4 also contains recommended control methods for some of the most commonly encountered invasive

plants. For more information on invasive plants visit the Connecticut Invasive Plant Working Group web page at http://www.hort.uconn.edu/CIPWG.

Because riparian areas are rich in plant species diversity, particularly in wetland plants, it is important to investigate the possible presence of threatened, endangered, or species of special concern. In some areas, such as in the Connecticut River valley, flood plain forests are considered a habitat of special concern. Many of these floodplain forests have been lost to agricultural uses and more recently to urban and suburban development.

The CTDEP Natural Resource Center maintains a Natural Diversity Database, which shows the approximate location of areas where threatened, endangered, or species of special concern have been reported. These maps are available at the CTDEP building in Hartford (see Appendix 1) and at some town offices, and should be consulted prior to working in a riparian area. If there is a chance that a threatened, endangered, or species of special concern is near or at the project area, CTDEP should be contacted to determine whether the project should be undertaken.

3.5 Animals

Wildlife resources should be evaluated to ensure wildlife habitat objectives are addressed. Vegetated buffers along streams can provide land-based wildlife with corridors to larger natural habitat areas, such as state parks or nature preserves. The presence and potential for linkage of wildlife corridors should be determined. Riparian areas are also valuable to migratory birds.

The habitat needs of the wildlife (space, food, water, and cover) at the site should also be evaluated to determine adequate buffer size and plant community. The streamside forest serves as a source of energy to the stream habitat. This energy is in the form of leaves, wood, and small insects that drop into the water. Stream bottom bacteria, fungi, and invertebrates feed on this detritus and form the basis of the aquatic food chain. Larger animals and fish feed on these small creatures.

Loss of streamside trees can have a negative impact on aquatic life. Insects, a favorite food of fish, are abundant in stream areas that are cooled by trees. Increases in stream temperatures may cause changes in the quantity and type of insects found in the stream. Also, warmer water temperatures increase the fish's need for oxygen while reducing the amount of oxygen available in the water.

The CTDEP Natural Diversity Database can be helpful in identifying areas where threatened, endangered, or wildlife species of special concern have been reported.

Riparian vegetation will not be successfully established in areas grazed and trodden by livestock. Many times livestock must be excluded from riparian buffers. Livestock use of the riparian zone and adjacent areas should be considered and evaluated so that water availability, shade, grazing space, and protection of plantings are considered during the planning process.

Chapter 4 -- Determining the Objectives of Your Project

Once a site has been recognized as a riparian area and conservation concerns have been identified, the objectives of the project need to be identified in order to develop an appropriate conservation plan. The objectives of a successful riparian buffer project should balance environmental concerns with other needs of the landowner or the community.

4.1 What are the Needs of the Landowner or the Community?

The landscape in which the project is located will have a tremendous influence on the planning and design of riparian buffers. Under different land uses buffers perform different functions, all leading to differences in buffer plans and designs. Also, determining the landowner's goals and wishes is critical to the success of the project.

4.1.1 Forested Areas

Maintaining a natural forest buffer along streams is part of a good forestry management plan. Management within forested riparian areas is usually aimed at minimal wood harvesting, fisheries and wildlife management, recreation, and water harvesting. In forested areas where timber harvesting operations occur, management objectives for riparian areas focus on water quality protection (mostly removing sediments from surface runoff) and habitat concerns. In a riparian buffer within this landscape, the areas closest to the stream will tend to be undisturbed and have a natural plant community. As the buffer zone extends away from the stream, timber production and harvesting become an essential component of the riparian zone management plan. Soils, slope, and biological consideration will be the major factors influencing the planning of a riparian buffer. Erosion controls may be needed in some forestry operations to protect the riparian buffer.Forest management information can be obtained from the CT DEP forestry division or from a Cooperative Extension System forester.

Clarifying the Land Owner's Objectives (Adapted from the *Forest Buffer Toolkit*, published by the Alliance for Chesapeake Bay and Pennsylvania DEP, 1998)

- *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 landowner's interest in conserving the site in perpetuity?*
- *What is the landowner's interest in harvesting timber or other forest products from the riparian area?*
- *What is the landowner's interest and ability to carry out management responsibilities?*
- *What is the landowner's interest in recreational pursuits?*
- *What is the landowner's interest in fish and wildlife habitats?*
- *What is the landowner's interest in maintaining a view or access to the stream?*
- *What is the landowner's interest in linking his/her riparian site to a planned greenway or recreational trail?*
- *Would the landowner be interested in participating in government or privately funded programs to help with the project?*
- *Are there any legal limitations currently placed on the property (deeds, easements) that would intervene with the project?*
- *Does the landowner have any objections to volunteers working in the site, and potentially coming back for maintenance work?*

4.1.2 Farms

In most farms the primary objectives are usually crop production and raising livestock, closely followed by resource conservation. In agricultural areas riparian buffers are designed and managed to provide shade to streams, restore stream habitat, and to trap and remove nutrients, sediments, and pesticides from surface runoff and subsurface/groundwater flows. These buffers also tend to be managed as wood lots, recreational open space, or wildlife habitat. Riparian buffers on farms should be one of several

conservation practices that are part of a conservation management system, which is intended to address environmental concerns and maintain agricultural productivity. Fencing may be needed to protect the riparian buffer on some farms. Water quality concerns from livestock manure, fertilizer, and pesticide use should be addressed in the conservation plan. Technical and financial assistance for the planning and implementation of riparian buffers in agricultural lands can be obtained from the USDA Natural Resources Conservation Service.

4.1.3 Residential Areas

In residential and suburban areas, land use objectives are primarily the development of residential and commercial areas (including roads), and of recreational areas (parks and playing fields). In developed areas, riparian vegetation is often cleared to obtain a better view or to gain accessibility to the water. As a result water is exposed to direct sunlight and to the harmful effects from adjacent land uses.

Lawns and yards are frequently fertilized and watered in residential areas. This can be harmful to the water quality of streams and ponds. When it rains or when yards are over-watered, fertilizers and other chemicals used for maintaining green lawns wash away and often reach water resources.

In developed areas, space is often limited, so riparian buffers tend to be narrow and established or managed for stream habitat and some water quality functions. In developing areas, riparian buffers are often maintained through enforcement of wetland and watercourses laws and through conservation easements. In these cases riparian buffers could be planned to perform many functions including sediment filtering, enhanced infiltration, nutrient uptake, temperature moderation, noise control, screening, recreation, non-motorized transportation trails, and wildlife habitat.

Streambank erosion is often a problem in developing areas due to increased storm water runoff from paved areas and yards. Streambank erosion control techniques may be needed to protect the riparian buffer in some areas. Water quality concerns from polluted runoff, septic fields, and sewage treatment plants are also a concern.

4.1.4 Urban Areas

In urban areas, land use objectives are primarily high-density residential, commercial, and industrial development. In urban areas riparian buffer corridors will tend to be narrow or highly irregular in extent or distance. These riparian buffers will tend to be protected, managed, or enhanced mostly for aesthetic, stream habitat, recreational, non-motorized transportation trails, or water quality purposes. Riparian forests have also found a place in stormwater management along with other urban best management practices (BMPs) such as detention ponds, stormwater treatment wetlands, infiltration systems, filter strips, and commercially available stormwater treatment systems.

In heavily developed urban and commercial areas, storm water runoff is rapidly captured in storm water sewers, and it is often directed into surface waters. Concentrated flows from channels and stormwater discharge pipes can bypass riparian buffers, making these buffers inefficient for filtering pollutants. Also, riparian buffers designed to address water quality may be too wide to be practical in certain areas.

Issues of flooding, water pollution, public access and litter may also need to be addressed in the riparian buffer plan.

4.2 What are the Natural Resources Needs?

The type of water resource, the designated and planned uses for the resource, threatened and endangered species (plants and animals), and habitat diversity are some of the resource conservation considerations that will influence the planning of a riparian buffer. These conservation objectives will determine the planned ecological functions of the riparian buffer.

Streams are important to us because we value the functions they perform. Some of the most commonly recognized functions of streams are:

- Transport of fresh water for drinking, irrigation, and power generation
- Habitat for fish and other aquatic creatures
- Provide transportation opportunities.
- Provide recreational opportunities such as fishing, swimming, boating, etc.
- Are aesthetically pleasing.

There are biological variations in streams, which are often related to the physical characteristics and the location of streams (see Section 3.2). The physical and biological characteristics of the stream will dictate some of the functions needed from a riparian buffer.

Streams and other bodies of water can also be classified based on their current and intended water quality and desired uses (see Section 3.2). Water resources designated for use as sources of drinking water, recreation, fishing, and aquaculture require greater water quality protection than those designated for waste assimilation, industrial, and navigational uses.

Wildlife habitat objectives can have a tremendous effect on the width and plant species composition of a riparian buffer. The widths of riparian buffers for wildlife habitat vary significantly depending on the species being targeted. Habitat needs could also influence the vegetative structure of riparian buffers, and could require forested areas, early successional/open fields, meadows, or grasslands. The presence or proximity of threatened and endangered species, or species of special concern, and their habitats could also be a deciding factor when determining the objectives of a project (see Section 3.5).

Chapter 5 -- Planning for a Green Buffer Along Blue Water

There are many ways to establish riparian buffers, ranging from protecting existing riparian areas to actually planting trees and shrubs.

In most cases, the activities involved in the establishment of a riparian buffer are not regulated. Nevertheless, when working near water it is always important to contact the local wetlands commission prior to commencing work.

5.1 Determining Riparian Buffer Widths

Riparian buffers are planned to protect the adjacent water resource, and/or to maintain valued ecological attributes of the riparian zone. There is no ideal buffer width for all applications in all areas. Buffer width should be determined on a case by case basis and should be based on specific site conditions, desired buffer functions, and landowner's objectives. Figure 5.1-a provides buffer width ranges associated with the most commonly accepted riparian buffer functions. These ranges represent minimum riparian buffer widths that, under various conditions (stream type, vegetation, soils, topography, geology, climate, etc.), have been found to significantly provide a specific function attributed to riparian areas.

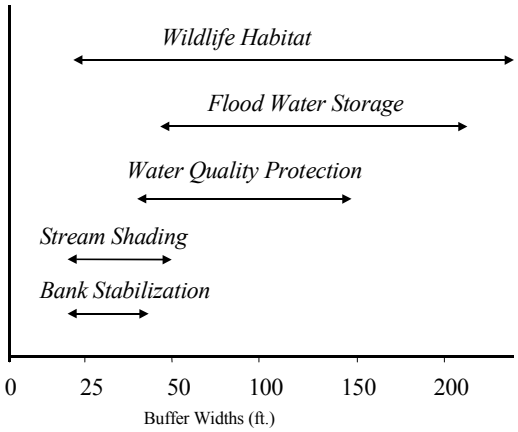


Figure 5.1-a Range of minimum riparian buffer widths for meeting specific buffer objectives[1]

The width of the buffer should be measured starting at the upper edge of the stream channel or at the normal water line, and extending perpendicular from the stream or pond. To provide an array of functions, the total width of a riparian buffer should range between 35 and 150 feet (this range of widths may not provide adequate habitat for some wildlife species). In most cases riparian buffers narrower than 35 feet provide only limited benefits, and may require long-term maintenance because they are more susceptible to erosion, sedimentation, and invasion of non-native plants.

The following criteria should be considered to help determine the width of a riparian buffer:

[1] Figure adapted from the Chesapeake Bay Riparian Handbook (See Appendix 10).

- Consider the specific buffer functions desired. Figure 5.2-A can be used to get a preliminary idea of how wide a buffer needs to be to provide the desired functions. Consult local professionals and research recently published studies to determine an appropriate buffer width.

- Consider the water resource's functional value(s) and the level of protection needed. Areas with sensitive fisheries, areas used for water contact recreation, and sources of drinking water require higher levels of protection than other areas.

- Consider the intensity of adjacent land uses. Are existing or planned land uses of low impact potential (such as parks), or high impact potential (such as urban development)?

The CT DEP Inland Fisheries Division developed a policy statement for riparian corridor protection (CT DEP, 1991). In the statement CT DEP recommends the use of riparian buffers 100 feet wide along each side of perennial streams, and 50 feet along each side of intermittent streams (See Appendix3).

Table 5.1-a contains riparian buffer widths believed to provide adequate habitat to various wildlife species. Except for cold water fisheries, widths listed in this table include the sum of buffer widths on one or both sides of watercourses or water bodies, and may extend beyond riparian boundaries.

Table 5.1-a Riparian Buffer Width Guidelines for Selected Wildlife Species

Species	Desired minimum width or range in feet	References
Wildlife dependent on wetlands and watercourses	30 to 750	Brown et al., 1990
Bald eagle	600 to 750	Wood et al., 1987.
Pileated woodpecker	165 to 500	Schroeder, 1983.
Beaver	300 to 500	Saunders, 1988. Olson and Hubert, 1994.
Small mammals	30 to 200	Cross, 1985
Amphibians and reptiles[1]	100 to 330	Golet et al., 1993. Rudolph and Dickson, 1990
Song Birds	40 to 660	Stauffer and Best, 1980.
Neotropical migrant birds	300	Keeler, 1993.
Cardinal	40	Stauffer and Best, 1980.
Blue jay, Black capped chickadee, Downy woodpecker	50	Stauffer and Best, 1980.
Brown thrasher, Hairy woodpecker, Red-eyed vireo	130	Stauffer and Best, 1980.
Red-bellied woodpecker, Warbling vireo	300	Stauffer and Best, 1980.
Scarlet Tanager, American Redstart, Rufous-sided towhee	660	Stauffer and Best, 1980.
Fish Habitat	100	Erman et al. 1977. Moring, 1982. Newbold et al., 1980. Murphy, n.d.

[1]Vegetative buffers surrounded by incompatible habitat may be inadequate for sustaining populations of some amphibian species in wetland areas. The information on this table should not be applied to vernal pools.

Currently, there is not sufficient data to support the use of a specific riparian buffer width to achieve specific water quality goals. The main reason for this lack of consensus is that the factors that influence the efficiency of the buffer for water quality renovation (soil, hydrology, topography, land uses, characteristics of pollutant, etc.) vary from site to site. Therefore, it is

often recommended that each potential riparian buffer site be individually evaluated to determine buffer widths. This could be a costly process and could require professional assistance.

If a riparian buffer project has the objective of protecting water quality, but does not have a specific water quality goal (for example, a 60% reduction of nutrients reaching the stream), 50 feet could be suggested as a buffer width. Although more research about the efficiency of riparian buffers as water quality filters is needed, buffers close to 50 feet wide or wider have often been found to significantly reduce sediments and sediment attached pollutants, in addition to maintain adequate water temperatures in streams (Castelle et al., 1994, U.S. ACE, 1991, Palone and Todd, 1998). Although narrower buffers have been often found to effectively remove pollutants, they tend to lack stability and may require frequent maintenance.

In heavily developed urban and commercial areas, storm water runoff is rapidly captured in storm water sewers, and it is often directed into surface waters. Concentrated flows from channels and stormwater discharge pipes can bypass riparian buffers, making these buffers ineffective for filtering pollutants. Also, riparian buffers designed to address water quality may be too wide to be practical in certain areas.

To properly address water quality issues in heavily developed areas with extensive storm water drainage systems, the use of urban best management practices (BMPs) for treatment of stormwater may be needed. Urban BMPs for reduction of water pollution include detention ponds, stormwater treatment wetlands, infiltration systems, rain gardens, filter strips, roof gardens, and commercially available stormwater treatment systems. Where applicable, storm water treatment BMPs can be installed within the upper zone of the riparian buffer.

5.1.1 NRCS Guidelines

The Natural Resources Conservation Service (NRCS) uses riparian buffers in combination with other conservation practices to help land managers minimize environmental impacts on water resources. The following buffer width criteria are based on the NRCS practice standard for Forested Riparian Buffers, which presents a 3-zone buffer model. Keep in mind that these recommendations are for minimum widths.

Zone 1

The primary functions of the waterfront zone (Zone 1) are to provide streambank or shoreline erosion control, provide shade, provide some filtering of pollutants, and maintain suitable habitat for aquatic organisms. The width of the Zone 1 should range from 15 to 25 feet. In many backyards, a buffer comprised only of Zone 1 (15 to 25 feet wide) may be sufficient to improve or maintain water and habitat quality without depriving homeowners of open backyard areas. Other situations in which small buffers may be adequate are in small headwater streams with small drainage areas, and in streams where there is low potential for polluted runoff from adjacent land uses.

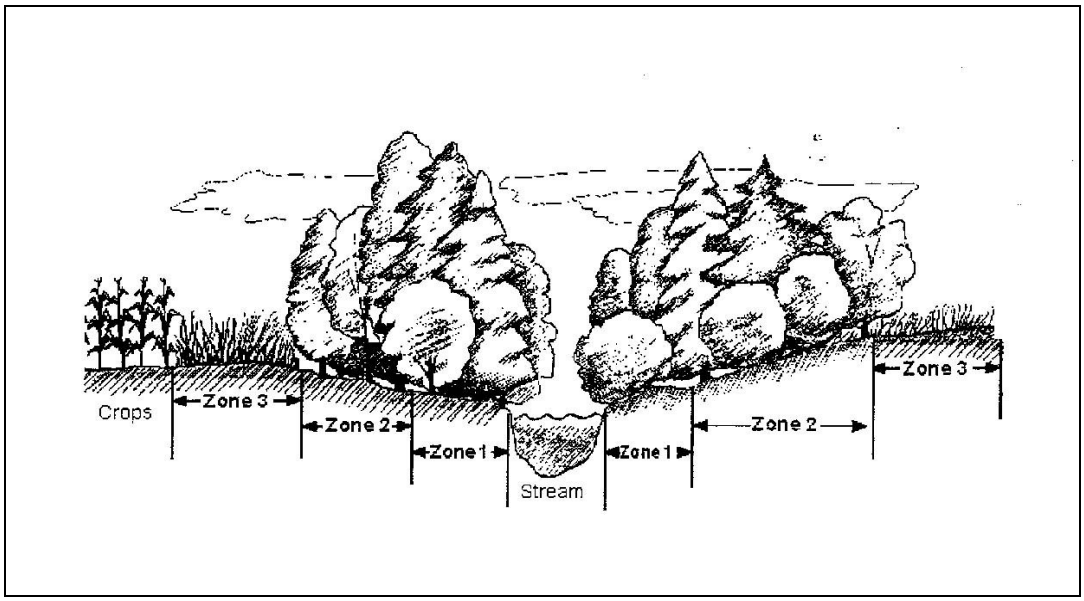


Figure 5.1-b NRCS's three zone riparian buffer model

Zone 2

The primary functions of the upper zone (Zone 2) are to filter pollutants from runoff and to provide wildlife habitat. A waterfront buffer should be widened with an upper zone to enhance filtering of pollutants in areas where there are potential sources of pollution such as landscaped areas, lawns, gardens, cropland, highly erodible land, and parking lots. Zone 2 can be extended to include such recreational and transportational uses as bikeways and trails. The upper zone can also be extended to include sensitive areas like wetlands and provide wildlife habitat. The width of Zone 2 should range from 20 to 135 feet.

Buffers for reducing nutrients, sediments, and other pollutants in surface runoff or shallow groundwater flows shall consist of at least zone 1 and zone 2. In active floodplain areas, the **minimum combined width** of zones 1 and 2 should be 100 feet or 30% of the geomorphic floodplain, whichever is less, but not less than 35 feet. A geomorphic floodplain is defined as the area adjacent to a watercourse that is built of alluvial sediments, which are associated with present flooding and depositional activity. In upland areas the minimum combined width of zones 1 and 2 should be at least 35 feet.

Zone 3

In some instances, a third zone is recommended as part of a buffer system. The third zone, located immediately upslope of Zone 2, contains a grass filter strip, or other control measure designed to control runoff, filter sediments, and allow water to infiltrate into the ground. Zone 3 is often used to enhance the water quality restoration functions of the buffer.

A grass filter strip should be considered where runoff from adjacent land uses is expected to contain high sediment loads. The minimum flow length (width) recommended to reduce sediment, particulate organic materials, and sediment-

adsorbed contaminant loads in surface runoff is 20 feet. The up-slope edge of the filter strip should be on the approximate contour. The final drainage area (area of contribution) to filter strip area ration shall be 60:1. Filter strips are not recommended for areas with slopes steeper than 10% or with erosion rates greater than 10 tons/acre/year. Grass filter strips require periodic maintenance, which includes the removal of sediments, reestablishment of vegetation, and removal of channels.

5.2 Protecting Existing Riparian Buffers

Riparian buffers are strips of permanent vegetation between water resources and non-forested land uses. Buffers help control potential pollutants and manage other environmental concerns. Where possible, preservation of existing buffers in natural riparian areas should be a priority. Preservation is a cost-effective way of protecting riparian resources. Education, regulation, and acquisition/easements are three commonly used methods of protecting existing riparian buffers.

5.2.1 Education

Because most of the land in Connecticut is in private ownership, public education is one of the best tools in maintaining existing vegetated buffers. Allowing land managers to know the importance of their natural resources is the first step towards insuring that the resources will be protected. The USDA Natural Resources Conservation Service provides technical assistance to landowners on identifying, maintaining, or improving existing vegetative buffers. Other agencies that provide riparian buffer information include the CTDEP Inland Water Resources Unit, and the local Soil and Water Conservation Districts (Appendix 1).

5.2.2 Regulation

In Connecticut, inland wetlands and watercourses are regulated under the Connecticut's Inland Wetlands and Watercourses Act, which gives municipalities the authority to regulate activities in or affecting wetlands. Some municipalities have regulated areas associated with wetlands and watercourses. These setback distances tend to vary from town to town. For guidelines on regulatory setback distances from watercourses and wetlands in Connecticut see CTDEP's *Guidelines for Upland Review Area Regulations Under Connecticut's Inland Wetlands and Watercourses Act*. A copy of this publication can be obtained from the CTDEP offices in Hartford (see Appendix 1). From a municipal regulatory standpoint it would be beneficial if minimum riparian buffer widths (see Section 5.1 of this handbook) were considered when deciding on regulatory setback distances.

5.2.3 Acquisition and Easements

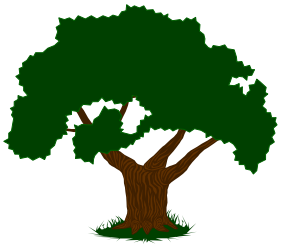
The CT DEP, town governments, local land trusts and others are actively involved in obtaining land ownership and easements to protect open space, including riparian areas. Insuring that the group obtaining the ownership or other rights to the riparian property understands and plans for a vegetated riparian buffer is critical for watershed health. Technical assistance for purchasing land or conservation easements is available through organizations such as the Connecticut Land Trust Service Bureau, The Trust for Public Land, and from the Land Preservation Alliance (see Appendix 7).

5.2.4 Tax Incentives

Land costs are high in Connecticut. This reduces the amount of land that can be protected by outright purchase. It also increases the need for some landowners to get economic gain from the land they own. In many cases there are lost opportunity costs to the landowner, if the land is not used for another purpose such as development or agriculture. Even in residential areas, heavily manicured lawns and landscaped yards are considered to increase the value of a property. Having an approved open space plan in a community, with associated property tax incentives for open space land and riparian buffers may help to reduce the land owners potential financial loss from maintaining a vegetated buffer.

5.3 Restoring a Riparian Buffer by Establishing Plants

There are three methods of plant establishment: natural regeneration, direct seeding, and planting of grown plants (seedlings, container stock, etc.). Natural regeneration and direct seeding are to be used where rapid establishment is not a high priority (for example, where streambank erosion is not a concern), and invasive plant species are absent. Where a native seed source exists within close proximity (see Section 3.4), allowing natural regeneration to occur may be the most cost-effective approach, just stop mowing next to the stream. Collected or purchased seeds may be sown to improve the success rate of desired species.



A naturally regenerated riparian forest buffer is considered initially established when plant densities have reached the planted buffer recommended densities for trees and shrubs (150 stems per acre). Three growing seasons (the period between late spring and early fall) is a reasonable amount of time in which to determine if natural regeneration will be successful. Trees and shrubs are considered established when they have begun to dominate herbaceous plants and undesired shrubs that are competing with them for nutrients, water, and sunlight.

When establishing a riparian forest buffer, it is recommended that all areas immediately adjacent to the watercourse (see Zone 1 in Figure 5.1-b) be planted to trees and/or shrubs if none are present. Quick establishment of woody vegetation on the streambanks is important to maintain adequate water temperatures and for bank stability.

Some wildlife activities can present challenges during plant establishment projects. Browsing deer, beaver, or cottontail rabbit activity might hinder establishment of riparian buffers. If local wildlife pressures are expected, protective measures (such as seedling protectors) should be planned.

5.4 Determining What to Plant

Once the width of the buffer and the planting method have been determined, the next step is to decide what to plant. Always favor native plants that have multiple values such as erosion control, wildlife habitat, aesthetic quality, and human use. Look at nearby vegetation to identify plants that grow successfully in the local area.

