Appendix: General Concepts of Riparian Vegetation Ecology

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Streamside vegetation provides numerous benefits to water quality, aquatic and terrestrial plants and animals, and local landowners. Vegetated riparian zones facilitate stream stability and function by providing rooted structure to protect against bank erosion and flood damage. Riparian buffers (See Fig 1) offer protection against pollution and the adverse impacts of human activities. Streamside forests also reduce nutrient and sediment runoff, provide food and shelter, and moderate fluctuations in stream temperature. Streamside vegetation also improves the aesthetic quality of the stream community.

Figure 1: The Riparian Buffer: The vegetated protective area between a waterbody and human activity.

The extent of the benefits from riparian buffers is proportional to the width of the riparian zone and its species diversity. For example, a narrow 25 foot buffer zone may offer only bank stabilization as a benefit while a buffer over 200 feet wide includes a diverse range of water quality and ecological benefits (Figure 2). A buffer containing a variety of different native species of trees, shrubs, grasses, and forbs offers the best protection. An area with a diverse mix of native species of different ages will function more appropriately than a simpler community, including resistance to disease and pests. Different types and species of plants also provide a variety of root depths to help stabilize streambanks of varying substrates and depths in both shallow and deep soils. Native plants in the riparian zone have the ability to resist or recover from disturbance, mainly from repeated inundation by floodwaters. Figure two helps illustrate these buffer community functions.

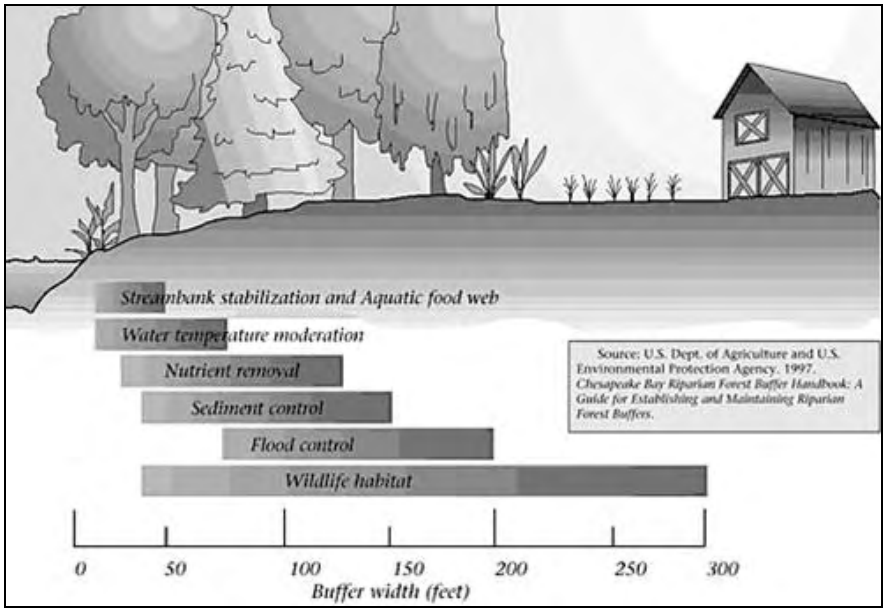

Figure 2: Riparian Buffer Widths and Their Functions.

The riparian forest community can be more extensive where a floodplain exists and valley walls are gently sloping. Where valley side slopes are steeper, the riparian community may occupy only a narrow corridor along a stream and transition to an upland forest community. Soils, ground water, and solar aspect may create conditions allowing the riparian forest species to occupy steeper slopes along a stream, as in the case where Eastern hemlock (Tsuga canadensis) inhabits steep, north facing slopes along a watercourse.

Natural Disturbance and its Effects on Riparian Vegetation

Natural disturbances can greatly affect the vigor of streamside vegetation. These disturbances include floods, ice or debris floes, and to a lesser extent, high winds, pests and disease epidemics, drought and fire. Deer herds can also alter the composition and structure of vegetation due to their specific browse preferences.

The effect of flooding on healthy streamside vegetation is generally short term and the recovery/ disturbance regime can be cyclical. Following a large flood, the channel and adjacent floodplains can be littered with everything from woody debris to downed live trees. In following years, much of the vegetation recovers. Trees and shrubs flattened by floodwaters re-establish their form. In stable streams, gravel bars and sites disturbed in previous flood events become seedbeds for natural regeneration of grasses and forbs. However, if significant flood or ice floe events occur too frequently to allow adequate vegetation re-establishment, large trees do not have the opportunity to establish.

Springtime ice break-up, like floods, can damage established vegetation along streambanks and increase mortality of young tree and shrub regeneration. Ice floes can also cause channel blockages, which result in erosion and scour associated with high flow channels and over-bank flow.
This type of disturbance generally has a short recovery period.

When stream managers seek to expedite or augment the recovery process, the following local geology and stream morphology factors are important to consider before attempting restoration: hydraulics of flowing water, morphological evolution of the stream channel, geology of the streambank, and the requirements and growth capabilities of vegetation.

Pests and diseases that attack vegetation also impact the riparian area. In portions of the eastern United States, the hemlock wooly adelgid (Adelges tsugae) attacks eastern hemlock and can affect entire stands. Currently, the adelgid is confined to the warmer southeastern section of New York State, which includes Orange County.

Human Disturbance and its Effects on Riparian Vegetation

"When we try to pick out anything by itself, we find it hitched to everything else in the universe."
- John Muir

The distinction between natural and human disturbances is important to understand. The effects of floods, ice floes, pests and disease can cause widespread damage to riparian vegetation but these effects are usually temporary. However, human activities often significantly alter natural conditions and can have a longer lasting impact on the capability of riparian vegetation to survive and function. These disturbances can include livestock overgrazing, cropping practices, construction and maintenance of highway infrastructure, real estate development and introduction of non-native species in the riparian zone.

Agriculture Influence

Continuous access to streams by livestock has a significant impact on the vigor, mortality and diversity of riparian vegetation. Grazing can reach an intensity that keeps grasses and forbs at a height too low to effectively uptake nutrients and impede storm runoff, which increases environmental contamination and streambank erosion. Intensive riparian grazing also inhibits the growth, establishment and/or regeneration of shrubs and trees while hoof shear (cattle-eroded stream access points) on streambanks exacerbates erosion. Cultivating row crops and mowing haylands to the stream's edge or the top of the streambank also result in decreased species diversity and riparian buffer width. These practices significantly increase runoff and associated nutrient contamination and erosion.

The United States Department of Agriculture's (USDA) Conservation Reserve Enhancement Program (CREP) is a voluntary program that protects environmentally sensitive agriculture land with vegetative riparian buffers often associated with exclusionary livestock fencing. This program provides numerous environmental benefits and has met with great success in the West Branch of the Delaware River watershed.

Highway/Public Utility Infrastructure Influence

Use and maintenance of state and local highways also impacts the vigor of riparian vegetation where narrow buffers exist between roads and streams. These areas receive runoff containing sediment and road chemicals that stunt vegetative growth or increase stress and mortality. Accelerated storm runoff from these highways also contributes to increased streambank erosion. Highway maintenance activities that regularly disturb the soil along shoulders and cut banks can welcome undesirable invasive plants. In areas where public utility lines parallel or cross streams, riparian areas are disturbed by the practice of

keeping vegetation trimmed to near ground level. This is another contributor to accelerated runoff and increased streambank erosion.

Residential Development Influence

Residential land use and development of new homes can have a significant impact on the watershed and ecology of the riparian area. Houses require access roads and utility lines that often have to cross streams. Homeowners who enjoy their stream and desire to be close to it may clear all the trees and shrubs along it to provide access and views. They may replace natural conditions with an un-natural mowed lawn that provides little benefit to stream health or local wildlife. These practices can lead to new streambank erosion or increase existing erosion.

Many people live close to a stream and have access to the water without destabilizing the bank. By careful selection of a route to the stream and locating access where the water's force on the bank is lower, a landowner can minimize disturbance to riparian vegetation and the streambank. Minimizing disturbance in flood prone areas and promoting a dense natural buffer provides property protection, aesthetic value and wildlife habitat. Riparian gardeners must know which riparian species are appropriate for planting. A list of native trees and shrubs is included in Table 1.