If plants need to be purchased, commercial availability of the plants can be a major factor during this step. This is particularly important when native plants are being used. Therefore, it would

be prudent to obtain catalogs from several local nurseries, to see what is available before going too far into the plant selection process.

An important step is the development of a Plant Schedule, which lists the species, quantity, and size of the plants needed for the project. To determine adequate mature plant size, consider the width of the stream. To provide adequate shade, the height of the streamside vegetation should equal or exceed the width of the stream.

5.4.1 Importance of Plant Diversity:

To enhance the functions of the riparian buffer it is important that the plant community is diverse so as to have different plant species, growth patterns, branching patterns, and plant sizes. A diverse plant community increases surface roughness, which helps to filter out water pollutants. Increasing the roughness of the surface by planting herbaceous (grasses, ferns, and forbs) ground covers and woody shrubs and trees can greatly improve the ability of the buffer to soak-up water and to filter out water pollutants.

Table 5.4-a Some Commercially Available Native Herbaceous Understory Plants.

Plant Name(*Scientific name*)	Light Exposure	Height	PH	Soil Drainage	Habitat
Forbs					
White Wood Aster (*Aster divaricatus*)	Partial Sun - Shade	2 ft.	4 to 5	Moist to Wet	Forest
Goldthread (*Coptis groenlandica*)	Shade	4 in.	4 to 5	Moist	Forest
Wintergreen (*Gaultheria procumbes*)	Shade	6 in.	4 to 5	Moist	Forest
Canada Mayflower (*Maianthemum canadese*)	Shade	2 to 6 in.	Acid	Moist	Forest
Partridge Berry (*Mitchella repens*)	Shade	2 in.	Acid	Dry to Moist	Forest
Mayapple (*Podophyllum peltatum*)	Shade	1 to 1.5 ft.		Moist	Forest
Ferns					
Maidenhair Fern (*Adiantum pedatum*)	Shade	2 ft	6 to 7	Moist	Forest
Lady Fern (*Athyrium filix-femina*)	Shade	2 to 3 ft	5 to 7	Moist to Wet	Forest, Forested Wetland
Hay-scented Fern (*Dennstaedtia punctilobula*)		1 to 3.5 ft.	5 to 6	Dry to Moist	Forest
Toothed Woodfern (*Drypteris cristata*)		1 to 2.5 ft.	5 to 6	Moist to Wet	Forest, Forested Wetland
Crested Woodfern (*Dryopteris carthusiana*)	Partial Sun - Shade	1.5 to 2.5 ft.	5 to 6	Moist to Wet	Wetlands
Sensitive Fern (*Onoclea sensibilis*)	Sun - Shade	1 to 2 ft.	5 to 7	Moist to Wet	Marsh, Forest, Forested Wetland, Floodplain Forest
Christmas Fern (*Polystichum acrostichoides*)	Shade	1 to 2.5 ft.	5 to 7	Dry to Moist	Forest
Graminoids					
Bluejoint (*Calamagrotis canadensis*)	Sun to Shade	1 to 3 ft.		Moist to Wet	Marsh, Floodplain Forest
Crinkled Sedge (*Carex crinitia*)	Partial Sun - Shade	1 to 5.5 ft.		Wet	Marsh, Forested Wetland, Floodplain Forest
Pennsylvania Sedge (*Carex pensylvanica*)	Sun to Shade	1 to 1.5 ft.	acidic	Dry to Moist	Grassland, Shrubland, Floodplain Forest, Forest

It is also important to use the vertical space well in a buffer planting. In most cases, planning for three layers of plants including a herbaceous layer, a shrub layer, and a tree canopy will provide the most biological diversity and the highest quality habitat improvements per area of buffer. Typically, there should be 3 to 4 understory plants for every canopy tree. Having trees adjacent to a stream is critical for stream shading, aquatic food supply, and woody debris for aquatic habitat. Appendix 8 contains a list of commercially available trees and shrubs for use in riparian buffer plantings.

5.4.2 Meadows and Grassland Areas

Although the most common vegetated communities in the State are forests, grasslands and open fields are critical components of the natural landscape. These open fields are especially important to many species of birds. Native grasslands and open fields are becoming rare ecosystems in the State as open areas are developed, and unmanaged land reverts to forest. In pre-colonial Connecticut grassland areas were common in the river valleys and the salt marshes. As land was cleared for agriculture, grasslands became widespread throughout the State. Today, the few remaining grasslands are mostly composed of introduced European forage grasses and are mowed frequently, which reduces the quality of habitat. Incorporating grassland areas into riparian buffers can provide valuable wildlife habitat.

Table 5.4-b Grasses and Sedges recommended for grassland bird habitat. Growth requirement information was obtained from the USDA Plants database at http://plants.usda.gov.

Name	Warm/Cool Season	Growth Requirements
Little bluestem *Schizachyrium scoparims*	Warm	Adapted to a wide range of soil textures, dry to moist sites, drought tolerant, low fertility requirements, intolerant to shade.
Big bluestem *Andropogon gerardii*	Warm	Adapted to a wide range of soil textures, dry to wet sites, drought tolerant, low fertility requirements, intolerant to shade
Broom-sedge *Andropogon virginicus*	Warm	Adapted to fine and medium texture soils, dry to moist sites, drought tolerant, low fertility requirements, intolerant to shade.
Switchgrass *Panicum virgatum*	Warm	Adapted to a wide range of soil textures, dry to wet sites, moderate drought tolerance, high fertility requirements, intolerant to shade, moderate salinity tolerance.
Red fescue *Festuca rubra*	Cool	Adapted to fine and medium texture soils, moist to dry sites, moderate drought tolerance, intermediate fertility requirements, intermediate shade tolerance.
Indian grass *Sorghastrum nutans*	Warm	Adapted to a wide range of soil textures, moist to dry sites, moderate drought tolerance, low fertility requirements, intolerant to shade, moderate salinity tolerance.
Side-oats gramma *Bouteloua curtipendula*	Warm	Adapted to a wide range of soil textures, moist to dry sites, moderate drought tolerance, intermediate fertility requirements, intolerant to shade, moderate salinity tolerance.

5.4.3 Native Plants

The best choice for buffer plantings are those which are native to the area. Native plants will provide for the habitat needs of the native wildlife. Native plants are less likely to out-compete other species in the same natural plant community. There are numerous native shrubs and trees available at local nurseries. Avoid invasive plants, such as multiflora rose, Japanese barberry, bittersweet, winged euonymus (burning

bush), autumn olive, and their cultivars (see Section 3.4). Appendix 4 contains a list of plants considered nonnative and invasive in Connecticut.

5.4.4 Plant Adaptation

There are several considerations involved in plant species selection. These include: the plant's hardiness zone, the planned land use, flood tolerance, growth rate, mature height, rooting qualities, the soils at the planting site, and the wildlife value. Appendix 8 contains a list of trees and shrubs that can be used for riparian plantings in Connecticut.

Determining the types of soils present on the property can help choose plants that are well suited for the site. At this point in the planning process soils information should have been collected. Inventory and evaluation of soil resources is discussed in Section 3.1 of this manual.

5.4.5 Wildlife Food and Cover

Providing adequate wildlife habitat should also be a consideration during plant selection. Seasonal food production, nesting and perching structures, and year round cover are some of the wildlife habitat needs that should be considered during the development of riparian buffer plans.

Sometimes planning a riparian buffer for wildlife goes beyond providing adequate space and wildlife corridors. To enhance the wildlife habitat function of a buffer, the plants in the buffer should provide adequate food and cover throughout the year. In most cases this requires a mix of hardwoods, conifers, shrubs, and herbaceous plants.

Numerous mature hardwood trees are needed for the production of seeds such as acorns and nuts. Patches of conifers provide valuable cover and food during winter conditions. Shrubs and herbaceous plants also provide valuable food and cover for wildlife, and sometimes require openings in the forest in order to provide adequate feeding, nesting, and bedding sites.

Oaks are known to produce large crops of acorns, which are at the top of the wildlife food list because they are palatable and plentiful. The twigs of young trees are also an important source of food for many wildlife species. Ducks such as mallards and wood ducks feed on the acorns; upland game birds such as grouse, turkey, and quail feed on the acorns and buds; songbirds such as grackles, jays, and thrashers also

Plants for Year Round Food & Cover

Summer Fruit:
- Highbush Blueberry
- Shadbush
- Red Mulberry
- Blackberry

Fall Fruit:
- Viburnums
- Dogwoods
- Elderberry
- Spicebush,
- Blackgum

Fall Seeds:
- Tuliptree
- Green Ash

Fall Nuts:
- Oaks
- Hickories

Winter Food:
- Winterberry
- Highbush Cranberry
- Chokeberries

Spring Seeds:
- Maples
- Elms

Nectar:
- Swamp Azalea

Evergreen Cover:
- White Pine
- Red Cedar
- Atlantic White Cedar
- Northern White Cedar
- Sheep Laurel

Herbaceous Plants:
- Jewelweed
- Joe Pye-wee
- Cardinal Flower
- Sedges and Rushes

feed on the acorns. Mammals such as chipmunks, raccoons, squirrels, and deer feed on the acorns, bark, and wood of oak trees.

Evergreens such as pines are also an important wildlife food source. Many birds feed on the soft evergreen needles and seeds, including a variety of songbirds, wild turkey, and quail. Small mammals such as chipmunks and mice feed on the seeds. Fur and game mammals such as hares, squirrels, and deer feed on the seed, bark, foliage and twigs of white pine.

Pines are also valuable as cover for wildlife. Young pines, with foliage spreading near the ground make good all year cover for game birds, fur bearers, deer, and other ground animals. Larger pines are favorite roosting places for robins during migration, and are one of the most common nesting sites for mourning doves. Pine needles are used as nesting materials by several species of songbirds. During heavy snow white tail deer use white pine stands as yarding areas.

If shelter is missing for certain wildlife species in the buffer zone, structures may be constructed. Typical constructed habitat structures include brush piles and bird boxes.

5.4.6 Plant Size

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

The most expensive approach is to plant the canopy, midstory, and understory in their 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, such as in urban development and part of an urban park system.

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 wildlife browsing. At a survival rate of 75 percent, roughly 200 plants are needed per acre. A spacing of 14 to 16 feet is appropriate for material several feet high and at least ¾ inch in diameter. Bare root material can grow relatively fast after the root system is established. Their applications are similar to those of B&B and large container stock.

Seedlings can be purchased container grown or bare root. In situations where a longer time to attain canopy closure is acceptable, smaller bare root seedlings are often used. Bare root seedlings are the least expensive types of plants. Depending upon plant condition, species, and site stresses the survival rates range from 30 to 90 percent. At an average survival rate of around 50 percent, the plant spacing should be 6 feet or 1,210 stems per acre.

Plugs and seeds are mostly recommended and available for planting of herbaceous species. For certain riparian tree species with large seeds, such as walnuts and oaks,

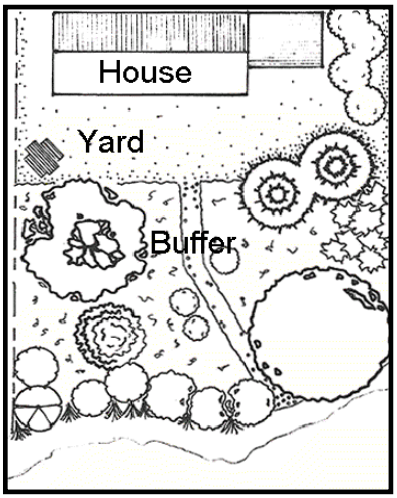
planting of the seed is an alternative. Seed can be broadcast or planted into a prepared seedbed. Plugs should be spaced 18 inches apart, in clusters, and on a prepared planting bed. The planted clusters should cover 50 to 65 percent of the total planted area.

Where funding is limited, least expensive materials can be widely used, while the most expensive material can be used sparingly in high visibility locations, or in other high priority areas where faster establishment is desired. Container grown plant materials tend to have higher survival rates than bare root stock because the plant never looses contact with the soil and suffers less stress. In addition to being less expensive, in most cases smaller plant materials are also easier to establish, which results in additional cost savings. A three-person crew can plant 100 seedlings in the same time that would take them to plant 20 large container stock plants. Where funding is not an issue, a diverse mix of materials should be used to provide diversity of growth stages. While planting smaller material may be the least expensive approach, consider that tree shelters are often required to obtain acceptable survival. Larger plants are more competitive with grasses and more visible to people on mowing equipment than are seedlings.

5.5 Landscaping

In urban or residential areas, aesthetic and landscaping are usually major considerations. Plant characteristics to consider for aesthetics include seasonal foliage color, flowers, fruits, and forms of branching.

The more natural the buffer the better it will perform its functions. The dominant vegetation in the buffer should consist of trees and shrubs selected for their suitability to the site and intended purpose. This is especially important in the streambank or shoreline.



Maintaining easy access and a year round view to the water resources may be an important consideration for many property owners. In residential and urban areas, protecting streams and ponds does not require that all backyards resemble a natural forest. Buffers can be landscaped to protect the water resource and at the same time provide accessibility and views to the stream or pond by following these two principles:

1. Keep the stream or pond shaded with a tree canopy.
2. Protect the streambanks or shorelines with a dense root system and soft woody vegetation.

Figure 5.5-a Backyard riparian buffer.

Selectively pruning some low tree branches, reducing use of evergreen trees and shrubs, and strategically spacing plantings can help maintain views and accessibility to the water resource. However, these practices will reduce the wildlife habitat value of the buffer by reducing important wildlife cover. An alternative to thinned or open buffers would be to keep an open access path to the stream or pond 10-15 feet wide. Where pedestrian access to the waters is desired, a hard surface trail with steps, or a ramp may be appropriate to prevent erosion.

5.6 Drawing a Planting Plan

At this point all the information required to develop a planting plan has been collected. The plan can be a simple line drawing of the site with areas denoted for plant species with appropriate notes on spacing and buffer widths. Additional information should include: a location map or directions to the site, a north arrow, adjacent property lines, an approximate scale, a table containing the planting schedule, a list of tools and materials, and instructions on site preparation and planting methods. Appendix 9 contains an example of a typical riparian buffer establishment plan.

5.7 Cost Estimates

There are two types of cost estimates that should be performed. Before embarking in a project, a preliminary estimate should be done to determine what are the financial needs and/or what are affordable options for the project. These factors can have a tremendous effect on your plan. Another more detailed cost estimate can be done after the plan is drawn. This estimate can be used to budget funds, contract services, purchase materials, and apply for grants. The detail cost estimate should be based on actual estimates from material suppliers and contractors. This detailed estimate should account for regional differences on cost of materials and labor. Always estimate an additional 10% to 15% from your total for miscellaneous expenses. The following list provides price ranges that can be used for preliminary cost estimates.

Site Preparation

Mowing	$50 to $100/acre
Invasive Plant Control	
Brush Hogging	$300 to $400/acre
Heavy Mechanical Control	$500 to $1,000/acre
Chemical Control	$100 to $200/acre
Soil Bed Preparation	
Tillage	$50 to $65/hour
Lime	$200/Ton
Fertilizer	$55/Ton

Planting

Plant Materials	
B&B	$10 to $30 each
Large Container	$7 to $15 each
Large Bare Root	$3 to $6 each
Seedlings	$0.50 to $2.00 each
Herbaceous 2” plugs	$0.75 to $1.50 each
Seeds (Meadow mix)[2]	$10 to $40 per pound

[2] Always review contents of seed mixes to ensure absence of nonnative invasive plants.

Planting Labor

B&B	$200 per hundred
Large Container	$120 per hundred
Large Bare Root	$60 per hundred
Seedlings	$30 per hundred
Herbaceous 2” plugs	$30 per hundred
Seeding – Conventional	$50 to $65/hour

Other Materials

Hay/Straw Mulch	$5 per bale
Wood-chip Mulch	$1.00 per cubic foot
Tree Protectors 3’ lengths	$60 per fifty
Wood Stakes 35”to 42” lengths	$40 per hundred

There may be additional costs to a landowner from maintaining a buffer, installing a fence, or installing other conservation practices associated with the buffer system. If a planned activity is regulated, permit fees could be another cost.

Chapter 6 -- Planting a Riparian Buffer

6.1 Planting Times

Spring is the best time for planting of most plant materials. This is especially applicable to bare rooted tree seedlings and cool season grasses. Early spring plantings ensure an adequate period for root growth prior to the moisture demands of the growing season. Planting during the summer subjects plants to moisture stress, unless proper care is taken to ensure adequate moisture in the root zone.

Bare rootstock should be handled only while dormant, preferably during early spring, before the leaf buds start to break in late April. Optimum spring planting conditions dates for cool season grasses are from April 15 through June 15. While less than optimal, in the moist conditions found in some streamside areas the planting of trees and shrubs can be extended into late May.

The optimum seeding time for warm season grasses and meadow mixes occurs between mid spring and early summer (May 1 through June 30). Late spring (May 15 through June 15) is preferred, where soil moisture is adequate. Soil temperatures of 55°F are required for seed germination.

Fall plantings should be limited to evergreens and cool season grasses. Optimum fall planting conditions for cool season grasses in Connecticut are from August 15 through September 15, or September 30 in coastal areas.

6.2 Purchasing Healthy Plants

If possible, the most likely sources of materials should be visited to check on the condition of stock. The size, condition, and health of the plants should be examined before ordering. Ordering should take place as early in the season as possible to ensure availability of plants and quality of stock. Consider ordering 10 to 15 percent more plants than in the planting schedule, especially of species that may be less tolerant to stress. These additional plants can be planted in a nearby "holding area" and used for replacement plantings.

It is important that guarantees and return policies are clear before an order is made. Plants that do not meet specifications should not be accepted and send back to the supplier with arrangements for replacement or refund. The materials should be examined for the following criteria:

- *Vigor* – The plants should have well developed branches and adequate buds. Seedlings should be pliable when bent. Seedlings that snap when bent are 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 desiccated, 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. Root-bound plants usually have roots protruding above the surface or through the drain holes, a leggy appearance, and/or they are unusually large for their 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.

6.3 Storage and Handling of Plant Materials

If seedlings are transported in an open truck or trailer, the plants should be covered with a tarp to prevent excess drying from high winds. The tarp should not be laid directly on top of the seedlings to allow for some air circulation.

Plant materials 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 rootstock can be stored for several weeks if "heeled in" by laying plants in a trench of loose soil or mulch. The tops should face towards the south at an angle of 30 to 40 degrees.

Container material is less susceptible to moisture stress and will keep well if properly watered.

Seedlings should be moist and cool upon receipt. Bare root seedlings should be planted immediately.

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. If it is necessary to store moss-packed seedlings for more than 2 weeks, one pint of water per package should be added. If clay treated do not add water to the package. Packages must be separated to provide adequate ventilation. Seedlings can also be refrigerated.

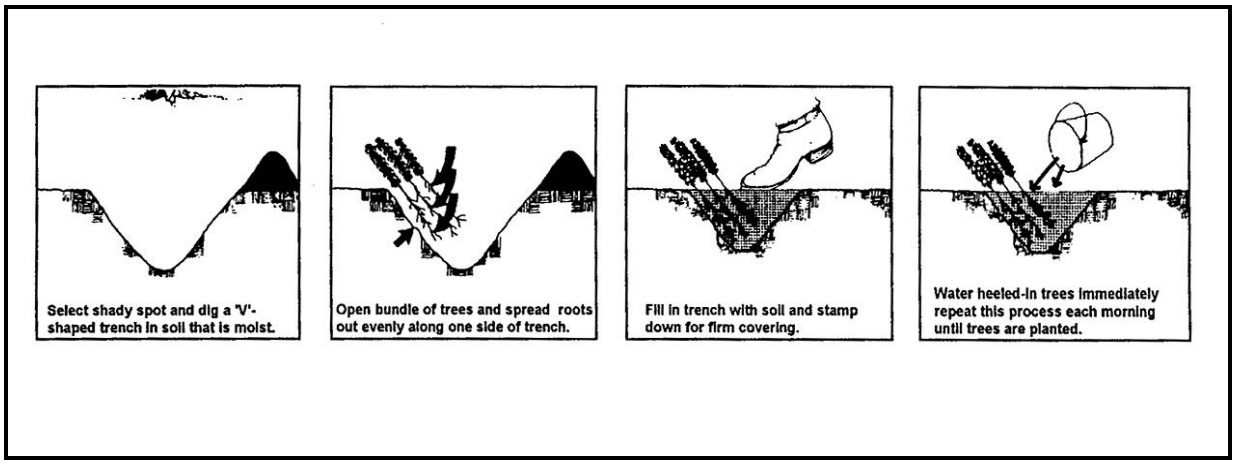


Figure 6.3-a. Heeling in Seedlings to Protect Roots. (Source: Tree Planting Notebook, Minnesota Department of Natural Resources, Division of Forestry)

Harden off plants that arrive from a greenhouse prior to planting outdoors. Keep them in a cool, partially shaded area, protected from the wind for 1 to 2 weeks prior to transplanting. Most unrooted cuttings should be soaked for 24 hours prior to planting.

When collecting wild plants, always get permission from the landowner. Avoid invasive species and choose the healthiest plants. Expect a higher mortality rate from wild plants than from nursery grown stock. Harvest no more than 1/5 of the mother plants to maintain plant health and aesthetics at the collection site.

6.4 Planting Layout and Site Preparation

Prior to planting, the site may be marked so the people doing the work can put the right plant in the right place. This can be especially helpful when working with volunteers. Markings can also be used to outline areas where specific work is scheduled, such as herbicide treatment, brush removal, or tillage. Appendix 9 contains an example of a riparian buffer planting plan.

Where precise detail is not essential, zones can be marked for a particular mix of plants. 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 through the project. In some cases a specific marker can be placed for each individual plant to be planted.

A variety of marking techniques 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 as well as color-coded flagged wires can be used to differentiate species. Survey flagging can be used in a similar manner if enough vegetation is present onto which the flagging can be tied.

Often a riparian restoration site will have a mixture of undesirable vegetative conditions that may require site preparation prior to planting. The method of site preparation will vary depending on what are the existing conditions, what is the planting method to be used, and what is the targeted vegetative community. Typically pre-planting site preparation is needed when working with small plant materials such as seedlings, which are not sufficiently tall to shade out existing vegetation.

If invasive plants are identified, a control strategy may be needed for the restoration site and adjacent areas.
Invasive plant control methods are divided into three categories, mechanical, chemical, and biological. A combination of mechanical and chemical controls is often the most effective strategy. Appendix 4 contains a list of plants considered exotic and invasive in Connecticut, with information about control methods for some of the most commonly found invasive plants. Surface and groundwater resources should not be exposed to herbicides if it can be avoided. It is best to acquire professional assistance if chemical controls are being considered.

6.4.1 Site Preparation for Forested Areas

Areas where the existing vegetation is primarily composed of sod forming grasses, such as pastures, hay fields, lawns, and playing fields are common waterfront restoration sites. These areas should be mowed prior to planting seedlings. In some cases young trees and seedling can be planted directly into the existing grass cover, then mulch can be applied around each plant to control weed and grass growth. Mowing and weeding may be necessary as part of a maintenance plan until the trees can shade out underneath growth.

In situations where the established buffer will be mowed as part of the maintenance plan, small plants should be planted in evenly spaced rows or in clusters to prevent tree loss from mowing activities.
Abandoned fields of various stages usually have some tree saplings, shrubs, and vines. In these sites, preparation focuses on releasing the desired plants from competition from undesired species. Mowing, brush hogging, and cutting, can be used to suppress growth around desired plants. The work in these areas should be limited, unless invasive plants are present.

Generally, adding fertilizer at the time of planting is not necessary, especially if the plants match the soil conditions at the site. If the soils have been seriously disturbed, such as at abandoned mine sites, then fertilizer and other soil amendments may be needed to recondition the soil for planting. A soil test will help determine the need for soil amendments.

6.4.2 Site Preparation for Grassland/Meadow Areas

To kill or subdue the existing vegetative cover, tillage or a combination of tillage and herbicide applications can be used. Herbicide use is mostly recommended for establishment of warm season grasses, which are slower to establish than cool season grasses, and for no-till plantings (when seed is directly drilled into the soil through the existing vegetative cover). Again, surface and groundwater resources should not be exposed to herbicides if it can be avoided. It is best to acquire professional assistance if chemical controls are being considered.

Soil test should be completed on the top 4 to 6 inches of topsoil in the fall prior to planting. Nutrient levels required for warm season grasses are much lower than those needed for a crop, and moderate levels are adequate. Because they encourage weed competition, nitrogen applications are not recommended during the establishment year. Potassium and phosphorus may be applied either prior to or at the time of planting. For warm season grasses pH levels should be corrected to around 5.5 or 6.0. A rule of thumb is to apply one ton of lime for each tenth below the target level. Apply lime during first tillage operation or at the time of planting. Follow soil test result recommendations, except for nitrogen, do not apply nitrogen at planting. Apply fertilizer just before or at time of planting.

Plow, disk, and harrow the field to break up existing vegetation, bury plant residues, improve soil tilth, and incorporate fertilizer. If plowing and disking is done early, emerging weeds can be controlled with a light harrowing or disking before seeding. During tillage removal of invasive plants such as multiflora rose shall take place.