Is Your Riparian Buffer Healthy or Not?

When living near streams questions often arise whether a property owner's riparian buffer is healthy or not. There are a multitude of factors that help determine the relative health of a riparian buffer.

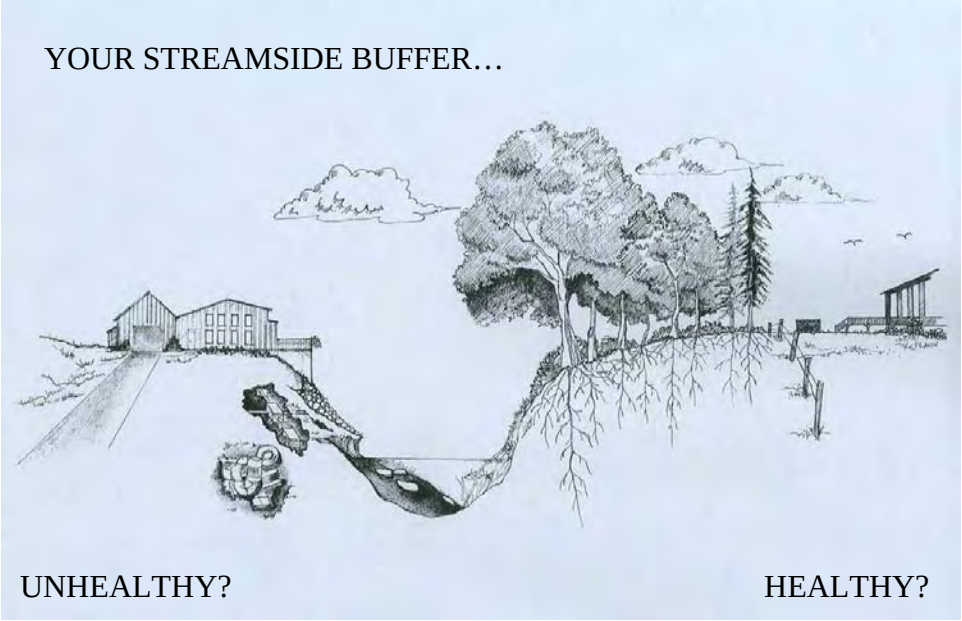

Figure 3: Unhealthy vs. Healthy Streamside Buffers. Source: Amy Flavin, NYC DEP Natural Resources

One of the most common characteristics of an unhealthy buffer is runoff. Runoff that flows over impervious surfaces, like roofs and paved driveways, flows at a greater speed which accelerates erosion and leaves no time for pollutants and excess silt to filter out. Pollutants are also carried into streams underneath the ground. Garbage dumps, both above and below the ground, pose a risk of leaching

pollutants into streams. Phosphorus, bacteria, and anything else you pour down your drain can also leach into adjacent waterways through malfunctioning septic systems.

Lawn, which has no habitat value, also helps to accelerate runoff as water travels twice as fast over lawn as it does over a healthy forest floor. Lawn to the water's edge also lacks the deep roots required to stabilize streambanks. Lawns put property at risk for erosion and deliver lawn chemicals directly to streams, thus jeopardizing the health of anything living in the stream. Hardened shorelines can also cause erosion, although it is deflected downstream, as well as, eliminate natural filtering and degrade habitat.

Structures, built or stored in the floodplain, are at great risk of being damaged and/or washed downstream. Not only can this cause personal loss, but large debris can further damage downstream property and infrastructure.

One of the main components to a healthy buffer is vegetation. Overhanging branches provide shade to keep streams from getting too warm for fish during the hot days of summer and provide nesting places for birds and other wildlife. Leaves provide the base of the food chain in aquatic ecosystems, feeding insects on both the streambed and floodplain that will in turn become prey for fish and small mammals.

Tree trunks, stems, branches, and leaves all help to slow the flow of water across the ground, capturing soil, pollutants, and excess nutrients along the way. By the time water reaches the stream, it is moving slower and is cleaner. Tree roots can also filter pollutants transported in groundwater prior to entering streams, while exposed roots provide shelter for fish and other aquatic species.