Recently tilled ground should be packed with a coil or roller packer prior to seeding. Packing can also be accomplished by traversing the field once with an empty press drill. The seedbed is considered firm enough when a footprint penetrates ¼ to ½ inch deep.

6.5 Planting Practices

6.5.1 Forested Areas

Balled and Burlapped (B&B) stock should never be picked up by the trunk or dropped. 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 are not recommended. All sod should be discarded. The root collar should be placed at the same level as the original soil. If the hole is over dug and backfill is needed, the tree should be planted an inch or two higher to allow for settlement.

After placement of the tree, completely remove any wiring, twine, and as much burlap as possible with out damaging the root ball. Work backfill around the root ball firmly compacting in place to avoid air pockets. Fill to the original grade, compact, water, and mulch. A watering depression should be formed around the tree by placing excess soil in a ring around the tree (see Figure 6.5-A). Mulch should be placed in a three to four foot diameter circle around the tree to inhibit herbaceous competition. Newly planted trees may need artificial support to prevent excessive swaying. Stakes can be used to support the trees.

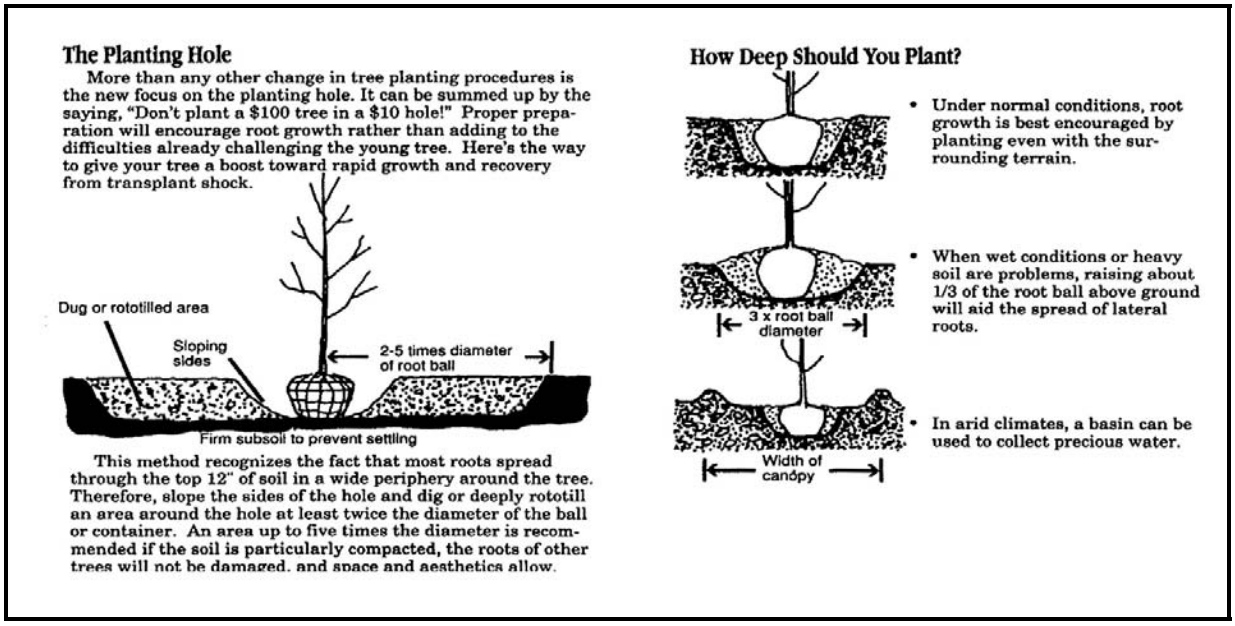


Figure 6.5-a. Planting Burlapped or Potted Trees. (Source: Tree City USA Bulletin No. 19, The National Arbor Day Fundation.)

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 spreads out in the planting hole. Plants with large and extensive circling roots should be rejected. Backfill, water, and mulch as with B&B plants.

Bare root seedlings and year transplants can be planted by hand or by machine. Machine plantings are most commonly done in nursery operations, orchards, and

Christmas tree farms. Hand planting methods, such as the slit method and the side hole method, are the most commonly used in habitat restoration projects. Hand planting tools such as planting bars and dibble bars are used for small stock, mattocks and hoe-dads are used to dig deeper holes for larger stock. The slit method, which consist of making a slit with a planting bar or dibble bar, is a fast commonly used way of hand planting small seedlings. Figure 6.5-B shows the appropriate steps for planting a seedling with the slit method.

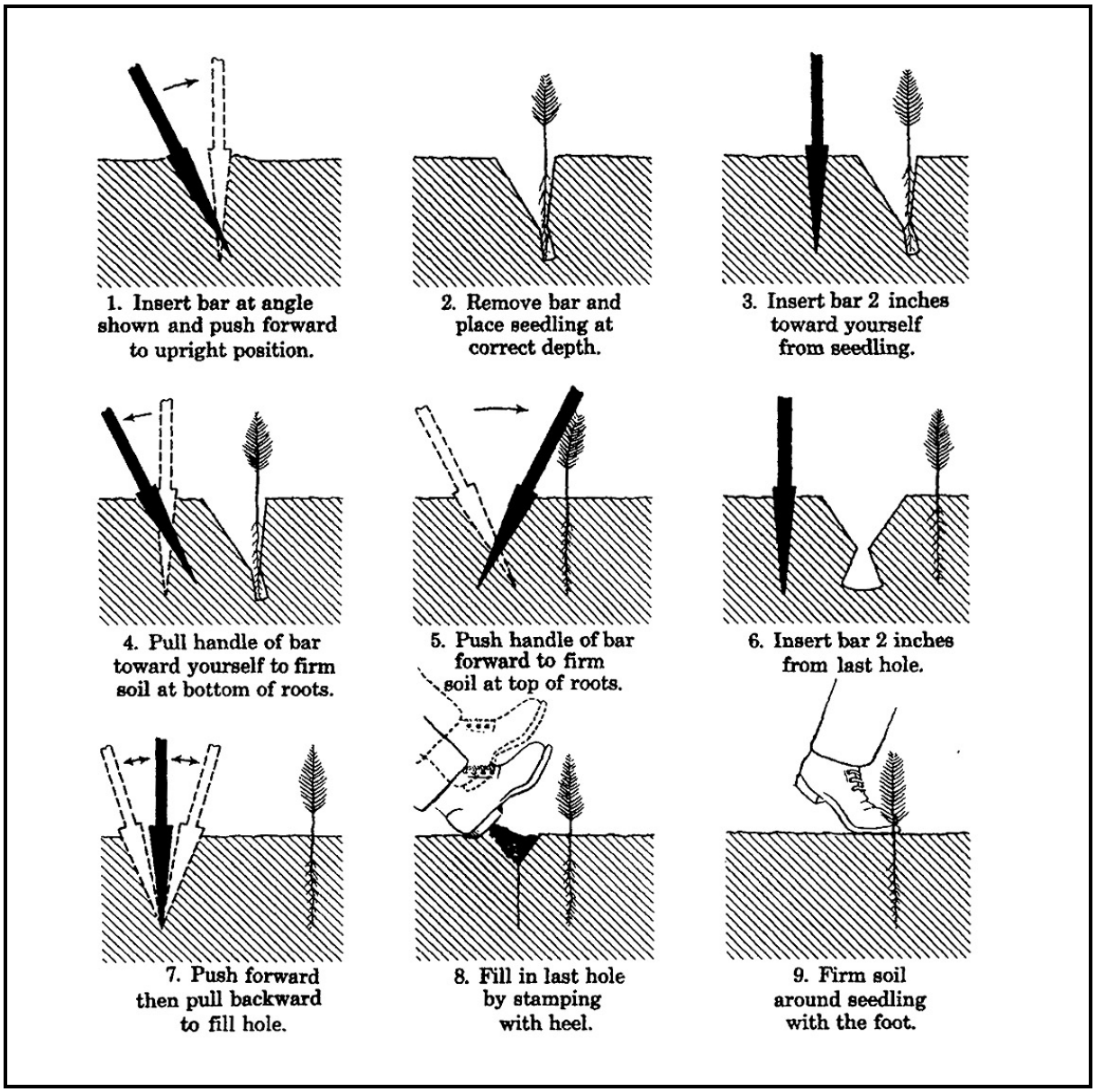


Figure 6.5-b. The Slit Method. Steps in the use of the slit method of planting seedlings in sandy soils. (Sketch by the U.S. Forest Service.)

The side hole method consists of digging a hole deep enough to accommodate to roots of larger seedlings. Mattocks or grub hoes are the tools of choice for this type of work. Figure 6.5-C shows the appropriate steps for planting a seedling with the side hole method.

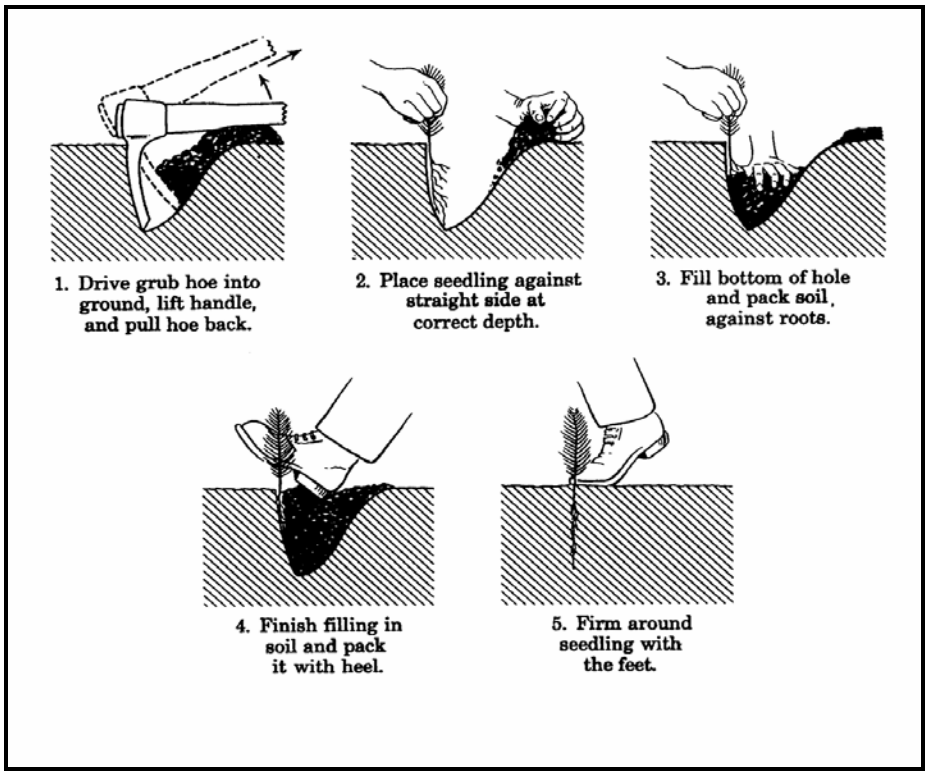


Figure 6.5-c. The Side Hole Method. (Sketch adapted from the U.S. Forest Service and from *The Practice of Siviculture*, Smith, 1996.)

When planting bare root seedlings, bring only as many seedlings as you can plant. Do not carry seedlings in your hand exposed to air and sun. Keep moss packed seedlings in a bucket with wet moss or muddy water. Cover clay treated seedlings with wet burlap. Seedling should be planted so the root collar is at the same level as the ground, the plant should be straight, the roots should not be bent, and the soil around it should be firmly packed.

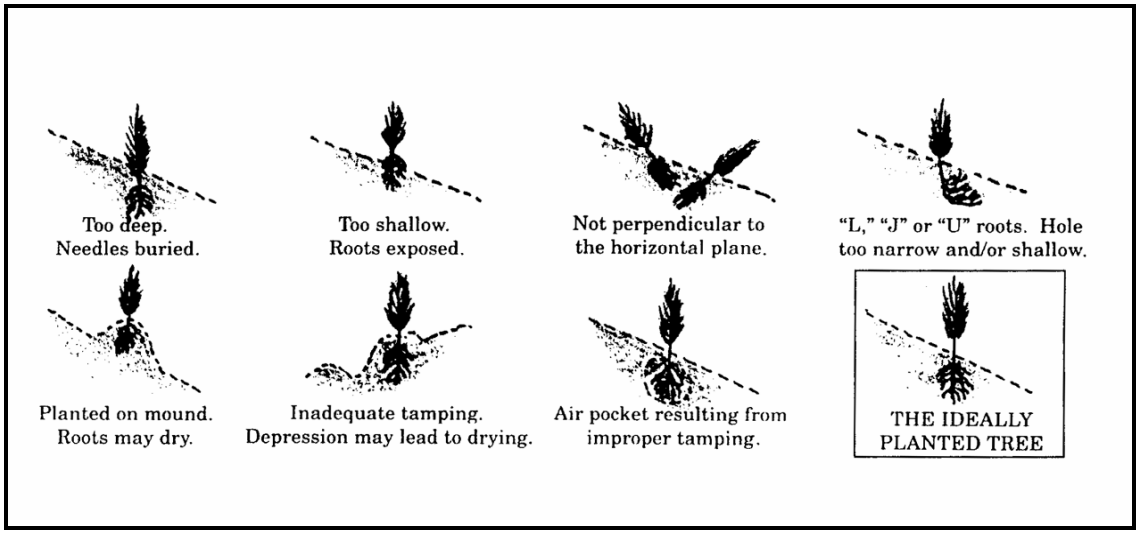


Figure 6.5-d. Common Seedling Planting Errors. (Source: *The Forest Steward*, The National Arbor Day Foundation, March/April 1996.)

6.5.2 Grassland/MeadowAreas

For conventional planting the seedbed should be free of weeds, fine textured and firm. A conventional planter or a modified warm season grass planter can be used. Band seed with a drill with press wheels at a depth of ½ inch.

The characteristics of warm season grass seeds require the use of specialized equipment or modifications to standard agricultural equipment or seeding practices to accomplish that objective. Specialized grass seeding drills usually have seed box agitators and/or specially designed seed cups to help ensure a uniform flow without carriers.

Seeds of some warm season species are awned and have sharply pointed tips. Others are light and fluffy. Any of those characteristics can result in uneven rates of seed flow in standard gravity fed grain drills and undesirable skips within seed rows. To overcome that problem, a light rate of oats (5 to 10 lbs/ac) or, preferably, an inert carrier like cracked wheat, cracked corn, oat groats, or vermiculite at half the bulk seed rate can be mixed with the grasses to improve seed flow. If inert carrier and seed are to be mixed in the drill box, first mix some of the carrier and seed in a separate container. The seed cups should be full of this mixture before filling the drill box. Switch grass is hard and slick and can be handled with out special drills. Big bluestem seed is chaffy and will not flow well unless it has been debearded, a process which removes the chaff and hair from this seed, if debearded a conventional planter may be used.

Grass seeds can also be broadcast into a prepared seedbed. The site should be harrowed prior to broadcast seeding, then lightly harrowed and firmly packed after seeding. Doubling the seeding rate is usually recommended for broadcast seedings.

Chapter 7 -- Where to Get Help

Projects that have strong partnerships of individuals and groups and a high degree of public participation are more likely to be successful. Networking increases the opportunities for information exchange, education, funding, and volunteer support.

7.1 Information and Advice

There are numerous public and private agencies that can provide technical advice and resource information to protect riparian buffers (See Appendix 1). Appendix 10 lists many sources of information on riparian buffers including manuals and other publications. The NRCS web site (www.ct.nrcs.usda.gov) contains links to several web sites that provide information about riparian areas and riparian buffers.

7.2 Volunteers

People will be needed for all stages of the buffer project. A wide range of skills and abilities will be helpful. Some jobs that may be needed include natural resource management, streamwalk surveys, grant administration, accounting, plant establishment and care, water monitoring, building signs or habitat structures, photography, or other site monitoring and maintenance. A list of the jobs needed done and when they are needed will be helpful. Land preservation organizations, environmental groups, boy and girl scouts, and watershed organizations are excellent sources of contacts and volunteers. A job description and training should be provided to the volunteers. Existing watershed organizations are listed in Appendix 11. News articles may attract new volunteers to your project. Volunteers may have some or all of their own tools (computers, phones, cameras, garden or carpentry tools) needed to complete the project. Liability issues should be reviewed with a legal professional.

Some Facts About Forestry and the Connecticut Economy (from *A Resource for Everyone: Forests and the Connecticut Economy*, published by the CT DEP Bureau of Natural Resources Division of Forestry, and the University of Connecticut CES College of Agriculture and Natural Resources, n.d.):

- $ Connecticut forests produce approximately 70 million board feet of timber annually, providing raw material for over 350 Connecticut processing and manufacturing firms. This results in a $414 million contribution to the state's economy.
- $ Connecticut growers sell at least 400,000 Christmas trees each winter, which results in earnings over $9 million.
- $ An average of 15,000 gallons of maple syrup, with a retail value of $1/2 million, are produced each year.
- $ At least 400,000 cords of firewood are harvested each year, displacing 112 million gallons of fuel oil, which would otherwise cost residents over $100 million.
- $ Connecticut produces over two million gallons of processed witch hazel each year, with a processed value of over $9 million.

7.3 Finances

Because there are societal benefits from maintaining and establishing vegetated buffers, some offsetting of landowners' expenses may be justified through government sponsored programs (See Appendix 1). Other funding opportunities for buffer projects include donations, grants, and fund-raising events. Local businesses are excellent sources of dollars, in kind services and/or equipment for your project.

Landowners can also derive some income from riparian forests. Selective harvesting of timber, farming or collection of specialty forest products (nuts, cooking wood, mushrooms, herbs, decorative cones), and hunting fees are some potential sources of

income from riparian buffers. Appendix 12 contains a collection of articles published by the USDA (*Agroforestry Notes*) on the topic of income opportunities in forested areas.

Forest farming activities will modify the forested buffer ecosystem but should not significantly interfere with its watershed protection capabilities. Focus should be placed on forest crops that have minimal disturbance to the forest floor and that are low risk of loss during flood events.

Traditional forest food crops that can be grown in a riparian forest setting include – nuts, maple syrup, honey and berries. Commercial nut production is best accomplished in an orchard setting, but wild walnuts and hickories can be harvested from a more natural setting if you get there before the squirrels and turkeys. Persimmons and pawpaws are native trees, which produce fruit. Raspberries, blackberries, and blueberries can be grown on the riparian forest edge, but will get higher production when grown in full sun. The flowers of some woodland trees impart a distinct flavor and aroma to honey.

Handicraft supplies might include - weaving and dying materials, basketry supplies, vines for wreaths or other decorative products like cones or seed pods. Laurel trigs can be cut for florists. Over harvest should be avoided so that the forest health is maintained and the crop production is sustainable. While Asiatic bittersweet has been used historically as a decorative product, its use is not recommended due to the risk of seed spread. Asiatic bittersweet is a non-native invasive plant that is harming our forests' health.

If considering a forest farming system on a riparian area there are several steps you should consider. These include inventory your forest resources, investigate existing businesses in the area, examine the markets, investigate the labor supply, look into financing, examine the legal aspects, market the products, and come up with an overall business plan. For more information about forest farming see the USDA National Agroforestry Center's web page http://www.unl.edu/nac/.

There are also land maintenance expenses that may be reduced through riparian buffers. Mowing, fertilizing, and repair of flooded or eroded areas are some examples of maintenance operations that can be eliminated if natural vegetation is established in riparian zones.

7.4 Getting the Word Out

Getting the word out to the public is an important educational tool, encourages public participation and can help get volunteers and project funding. It is important to develop a list of local newspapers, radio stations and televisions stations. A list of news organizations in your area can be found in your local phone book. Press releases can be prepared about newsworthy events.

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Appendix 1

Sources of Natural Resources Information and Technical Assistance in Connecticut

Name of Agency or Organization	Mailing Address	Phone, Email, Website
CT Department of Environmental Protection – Environmental & Geographic Information Center	79 Elm Street Hartford CT 06106	(860) 424-3540 (Maps & Publications) http://dep.state.ct.us
Connecticut Soil & Water Conservation Districts	139 Wolf Den Road Brooklyn CT 06234	(860) 774-0224 lee-scruba@ct.nacdnet.org www.conservect.org/eastern/index.shtml
	238 West Town Street Norwich CT 06360	(860) 887-4163 lee-scruba@ct.nacdnet.org www.conservect.org/eastern/index.shtml
	1185 New Litchfield Street Torrington CT 06790	(860) 626–7222 ncd@snet.net www.conservect.org/northwest/index.shtml
	24 Hyde Avenue Vernon, CT 06066	(860) 875-3881 tollandc@snet.net www.conservect.org/northcentral/new_page_1.htm
	North Farms Executive Park 900 Northrop Road, Suite A Wallingford, CT 06492	(860) 269-7509 SWCD43@SBCglobal.net www.conservect.org/southwest/southwest.htm
	627 River Street Windsor, CT 06095	(860) 688-7725 hartford.soil@snet.net www.conservect.org/northcentral/new_page_1.htm
	De Koven House 27 Washington Street Middletown, CT 06457	(860) 346-3282 ctrivercoastal@ct.nacdnet.org www.conservect.org/ctrivercoastal/index.shtml
USDA Service Centers	139 Wolf Den Road Brooklyn CT 06234	(860) 774-0224 joyce.purcell@ct.usda.gov www.ct.nrcs.usda.gov/contact/brooklyn_office.html
	238 West Town Street Norwich CT 06360	(860) 887-3604 javier.cruz@ct.usda.gov www.ct.nrcs.usda.gov/contact/norwich_office.html
	1185 New Litchfield Street Torrington CT 06790	(860) 626–8258 kathleen.johnson@ct.usda.gov www.ct.nrcs.usda.gov/contact/torrington_office.html
	North Farms Executive Park 900 Northrop Road, Suite A Wallingford, CT 06492	(860) 269-7509 richard.kszystyniak@ct.usda.gov www.ct.nrcs.usda.gov/contact/wallingford_office.html
	627 River Street Windsor, CT 06095	(860) 688-7725 jewel.mckenzie@ct.usda.gov www.ct.nrcs.usda.gov/contact/windsor_office.html
NRCS State Office	344 Merrow Road, Suite A Tolland, CT 06084	(860) 871-4011 www.ct.nrcs.usda.gov
NRCS Urban and Community Assistance Office	1 Bradley Road Woodbridge, CT 06525	(203) 389-6925 carol.donzella@ct.usda.gov www.ct.nrcs.usda.gov/contact/urban_office.html
U.S. Environmental Protection Agency	1 Congress Street Suite 1100 Boston, MA 02114	1 (888) 372-7341 http://epa.gov/owow http://epa.gov/region01
U.S. Fish & Wildlife Service	Regional Office 300 West Gate Center Drive Hadley, MA 01035	(413) 253-8200 northeast@fws.gov www.fws.gov

Name of Agency or Organization	Mailing Address	Phone, Email, Website
	Silvio O. Conte National Fish & Wildlife Refuge 38 Avenue A Turner Falls, MA 01376	(413) 863-0209 www.fws.gov/r5soc
	Stewart B. McKinney National Wildlife Refuge P.O. Box 1030 Westbrook, CT 06498	(860) 399-2513 R5RW_SBMNWR@fws.gov http://northeast.fws.gov/ct/sbm.htm
U.S. Geological Service	101 Pitkin Street East Hartford, CT 06108	(860) 291-6740 dc_ct@usgs.gov www.usgs.gov
University of Connecticut Cooperative Extension System	67 Stony Hill Road Bethel, CT 06801	(203) 207-8440 fairfield@canr.uconn.edu www.canr.uconn.edu/ces
	139 Wolf Den Road Brooklyn, CT 06324	(860) 774-9600 windham@canr.uconn.edu www.canr.uconn.edu/ces
	1066 Saybrook Road Haddam, CT 06338	(860) 345-4511 middlesex@canr.uconn.edu www.canr.uconn.edu/ces
	305 Skiff Street North Haven, CT 06473	(203) 407-3161 newhaven@canr.uconn.edu www.canr.uconn.edu/ces
	562 New London Tpke Norwich, CT 06360	(860) 887-1608 newlond@canr.uconn.edu www.canr.uconn.edu/ces
	1304 Windsted Road Torrington, CT 06790	(860) 626-6240 litchfield@canr.uconn.edu www.canr.uconn.edu/ces
	24 Hyde Avenue Vernon, CT 06066	(860) 875-3331 tolland@canr.uconn.edu www.canr.uconn.edu/ces
	West Hartford Campus University of Connecticut 1800 Asylum Avenue West Hartford, CT 06117	(860) 570-9010 hartford@canr.uconn.edu www.canr.uconn.edu/ces
Connecticut Agricultural Experiment Station	123 Huntington Street Box 1106 New Haven, CT 06504	1 (877) 855-2237 (toll free) (203) 397-48500 (local) Michael.Last@po.state.ct.us www.caes.state.ct.us/
University of Connecticut Map Library	Homer Babbidge Library 369 Fairfield Road Storrs, CT 06269	(860) 486-2000 www.lib.uconn.edu

Appendix 2

Soil Quality
and
Site Assessment Card

USDA, Natural Resources Conservation Service

Soil Quality and Site Assessment Card

for Connecticut Community Gardeners

What Are Soil Quality and Site Assessment Cards?

- They are field tools developed collaboratively by the local community, the Natural Resources Conservation Service, and conservation partners.
- They are used to assess the current status of soil quality, and over time will determine changes in soil quality affected by management.
- These cards can be used throughout Connecticut.
- They display locally selected soil quality and site assessment indicators and associated descriptive terms.
- They list soil quality and site assessment indicators that can be assessed without the aid of technical or laboratory equipment.
- The only tools required are a shovel and a coat hanger (or wire flag).
- Examples of indicators include compacted soil layers, abundance of earthworms, and amount of sun exposure.

Why Develop Soil Quality and Site Assessment Cards for Connecticut?

- They are tools for people to assess soil quality on a site themselves.
- The assessment is a tool to communicate with soil scientists and other environmental professionals about issues and problems relating to soil quality.
- The cards focus on indicators identified by community people.

These cards are not, however, intended to be used by farmers or people involved in production agriculture. Although they were designed for community garden use, they can also be used to rate sites and soil for other potential land uses. Keep in mind the cards are for people to do general evaluation of property, but are not a substitute for detailed, on-site investigations by professionals. Professional investigations may be necessary to satisfy federal, state, and local regulations.

After completing the assessment, decide how your ratings will affect your plans for the site. For indicators you rated as ***Poor***, look at the **Management Options** section for that indicator. Design your site plans with these options in mind. Should you have questions about the process, contact:

Marjorie Faber
Assistant State Soil Scientist
USDA, Natural Resources Conservation Service
100 Northfield Drive, 4th Floor
Windsor, CT 06095
(860) 688-7725 (ext. 115)

1/2002

NRCS
USDA, Natural Resources Conservation Service

How to Use the Site Indicator Scorecards

Equipment Required:

- pen or pencil

General Instructions:

- Go to the site you want to rate and look around the entire site.
- Concentrate on the specific area(s) on the site that you want to use.
- Complete the field notes section below.
- Rate each indicator on the back side of this card by marking an ***X*** in the appropriate box.
- Complete soil assessment scorecard.

Field Notes:

Date: _____

Name of Site _____

Location _____

Weather Conditions _____

Current Use of the Site _____

Future Plans for the Site _____

Site Drawing:

NRCS
USDA, Natural Resources Conservation Service

How to Use the Soil Indicator Scorecards

Equipment Required:

- Shovel
- Wire coat hanger
- Pen or pencil
- Tape measure or ruler
- 1 gallon water for each soil scorecard

General Instructions:

- Go to the site you want to rate and look around the entire site.
- Select a typical spot and dig a hole approximately one to two feet deep. This hole will be used for the soil examination.
- Dig another hole five inches deep nearby. This hole will be used to see how fast water moves through the soil.
- Complete the field notes section below.
- Rate each indicator on the back side of this card by marking an ***X*** in the appropriate box.
- Complete additional soil scorecards for other locations on your site.
- Complete site assessment scorecard.

Field Notes:

Date: _____

Name of Site _____

Location _____

Weather Conditions _____

Current Use of the Site _____

Future Plans for the Site _____

Site Drawing:

SITE INDICATOR SCORECARD
for Connecticut Community Gardeners

NRCS
USDA, Natural Resources Conservation Service

Date: _____
Site Name: _____
Form Completed By: _____

☒ *applicable box*

Site Indicator	Poor	Tolerable	Best
Accessibility			
1. Walking distance to site.	10+ minutes. ☐	5-10 minutes. ☐	0-5 minutes. ☐
2. Availability of parking.	None. ☐	Difficult. ☐	No problem. ☐
3. Visibility from street.	Can't see site, or it is very visible. ☐	☐	Somewhat visible. ☐
4. Hilliness of site.	Very hilly. ☐	Some slope. ☐	Level or nearly level. ☐
Topography			
5. Direction the slope faces.	North. ☐	East, West. ☐	South. ☐
6. Bedrock, ledge, or large boulders on site.	Too many to work around. ☐	Some, but can work around them. ☐	None. ☐
Location/Distance to Water			
7. Water access -- city water, pond, or river for irrigation.	No water available on the site, and no access to bring it to site. ☐	Have to connect to city water or bring water to site. ☐	Water available easily. ☐
8. Water quality tested.	Bad quality, can't use. ☐	Fair quality. ☐	Good quality. ☐
9. Runoff.	After rainfall, a lot of soil washes from site. ☐	After rainfall, a little soil soil washes from site. ☐	After rainfall, no soil is seen to wash from site. ☐
10. Water on surface during the growing season (spring, summer, fall).	After a moderate rainfall, water stays on surface for a few days. ☐	After heavy rainfall, water stays on surface for a short time. ☐	After rainfall, no water is observed on the soil surface. ☐
11. Sun exposure through the day.	Shady, very little exposure. ☐	Sun is blocked some of the time. ☐	Mostly sunny. ☐
12. Amount of existing pavement on site.	Too much pavement, will interfere with plans for the site. ☐	Some, but can work around. ☐	None. ☐
13. Debris (construction materials, bricks, concrete, etc.)	A lot on the surface. ☐	Occasional. ☐	None. ☐
14. Shortcuts through site.	Lots. ☐	Some. ☐	None. ☐
15. Neighborhood pets.	Site used heavily by animals. ☐	Some use. ☐	No pet evidence observed. ☐
16. Human activity on site.	Lots of evidence of people on site. ☐	Some people use site. ☐	Very little or no evidence of people on site. ☐
17. What's growing on the site now?	Lots of unwanted trees or brush. ☐	Some unwanted trees and brush. ☐	Plants will not interfere with site plans. ☐
History of Site			
18. History of site.	Not known. ☐	Some stories may be true. ☐	Definitely known. ☐

SOIL INDICATOR SCORECARD

for Connecticut Community Gardeners

NRCS
USDA, Natural Resources Conservation Service

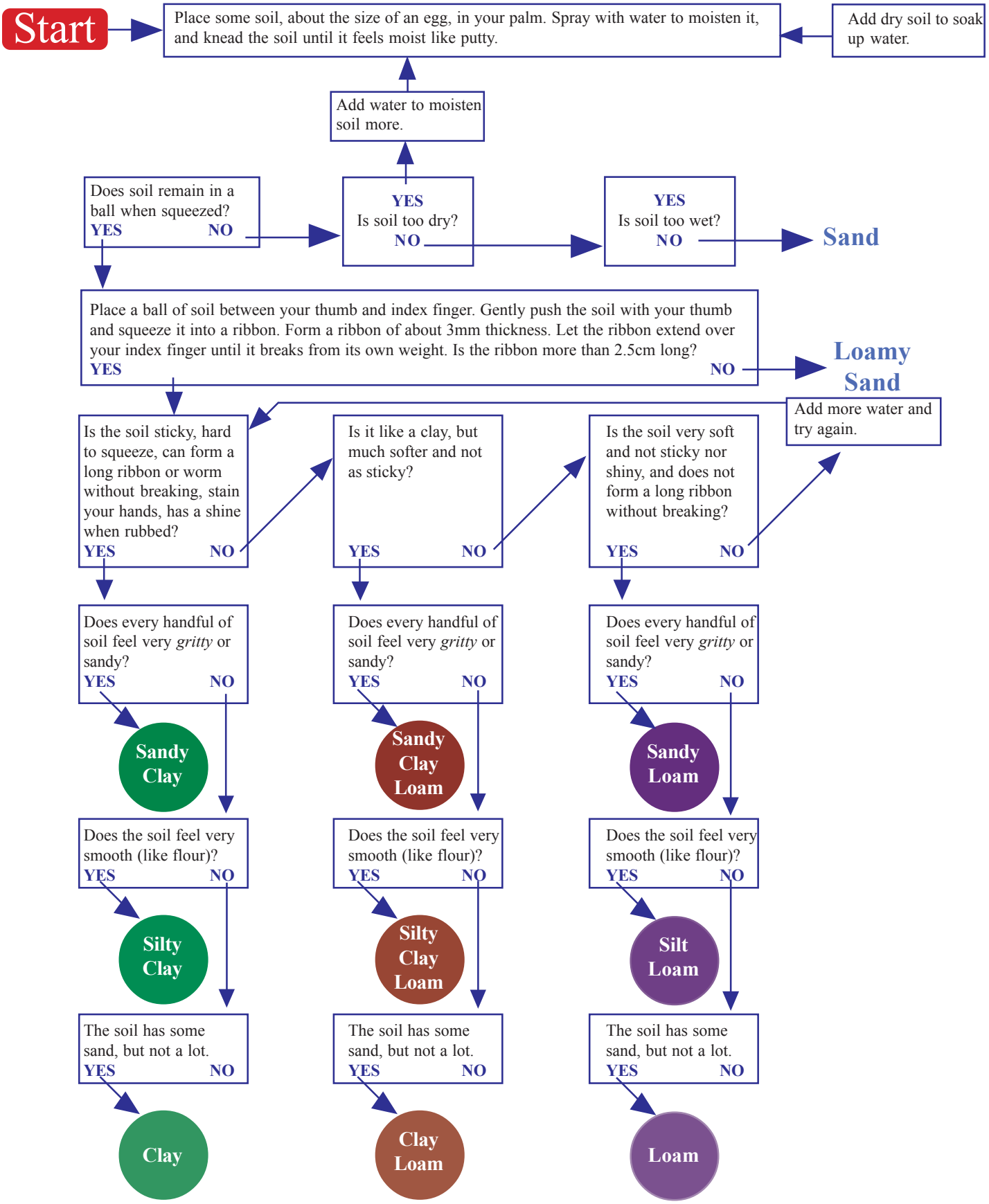
Date: _____
Site Name: _____
Form Completed By: _____

☒ *applicable box*

Soil Indicator	Poor	Tolerable	Best
19. Can you use the soil that is on the site? (Is there soil on this site?)	No. Need to bring soil to site. ☐	Some. ☐	Yes, all soil is workable. ☐
Surface of Soil			
20. Cracks on soil surface in July and August.	Many cracks. ☐	Occasional thin cracks. ☐	No cracks. ☐
21. How do existing plants grow? Compare same kind of plant.	Plants are dead or scraggly. ☐	Plant color and size are different. ☐	Plants look healthy. ☐
Soil Examination			
22. Smell of soil.	Oily, chemically, gasoline, rotten eggs, or bad or strange. ☐	No smell. ☐	Fresh, earthy. ☐
It is not possible to smell some contaminants, like lead, in the soil. Avoid the site if the soil smell is poor unless you can determine the site history is safe and environmental testing for contaminants indicates the areas is safe. Do not touch the soil if the smell is offensive.			
23. How hard is it to dig a hole two feet deep?	Not possible. ☐	Moderately difficult. ☐	Easy. ☐
24. Try to insert a wire coat hanger into soil surface two days after rainfall during the growing season.	Coat hanger bends or cannot be inserted. ☐	Coat hanger can be pushed in with pressure. ☐	Coat hanger goes in easily with fingers. ☐
	and		
	Soil feels firm. ☐	Soil feels somewhat firm. ☐	Soil feels loose. ☐
25. Depth of soil	Less than 1 foot. ☐	Between 1 and 2 feet. ☐	More than 2 feet. ☐
26. Depth of topsoil layer	0-2 inches. ☐	2-5 inches. ☐	5+ inches. ☐
27. Color of topsoil layer	Yellow, gray, multi-colored. ☐	Light brown. ☐	Black, dark brown, dark red, color is uniform. ☐
28. Moisture of soil two days after heavy rain.	Soil is very dry or very wet. ☐	Soil is somewhat dry or muddy. ☐	Soil is moist, but not muddy. ☐
29. How quickly water drains in one foot deep hole during the growing season.	Water stays in hole and doesn't drain after 15 minutes. ☐	Water drains, but less than one inch in 15 minutes. ☐	Water enters soil quickly and moves down more than one inch in 15 min. ☐
30. How does moist soil feel (texture) -- ***Use Guide to Soil Texture by Feel*** Handbook.	Sand, loamy sand, sandy clay, silty clay, or clay. ☐	Clay loam, silty clay loam, or sandy clay loam. ☐	Sandy loam, loam, or silt loam. ☐
31. How moist soil particles hold together.	Soil is hard and very difficult to break with fingers. ☐	Soil breaks apart with some difficulty with fingers. ☐	Soil crumbles easily with fingers. ☐
32. Roots in the top 12 inches of soil.	None. ☐	Some, roots grow mostly across the soil, not down. ☐	Many, roots grow mostly down into the soil, not across. ☐
33. Worms and other bugs in the soil.	None. ☐	A few. ☐	Many. ☐
34. Stones or rocks in the soil.	Too many. ☐	Some. ☐	None. ☐
35. Debris in the soil (bricks, construction materials, glass, concrete, etc.)	Too much to dig around. ☐	A little bit, doesn't interfere with digging. ☐	None. ☐
36. Rotten stumps, old trees in the soil.	Lots of stumps and trees. ☐	A few small pieces. ☐	None. ☐

Guide to Texture by Feel

Begin at the place marked ***Start*** and follow the chart by answering the questions until you determine your soil's texture.



NRCS
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Management Options

For Site Indicators Rated Poor:

Accessibility

1. Consider creating wide, easy paths to the site.
2. If the users do not have to drive to the site, parking may not be an issue.
3. Consider the safety and the potential for vandalism at the site.
4. Create winding access paths to the site across the slopes to decrease erosion potential on the paths.

Topography

5. As the slope increases, the direction of the slope becomes more important. If you have a steep north-facing slope, consider growing plants that need less sun and have a shorter growing season. ***Slope aspect*** is the direction toward which the surface of the soil faces. Slope aspect may affect soil temperature, evapotranspiration, winds received, and snow accumulation.
6. Consider designs that work around or incorporate the rock.

7., 8. Consider using rainfall and/or collecting rainfall for irrigation. Grow plants that don't need much water.

9. Reduce surface runoff by keeping soil surface covered with plants and/or mulch. Avoid planting in runoff collection areas.
10. If wet spots persist, avoid these areas or consider artificially draining the site or adding fill (if possible and permitted).

Sun Exposure

11. Most vegetables need a minimum of 4 hours of sun. Consider cutting down trees or limbs that block the sun or growing shade tolerant plants.

Current Use

12. Consider removing unwanted pavement or incorporate existing paved areas into site design.
13. Note the kind of debris. If the debris is in the soil, get a soil test done to see if the site is contaminated.
14. Consider keeping gardens out of established shortcut paths. Incorporate existing paths into the site design.
15. If this is a problem, consider creating dog walk areas or fence in gardens.
16. Can the current use of the site be accommodated or eliminated? Incorporate current land uses into the site if possible.

Existing Vegetation

17. If excessive, cut brush and consider cutting trees that obscure the sun or use shade tolerant plants.

History of Site

18. Depends on date of buildings, date of demolition, materials used, type of industry, etc. Complete soil test to see if site is contaminated.

For Soil Indicators Rated Poor:

19. If you need to bring soil to the site, you can rate the purchased soil using indicators #22, 27, 30-36.

Surface of Soil

20. Add sandy soil to the surface and plow it into the topsoil.
21. Have a soil nutrient analysis test completed. Add recommended nutrients.

Soil Examinations

22. Seek professional environmental guidance for site if soil smells strange or soil test indicates contamination.

23., 24. What is stopping the digging or coat hanger? Is it hard bedrock, debris, water, or just hard soil? ***Compaction*** occurs when soil particles are pressed together, reducing the pore space between them. This often occurs due to heavy traffic, especially when the soil is wet. If compaction is a problem, consider constructing raised beds, or add compost or organic matter to soil and rototill or plow. If bedrock is a problem, see **Management Options** #6 and #25. If wetness is a problem, see **Management Option** #23. If debris is present, see **Management Option** #35.

25. Grow short rooted plants or consider constructing raised beds.
26. Add compost or organic matter to the topsoil. ***Organic matter*** is that fraction of the soil composed of everything that once lived. It includes plant and animal remains in various stages of decomposition, cells and tissues of soil organisms, and substances from plant roots and soil microbes.
27. At least four inches of good quality topsoil, with compost or organic matter. *See* ***Purchasing Topsoil*** *handout.*
28. ***Available water capacity*** is the amount of water that a soil can store that is available for use by plants. Increase the available water capacity by adding compost or organic matter and rototill. If the soil is dry, irrigate the site. If the soil is too wet, consider properly draining the area of the excess water (if practical and permitted).
29. Observe the movement of the water in the hole after rainfall or after adding a bucket of water to the hole. If wetness is a problem, see **Management Option** #28, or grow plants that can grow in wet conditions.
30. If the soil is too sandy, add organic matter and loamy material, and if the soil is too clayey, add sandy soil. Plow or rototill the soil surface to incorporate the added soil.
31. Plow or rototill soil after adding organic matter or compost. Or consider raised beds.
32. The number and type of roots may depend on what plants are growing on the site. If the roots are horizontal or deformed, something in the soil is stopping the plants from rooting properly. Check the wetness and firmness of the soil. To improve the chance for roots to grow, add compost or organic matter and rototill the soil.
33. Increase the number of worms and bugs by adding compost or organic matter to the soil.
34. If there are a lot of stones or rocks, use them as part of the landscaping (such as a stone wall).
35. Complete a soil test to see if the site is contaminated. If soil test indicates contamination is not a problem, remove the debris by hand or screen it out.
36. Remove large stumps, if possible. Consider building raised beds or using another location.

12/2001

USDA, Natural Resources Conservation Service

University of Connecticut
Department of Plant Science
Soil Nutrient Analysis Laboratory, 6 Sherman Place, Box U-5102, Storrs, CT 06269-5102
(860) 486-4274 (phone) * (860) 486-4562 (fax)

Connecticut Environmental Laboratories That Perform Lead Testing on Soil

Northeast Laboratories, Inc. - Berlin
(860) 828-9787
$35/sample

Spectrum Analytical - Bloomfield
(860) 242-6294
$15/sample

Premier Laboratory, LLC - Brooklyn
(860) 774-6814 or (860) 334-0103
$30/one sample; $22/two or more samples*

Phoenix Environmental Laboratories, Inc. - Manchester
(860) 645-1102
$21/sample

Connecticut Testing Laboratories - Meriden
(203) 634-3731
$25/sample

Analytical Consulting Technology, Inc. - Middlebury
(203) 598-0040
$10.50/sample

Environmental Science Corporation - Middletown
(860) 632-0600
$20/sample

Baron Consulting Company - Milford
(203) 874-5678
$20/sample

EnviroAnalytical, Inc. - Monroe
(203) 459-1800
$20/sample

Hydro-Technologies - New Milford
(860) 355-8773
$20/sample

Brooks Laboratories, Inc. - Norwalk
(203) 853-9792 or (800) 843-1631
$25/sample

Eco-Science Laboratory - Norwich
(860) 889-8104
$25/sample

Severn Trent Laboratories - Shelton
(203) 929-8140
$20/sample

Environmental Analysis Corp. - Stamford
(203) 324-3811
$25/sample

Complete Environmental Testing - Stratford
(203) 377-9984
$12/sample

EAS Laboratories - Watertown
(860) 274-5461
$12/sample

York Analytical Laboratories, Inc. - Stamford
(203) 325-1371
$10/sample

many labs have discount prices on multiple samples

Appendix 3

Connecticut
Department of Environmental Protection
Inland Fisheries Division
Policy on Riparian Corridor Protection

DEPARTMENT OF ENVIRONMENTAL PROTECTION
INLAND FISHERIES DIVISION

POLICY STATEMENT
RIPARIAN CORRIDOR PROTECTION

I. INTRODUCTION, GOALS, AND OBJECTIVE

Alteration and exploitation of riparian corridors in Connecticut is a common event that significantly degrades stream water quality and quantity. Inasmuch as riparian ecosystems play a critical role in maintaining aquatic resource productivity and diversity, the Inland Fisheries Division (Division) recognizes that rigorous efforts are required to preserve, protect, and restore these valuable resources. Consequently, a riparian corridor protection policy has been developed to achieve the following goals and objective:

Goals

Maintain Biological1y Diverse Stream and Riparian Ecosystems, and

Maintain and Improve Stream Water Quality and Water Quantity.

Objective

Establish Uniform Riparian Corridor Buffer Zone Guidelines.

II. DEFINITIONS

For the purpose of implementing a statewide riparian corridor protection policy, the following definitions are established:

Riparian Corridor: A land area contiguous with and parallel to an intermittent or perennial stream.

Buffer Zone: An undisturbed, naturally vegetated area adjacent to or contained within a riparian corridor that serves to attenuate the effects of development.

Perennial Stream: A stream that maintains a constant perceptible flow of water within its channel throughout the year.

Intermittent Stream: A stream that flows only in direct response to precipitation or which is seasonally dry.

III. RIPARIAN FUNCTION

Naturally vegetated riparian ecosystems perform a variety of unique functions essential to a healthy instream aquatic environment. The delineation and importance of riparian functions are herein described. Vegetated riparian ecosystems:

- Naturally filter sediments, nutrients, fertilizers, and other nonpoint source pollutants from overland runoff.

- Maintain stream water temperatures suitable for spawning, egg and fry incubation, and rearing of resident finfish.
- Stabilize stream banks and stream channels thereby reducing instream erosion and aquatic habitat degradation.
- Supply large woody debris to streams providing critical instream habitat features for aquatic organisms.
- Provide a substantial food source for aquatic insects which represent a significant proportion of food for resident finfish.
- Serve as a reservoir, storing surplus runoff for gradual release into streams during summer and early fall base flow periods.

IV. RIPARIAN CORRIDOR BUFFER ZONE GUIDELINES

Recognizing the critical roles of riparian corridors, the Division provides buffer zone guidelines that are designed to bung uniformity and consistency to environmental review. The guidelines are simple, effective, and easy to administer. The following standard setting procedure should be used to calculate buffer zone widths.

Perennial Stream; A buffer zone 100 feet in width should be maintained along each side.

Intermittent Stream: A buffer Zone 5O feet in width should be maintained along each side.

Buffer zone boundaries should be measured from either, (1) edge of riparian inland wetland as determined by Connecticut inland wetland soil delineation methods or (2) in the absence of a riparian wetland, the edge of the stream bank based on bank-full flow conditions.

The riparian corridor buffer zone should be retained in a naturally vegetated and undisturbed condition. All activities that pose a significant pollution threat to the stream ecosystem should be prohibited.

Where the Division policy is not in consonance with local regulations and policies regarding riparian corridor buffer zone widths and allowable development uses within these areas, local authorities should be encouraged to adopt the more restrictive regulations and policies.

12/13/91
Date

James C. Moulton
Acting Director

POSITION STATEMENT
UTILIZATION OF 100 FOOT BUFFER ZONES TO PROTECT RIPARIAN AREAS IN CONNECl1CUT

BY
BRIAN D. MURPHY
TECHNICAL ASSISTANCE BIOLOGIST
INLAND FISHERIES DIVISION

I. INTRODUCTION

One tenet of the Inland Fisheries Division Policy on Riparian Corridor Protection is the utilization of a 100 foot buffer zone as a minimum setback along perennial streams. The adoption of such a policy is sure to be controversial. Laymen, developers and natural resource professionals alike will ask questions such as: Why was a standard setting method adopted? What's magical about 100 feet? Will 100 feet be sufficiently protective, or will it be overly protective? In response, this paper outlines the ramifications of adopting a riparian corridor policy including the use of a 100 foot buffer zone.

II. STANDARD SETTING VERSUS SITE SPECIFIC BUFFER ZONES

There are two approaches for determining buffer zone width; standard setting and site specific Standard setting methods define an area extending from the streambank edge or highwater mark to some landward fixed point boundary. Site specific methods utilize formulas that incorporate and consider special site specific land characteristics, hence, the calculation of a variable width buffer zone. In both case, buffers are employed to define an area in which development is prohibited or limited.

A major advantage of standard setting methods is that they are easy to delineate and administer, thereby improving the consistency and quality of environmental assessments. Furthermore, valuable staff time would not be required to determine site specific buffer ~ones along each and every watercourse of concern.

The exact width of a buffer zone required for riparian corridor protection is widely dispute (Bottom et al. 1985 and Brinson et al. 1981). Buffer width recommendations found in the literature vary from as little as 25 feet to as great as 300 feet (Palfrey et al. 1982). The 100 foot buffet is widely accepted in Connecticut having been adopted by numerous inland wetland and conservation commissions as an appropriate minimum setback regulation for streambelts. In addition, Division staff have been recommending the utilization of the 100 foot buffer zone to protect streambelts since the early 1980’s. Scientific research has not been generated to dispute the adequacy of utilizing 100 foot buffer zones protect Connecticut's riparian corridors. In fact, to ensure that riparian functions are not significantly altered, recent scientific information points towards maintaining buffer zones that would be at minimum, 100 feet in width (see section III).