Having a nice, manicured lawn does not have to be at odds with living next to a stream. You can still have access to the stream by leaving openings in your landscape design. When raking leaves or gathering grass clippings designate a compost area in the corner of your yard as far from the stream bank and flood prone areas as possible.

Finally, building away from the edge of the stream allows floodplains to function effectively and will reduce the probability and magnitude of property damage. In addition to providing storage for high flows, floodplains minimize sedimentation, filter pollutants, process organic wastes, moderate temperature fluctuations, and provide habitat for a variety of plants and animals.

Designing and Managing a Healthy Riparian Buffer

Native vegetation composition will play a significant role in the overall health of a buffer, as well as, maintenance. Native plants are the preferred choice as they are adapted to the climate of the region and are typically more resistant to pests and diseases. Natives also provide preffered habitat and food for native wildlife.

When designing with natives it is important to vary not only the species, but the type of vegetation. A broad composition should not only include trees and shrubs, but native grasses and wildflowers. Most riparian buffers in need of restoration typically occur within urban and suburban settings, it is often necessary to accommodate multiple uses within the buffer itself. A three-zone system is a common approach that can be adapted to each specific situation (Figure 4).

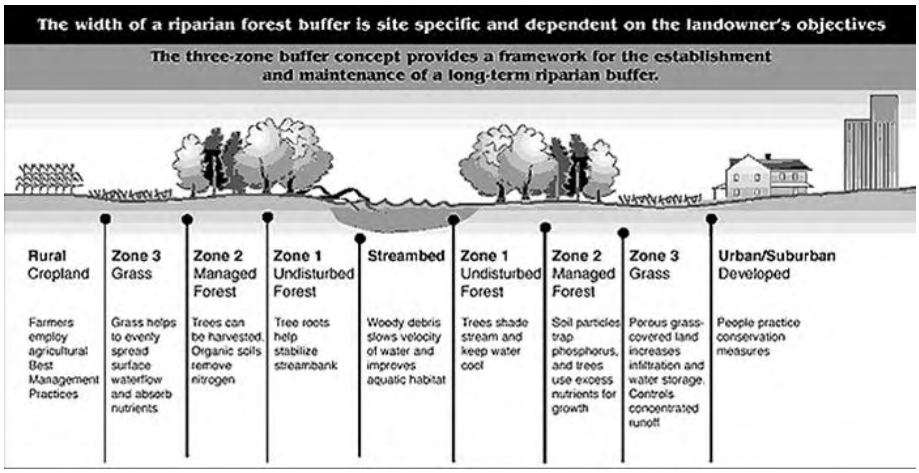

Figure 4: The Three-zone Buffer Concept.

Zone 1, or the undisturbed forest, is the area from the top of the streambank, extending approximately 25' away from the waterbody. Stream stabilization is critical in this zone, as well as, the presence of mature trees to shade the stream and provide deadfall and leaf litter inputs. When establishing trees in this zone, a good rule of thumb is a three tree minimum; planting a tree on the edge of the bank, then 10' further inland, then another 10'. Generally, this zone is intended to restrict all uses. Typical tree species include Sycamore, Silver Maple, Black Willow, and Eastern Cottonwood. Typical shrub species include Buttonbush, Silky Dogwood, and various native willows.

The second zone, or managed forest, is intended to allow for some passive recreation such as hiking trails or picnicking. An average width for this zone would be 50' and consist of a wide array of native trees, shrubs, grasses, wildflowers, and ferns. Typical tree species include Red Maple, Swamp White Oak, Pin Oak, Ironwood, River Birch, and Black Gum. Typical Shrub species include Serviceberry, Red Chokeberry, Black Chokeberry, Summersweet, Red-osier Dogwood, Winterberry, Spicebush, Ninebark, Elderberry, Arrowwood Viburnum, and Cranberry Bush Viburnum.

Zone 3, or the Grass/Transitional Zone, is typically 25' in width and buffers the forested buffer (Zones 1 and 2) from human activity. The most common application of this zone is the back yard, for a residential setting, or the grass filter strip, for an agriculture setting. Typical native grasses include Big Bluestem, Switchgrass, Little Bluestem, and Indian Grass.