Site specific methods define buffer widths according to the character and sensitivity of adjacent streamside lands. These buffer widths. also referred to as “floating buffers," consider physical s characteristics such as slope, soil type, and vegetative cover. The advantage of site specific methods that buffer widths are designed using site characteristics and not an arbitrary predetermined width. Unfortunately, there is no “one” universally accepted formula or model and none have been developed for use in Connecticut. Most formulas are based on the degree to which sediment can be removed or filtered by natural vegetation, thus, the primary useage is sediment control. Other weaknesses of site specific techniques are: (1) all areas must be evaluated on a case-by case basis and, (2) the subjectivity of different techniques (i.e. if the evaluation technique is inadequate, the buffer width will also be inadequate).

Additionally, these formulas only concentrate on one specific riparian function at a time and do not take into account multiple riparian functions, especially those of inland fisheries values as discussed in Section III. Consequently, site specific formulas approach riparian function on a single dimension rather than taking a more realistic, holistic approach.

In the absence of a scientific model to determine buffer widths suitable to protect Connecticut's riparian corridors, the utilization of a standard setting method is environmentally and politically prudent.

III. RIP ARIAN FUNCTION

To assess the efficacy of a 100 foot buffer zone, the literature was searched to identify studies which have applied a quantitative approach to buffer width determination. Literature was searched for studies which both support and dispute the 100 foot zone. The following is a summary "by riparian function" of quantitative studies which assess buffer widths.

Sediment Control

Width, slope and vegetation have been cited as important factors in determining effectiveness of buffer zones as sediment filters (Karr and Schlosser 1977). Wong and McCuen (1981), who developed and applied a mathematical model to a 47 acre watershed, found that a 150 foot zone along a 3% slope reduced sediment transport to streams by 90%. Mannering and Johnson (1974) passed sediment laden water through a 49.2 foot strip of bluegrass and found that 54% of sediment was removed from the water. Trimble and Sartz (1957) developed recommendations as to width of buffer areas between logging roads and streams to reduce sediment load. They determined a minimum strip of 50 feet was required on level land with the width increasing 4 feet for each 1% slope increase. Buffer widths as determined by Trimble and Sartz (1957) have been characterized as evaluated guesses rather than empirically defined widths (Karr and Schlosser 1977). Rodgers et al. (1976) stale that slopes greater than 10% are too steep to allow any significant detention of runoff and sediment regardless of buffer width. After a critical review of the literature, Karr and Schlosser (1977) determined that the size and type of vegetative buffer strip needed to remove a given fraction of the overland sediment load cannot be universally quantified. Existing literature does suggest that 100 foot riparian buffers will assist with sediment entrapment, although efficacy will vary according to site conditions.

Temperature Control

Brown and Brazier (1973) evaluated the efficacy of buffer widths required to ameliorate stream water temperature change. They concluded that angular canopy density (ACD), a measure of the ability of vegetation to provide shading, is the only buffer area parameter correlated with temperature control Results show that maximum angular canopy density or maximum shading ability is reached within a width of 80 feet. Study sites were 9 small mountain streams in Oregon that contained a conifer riparian vegetative complex. Whether or not maximum angular canopy density is reached within 80 feet in a typical Connecticut deciduous forest riparian zone is doubtful. Tree height in Connecticut riparian zones is smaller than in Oregon (Scarpino, personal communication); therefore buffers greater than 80 feet in width would be required for temperature maintenance in Connecticut.

Nutrient Removal

Nutrient enrichment is caused by phosphorous and nitrogen transport from, among other things fertilized lands and underground septic systems. Most research on nutrient enrichment has focused on overland surface flow. Karr and Schlosser (1977) report that 88% of all nitrogen and 96% of all phosphorous reaching watercourses in "agricultural watersheds" were found to be attached to sediment particles; thus, successful nutrient removal can be accomplished through successful sediment removal. There are conflicting reports on the ability of buffer widths to remove nutrients with most research being

tested on grass plots. Butler et al. (1974) as cited by Karr and Schlosser (1977) found that a 150 foot buffer width of reed canary grass with a 6% slope caused reductions in phosphate and nitrate concentrations of between 0-20%. Wilson and Lehman (1966) as cited by Karr and Schlosser (1977) in study of effluent applied to 300 m grass plots found that nitrogen and phosphorous concentrations were reduced 4 and 6%, respectively. Studies on subsurface runoff as cited in Clark (1977) found high concentrations of nitrates at 100 feet from septic systems with unacceptable levels at 150 feet. Clark (1977) recommended that a 300 foot setback be used whenever possible, with a 150 setback considered adequate to avoid nitrate pollution. Environmental Perspective Newsletter (1991) states that experts who commonly work with the 100 foot buffer zone set by the Massachusetts Wetlands Protection Act are increasingly finding that it is insufficient since many pollutants routinely travel distances far greater than 100 feet with nitrate-nitrogen derived from septic systems moving distances of greater than 1000 feet. Research indicates that the adoption of 100 foot buffer widths for Connecticut riparian zones will assist with the nutrient assimilation; 41lbeit, complete removal of all nutrients may not be achieved.

Large Woody Debris

The input of large woody debris (LWD) to streams from riparian zones, defined as fallen trees greater than 3 m in length and 10 cm in diameter has been recently heralded as extremely critical to stream habitat diversity as well as stream channel maintenance. Research on large woody debris input has mainly been accomplished in the Pacific Northwest in relation to timber harvests. Murphy and Koski (1989) in a study of seven Alaskan watersheds determined that almost all (99%) identified sources of LWD were within 100 feet of the streambank. Bottom et al. 1983 as cited by Budd et al. (1987) confirm that in Oregon most woody structure in streams is derived from within 100 feet of the bank. Based on research done within old-growth forests, the Alaska region of the National Marine Fisheries Service, recognizing the importance of LWD to salmonid habitat, issued a policy statement in 1988 advocating the protection of riparian habitat through the retention of buffer strips not less than 100 feet in width (Murphy and Koski 1989). All research findings support the use of a 100 foot buffer zone in Connecticut for large woody debris input.

Food Supply

Erman et al. (1977) conducted an evaluation of logging impacts and subsequent sediment input 10 62 streams in California. Benthic invertebrate populations (the primary food source of stream fishes) in streams with no riparian buffer strips were compared to populations in streams with buffer widths of up to 100 feet. Results showed that buffer strips less than 100 feet in width were ineffective as protective measures for invertebrate populations since sediment input reduced overall diversity of benthic invertebrates. Buffer strips greater than 100 feet in width afforded protection equivalent to conditions observed in unlogged streams. The ultimate significance of these findings is that fish growth and survival may be directly impacted along streams with inadequate sized riparian buffer zones. All research supports the feasibility of implementing a 100 foot buffer zone in Connecticut to maintain aquatic food supplies.

Streamflow Maintenance

The importance of riparian ecosystems in terms of streamflow maintenance has been widely recognized (Bottom et al. 1985). In Connecticut, riparian zones comprised of wetlands are of major importance in the hydrologic regime. Riparian wetlands store surplus flood waters thus dampening stream discharge fluctuations. Peak flood flows are then gradually released reducing the severity of downstream flooding. Some riparian wetlands also act as important groundwater discharge or recharge areas. Groundwater discharge to streams during drier seasonal conditions is termed low flow augmentation. The survival of fish communities, especially coldwater salmonid populations is highly dependent upon low flow augmentation (Bottom et al. 1985). Research, although documenting the importance of riparian

zones as areas critical to streamflow maintenance, has not investigated specific riparian buffer widths required to provide the most effective storage and release of stream flows.

IV. OTHER POLICY CONSIDERATIONS

Measurement Determination

The proposed policy states that buffer zone boundaries should be measured from either the edge of the riparian inland wetland as determined by Connecticut inland wetland soil delineation methods or in the absence of a riparian wetland, the edge of the streambank based on bank-full flow conditions. This boundary demarcation is' absolutely necessary to ensure that all riparian wetlands are protected. For example, if all measurements were to start from the perennial stream edge and extend landward for a distance of l00 feet, many riparian zones that contain expansive wetlands greater than 100 feet in width would be left unprotected.

Also, since boundary demarcation includes wetland delineation, the ultimate width of the buffer will vary according to site specific features. Consequently, buffer width determination as stated by Division policy is a “hybridization” of both standard setting and site specific methods. This hybridization of methods is advantageous since it acknowledges the sensitivity of streamside wetlands.

Home Rule

Where the Division policy is not in consonance with local regulations and policies regarding riparian corridor buffer zone widths; local authorities would be encouraged to adopt the more restrictive regulations and policies. This feature incorporates flexibility to acknowledge the importance of local "home rule" regulations or policies already in accepted practice. Conversely, towns and cities without accepted policies and regulations could choose to enact the Division policy.

Allowable Uses in Buffer Zones

The Division policy states that “the riparian corridor buffer zone should be retained in a naturally vegetated and undisturbed condition and that all activities that pose" significant pollution threat to the stream ecosystem should be prohibited.” In essence, the buffer zone becomes an area where no development should be allowed. For this policy to be effective, there should be no exceptions, a blanket restriction of all uses would be recommended. Further clarification and more precise definitions of allowable U5CS will, however, be required in the future if the policy evolves into a departmental regulation.

Recently, the Connecticut Supreme Court has ruled that local agencies can prohibit specific development within buffer zones. The *Lizotte v. Conservation Commission of the Town of Somers, 216 Conn.320 (1990)* decision ruled that the construction or maintenance of any septic system, tank, leach field, dry well, chemical waste disposal system, manure storage area or other pollution source within 150 feet of the nearest edge of a watercourse or inland wetland's seasonal high water level can be prohibited (Wetlands Watch 1990). If this decision is a precursor of the future, Connecticut courts will continue to the support the use of buffers, especially those which restrict or prohibit detrimental activities.

V. CONCLUSIONS

The following actions are required to preserve, protect, and restore Connecticut's riparian corridors:

1. The Inland Fisheries Division needs to adopt and implement the proposed policy so that staff can use it as a guideline to assist cities, town, developers, and private landowners with making sound

land use decisions. This policy will act to solidify a collective position concerning riparian corridor protection.

2. While the proposed policy in its "current form," represents a recommendation from the CTDEP Inland Fisheries Division, the ultimate goal of the Division, the ultimate goal of the Division should be to progressively implement this policy as either a CTDEP regulation or State of Connecticut statute.

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Appendix 4

Non-Native, Invasive Plants

The following information has been made available by the Connecticut Invasive Plant Working Group. The plant list and criteria used for listing plants were developed by Dr. Leslie Merhoff of the George Safford Torrey Herbarium, at the University of Connecticut, in conjunction with the State Geological and Natural History Survey of Connecticut and the Connecticut Invasive Plant Working Group. For up-to-date information, visit the Invasive Plant Working Group website at www.hort.uconn.edu/CIPWG.

Connecticut Invasive Plant Working Group's January 2003 Invasive and Potentially Invasive Plant List

Alphabetized by Connecticut NRCS* by common name.

Non-native, invasive plants are followed by potentially invasive plants.

The letters (W, R, or P) after the common name refer to the status of the plant.

W = Widespread and Invasive (has invasive characteristics and causes serious management concerns or poses a serious threat to the biological diversity of the state. *Widespread* is used for seriously invasive plants that are widespread in Connecticut).

R = Restricted and Invasive (has invasive characteristics and causes serious management concerns or poses a serious threat to the biological diversity of the state. Restricted refers to distribution in Connecticut being restricted to a particular region or habitat type).

P = Potentially Invasive (has invasive characteristics and is behaving invasively somewhere in or near Connecticut).

Has Invasive Characteristics = not native, but survives in the wild and has the biological potential for (1) rapid and widespread dispersion and establishment; (2) dispersing over spatial gaps away from the site of introduction, and (3) existing in high numbers away from intensively managed artificial habitats.

NON-NATIVE, INVASIVE PLANTS

Common Name		Scientific Name	Synonym 1	Synonym 2
Amur Honeysuckle	**R**	*Lonicera maackii*		
Asiatic Bittersweet	**W**	*Celastrus orbiculatus*		
Autumn Olive	**W**	*Elaeagnus umbellata*		
Bella Honeysuckle	**W**	*Belle Honeysuckle*	*Lonicera* x *bella*	
Black Locust	**W**	*Robinia pseudoacacia*		
Black Swallow-wort	**W**	*Cynanchum louiseae*	*Vincetoxicum nigrum*	*Cynanchum nigrum*
Brazilian Water-weed	**R**	*Egeria densa*	Anacharis	
Buckthorn	**W**	*Rhamnus cathartica*	Common Buckthorn	
Coltsfoot	**R**	*Tussilago farfara*		
Common Reed	**W**	*Phragmites australis*	Phragmites	
Cottonweed	**W**	*Froelichia gracilis*		
Crispy-leaved Pondweed	**W**	*Potamogeton crispus*	Curly Pondweed	
Cypress Spurge	**W**	*Euphorbia cyparissias*		
Dame's Rocket	**W**	*Hesperis matronalis*		
European Buckthorn	**W**	*Frangula alnus*	Glossy Buckthorn	*Rhamnus frangula*
European Water-milfoil	**R**	*Myriophyllum spicatum*		
Fanwort	**R**	*Cabomba caroliniana*		
Forget-me-not	**R**	*Myosotis scorpioides*	True Forget-me-not	Water Scorpion-grass
Garden Loosestrife	**R**	*Lysimachia vulgaris*		
Garlic Mustard	**W**	*Alliaria petiolata*		
Hydrilla	**R**	*Hydrilla verticillata*		
Japanese Barberry	**W**	*Berberis thunbergii*		
Japanese Honeysuckle	**W**	*Lonicera japonica*		
Japanese Hops	**R**	*Humulus japonicus*		
Japanese Knotweed	**W**	*Fallopia japonica*	*Polygonum cuspidatum*	
Japanese Stilt Grass	**W**	*Microstegium vimineum*		
Lesser Celandine	**R**	*Ranunculus ficaria*		
Mile-a-minute Vine	**R**	*Polygonum perfoliatum*		
Morrow's Honeysuckle	**W**	*Lonicera morrowii*		
Multiflora Rose	**W**	*Rosa multiflora*		
Narrowleaf Bittercress	**W**	*Cardamine impatiens*	(Cardamine impatiens)	
Porcelain berry	**R**	*Ampelopsis brevipedunculata*		
Purple Loosestrife	**W**	*Lythrum salicaria*		
Spotted Knapweed	**W**	*Centaurea maculosa*	*Centaurea biebersteinii*	
Swallow-wort	**W**	*Cynanchum rossicum*	*Vincetoxicum rossicum*	Pale Swallow-wort
Tall Pepperwort	**R**	*Lepidium latifolium*		
Tree-of-heaven	**W**	*Ailanthus altissima*		
Variable Water-milfoil	**R**	*Myriophyllum heterophyllum*		
Water Chestnut	**R**	*Trapa natans*		
Watercress	**W**	*Nasturtium officinale*	True Watercress	
Wineberry	**R**	*Rubus phoenicolasius*		
Winged Euonymus	**W**	*Euonymus alatus*	Winged Burning Bush	
Yellow Iris	**W**	*Iris pseudacorus*		

*The Natural Resources Conservation Service (NRCS) is a member of the Connecticut Invasive Plant Working Group (CIPWG), a group whose mission is "to gather and convey information on the presence, distribution, ecological impacts, and management of invasive plant species; to promote uses of native or non-invasive ornamental alternatives throughout Connecticut; and to work cooperatively with researchers, conservation organizations, government agencies, the green industries, and the general public to identify and manage invasive species pro-actively and effectively." For further information on CIPWG, visit www.hort.uconn.edu/CIPWG/

POTENTIALLY INVASIVE PLANTS

Common Name		Scientific Name	Synonym 1	Synonym 2
American Water Lotus	P	*Nelumbo lutea*		
Amur Maple	P	*Acer ginnala*		
Barberry	P	*Berberis vulgaris*	Common Barberry	
Border Privet	P	*Ligustrum obtusifolium*		
Brooklime	P	*Veronica beccabunga*		
California Privet	P	*Ligustrum ovalifolium*		
Canada Blue-grass	P	*Poa compressa*		
Canada Thistle	P	*Cirsium arvense*		
Climbing Nightshade	P	*Solanum dulcamara*		
Cup-plant	P	*Silphium perfoliatum*		
Drooping Brome-grass	P	*Bromus tectorum*	Cheatgrass	
Elsholtzia	P	*Elsholtzia ciliata*		
Empress-tree	P	*Paulownia tomentosa*		
Eulalia	P	*Miscanthus sinensis*	Chinese Silvergrass	
European Fly-honeysuckle	P	*Lonicera xylosteum*		
European Privet	P	*Ligustrum vulgare*		
Eutrophic Water-nymph	P	*Najas minor*		
False Indigo	P	*Amorpha fruticosa*		
Flowering-rush	P	*Butomus umbellatus*		
Garden-heliotrope	P	*Valeriana officinalis*		
Giant Hogweed	P	*Heracleum mantegazzianum*		
Giant Knotweed	P	*Fallopia sachalinensis*	Polygonum sachalinense	
Gill-over-the-ground	P	*Glechoma hederacea*	Run-Away Robin	
Goutweed	P	*Aegopodium podagraria*		
Japanese Rose	P	*Rosa rugosa*		
Jimson-weed	P	*Datura stramonium*		
Kudzu-vine	P	*Pueraria lobata*		
Leafy Spurge	P	*Euphorbia esula*		
Moneywort	P	*Lysimachia nummularia*		
Nepalese Crane's-bill	P	*Geranium nepalense*		
Norway Maple	P	*Acer platanoides*		
Parrotfeather	P	*Myriophyllum aquaticum*		
Pond Starwort	P	*Callitriche stagnalis*	(Callitriche stagnalis)	
Ragged Robin	P	*Lychnis flos-cuculi*		
Reed Canary-grass	P	*Phalaris arundinacea*		
Russian Olive	P	*Elaeagnus angustifolia*		
Scotch Thistle	P	*Onopordum acanthium*		
Sheep Sorrel	P	*Rumex acetosella*		
Silver Hairgrass	P	*Aira caryophyllea*		
Small Carpgrass	P	*Arthraxon hispidus*	(Arthraxon hispidus)	
Smartweed species	P	*Polygonum caespitosum*	(Polygonum caespitosum)	
Star of Bethlehem	P	*Ornithogalum umbellatum*		
Summer Cypress	P	*Kochia scoparia*		
Sycamore Maple	P	*Acer pseudoplatanus*		
Tall Impatiens	P	*Impatiens glandulifera*		
Tall Mannagrass	P	*Glyceria maxima*		
Tatarian Honeysuckle	P	*Lonicera tatarica*		
Water Shamrock	P	*Marsilea quadrifolia*		
White Poplar	P	*Populus alba*		
Wild Garlic	P	*Allium vineale*		
Yellow Floating Heart	P	*Nymphoides peltata*		

NRCS Natural Resources Conservation Service

For more invasive plant information from Connecticut NRCS, visit www.ct.nrcs.usda.gov/plants.html

Appendix 5

Streamwalk Survey Sheets

The following forms are the basic models for survey sheets used to collect information during streamwalks. Although the forms were developed for use in Connecticut, the format should be usable in most wade-able fresh water streams. A training manual and other supporting information are also available from Connecticut NRCS at www.ct.nrcs.usda.gov.

STREAM SEGMENT SURVEY SHEET

Make all observations facing *DOWNSTREAM*.

NAME(S): _____ **DATE(S):** _____
PHONE(S): _____ **NAME OF STREAM:** _____
DRAINAGE BASIN CODE: _____ **SEGMENT CODE:** _____

NOTE: Items marked with an asterisk (*) may indicate an impairment.

Did you survey this whole section of the stream? ❑ Yes ❑ No
(Which section(s) were not surveyed? Why?)

1. **Describe Location and Extent of Segment** *(i.e. from _____ to _____)*. **If Possible, Use Landmarks and Road Names:**

2. **Average Water Depth:** _____ ft. **Average Water Width:** _____ ft.

3. **How would you describe this section of the stream? Check any that apply:**
   _____ Cascade _____ Step-Pool sequence _____ Pool-Riffle sequence _____ Glide
   _____ Run _____ Steep (slope > 3%) _____ High Gradient (1% < slope <3%) _____ Flat (slope <1%)
   _____ Piped _____ Channeled _____ Lined (stone, concrete)
   _____ Flood control or water reservoir area or lake (>5ac.)
   _____ Other (Describe):

4. **Streambank Cover/Vegetation:**

Type	***Few***	***Common***	***Abundant***
Confers (pines, higher than 20 ft.)	_____	_____	_____
Deciduous (oaks/maples, higher than 20 ft.)	_____	_____	_____
Small trees and shrubs (smaller than 20 ft.)	_____	_____	_____
Grasses/Emergent (cattails/rushes)	_____	_____	_____
Lawns*	_____	_____	_____
Natural Rock/Ledge	_____	_____	_____
Artificial (concrete/riprap/walls/buildings)*	_____	_____	_____

   Are streambank soils mostly exposed? ❑ **Yes*** ❑ **No**

5. **Looking downstream, estimate the average uninterrupted width of riparian vegetation:**
   Right side: _____ <25'* _____ 25-100' _____ >100'
   Left side: _____<25'* _____ 25-100' _____ >100'

6. **Estimate the number of:**
   Impoundments (small ponds*, dams*) _____ Discharge pipes* _____

For more information, contact the Natural Resources Conservation Service (860) 887-4163, (860) 871-4011
or the Department of Environmental Protection, Bureau of Water Management (860) 424-3096
June 1999

7. Visually Describe Water Conditions:

_____ Clear _____ Turbid* _____ Green* _____ Rusty-Red*
_____ Yellow-Brown* _____ Roamy* _____ Oil Slicks* _____ Milky*

Are discharge pipes or overland runoff associated with changes in water conditions? ❑ Yes* ❑ No

Comments:

8. Describe Aquatic Vegetation:

A. Algae Growth:

_____ Everywhere* _____ Floating _____ Matted on Substrate
_____ In Spots _____ Hairy _____ Brown
_____ Absent _____ Scum _____ Green

B. Large Vascular Aquatic Plants:

_____ Everywhere* _____ Floating free (duck weed) _____ Submerged rooted
_____ In spots _____ Floating rooted (water lily) (eel grass, Elodea)
_____ Absent _____ Submerged free (coontail, milfoil) _____ Emergent (cattails, rushes)

Are discharge pipes or overland runoff associated with algae blooms? ❑ **Yes*** ❑ **No**

Comments:

9. Approximate Composition (%) of Substrate Materials (sum should equal 100%):

_____% Silt or Clay (smooth)* _____% Sand (gritty)* _____% Gravel (.1-2")
_____% Cobbles (2-10") _____% Boulders (>10") _____% Bedrock
_____% Concrete or Riprap _____% Organic (plant debris, muck, and shells)

Do you see excessive fine sediment deposits on the streambanks, or sediment deltas originating from storm pipe outlets, tributaries, or overland runoff? ❑ **Yes*** ❑ **No**

Comments:

10. Immediately Adjacent Land Uses: **Label: 1 = Most 4 = Least**

_____ Rural Residential _____ Suburban _____ Agricultural _____ Industrial
_____ Urban Residential _____Forest _____ Commercial _____ Recreational
_____ Schools _____ Non Residential Roads

11. Additional Comments or Observations:

12. Impaired Sites

Site Number	Type of Impairment(s)	Describe Location (Locate and Label in Map)	Description of Site

Label: Assign a number to each impaired site you identify starting with the number 1.
Impairments: Excessive algae growth, Barriers to fish passage (dams, culverts above low flows, obstructions higher than 8 inches), Litter Sedimentation, Streambank erosion, Lack of riparian vegetation, Discharges (from pipes or channels), Channelization or Streambank Manipulation, etc.
Location: Approximate distance and direction from nearest landmarks (i.e., Roads, Buildings, Power Lines, etc.)
Description: Describe conditions – water colors, smells, algae and large aquatic plant growth, adjacent land uses, potential sources of pollution, etc.

Appendix 6

Riparian Area Inventory

These worksheets may be used in conjunction with, or in addition to, the streamwalk survey sheets in order to get a full description of the riparian area above the stream and the land uses associated with the water resource. The inventory has three sections that include a physical and land use description of three zones, and the most impacting land use within 500 feet of the stream. The Assessment Worksheet is used to prioritize areas of concern within the riparian area. The Action Matrix is the first step in producing an action plan to implement preservation, restoration, or enhancement of the riparian areas.

RIPARIAN AREA INVENTORY

The Riparian Area Inventory is intended as a follow up for Stream Teams, Conservation Commissions, Watershed Associations or Watershed Teams who have identified areas that would benefit from a riparian restoration project. Many of these groups have completed a Shoreline Survey (identifying problems that should be mitigated and natural resources that should be protected) and proposed an Action Plan. The Riparian Area Inventory is intended to be a follow up survey to help groups implement the portions of their Action Plans that deal with riparian buffers. This Riparian Area Inventory examines the land use adjacent to the stream and looks at the functions of this area with respect to the river.

Rivers and streams are dynamic and changing, Erosion of a stream bank can be a natural part of the process, or it can be exacerbated by lack of vegetation. Re- vegetation can be very effective on small and medium sized streams where loss of vegetation has its greatest impact. Placing native vegetation on eroded stream banks can stabilize the soil and stream bank and provide habitat for wildlife. The intent of the survey is to find areas that can not only benefit from vegetative -native species -restoration but are suitable for a volunteer project.

Things to consider as you choose preliminary sites. (1) Volunteers must have a site where they can work safely. Avoid sites where the flow of the stream or the steepness of the site could provide danger. (2) Projects must be relatively simple. Avoid choosing sites that would threaten structures, bridge abutments, foundations or sewer pipes, or areas that require regrading and/or heavy machinery .When in doubt get technical help and consult the Conservation Commission.

The Riparian Area Inventory includes four steps leading to implementation

1. Background Work
    a. Shoreline Survey
    b. Preliminary choice of areas to survey
    c. Evaluation of type of natural landscape
    d. Orientation using USGS topographic maps and aerial maps
2. Field Work: Inventory Data Sheets
    a. Riparian Area Inventory describes the physical nature of the riparian corridor
    b. Land Use Sheets describes the specific land uses
3. Assessment Sheets and Action Matrix
    a. Riparian Area -Forested
    b. Riparian Area -Nonforested
4. Action Plan

By bringing the information together -the background work, the inventory, and the assessment, Stream Teams can determine which site is the most likely to benefit from restoration.
The assessment and the riparian inventory will take into account the resource priority or physical attributes of the riparian buffer. The Action Matrix takes into account several other criteria such as management objectives, feasibility, and funding sources. The Stream Team's Action Plan will include 'tasks and steps restl1lting in implementation of the riparian restoration.

Riparian Area Inventory Sheets

As part of your background work, you should use topographic maps to determine the length of your survey areas. Once you have determined the area, you can do a preliminary reconnaissance to determine potential problems with access and safety issues. In general, the minimum length of your area should be l00 feet and the maximum length should be 1000 feet. This allows the data collector to obtain the information in a reasonable amount of time and still be accurate. Other guidelines that could be used would be continuous land use type, the area of similar buffer or vegetated widths, and changes in stream width.

Riparian Area Inventory: The purpose of the inventory is primarily to gather data about the site. The Riparian Area Inventory looks at three zones and the land uses within 500 feet of the stream. **Zone 1** is the stream side zone or plant community adjacent to the stream. **Zone 2** is the middle zone or area directly outward from zone 1. **Zone 3** is the buffer's "buffer" or land directly outward from Zone 2 and within 500 feet. The major historical plant community associated with riparian buffers is a mature forest, although on certain sites, the historic plant community might be shrubs or grass.

Zone 1 begins at the top of the stream bank and occupies a strip of land with a fixed width of fifteen (15) feet measured horizontally on a line perpendicular to the streambank. You are asked to describe physical characteristics as well as vegetation in this zone. This zone is important because it is adjacent to the stream and is the area of the interface of land and water. This zone has the potential to be important habitat, to filter pollutants, to provide shading for temperature control, to prevent erosion, and to contribute necessary large woody debris to the stream ecosystem. For the most benefit to the stream this section should be in trees or shrubs.
If clear cut and inappropriately used, it has the potential to be a barrier to wildlife, to bring nonpoint source pollution runoff into the stream, to allow raised temperatures, and to encourage erosion and sedimentation. Vegetation in this zone should not be disturbed, and where absent should be reestablished. Vegetation on the east and south bank provide the most shade.

Zone 2 begins at the edge of Zone 1 and occupies an additional strip of land with a minimum width of twenty (20) feet measured horizontally in the direction of flow. Total minimum widths of Zone 1 and 2 is therefore 35 feet. Zone 2 may be increased to create a greater combined width for Zone 1 and 2. The width of Zone 2 depends on the purposes of the buffer. In general, 45 feet is a good multifunction width for Zone 2, but the width varies depending on stream order, extent of the 100 year floodplain, adjacent steep slopes or protected wetland areas. This width will provide wildlife habitat, including travel corridors and cover, as well as a filtering area for nutrients and other pollutants. This zone should also be in trees and shrubs for the maximum benefit to the stream. In forested areas, periodic harvesting of vegetation is encouraged in order to maintain vigorous growth and leaf litter replacement and to remove nutrients and pollutants sequestered in the form of wood in tree boles and large branches. Shade levels and production of leaf litter, detritus and large woody debris still must be maintained.

Zone 3 begins at the outer edge of Zone 2 and is often mowed grass and forbs. Zone 3 is used to convert concentrated flow to uniform, shallow sheet flow before the water enters Zone 1 and 2. This zone is usually at least 25 feet or more.

Land Use Inventory

The purpose of this portion of the survey is to characterize land use and vegetation in the selected areas. In other words, identify the present and historic or original plant communities. This sheet asks for data on all three zones. Information on this sheet will help you choose what your management goal is for this segment. Inventorying the land use within 500 feet of the stream is also important because it provides information about the type or condition of the water flowing into the riparian area. This will have an impact on the target width of Zone 2 and the importance of Zone 3. In many areas, Zone 3 will be developed and you will want to determine how flow is getting through to Zone 2. This information will also assist in identifying areas that need preservation, enhancement or restoration.

For example, if the land use within 500 feet of the stream is a mowed residential lawn up to the stream bank, then Zone 3 might not be necessary and Zone 2 could be increased from the minimum, depending on the landowner's objectives. At this site, enhancement may be the management goal. On the other hand, if the land use within 500 feet is primarily paved with a bit of grass in Zone I, restoration of Zone 1 and 2 may be your management goal. If pipes are present, Zone 3 would be used to divert flow from a pipe and slow it down prior to entering Zone 2. Due to land use constraints, Zones 2 and 3 may be narrower than the ideal or may not be possible in certain locations.

Riparian Area Inventory

Name _____ Date_____ Time _____Segment _____(min 100'), (max 1000')
Weather conditions today_____
Weather Past 3-5 days _____

Basic Information

Stream Side Zone 1 - ≥ 15 ft

Zone width_____ft. **Zone slope_____%** **Av. Tree ht.____ft.**

- ☐ **Constructed Steam Bank**
- ☐ **vertical wall**
- ☐ **constructed slope**
- ☐ **Natural Stream Bank**
- ☐ **grass**
- ☐ **brush**
- ☐ **trees**
- ☐ **eroding soil**
- ☐ **Bare soil**
- ☐ **Slumping Bank**
- ☐ **Gully Entering Stream**

Aspect (E,W,N,S)_____ **Stream width _____ft.**

Stream Side Zone 1 vegetative information. **Describe** _____

_____

_

_____

_

Plant Information Trees present ☐

Spacing between trees and shrubs ☐ 0 -10 ft between trees or shrubs ☐ 10-20 feet ☐ > 20 ft

Some trees hanging over or in stream ☐

Density of grass ☐ Thick (bare soil on < 10%) ☐ adequate

☐ sparse (bare soil < 25% surface)

Types of plants (common names)

trees_____

_____

shrubs_____

_____

herbs _____

_____

Shading

- ☐ well shaded 100-80%
- ☐ moderately shaded 80-50%
- ☐ some shade 50-25%
- ☐ <25%

Ground cover

- ☐ sod
- ☐ bare soil
- ☐ turf
- ☐ forest duff (leaves, needles, mulch)
- ☐ shrubs & herbaceous plants

Other remarks:

Riparian Area Inventory

Name _____ Segment _____

Middle Zone 2 - ≥ 20 ft

Width _____ft. Slope _____ft.

- ☐ **bare soil ___%**
- ☐ **paved**
- ☐ **gravel or compacted soil**
- ☐ **Buildings**
- ☐ **grass-** ☐ **mowed** ☐ **unmowed**
- ☐ **shrubs--** ☐ **continuous cover** ☐ **scattered**
- ☐ **trees--** ☐ **continuous cover** ☐ **scattered**
- ☐ **land use Type** _____

Middle Zone 2 Vegetative information. Describe_____

_____

_____

Plant Information Trees present ☐

Spacing between trees and shrubs ☐ 0 -10 ft between trees or shrubs ☐ 10-20 feet ☐ > 20 ft

Density of grass ☐ Thick (bare soil on < 10%) ☐ adequate

☐ sparse (bare soil < 25% surface)

Types of plants (common names)

Trees_____

_____

Shrubs_____

_____

Herbs_____

_____

Shading

☐ Well-shaded 100-80% ☐ moderately shaded 80-50% ☐ some shade 50-25% ☐ <25%

Ground cover

☐ sod ☐ bare soil ☐ turf ☐ forest duff (leaves, needles, mulch) ☐ shrubs & herbaceous plants

Other remarks:

Name _____Segment _____ Page 3

Buffer's buffer Zone 3
Describe_____

_____

__

_____

Width _____ **Slope** _____

- ☐ bare soil__%
- ☐ paved ☐ grass--- ☐ mowed ☐ unmowed
- ☐ gravel or compacted soil ☐ shrubs--☐ continuous cover ☐ scattered
- ☐ Buildings ☐ trees-- ☐ continuous cover ☐ scattered
- ☐ land use Type _____

Other remarks:

Most Impacting Landuse (within 500 ft) Describe_____

_____

_

_____

Width _____ **Slope** _____

- ☐ bare soil __%
- ☐ paved ☐ grass--- ☐ mowed ☐ unmowed
- ☐ gravel or compacted soil ☐ shrubs-- ☐ continuous cover ☐ scattered
- ☐ Buildings ☐ trees-- ☐ continuous cover ☐ scattered
- ☐ Other explain_____

_____

Name _____ Segment _____

Land Use Inventory

Wildlife use ☐ No evidence of wildlife ☐ wildlife present

☐ birds ☐ mammals ☐ amphibian/reptiles

Types of wildlife (Common names)_____

Birds_____

Mammals_____

Amphib./Reptiles_____

☐ wildlife having a negative effect on riparian area, ☐ grazing, ☐ erosion

Wildlife habitat

Buffer segment is continuous over 2 or more stream segments both up and down stream ☐

Buffer segment connects across stream to buffer on opposite side ☐

Plants with berries, nuts or cones present ☐ or possible ☐

"Edge" of large trees, shrubs and unmowed vegetation present ☐

Snags ☐, dens ☐, burrows ☐, rock piles ☐, cliffs ☐ or caves ☐ present

Threatened or endangered plants ☐ animals ☐ if known or possible

Forest land use

☐ No evidence of recent harvest ☐ Recent harvest (<5 yrs) stumps present

☐ Currently being harvested

☐ 100% removal of trees ☐ 50 -99% removal ☐ less than 50% removal

☐ Evidence of erosion from any sources reaching the stream

☐ Evidence of historic plant community. Describe_____

Residential use ☐ evidence of people accessing the water body ☐ no access

(for private residences or housing complexes) ☐ Paths to the water use__ ☐ Other signs of private use_____

Urban/rural Land Use ☐ Lawns ☐ Natural area ☐ Garden area ☐ Playground

☐ Buildings ☐ Other _____

☐ Erosion (describe) _____

Name _____Segment _____ Page 5

Land Use Inventory

Agricultural use

☐ abandoned, no mowing ☐ abandoned, periodic mowing ☐ Tilled soil

☐ pasture ☐ contour farming ☐ strip crops ☐ grassed buffer

☐ Evidence of erosion from any sources reaching the stream

Describe erosion _____

Commercial/Industrial ☐ Raised beds with curbing ☐ raised beds, no curbs

☐ paved, good cond. ☐ bare ground or stones

☐ paved, poor cond. ☐ grass, managed ☐ wild, unmanaged

Pollution describe_____

Other Information

Storm Water

☐ storm water pipes present #_____ ☐Flowing ☐ Not Flowing

☐ ditches present #_____ ☐Flowing ☐ Not Flowing

Distance from outlet of pipe or ditch to the stream or brook _____ft.

Describe water in pipe or ditch:_____

☐ Catch basins or drains present # _____ ☐Clean ☐ Debris

☐ Overland flow through vegetation ☐ Overland flow with pavement and curbs

Suitability for a volunteer project:

1. **Describe erosion:**

2. **Describe slope:**

3. **Describe trash and debris:**

4. **Describe evidence of public use and or ownership if known:**

5. **Management Objective: Preservation___ Enhancement___ Restoration___**

6. **Proposed Management Alternatives:**

Assessment Worksheet

The Assessment takes the information gathered in the Inventory Sheets and gives you the ability to determine which section of the riparian area has the greatest potential for restoration, enhancement, or preservation. A low score represents a need for restoration, while a high score may indicate a good area for preservation.

Before using the assessment pages …

1. Locate an ideal riparian buffer site and evaluate it using the assessment sheets.
2. Compare the results to the sites in question.

By locating an *ideal* riparian buffer site on your stream, you will be able to compare what your sire looks like with a healthy buffer system. The ideal buffer site will depend on the broader ecosystem that you are trying to protect to enhance. For example, in a coastal salt marsh you could try to find the healthiest or widest sections of marsh and look at those for habitat elements such as native vegetation or tidal creeks. In a forested ecosystem, you would look for an area with a good canopy and shade, leaf litter, and an understory. It may not be practical or desired to exactly recreate the ideal buffer at the site in question, but it provides a basis for comparison. It is important to identify the habitat elements present in a healthy buffer that are important for that particular ecosystem, as well as the aspects of the buffer that serve to remediate pollution. You should try to enhance or restore as many habitat elements from the native ecosystem as practical.

This assessment only evaluates the physical attributes of the riparian buffer; the next step is to use an action matrix which incorporates other criteria such as feasibility, management objectives, management alternatives, and funding sources.

Riparian Buffer Assessment Worksheet

Name _____ Segment _____

Highest Value: Buffer with a 35 foot uncut stream zone and a managed, healthy, vigorous forest for 65 feet with no soil disturbance up-slope from the forested zone. Buffer has large and tall trees nearest the bank. Trees are as tall as the stream is wide and some overhang. ***TALLY THE POINTS.***

Forest Cover (70 points maximum)

1. How Wide is the Buffer? (Zone 1 and Zone 2 combined).
   Add **10 points** for every 20 feet of trees growing within 100 feet of the stream. _____

   Add **5 points** for every 20 feet of shrubs or thick, uncut grass (no trees) within 100 feet of the stream. +_____

2. What is the Composition of the Buffer?
   Add **10 points** for a mixed softwood and hardwood stand. +_____

   Add **10 points** for a dense (>80% cover) understory of shrubs or saplings. +_____

Effectiveness of Forest Cover

1. Add **10 points** if the spacing between the trees is 0-10 ft. or the trees provide continuous cover (cover/management). +_____
2. How Much Shade Does the Buffer Provide to the Stream?
   Add **10 points** if the buffer is located to the east or south of the stream (aspect). +_____
3. How High is the Buffer?
   a. The buffer tree height is ½ the stream width.
   b. The buffer tree height is as tall as the stream is wide.
      (Add **5 points** for (a); and **10 points** for (b)) +_____

.

Overland Flow

1. What is the Major Up-Slope Land Cover?
   a. The major up-slope land cover is trees.
   b. The major up-slope land cover is thick, unmowed grass/shrubs.
   c. The major up-slope land cover is agricultural crops/mowed grass (lawns).
   d. The major up-slope land cover is pavement.
      (Add **10 points** for (a); **5 points** for (b); **2 points** for (c); and **0 points** for (d)). +_____

2. Add **10 points** if there are no signs of surface flow (gullies, swales) or subsurface pipes entering the stream. +_____

Woody Debris (Habitat) and Length

1. Add **10 points** if some trees are hanging over the stream or have fallen in the stream. +_____

2. Add **10 points** if the buffer is continuous over 2 or more stream segment lengths up and down stream. +_____

Riparian Buffer Assessment Worksheet Guide

USE: This Guide is intended to accompany a riparian area survey in order to rank the effectiveness of a buffer in terms of multiple functions. A more specific and technical assessment can be accomplished with the SVAP developed by NRCS.

Before Using:

1. Locate an ideal riparian buffer site and evaluate.
2. Adjust the points based on the priority concerns. If large, woody debris is the concern, adjust point value to reflect this function importance.
3. Ground test the ranking procedure with an excellent, moderate, and poor site and adjust ranking points to meet desired results.

Forest Cover – Riparian Forest Buffers are the best vegetative cover for multiple benefits. Mixed forest of various species are much better than single, and allow for vigorous growth. Over harvesting, removal of enough trees to allow complete sunlight to reach the surface over a large surface, removes too many trees that could be absorbing nutrients. Likewise, the removal of trees from the stream edge removes or prevents the potential for large, woody debris from entering the stream system.

Water Flow – Any time a riparian buffer is compromised by the presence of a direct flow ditch, stream, or pipe, the buffer fails to complete its function. The situation is greatly worsened by any erosion that may be associated with the ditch, stream, or pipe. Buffers are also influenced greatly by water flow from different types of up-slope land uses. For example, impervious surfaces may concentrate flow; whereas agricultural fields or lawns may spread flow out or filter flow prior to entering the buffer.

Location – Buffer on particular sides of the stream are of greater importance in respect to shading.

Height – The larger and taller a buffer is in respect to the stream, the greater the value in providing shading and stream detritus.

Woody Debris and Length – The presence of woody debris greatly enhances fish habitat values. Wildlife and recreational functions are enhanced by long, continuous lengths of riparian areas on both sides of the stream.

ACTION MATRIX USER GUIDE

The ACTION MATRIX worksheet can be used in conjunction with the shoreline survey, riparian buffer, and wildlife habitat inventories to help assess, prioritize, and provide alternative actions for problems identified in the watershed.

STREAM SEGMENT

This information identifies the stream and section surveyed.

PROBLEM LOCATION/EXISTING CONDITION

This information identifies the location of the segment and its present condition. The present condition describes the damage in economic and resource terms.

PROBLEM/OPPORTUNITY CATEGORY

The Problem Category identifies the basic area of concern or resource being affected, such as wildlife or fish habitat, dam removal, riparian buffer, water quality, sedimentation, point source pollution.

RESOURCE PRIORITY

The Priority rating comes from the individual segment assessments completed previously by the volunteers. This rating is numerical with the lower total number being a priority for restoration efforts. The priority rating identifies the potential for restoration between segments. The assessment takes into account information on the historic and present plant community. In urban settings, it is often essential that the riparian corridor should be protected by a wide (100 feet or more) stream buffer, preferably made up of the original plant community.

FEASIBILITY

The feasibility rating comes from various locally identified social concerns and issues, such as landowner concerns, economic considerations, present land use vs. proposed land use. There is also the consideration that the project site can be maintained and protected. This rating can be numerical with each concern or issue being given one point and the lower total would be more feasible for restoration.

This means that the segment with the least concerns is the more feasible project. This factor also includes the likelihood that the problem can be solved and the estimated time it will take to solve the problem.

Feasibility Criteria

1. <u>Ability to Influence Change</u>
   Does the Stream Team have some ability to affect the change? For example, have funds, by obtaining a grant or have volunteer time and other non-financial resources.

2. Delay Between Actions and Results
   Can the problem be solved quickly, or will it take a long time? For example, it may take decades to see results from changes on the land that ultimately affect a deep aquifer, but changes near a streambank may quickly affect the quality of the stream's water. Early successes motivate more action and some actions rely on other actions for success.

3. Willingness to Change
   Do you have cooperative landowners? Or does the situation have a critical safety or health issue?

4. Cost/Benefit Ratio
   What is the return on funds to be invested? Will the cost outweigh the benefits or will the benefits outweigh the cost?

5. Consider Existing Legal Constraints – including existing federal, state, and local permitting requirements.

MANAGEMENT OBJECTIVE

This information identifies what management is necessary for a stream segment. If possible, describe the objective in measurable terms. Some examples of management objectives that could be used are preservation, enhancement, or restoration. ALL stream segments should have a management objective.

MANAGEMENT ALTERNATIVES

This information contains suggested conservation practices that may be used as a solution to the problem or alternatives for meeting the management objectives of that stream segment. Make sure to document the advantages and disadvantages of each alternative (this may be addressed under feasibility). This information will help when obtaining funding for projects.

Here are Some Management Alternatives/Actions that Might be Considered:

TECHNICAL ASSISTANCE

- Construction site erosion control
- Filter (grass) or buffer strips (grass and/or trees and shrubs)
- Reduced dumping of oil and/or chemicals in storm sewers
- Tree and shrub plantings (native species only)
- Home water conservation
- Septic system maintenance
- Roadside erosion control (plunge pools, culvert installation)
- Private/rural road maintenance
- Storm water management (sediment basins, diversions, level lip spreaders)
- Stream bank stabilization (bio-engineering, riprap)
- Constructed wetlands
- Riparian zone management
- Upland and wetland wildlife habitat maintenance and enhancement
- Forest stand improvement
- Tree and shrub pruning
- Critical area planting
- Urban forestry

- Removal of exotic and/or invasive species
- Vegetated swales
- Porous pavement
- Cessation of mowing or careful timing of mowing
- Human or livestock exclusion

REGULATORY

- Local ordinances and zoning
- Reduction of land-disturbing activities
- Limit impervious surface area in the watershed
- Eradication of invasive species
- Tax advantages
- Direct purchase of land or easement

INFORMATION/EDUCATION

- Information/Education Campaign

SOURCES OF FUNDING

This information identifies sources of funding for possible solutions. The following are a few that might be used:

- EPA 319 grants
  - Demonstration plots
  - Watershed Tours
  - Workshops
  - Cost Sharing
- EPA 604B grants
- U.S. Forest Service Grants
  - Forest Legacy Program
  - Rural Development
- SARE Grants
  - Demonstration Plots
- Cooperative Extension Grants
- NRCS Programs (cost sharing and educational grants)
  - Environmental Quality Incentives Program (EQIP)
  - Wetland Reserve Program (WRP)
  - Wildlife Habitat Incentives Program (WHIP)
- Nature Conservancy
- Trout Unlimited

REMARKS

Any other pertinent information related to the problem. This may include information on how progress will be monitored.

REFERENCES

Stream Corridor Restoration, Principles, Processes, and Practices. October 1998. The Federal Interagency Stream Restoration Working Group, USDA.

Conservation Corridor Planning at the Landscape Level: Managing for Wildlife Habitat. September 1998. Johnson, Craig W., Department of Landscape Architecture and Environmental Planning, Utah State University. Wildlife Habitat Management Institute. USDA-NRCS.

Appendix 7

A Land Owners Guide to Land Preservation Options

The Land Preservation Alliance provided the information contained in this appendix. The Land Preservation Alliance is a non-profit tax-exempt organization based in Litchfield, Connecticut. Its purpose is to provide education, expertise and hands-on assistance to non-profit land preservation organizations to help them act proactively to preserve the lands in the Northwest Corner of Connecticut that are most in need of preservation because of their importance ecologically, aesthetically, or for recreation.

To enhance the likelihood of increasing quality land preservation in the Northwest Corner, the Land Preservation Alliance also provides education and assistance to landowners and local officials on various topics related to land preservation including conservation options available to landowners and their tax consequences, the beneficial effect of land preservation on the local tax base, and the role of land trusts in land preservation.

Laurie Boynton, a Cornell Law School graduate who has worked in environmental law, land preservation, and contract negotiations for 18 years, formed the Land Preservation Alliance in the fall of 1998. She has served as the Director of Land Protection and the Director of the Land Trust Service Bureau for The Nature Conservancy, as Legal Counsel to the Commissioner of the Connecticut Department of Environmental Protection, and as an attorney in the environment section of the Connecticut Attorney General's office.

LAND PRESERVATION ALLIANCE

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A Landowner's Guide to Land Preservation Options

November, 1999

Current Programs and Funding for Land Preservation in Connecticut

Non-profit land conservation organizations

1. Land Trusts – local and regional (see separate list)

Non-profit, non-government land preservation charities. Generally town by town, although some are regional. Land trusts are operated by residents as volunteers; only 3 of 35 in and adjacent to Litchfield County have paid staff. Historically, land trusts did not buy land – but this is changing (e.g., Southbury Land Trust and Platt Farm). As private non-profit organizations, land trusts need to raise money through donations for operations and for each property they buy. Land Trusts can also help landowners in working with other organizations and with governments.

2. Other non-profit, non-government conservation organizations that accept or buy land

National Audubon Society - Audubon in Sharon*; Bent of the River, Southbury
Connecticut Audubon Society, Hartford: (860) 527-8737
Housatonic Valley Association* - Housatonic River watershed
The Nature Conservancy, Middletown – (860) 344-0716
- focuses on protection of land that is important for rare species
Connecticut Forest and Park Association*

Town Government

All towns are authorized to accept donations of land and to buy land. They are also authorized to set up a fund for the purchase of open space,[1] which may be funded by taxes or the issuance of bonds. Towns are also eligible for DEP matching grants to buy open space, as discussed below. Open space planning and acquisition activity varies widely by town, with some Connecticut towns having no activity and others funding millions of dollars of acquisitions.