<u>Opportunities for Riparian Buffer Restoration</u>

Riparian Buffer projects in Orange County associated with agricultural practices should contact the United States Department of Agriculture's (USDA) Conservation Reserve Enhancement Program (CREP) and/or the Orange County Soil and Water Conservation District.

For non-agriculture buffer projects, the New York State Department of Conservation's NYS DEC) Hudson River Estuary Program's "Trees for Tribs" initiative offers free native trees and shrubs for qualifying projects in the Hudson River Estuary watershed within the State of New York from the Verrazano Narrows Bridge to the Troy Dam. The "Trees for Tribs" initiative is one of the key components and focuses for meeting one of the Hudson River Estuary Action Agenda's goals for streams and tributaries of the Hudson River Estuary Watershed. This goal is "By 2015, protect and

restore 750 miles of forest buffers through cooperative partnerships and local land use strategies to protect habitat, reduce flooding damage, and cleanse stormwater runoff".

Typical applicants include non-profit watershed groups, land trusts, environmental organizations, municipalities, specialty farmers, and home owners. The Estuary Program's Riparian Buffer Coordinator will assist with site analysis and evaluation to determine if a stream buffer planting project is feasible. If so, technical assistance will be provided in developing a planting/restoration plan, recommendations for invasive species management, and native plant selection. Finally, free trees and shrubs, as well as, any necessary bio-engineering materials will be provided. Plantings will be coordinated with the Riparian Buffer Coordinator and SCA Riparian Buffer Specialist intern. Volunteers, supplied by the applicant, will be the primary source of labor for the planting.

During Fall of 2007 the "Trees for Tribs" initiative was officially launched and was responsible for the completion of 12 restoration/planting projects with the help of 19 different environmental groups and over 225 total volunteers (approximately 775 total volunteer hours). Over 2,000 native trees and shrubs were planted along streambanks in the Hudson River Estuary watershed, including several bio-engineering projects focusing on streambank stabilization.

Several projects were completed in Orange County, including one along the Moodna Creek in the Town of Cornwall at the Moodna Viaduct. Coordinating organizations for the Moodna project included the Moodna Creek Watershed Coalition, Orange County Water Authority, NYS OPRHP, Palisades Interstate Park Commission, and Open Space Institute. Over 300 native trees and shrubs were planted with the help of over 30 volunteers in a single morning. An additional planting is scheduled at the Viaduct site for Spring of 2008.

Native Riparian Trees of The Moodna Watershed

Scientific Name	**Common Name**
Acer rubrum	Red Maple
Acer saccharinum	Silver Maple
Alnus rugosa	Speckled Alder
Alnus serrulata	Smooth Alder
Betula lenta	Black birch
Betula nigra	River Birch
Betula populifolia	Grey Birch
Carpinus caroliniana	Ironwood
Carya ovata	Shagbark Hickory
Juglans nigra	Black Walnut
Larix laricina	Tamarack
Liriodendron tulipifera	Tulip Tree
Nyssa sylvatica	Black Gum
Pinus resinosa	Red Pine
Pinus strobus	White Pine
Platanus occidentalis	Sycamore
Populus deltoides	Eastern Cottonwood
Quercus bicolor	Swamp White Oak
Quercus macrocarpa	Bur Oak
Quercus palustris	Pin Oak

Salix nigra	Black Willow
Sassafras albidum	Sassafras

Native Riparian Shrubs of the Moodna Watershed

Scientific Name	**Common Name**
Amelanchier canadensis	Serviceberry
Amelanchier arborea	Downy Serviceberry
Aronia arbutifolia	Red Chokeberry
Aronia melanocarpa	Black Chokeberry
Cephalanthus occidentalis	Buttonbush
Clethra alnifolia	Summersweet
Cornus amomum	Silky Dogwood
Cornus sericea	Red-osier Dogwood
Ilex verticillata	Winterberry
Physocarpus opulifolius	Ninebark
Rosa palustris	Swamp Rose
Salix discolor	Pussy Willow
Salix exigua	Sandbar Willow
Salix humilis	Prairie Willow
Sambucus canadensis	Elderberry
Viburnum dentatum	Arrow-wood Viburnum
Viburnum lentago	Nannyberry
Viburnum trilobum	Cranberry Bush Viburnum

"Trees for Tribs" contact information:

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