State Government

1. Connecticut Department of Environmental Protection (DEP)

In 1997, the legislature adopted a goal of having at least 10% of the state's 3 million-acre land area owned by the state as open space (currently at approx. 7%). In 1999, the legislature set goals for the number of acres to be acquired by DEP in each year through 2002, and adopted an additional goal of having at least 11% of the state's land area held by towns, water companies and nonprofit land conservation organizations as open space.

(over)

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* These organizations are listed in the list of sponsors for this seminar.
[1] Section 7-131r of the Connecticut General Statutes.

Connecticut Department of Environmental Protection (DEP) – **cont'd.**

(a) Recreation and Natural Heritage Trust Program
Contact: Beth Varhue, DEP Land Acquisition (860) 424-3016

This program was dormant for nearly 5 years before the legislature revived it in 1998. $20 million has been approved in each of the next two years for DEP to purchase land. The budget for the second year can be altered next Spring, so ongoing support in the legislature for this program will be important. DEP generally only purchases land outright, and does not work with the other land preservation options we've discussed.

(b) DEP matching grant program for land trusts, municipalities and water companies
Contact: Dave Stygar, DEP Land Acquisition (860) 424-3016

This program was created in 1998. $12 million has been approved in each of the next two years for DEP to give matching grants to land trusts, municipalities and water companies to purchase land or conservation easements. The grants range from 40-65% of the cost (generally 40% for land trusts and most towns). The budget for the second year can be altered next Spring, so ongoing support in the legislature for this program will be important.

Grant applications are evaluated using a point system that ranks the value of the land in many areas, including recreation, forestry, wildlife, rare species, farmland, fisheries and water resources. A number of other issues include: whether the land is adjacent to other protected land; whether partnerships are being used to preserve the land; whether the funds to match the grant are available; whether the landowner has agreed to sell for conservation, and the cost of the land related to its appraised value; the level of threat that the land will be developed; the amount of open space in the area; and consistency with state, regional and local plans. In order to qualify, public access to the land for passive recreation must be allowed. Grant applications are accepted in the November and April, with decisions two months later.

2. Connecticut Department of Agriculture

Farmland Preservation Program – Purchase of Development Rights
Contact: Joseph J. Dippel (860) 713-2511

Although this program has $5 million in funding appropriated for the purchase of development rights on farmland, the State Bond Commission has not approved any farmland preservation projects presented to in the last year, and it only approved 2 purchases the year before. There is currently a backlog of over 200 projects. A change in the state law to provide "lump-sum" bonding for the program, as was done for DEP in 1998, instead of needing Bond Commission approval for each purchase could break the logjam.

Federal Government

U.S. Department of Agriculture

Farmland Preservation Program – the USDA has a program that may be available for farmland preservation in Connecticut. Contact the USDA Natural Resources Conservation Service in Torrington for further information: (860) 626-8258.

Forest Legacy Program – a program that pays up to 75% of the cost for a conservation easement on or outright purchase of environmentally important forest lands. Generally, the land is then owned, or the easement held, by the USDA. Since 1990, two parcels, totaling 225 acres, have been protected in Connecticut under this program; another two, totaling 250 acres are in negotiation. Contact: Fred Borman at DEP (860) 424-3630.

Appendix 8

Connecticut Commercially Available Riparian Trees and Shrubs

This appendix was written to provide some of the information needed to make decisions about plant selection based on plant suitability to site conditions. Details about Connecticut Soils Groups, Plant Hardiness Zones, and Ecoregions are included.

8A Connecticut Soils Groups Information
8B Plant Hardiness Zones Map

Connecticut Commercially Available Native Trees and Shrubs for Use In Riparian Buffer Plantings

NAME	Soil Group	Hardiness Zone	Height 10yr; 20yr; average ultimate	Tolerance to Shade	Wildlife Value	Habitat
Evergreens						
Atlantic White Cedar (*Chamaecyparis thyoides*)	2a, 2h, 10	3	10 ft; 20 ft; 80 ft	Low	Low food value. Winter cover.	Fresh water swamps or wet woods, and acid peat beds.
American Holly (*Ilex opaca*)	2, 2a, 2h, 3, 3a, 4	5	N/A; 20 ft; 60 ft	Medium	Moderate food value. Many songbirds feed on the fruit. A few other species compete with the birds for the	Grows in a variety of conditions, but prefers deep moist bottomlands.
Eastern Red Cedar (*Juniperus virginiana*)	4, 5, 5a, 6, 6a, 6ga, 7	2	N/A; 25 ft; 80 ft	Low	High food value. Fruit widely eaten. Winter cover.	Wide range from low wet swampy areas to dry rock outcrops with thin soils. Abundant in old fields.
Black Spruce (*Picea mariana*)	2h	2	8 ft; 20 ft; 85 ft	High	Low food value. Winter cover	Flatlands and lake margins.
Pitch Pine (*Pinus rigida*)	2h, 6a, 6ga, 7, 10	2	N/A; 20 ft; 80 ft	Low	High food value. Seeds and twigs widely eaten. Winter cover.	Sandy and gravelly areas along river valleys and low coastal areas.
Eastern White Pine (*Pinus strobus*)	5a, 6, 6a, 6ga, 7	3	10 ft; 40 ft; 150 ft	Medium	High food value. Seeds, needles, twigs, and bark are widely eaten. Winter cover.	Widely distributed. Abundant in old fields. Prefers dry woodlands.
DECIDUOUS TREES						
Red Maple (*Acer rubrum*)	2a, 2h, 3, 3a, 4, 5, 5a	3	20 ft; 35 ft; 60 ft	High	Moderate food value. Seed and twigs are eaten by some species.	Grows in a variety of conditions, from coastal areas to the mountains, from dry hills to swamps.

NAME	Soil Group	Hardiness Zone	Height 10yr; 20yr; average ultimate	Tolerance to Shade	Wildlife Value	Habitat
Silver Maple (*Acer saccharinum*)	2, 3, 4, 5	3	25 ft; 45 ft; 75 ft	High	Moderate food value. Seed and twigs are eaten by some species.	Prefers wet areas on floodplains, along streams, ponds, and lakes.
Sugar Maple (*Acer saccharum*)	2, 3, 4, 5	2	10 ft; 20 ft; 100ft	High	High food value. Many species feed on the seeds, twigs, and bark.	Well drained lowlands.
Black/Sweet/Cherry Birch (*Betula lenta*)	3, 3a, 4, 5, 5a	3	N/A; 15 ft; 60 ft	Medium	Moderate food value. Seeds and twigs eaten by some species.	Wide range of habitats, from low coastal elevations to high mountains. Prefers moist, rich, well drained soils, but can be found in rocky or stony areas.
Gray Birch (*Betula populifolia*)	5, 5a, 6, 6a, 6ga, 7	3	15 ft; 40 ft; 40 ft	Low	Moderate food value. Seeds and twigs eaten by some species.	Wet or dry sandy or gravelly soil. Pioneer species in abandoned open areas.
American Hornbeam (*Carpinus caroliniana*)	3, 3a, 4, 5, 5a	3	N/A; 18 ft; 40 ft	High	Low food value. A few species eat the seeds.	Understory of moist forested bottomlands, swamps, and river margins.
Bitternut Hickory (*Carya cordiformis*)	4, 5, 5a, 6, 6a, 6ga	4	10 ft; 30 ft; 100 ft	Medium	Low food value. Bitter nut occasinally eaten by some rodents.	Prefers rich bottomlands. Can be found in frequently flooded areas and on drier hillsides.
Shagbark Hickory (*Carya ovata*)	4, 5, 5a, 6, 6a	4	3 ft, 15 ft, 80ft	Medium	Moderate food value. Nuts are valuable food for some species.	Grows in upland slopes and in deep, well drained soils in lowlands and valleys.
White Ash (*Fraxinus americana*)	3, 4, 5	3	18 ft; 40ft; 90 ft	Medium	High food value. Seeds, twigs, and leaves are eaten by many species.	Along streams and lower slopes of hills.

NAME	Soils Group	Hardines Zone	Height 10yr; 20yr; average ultimate	Tolerance to Shade	Wildlife Value	Habitat
Green Ash (*Fraxinus pensylvanica*)	2, 3, 4	2	N/A; 30 ft; 60 ft	Medium	High food value. Seeds, twigs, and leaves are eaten by many species.	Along streambanks, floodplains, and wet upland sites.
Black Walnut (*Juglans nigra*)	3, 4	4	26 ft; 35 ft; 90 ft	Low	Low food value. Squirrels are the primary consumers of the nuts.	Low altitudes, including well drained soils of bottomlands and fllodpains.
Black Gum/Tupelo (*Nyssa sylvatica*)	2, 2a, 3, 3a	5	13 ft; 30 ft; 80 ft	High	High food value. Fruits and twigs are eaten by many species.	Two varieties. Typical Black Tupelo occurs in uplands and stream bottoms. Swamp Tupelo (biflora) occurs in wet bottomlands with heavy organic or clay soils.
American Sycamore (*Platanus occidentalis*)	3, 4, 5, 5a, 6, 6a, 10	3	15 ft; 65 ft; 100 ft	Medium	Low food value. Very few species eat the seeds.	Lowlands, including floodpains and river valleys, along streams and rivers. Tolerates very wet conditions.
Eastern Cottonwood (*Populus deltoides*)	2, 3, 5	4	32 ft; 80 ft; 130 ft	Medium	High food value. Buds, twigs, foliage, and bark are eaten by many species.	Moist lowlands near rivers, streams, and swamps.
Bigtooth Aspen (*Populus grandidetata*)	5, 6, 6a, 6ga, 7	2	32 ft; 40 ft; 65 ft	Low	High food value. Buds, twigs, foliage, and bark are eaten by many species.	Well drained sandy soils along streams, lakes, and swamp borders.
American plum (*Prunus americana*)	3, 3a, 4, 5, 5a	3	N/A; 25 ft; 25 ft	Low	High food value for many species.	Rocky and sandy soils along streams. Pioneer species in abandoned open areas.
Swamp White Oak (*Quercus bicolor*)	3, 3a, 4	4	30 ft; N/A; 100 ft	Medium	High food value. Large crops of acorns are valuable food for many species.	Lowlands, along the edges of swamps, wet flats, and meadows.

NAME	Soils Group	Hardines Zone	Height 10yr; 20yr; average ultimate	Tolerance to Shade	Wildlife Value	Habitat
Pin Oak (*Quercus palustris*)	2, 2a, 3, 3a, 4	4	70 ft	Low	High food value. Large crops of acorns are valuable food for many species.	Lowlands, primarily wet flats, and floodplains. Tolerates short periods of flooding.
Northern Red Oak (*Quercus rubra*)	4, 5, 5a, 6, 6a	4	26 ft; 36 ft; 100 ft	Low	High food value. Large crops of acorns are valuable food for many species.	Mostly found in upland hills, but can be found in river valleys and ravines.
Black Willow (*Salix nigra*)	2, 2a	3	25 ft; 50 ft; 100 ft	Low	Low food value. A few species feed on the shoots and on the inner bark.	Does well in almost any soil, but requires a constant supply of water to their root system. Common along streams, pond edges, and low wet sites.
American Elm (*Ulmus americana*)	3, 3a, 4, 5, 5a	2	20 ft; 50 ft; 120 ft	Medium	Low food value. Dutch Elm Disease tends to kill tree before it produces seeds. Potentially a good source of woody debris in streams.	Bootomlands, flats, floodplains, ravines, and protected slopes. Grows in a wide variety of soil conditions.
Small Trees and Shrubs						
Winterberry (*Ilex verticillata*)	2, 2a, 2h, 3, 3a, 4	3	13 ft; 20 ft; 20 ft	Medium	Moderate food value. Many songbirds feed on the fruit. A few other species compete	Swamps, bogs, streams, and wet areas.
Indigo/Silky Dogwood (*Cornus amomum*)	2, 2a, 2h, 3, 3a, 4	3	N/A; 7 ft; 10 ft	Medium	High food value. Many species feed on the fruit, twigs, and leaves.	Along streams, rivers, and moist sites.

NAME	Soils Group	Hardines Zone	Height 10yr; 20yr; average ultimate	Tolerance to Shade	Wildlife Value	Habitat
Flowering Dogwood (*Cornus florida*)	5, 5a, 6, 6a, 6ga	5	N/A; 30 ft; 60 ft	High	High food value. Many species feed on the fruit, twigs, and leaves.	Found in the forest understory in a variety of conditions, from light well drained upland soils to moist soils along streams and lower slopes.
Red-osier Dogwood (*Cornus sericea*)	2, 3, 4, 5	2	N/A; 6 ft; 9 ft	Medium	High food value. Many species feed on the fruit, twigs, and leaves.	Along streams, rivers, and moist sites.
Elderberry/American Elder (*Sambucus canadensis*)	2, 3, 4	4	N/A; 7 ft; 12 ft	Low	Moderate food value. Many songbirds feed on the fruit. A few other species compete with the birds for the fruits.	Along streams and rivers in disturbed open areas, including margins of woodlands and fence rows, with rich moist soils,
Highbush Blueberry (*Vaccinum corymbosom*)	2a, 2h, 3a, 5a	3	5 ft; 10 ft; 10 ft	High		Found in wet meadows and forested wetlands. Thrives in acid muck or peaty wetland soils, grows well in dry open sites.
Northern Arrowwood (Viburnum dentatum)	2, 2a, 2h, 3, 3a, 4	2	N/A; N/A; 12 ft	Medium		Moist thickets.
Nannyberry (*Viburnum lentago*)	2, 2a, 2h, 3, 3a, 4, 5, 5a	2	7 ft; 13 ft; 13 ft	Medium	High food value. Many species feed on the fruit, twigs, and leaves.	Along the edges of woodlands, streambanks, and swamps.
American/Highbush Cranberry (*Viburnum trilobum*)	2a, 2h, 3, 4, 5	3	N/A; 6 ft; 12 ft	Low	Moderate food value. Many songbirds feed on the fruit. A few other species compete with the birds for the fruits.	Edge of woodlands, moist woods, and bogs.

8A – CONNECTICUT
Soils Groups Information

The Soil Groups of Connecticut were developed to group soils that are likely to support similar plant species on the basis of shared physical and chemical characteristics. By using the soil groups and the following trees and shrubs list as references, one can select plants that are suited for the project site. The soil survey map of the area can be use to determine soil types at the site. Some soil names used in the original soil surveys (published from 1962 to 1983) have been changed and may not appear on this list. For updated soil survey information, contact your local Natural Resources Conservation Service office.

Group 2, Wet Soils:
- Alden
- Bash
- Fluvaquents
- Fredon
- Halsey
- Lim
- Limerick
- Loonmeadow (Lyme)
- Maybid
- Mudgepond (Massena)
- Raynham
- Rippowam
- Saco
- Scitico
- Shaker

Group 2a, Wet and Acid Soils:
- Brayton
- Leicester
- Menlo
- Raypol
- Ridgebury
- Walpole
- Whitman
- Wilbraham

Group 2H, Wet and Organic Soils:
- Bucksport
- Catden (Carlisle)
- Freetown
- Natchaug (Palms)
- Scarboro
- Timahwa (Adrian)
- Wonsqueak

Group 3, Moist Soils:
- Amenia
- Georgia
- Hadley
- Nellis
- Stockbridge
- Winooski

Group 3a, Moist and Acid Soils:
- Broadbrook
- Cheshire
- Wapping
- Watchaug

Group 4, Slightly Moist & Restricted:
- Belgrade
- Berlin
- Bernardston
- Brancroft
- Elmridge
- Fullam

Group 5, Slightly Moist:
- Ashfield

Group 5a, Slightly Moist and Acid:
- Bice
- Dummerston
- Lanesboro
- Ludlow
- Rainbow
- Schroon
- Sutton
- Woodbridge

Groups 6, Dry:
- Copake
- Groton
- Hero

Group 6a, Dry and Acid:
- Agawam
- Branford
- Brookfield
- Canton
- Charlton
- Chatfield
- Ellington
- Enfield
- Hartford
- Haven
- Macomber
- Merrimac
- Millsite
- Montauk
- Ninigret
- Paxton
- Shelburne
- Sudbury
- Tisbury
- Wethersfield
- Yalesville

Group 6ga, Dry, Acid, & Gravelly:
- Gloucester
- Hinckley
- Narragansett
- Occum
- Pootatuck

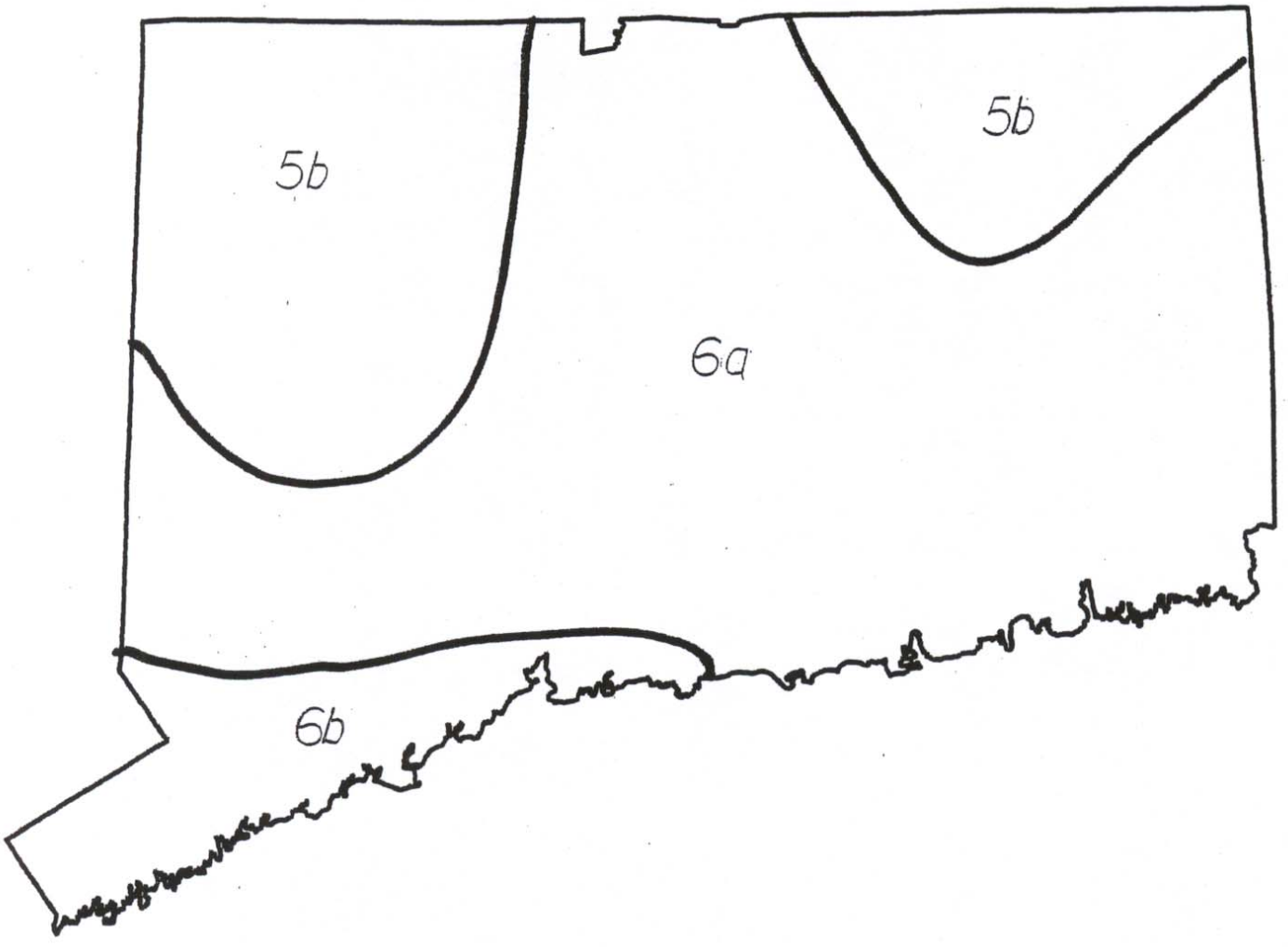
Group 7 Dry & Sandy Surface:
- Deerfield
- Manchester
- Penwood
- Suncook
- Udipsamments
- Windsor

Group 10, Limited:
- Beaches
- Brimfield
- Dumps
- Farmington
- Hollis
- Holyoke
- Ipswish
- Pawcatuck
- Pits
- Rock outcrop
- Taconic
- Udifluvents
- Udorthents
- Urban Land
- Westbrook
- Westminster

8B – CONNECTICUT
Plant Hardiness Zone Map

Hardiness zone limits have proven useful in planning selections of trees and shrubs. Hardiness zones are areas based on minimum temperatures, a factor that affects the survival and growth of many plants. There are three plant hardiness zones in Connecticut, zones 5b, 6a and 6b. Plants with hardiness zones equal to or less than 6b are adapted to Connecticut's climate.

Zone 5b: -15º to -10º F
Zone 6a: -10º to -5º F
Zone 6b: -0º to -5º F



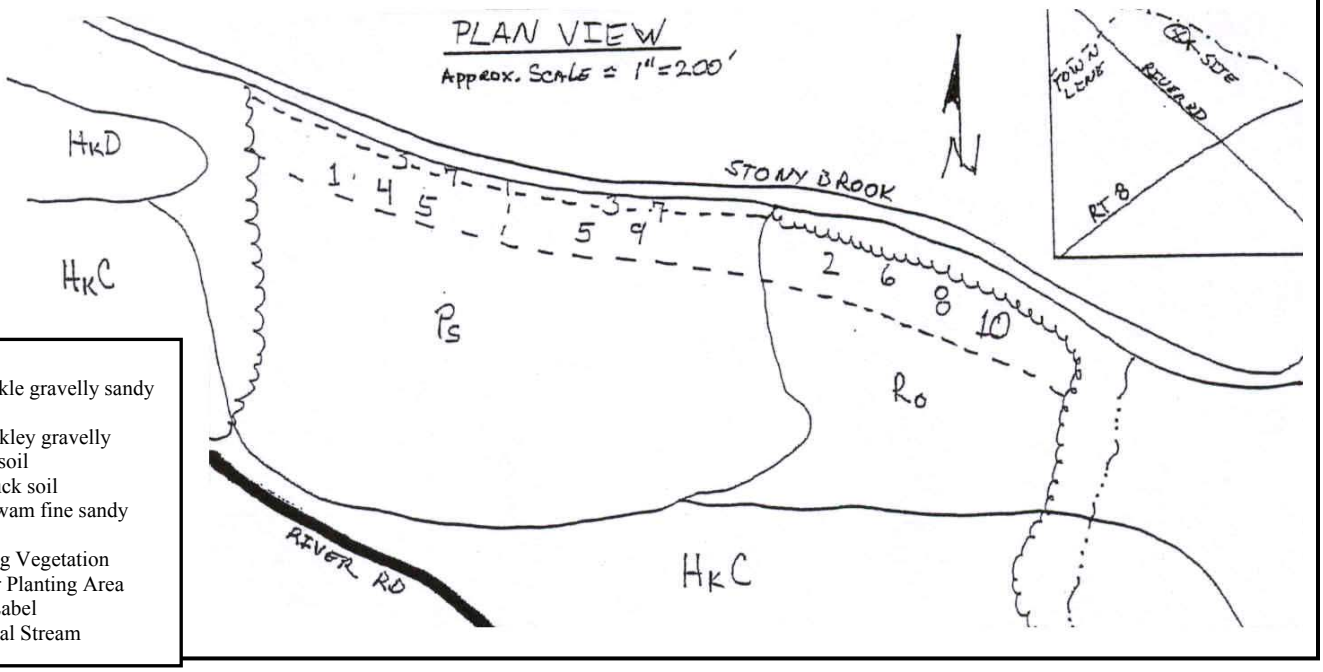
Appendix 9

Sample Riparian Buffer Planting Plan

Stony Brook
Riparian Buffer Restoration Plan

Project Sponsors:
Stony Brook Watershed Association
Town Land Trust
USDA Natural Resources Conservation Service

Buffer Length 950 ft., **Buffer Width** 75 ft.



Legend:
HkC – Hinckle gravelly sandy loam soil
HkD – Hinckley gravelly sandy loam soil
Ps – Pootatuck soil
Ro – Rippowam fine sandy loam soil
- Existing Vegetation
- Buffer Planting Area
1 2 - Plant Label
- Seasonal Stream

Notes:
1. Plant on early spring, April 15 to June 15. Keep plants moist and shaded during planting.
2. The plants should have well-developed pliable branches and adequate buds. Leaves should not be discolored or desiccated, or show spotting indicative of potential disease or nutrient stress.
3. Plants should have the specified size. Container plants should be upright and firmly rooted. Inspect for circling, kinked, or "J" roots.
4. The trunk should be free of injury. There should be no insect egg masses or fungi on the branches or trunk.
5. The root collar should be placed at the same level as the original soil.
6. 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 spreads out in the planting hole. Backfill, water, and mulch.

Maintenance:
Plants may need to be watered during the first year if drought conditions occur. Inspect site yearly for the next two tears to identify maintenance needs. Look for signs of weed or invasive plant competition, deer browsing, and vandalism.

Planting Schedule:

Label	Plant Name	Scientific Name	Size	Pattern/Spacing	Quantity
1	Big tooth Aspen	*Populus grandidentata*	Bare root seedlings (6" to 12")	@ 5 ft.	180
2	Black Gum	*Nyssa sylvatica*	1 to 2 Gal. Container (12" to 18")	@30 ft.	5
3	Elderberry	*Sambucus canadensis*	Bare root seedlings (6" to 12")	@ 5 ft.	120
4	Eastern Red Cedar	*Juniperus virginiana*	1 to 2 Gal. Container (12" to 18")	@30 ft.	10
5	Gray Birch	*Betula populifolia*	Bare root seedlings (6" to 12")	@ 5 ft.	360
6	Highbush Blueberry	*Vaccinum corymbosoum*	1 to 2 Gal. Container (12" to 18")	@ 15 ft.	140
7	Nannyberry	*Viburnum lentago*	Bare root seedlings (6" to 12")	@ 5 ft.	120
8	Red Maple	*Acer rubrum*	Bare root seedlings (6" to 12")	@ 5 ft.	12
9	Shagbark Hickory	*Carya ovata*	1 to 2 Gal. Container (12" to 18")	@30 ft.	15
10	Swamp White Oak	*Quercus bicolor*	1 to 2 Gal. Container (12" to 18")	@30 ft.	12

Appendix 10

Riparian Forested Buffer References

Buffers for Wetlands and Surface Waters - A Guidebook for New Hampshire Municipalities. University of New Hampshire Cooperative Extension, New Hampshire Office of State Planning, Audubon Society of New Hampshire, USDA NRCS. November 1995.

Buffer Strips for Riparian Zone Management – A Literature Review. US Army Corps of Engineers, New England Division, Waltham, MA. Prepared for the State of Vermont. January 1991.

Chesapeake Bay Riparian Handbook: A Guide for Establishing and Maintaining Riparian Forest Buffers, NA-TP-02-97. USDA Forest Service Northeastern Area - Forest Resource Management - State and Private Forestry, Radnor, PA. 1997.

Environmental Land Planning Series; Site Planning for Urban Stream Protection (95708), December, 1995. Center for Watershed Protection Inc., Silver Spring, MD.

Instructors Guide for Forested Wetlands & Streamside Forests – Information for Developing Landowner Forest Management Plans. Gordon Steward. National Wetlands Conservation Alliance, September 1996.

Pennsylvania Stream Releaf Forest Buffer Toolkit, Replanting Pennsylvania's Streamsides. Alliance for Chesapeake Bay and Pennsylvania Department of Environmental Protection. September 1998.

Riparian Forest Buffers - Function and Design for Protection and Enhancement of Water Resources, NA-PR-07-91. USDA Forest Service Northeastern Area - Forest Resource Management - State and Private Forestry, Radnor, PA. 1991.

The River Book: The Nature and Management of Streams in Glaciated Terraces, DEP Bulletin Number 28, ISBN 0-942085-06-x. James Grant MacBroom. Connecticut Department of Environmental Protection Natural Resources Center. 1998.

Stream Corridor Restoration - Principles, Processes, and Practices. The Federal Interagency Stream Restoration Working Group. October 1998.

Vegetated Buffers in the Coastal Zone - A Summary Review and Bibliography, ISBN 0-938 412-37-x. Coastal Resources Center, Rhode Island Sea Grant, University of Rhode Island. July 1994.

Appendix 11

Directory of Connecticut River and Watershed Organizations

DIRECTORY OF RIVER AND WATERSHED ORGANIZATIONS

COMPILED BY CT DEP WATERSHED MANAGEMENT PROGRAM
2000

BLACKLEDGE RIVER WATERSHED COMMITTEE
c/o Jim Murphy
64 Cone Road
Hebron, CT 06248-1306
Tel: (860) 228-3211

BRANFORD RIVER PROJECT
P.O. Box 254
Branford, CT 06405
Tel: (203) 481-5765
Email: mstorm@worldnet.com
Web: www.branfordlandtrust.org/brpmain.html

BYRAM RIVER WATERSHED ALLIANCE
c/o Bob Jensen
24 Caroline Place
Greenwich, CT 06831
Tel: (203) 637-9333
Email: bob@bobjensen.net

CANDLEWOOD LAKE AUTHORITY
P.O. Box 37
Sherman, CT 06784
Tel: (860) 354-5928
Web: www.candlewoodlake.org/authority.htm

CLEAN SOUND, INC.
c/o John Toth
30 Ojibwa Road
Shelton, CT 06484
Tel: (203) 929-6195
Email: tcyanicky@erols.com
Web: http://cleansound.org/

COGINCHAUG RIVER GREENWAY COMMITTEE
c/o Jim Gibbons
P.O. Box 70
Haddam, CT 06438-0070
Tel: (860) 345-4511
Email: jgibbons@canr1.cag.uconn.edu

COGINCHAUG RIVER TASK FORCE
P.O. Box 96
Middlefield, CT 06455
Tel: (860) 349-9593

COLUMBIA CANOE CLUB
c/o Sue Audette
41 Pine Woods Lane
Mansfield, CT 06250
Tel: (860) 456-4906
Web: www.geocities.com/caherrick/

CONNECTICUT ASSOCIATION OF CONSERVATION AND INLAND WETLANDS COMMISSIONS, INC.
c/o Tom Odell
9 Cherry Street
Westbrook, CT 06498
Tel: (860) 399-1807
Email: todell@snet.net
Web: www.caciwc.org/

CONNECTICUT AUDUBON SOCIETY
118 Oak Street
Hartford, CT 06106-1514
Tel: (860) 527- 6750
Email:bmclaughlin@ctaudubon.org
Web: www.ctaudubon.org

NEW ENGLAND CANOE AND KAYAK RACING ASSOCIATION
(formerly Connecticut Canoe Racing Association)
c/o Ray Thiel
456 Bassets Bridge Road
Mansfield, CT 06250
Tel: (860) 889-9893
Web: www.necanoe.org/MeetNECRA.htm

CONNECTICUT CONSERVATION ASSOCIATION, INC.
3010 Fairfield Avenue
Bridgeport, CT 06605

CONNECTICUT FEDERATION OF LAKES
c/o George Knoecklein
40 Sagewood Lane
Windsor, CT 06095
Tel: (860) 456-3179
Email: Knoecklein@Juno.com
Web: http://ctlakes.org/ct_lakes_version_1_001.htm

CONNECTICUT FLY FISHERMEN'S ASSOC., INC.
c/o Ray Riley
P.O. Box 380268
East Hartford, CT 06138-0268
Web: www.ctflyfish.org/

CONNECTICUT FOREST AND PARKS ASSOCIATION, INC.
16 Meriden Road
Rockfall, CT 06481-2961
Tel: (860) 346-2372
Email: conn.forest.assoc@snet.net
Web: www.ctwoodlands.org/

CONNECTICUT FUND FOR THE ENVIRONMENT
205 Whitney Avenue
New Haven, CT 06511
Tel: (203) 787-0646
Email: protect@cfenv.org
Web: www.cfenv.org/

CONNECTICUT RIVER ASSEMBLY
c/o Karen Berchtold
CRCOG
241 Main Street, 4th Floor
Hartford, CT 06106
Tel: (860) 522-2217, Ext. 29
Email: kberchtold@crcog.org

CONNECTICUT RIVER COMMITTEE
155 South Main Street
Suffield, CT 06078
Tel: (860) 668-2739

CONNECTICUT RIVER GATEWAY COMMISSION
c/o Linda Krause
P.O. Box 778
Old Saybrook, CT 06475-0778
Tel: (860) 388-3497
Email: crerpa@connix.com

CONNECTICUT RIVER MUSEUM
67 Main Street
Essex, CT 06426
Tel: (860) 767-8269
Email: crm@ctrivermuseum.org
Web: www.ctrivermuseum.org/

CONNECTICUT RIVER SALMON ASSOCIATION
c/o Robert Jones
76 Deming Street
South Windsor, CT 06074
Tel: (860) 644-0159
Email: info@ctriversalmon.org
Web: www.ctriversalmon.org/

CONNECTICUT RIVER WATCH
c/o Jane Brawerman
deKoven House
27 Washington Street
Middletown, CT 06457
Tel: (860) 346-3282
Email: jane-brawerman@ct.nacdnet.org

CONNECTICUT RIVER WATERSHED COUNCIL
15 Bank Row
Greenfield, MA 01301
Tel: (413) 772-2020
Email: crwc@crocker.com
Web: www.ctriver.org

FARMINGTON CANAL RAIL-TO-TRAIL ASSOCIATION
c/o Bill Davies
940 Whitney Avenue
Hamden, CT 06517
Tel: (203) 281-7194
Email: bdavies@snet.net

FARMINGTON RIVER ANGLERS ASSOCIATION, INC.
c/o Dick Reynolds
18 Saddle Ridge Drive
West Simsbury, CT 06092
Email: president@fraa.org
Web: www.fraa.org

FARMINGTON RIVER CLUB
c/o Bill Cole
P.O. Box 475
Canton, CT 06019
Tel: (860) 693-6445

FARMINGTON RIVER COORDINATING COMMITTEE
c/o Liz Lacy
P.O. Box 395
Pleasant Valley, CT 06063
(860) 379-0282
Web: www.farmingtonriver.org/

FARM RIVER PROTECTION ASSOCIATION
c/o Niki Whitehead
9 Hilton Avenue
East Haven, CT 06512

FARMINGTON RIVER WATERSHED ASSOCIATION
c/o Frank Untermyer
749 Hopmeadow Street
Simsbury, CT 06070
Tel: (860) 658-4442
Email: info@frwa.org
Web: www.frwa.org

FRIENDS OF ASH CREEK
90 Kenwood Avenue
Fairfield, CT 06430
Tel: (203) 259-5605
Email: rtking401@aol.com

FRIENDS OF THE CONNECTICUT RIVER
c/o Gerry Owen
P.O. Box 215
Middle Haddam, CT 06456
Tel: (860) 267-4900

HARBOR WATCH/RIVER WATCH
10 Woodside Lane
P.O. Box 165
Westport, CT 06881
Tel: (203) 227-7253
Email: info@earthplace.org
Web: www.earthplace.org/environment/water_quality.html

HOCKANUM RIVER LINEAR PARK COMMITTEE
c/o Douglas Smith
407 Woodbridge Road
Manchester, CT 06040
Tel: (860) 649-5678

HOCKANUM RIVER WATERSHED ASSOCIATION
c/o Doug Smith
407 Woodbridge Road
Manchester, CT 06040
Tel: (860) 649-5678
State Contact: Stan Zaremba,
Nonpoint Source Coordinator
(860)424-3730
E-mail: stan.zaremba@po.state.ct.us

HOUSATONIC AREA CANOE AND KAYAK SQUAD (HACKS)
c/o Maurice Convard
River House
255 Dugway Road
Falls Village, CT 06031
Tel: (860) 824-5899
Email: mconvard@charter.net
Web: http://users.bestweb.net/~keech/hacks.htm

HOUSATONIC COALITION
c/o Mike Piquette
18 Lantern Hill Road
Trumbull, CT 06611
(203) 261-1868
Email: leeniekate@aol.com

HOUSATONIC FLY FISHERMEN'S ASSOCIATION
P.O. Box 5092
Hamden, CT 06518
Tel: (203) 248-5079
Email: tarponsearcher@yahoo.com
Web: www.hffa.net/

HOUSATONIC LAKE AUTHORITY
P.O. Box 26
Derby, CT 06410

HOUSATONIC RIVER COMMISSION
c/o Northwestern Connecticut Council of Governments
17 Sackett Hill Road
Warren, CT 06754
Tel: (860) 868-7341

HOUSATONIC VALLEY ASSOCIATION, INC.
P.O. Box 28
Cornwall Bridge, CT 06754
Tel: (860) 672-6678
Email: hvact@optonline.net
Web: www.hvathewatershedgroup.org

LAKE LILLINONAH AUTHORITY
45 Main Street
Newtown, CT 06470
Web: www.newtown-ct.gov/Public_Documents/NewtownCT_BComm/lillinonah

LAKE ZOAR AUTHORITY
Southbury Town Hall
501 Main Street South
Southbury, CT 06488
(203) 264-5246
Web: www.newtown-ct.gov/Public_Documents/NewtownCT_BComm/zoar

MATTABESSET RIVER WATERSHED ASSOCIATION
c/o Jim Creighton
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Kensington, CT 06037
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Web: www.mrwa-ct.org/links.htm

MATTABESSET STAKEHOLDER GROUP
c/o Stephanie Shakofski
Middlesex County Soil and Water Conservation District
deKoven House
27 Washington Street
Middletown, CT 06457
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MIANUS RIVER WATERSHED COUNCIL
c/o Dave Medd
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Greenwich, CT 06830
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MILL RIVER WATERSHED ASSOCIATION
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Hamden, CT 06518
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Email: martin.mador@yale.edu

MILL RIVER WETLAND COMMITTEE, INC.
c/o Joy Shaw
476 Old Mill Road
Fairfield, CT 06430
Tel: (203) 259-1847
Email: river-lab@juno.com
Web: http://members.localnet.com/~urquhart/mrwc.html

MYSTIC RIVER – WHITFORD BROOK WATERSHED ASSOCIATION
24 West Mystic Avenue
Mystic, CT 06355
Tel: (860) 536-1804

NATCHAUG RIVER ALLIANCE
c/o Rusty Lanzit
36 Morey Road
Chaplin, CT 06235
Tel: (860) 455-9754

NATURE CONSERVANCY CONNECTICUT CHAPTER
55 High Street
Middletown, CT 06457-3788
Tel: (860) 344-0716
Email: ct@tnc.org
Web: http://nature.org/wherewework/northamerica/states/connecticut/

NAUBESATUCK RIVER WATERSHED COUNCIL
c/o Kurt Heidinger
19 Chaplin Street
Chaplin, CT 06235
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39 Plainfield Drive
Waterbury, CT 06708
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Email: Robbette@hotmail.com

NAUGATUCK RIVER WATERSHED ASSOCIATION, INC.
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Middlebury, CT 06762
Tel: (203) 758-9166
Web: www.geocities.com/tjamitch/naugy/nrwa.htm

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Cooperative Extension System
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Haddam, CT 06438-0070
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Web: http://nemo.uconn.edu/

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New Haven, CT 06515
Tel: (203) 946-6768
Email: mtorresq@newhavenct.net
Web: http://cityofnewhaven.com/parks/riverkeeper.htm

NIANTIC RIVER WATERSHED ASSOCIATION
29 Attawan Avenue
Niantic, CT 06357-3638
Tel: (860) 860-848-5606

NORWALK RIVER WATERSHED ASSOCIATION, INC.
P.O. Box 197
Georgetown, CT 06829
Tel: (203) 846-8210
Email: info@norwalkriver.org
Web: www.norwalkriver.org

NORWALK RIVER WATERSHED INITIATIVE
c/o Jessica Kaplan
356 Thayer Pond Road
Wilton, CT 06897
Tel: (203) 834-0033
Email: kaplan356@aol.com
Web: www.norwalkriverwatershed.org/

OXOBOXO RIVER
Montville Environmental and Economic Cooperative
28 Fowler Drive
Uncasville, CT 06382
Tel: (860) 665-5326

PAWCATUCK WATERSHED PARTNERSHIP
c/o Jeff Nield
Rhode Island Department of Environmental Mgmt. – Suite 330
Office of Strategic Planning and Policy
Providence, RI 02903
Tel: (401) 222-3434, Ext. 4405

PEQUABUCK RIVER WATERSHED ASSOCIATION
c/o Carl Swanson
P.O. Box 1461
Bristol, CT 06010
Tel: (860) 589-5547
Email: PRWA@attbi.com

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Central Connecticut Regional Planning Agency
225 North Main St., Suite 304
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Tel: (860) 589-7820
Email: ccrpampo@ct1.nai.net

POMPERAUG RIVER WATERSHED COALITION
P.O. Box 141
Southbury, CT 06488
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Email: info@pomperaug.org
Web: www.pomperaug.org/

POMPERAUG RIVER WATCH
c/o Linda Schocken
72 Paper Mill Road
Woodbury, CT 06798

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Appendix 12

Income Opportunities in Forested Areas – Agroforestry Notes

Agroforestry Notes

USDA Forest Service, Rocky Mountain Research Station • USDA Natural Resources Conservation Service

November, 1997

Forest Farming: An Agroforestry Practice

Introduction

Most public and private forest lands of North America have been modified to varying degrees from years of human activity. Certain high-value 'non-timber forest products' have been over-exploited and are difficult to find. Forest farming practices can be used by private enterprise to grow desirable non-timber forest products on private lands, to supplement family income, and to allow biodiversity to reestablish within forests.

Definition

Special forest products (SFPs) or non-timber forest products (NTFPs) are high-value specialty product items derived from green plants, fungi, invertebrates, and other organisms that inhabit forested areas.

These products fall into four general categories (See table on page 2):

- food (e.g., mushrooms and nuts)
- botanicals (e.g., herbs and medicinals)
- decoratives (e.g., floral greenery and dyes)
- handicrafts (e.g., baskets and wood products)

In forest farming, high-value specialty crops are cultivated under the protection of a forest canopy that has been modified to provide the correct conditions. Forest farming provides short-term income while high-quality trees are being grown for wood products.

USDA

National Agroforestry Center

Special Forest Products

Specialty Products	Examples	Use	Region of the United States							
			Northeast	Southeast	Midwest	N. Plains	S. Plains	Intermountain	Pacific N-west	Pacific S-west
Food	Shiitake, matsuki, and other mushrooms	food, medicinals	X	X	X	X	X	X	X	X
	Black locust and plum honey	food, candy	X	X	X	X	X			
	Walnuts, acorns, pecans, and Pinon pine nuts	food, dyes	X	X	X	X	X	X	X	X
	Blueberries, huckleberries, and other berries	food, dyes	X	X	X	X	X	X	X	X
	Maple, birch, and boxelder sap	syrups, candy	X	X	X	X		X	X	
Botanicals	Ginseng	longevity, general strengthening, teas, herbs	X	X	X	X	X	X	X	X
	Goldenseal	eyewash, laxative, tonic, hemorrhagic	X	X	X					
	Saw-palmetto	food, prostate health		X						
	Slippery elm bark	food flavoring, laxative	X	X						
	Elder flowers	food flavoring, eye and skin health	X	X	X	X	X	X	X	X
	Eucalyptus leaves	flavoring agent, expectorant							X	X
Decoratives	Salal, beargrass, sword fern, and other greenery	decoration, crafts, baskets				X	X	X	X	X
	Club fern, spanish moss, and other mosses	decorations, crafts, baskets	X	X	X				X	X
Handicrafts	Wild grape, kudzu, vine maple, and other vines	baskets, crafts		X					X	X
	Cedar and pine oils	aromatics	X	X	X	X	X	X	X	X
	Poplar, willow, and switchgrass biomass plantings	fuel, paper	X	X	X	X	X	X	X	X
	Cedar, poplar, and willow residues	mulches, animal bedding, litter products	X	X	X	X	X		X	
	walnut crotches, wormy chestnut, diamond willow, cedar veneer, and mesquite	wood decorations and carvings			X	X	X	X	X	

Concepts and Principles

In forest farming practices, high-value specialty crops are intentionally cultivated under the protection of a forest overstory that has been modified and managed to provide the appropriate microclimate conditions. Typically, these systems are established on private land by thinning an existing forest or woodlot to leave the best crop trees for continued wood production and to create the appropriate conditions for the understory crop to be grown. Then, the understory crop is established and intensively managed to provide short-term income.

Planning and Design

A forest farming practice is usually a small area of land (5 acres or less) whose vertical, horizontal, and below-ground dimensions are managed intensely to produce multiple crops simultaneously. Systems usually focus on a single SFP plus timber, but can include several products. Examples of systems include:

- ginseng + maple syrup + bee products + timber
- shiitake mushrooms + timber
- ferns + beargrass + mushrooms + timber
- ginseng + walnuts + black walnut veneer logs

The amount of light in the stands is altered by thinning, pruning, or adding trees. Existing stands of trees can be intercropped with annual, perennial, or woody plants. Compatibility among understory and overstory plants and cultural methods is essential.

Before investing time and money in growing a particular SFP, an entrepreneur needs to:

- obtain production and processing information
- locate a source of technical expertise
- locate or develop potential markets

A common problem with developing an enterprise around a new product is the scarcity of technical information. Sources of expertise for producing SFPs can be obtained from state forestry and conservation agencies, the Cooperative Extension Service in county offices or state universities, the Natural Resources Conservation Service, and the USDA Forest Service.

A market analysis and business plan are essential before starting an enterprise. The existence and type of market depend on the SFP. Markets are often local stores or cooperatives. For example, shiitake, matsutake, morel, and chanterelle mushrooms, and truffles, may be sold directly to gourmet French and Asian restaurants, Asian and natural food stores, or to a middleman or cooperative for resale to larger more distant markets. Markets for decorative products like salal and beargrass are in urban areas and overseas. Decoratives may be sold through cooperatives or to local buyers. Non-local buyers may also be reached through the internet.

Benefits

Economic

Some products especially medicinals and botanicals can have tremendous economic value, while others provide a lower but steady supplemental income. For example,

- Forest-cultivated ginseng averages $200-$400 per pound, depending upon how closely the product resembles wild ginseng
- A cord of wood worth $50-$100 can produce $500 worth of shiitake mushrooms. In 1990, wholesalers paid from $3.50 to $10 per pound for shiitake mushrooms in the Southeast. Retail prices were between $9 and $12 per pound

- Markets for floral decoratives nave been steady or increasing. In 1991, buyers paid $1.00 and $1.00-$1.60 for salal and beargrass, respectively, and about $0.01 per swordfern frond
- In 1996, honey was worth approximately $3.00 per pound

Conservation and System-Level

Forest farming activities modify the forest ecosystem but do not significantly interfere with its crucial contributions of water capture and filtering, soil erosion control, microclimate moderation, and wildlife habitat. Producers should avoid harmful species and follow EPA approved guidelines for herbicides, fungicides, and insecticides.

Social

Forest farming provides opportunities to generate short-term income from existing woodlots, with minimum capital investment. Especially on small family farms, this can contribute significantly to rural economic development and diversification.

Additional Information

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The National Agroforestry Center is a partnership of the USDA Forest Service and the USDA Natural Resources Conservation Service. The Center's purpose is to accelerate the development and application of agroforestry technologies to attain more economically, environmentally, and socially sustainable land-use systems. To accomplish its mission, the Center interacts with a national network of cooperators to conduct research, develop technologies and tools, establish demonstrations, and provide useful information to natural resource professionals.

Appendix 13

Riparian Buffer
Checklist for Success

Riparian Buffer Checklist for Success

Adapted from the Forest Buffer Toolkit, published by the Alliance for Chesapeake Bay and Pennsylvania DEP, 1998

Site Selection

- ❑ Site is suitable for restoration
- ❑ Landowner permission is granted

Site Analysis

- ❑ Evaluated site's physical conditions (soils, geology, terrain)
- ❑ Evaluated site's vegetative features (desirable and undesirable species, native species, sensitive habitats)
- ❑ Sketch or map of site prepared/obtained
- ❑ Evaluate potential effects of project (stream flows, flood flows, accessibility)

Buffer Design

- ❑ Considered landowner objectives in creating buffer design
- ❑ Determined desired functions of buffer in determining buffer widths
- ❑ Species selection matches site conditions (hardiness zone, moisture, soil pH)
- ❑ Species selection meets objectives of buffer functions (water quality, wildlife habitat, recreation, etc.)
- ❑ Plant sizes meet budget limitations
- ❑ Sketch of plan developed

Site Plan Includes the Following Information

- ❑ Map of the site with appropriately marked planting zones
- ❑ Plant species list
- ❑ Planting directions
- ❑ Equipment/tool list
- ❑ Site preparation directions
- ❑ Maintenance schedule

Site Preparation

- ❑ Undesirable species are eliminated well ahead of planting date
- ❑ Planting layout is marked for volunteers at the site
- ❑ Plants and planting materials are purchased

Planting Day

- ❑ Plants are kept moist and shaded
- ❑ Adequate number of tools are on hand
- ❑ Press has been notified
- ❑ Volunteers are adequately trained and have signed waiver forms
- ❑ Refreshments are on hand
- ❑ Photos are taken

Site Maintenance

- ❑ Responsibilities are assigned for watering, weeding, mowing, and maintenance of tree shelters or mats.
- ❑ Site is monitored regularly for growth and potential problems

Cut on dotted line

If this publication was helpful to you in the implementation or preservation of a riparian buffer, we would like to know about it. Please return this postcard with the requested information.

Who implemented the project? _____

_____

Site Location (name at least the Town) _____

_____

When was the buffer implemented? _____

What is the average width of the buffer? _____

What is the average length of the buffer? _____

Should you need additional assistance, contact your local NRCS office:

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