Appendix B - Stream Restoration Information

The restoration of an environmentally degraded stream involves modifications to many different physical, chemical, and biological components of the stream ecosystem. The following narrative outlines some of the common techniques used to restore both streams and their associated riparian corridor. The stream restoration activities proposed in Chapters 4 through 8 of the plan directly correspond to the activities described below.

Restoration of the Riparian Corridor

The restoration of the riparian corridor is the most common technique used in stream restoration. Because of the heavy loss of the vegetated riparian corridor of many streams, particularly those within the Middle Potomac Watersheds, the need for riparian restoration is obvious. In addition, riparian restoration is one of the least expensive of all stream restoration activities.

Riparian Vegetation Plantings

The reestablishment of the riparian corridor is most quickly achieved through the replanting of the existing corridor in areas where the native vegetation has been removed. This has occurred in several areas throughout the watershed where landscaping and lawn care by local property owners have resulted in the removal of the native vegetation.

The restoration of the riparian corridor typically involves the planting of bare root saplings, in a triangular or scattered pattern, along the existing stream banks. This method is selected because it is very cost effective, flexible, and easy to install. In addition, this technique provides an excellent opportunity for volunteerism and is useful in providing community support for stream restoration activities. Although best management practices vary, a minimum 50-foot riparian buffer on each side of the channel is desired for this watershed. Plant species selected for planting should be native species that reflect the vegetative community natural to the area. Typical riparian shrub species for the Mid-Atlantic region include black haw (*Viburnum prunifolium*), possumhaw (*Viburnum nudum*), silky dogwood (*Cornus amomum*), grey dogwood (*Cornus racemosa*), and spicebush (*Lindera benzoin*). Typical riparian tree species include American sycamore (*Platinus occidentalis*), green ash (*Fraxinus pennsylvanica*), basswood (*Tilia americana*), tuliptree (*Liriodendron tulipifera*), and willow oak (*Quercus phellos*).

Removal of Invasive Species

As a result of the introduction of exotic plant species to urban gardens and landscapes, exotic invasive species now occupy the natural riparian corridors along streams. Typical invasive riparian species include amur honeysuckle (*Lonicera maackii*), Japanese honeysuckle (*Lonicera japonica*), wintercreeper (*Euonymus fortunei*), periwinkle or ground myrtle (*Vinca minor*), and English ivy (*Hedera helix*). Selective cutting is often used in removing honeysuckle; however, it is labor intensive and time consuming. In addition, chemical agents, such as Roundup, have been successful in removing certain selected invasives, particularly evergreen species such as wintercreeper and periwinkle as well as those with persistent leaves such as amur honeysuckle. This activity is also a great opportunity to enlist the help of volunteers.

Physical Removal of Unstable Trees

Because of the severe erosion of the stream banks, large trees along the existing stream channel often become unstable and begin to tilt and fall into the channel as the eroding channel exposes their root base. This woody debris subsequently accumulates within the stream channel, further hindering flow and often creating flooding hazards, particularly at culverts and other channel constriction locations. To reduce this hazard, trees that have already fallen into the channel are cut up and removed. Additionally, unstable trees still imbedded within the stream bank but in danger of falling into the channel are cut immediately above the root wad and removed. The existing root wad is left in place to provide stability to the bank and slow the existing erosion.

Modifications to the Stream Channel

Modification of Culverts

The placement of culverts within the natural channel has had profound impacts upon the streams in which these structures have been placed. Typically the specifications for the size and dimensions of culverts are based solely on the expected discharge of the stream during various flood events; accordingly, historically little or no considerations were made regarding the effects that a culvert might have on the future evolution of a stream and the associated changes of its banks, floodplain, or channel dimensions. As a result, many stream restoration activities require modifications to existing culverts.

Incorrectly placed culverts, as well as those that are incorrectly sized, have dramatically changed the characteristics of streams, both upstream and downstream of the structure. Accordingly, additional modeling of the stream hydrology, hydraulics, and channel evolution are necessary prior to any action. Modification of stream crossing structures is generally expensive and usually requires some degree of urban disruption. Although time consuming and expensive, the modification of these structures are often the best way to correct or direct the evolution of an existing stream.

Floodplain Creation

With increased urbanization of the watershed, the overall discharge of streams has dramatically increased even in small headwater streams. As a result of this increased discharge, two common effects are seen within the headwater streams: a high degree of downcutting within the channel and more frequent overflow of the channel, resulting in frequent flooding of the surrounding area. Both of these problems can be addressed by the configuration of the floodplain. The stream's channel naturally downcuts, initiating bank erosion, widening its channel, and eventually reestablishing a floodplain. By pulling back the existing banks, stabilizing the new banks with natural vegetation, utilizing bioengineering techniques, and recreating a floodplain, both the downcutting and frequent flooding of the channel can be controlled.

This technique works best in an area with sufficient undeveloped space along the existing channel to allow for the manipulation of the banks, such that a floodplain terrace can be created. This is also useful in areas where the stream has over-widened, resulting in severe aggradation of the substrate, such that the original stream baseflow is either greatly reduced or has been rendered hyporheic. The configuration of the floodplain terrace is also useful in the creation of associated fringe riparian wetlands, to complement the stream with regard to habitat improvement or flood reduction.

Channel Reconfiguration

As a result of past land use changes within the watershed, existing stream channels have been widened, straightened, ditched, rip rapped, grouted, and otherwise altered. Straightened channels lose much of their aquatic habitat value as well as their ability to reduce stream energy and shear strength, particularly during flood events. One of the main stream restoration techniques to restore habitat value to a stream, as well as reduce stream energy, is the reconfiguration of the existing channel.

By changing the grade and length of the stream channel with the use of meanders, the channel dimensions and stream microhabitats, such as riffle, pool, run, and glide habitats, can be restored. Meanders also function to cycle substrate material through the stream reach, to reduce shear strength against the channel banks, to reduce bank erosion, and to reduce downcutting of the stream channel. As with floodplain creation, this technique works well in areas where there is sufficient area adjacent to the existing channel to expand the channel and create the necessary meanders.

Bioengineering of Stream Bank

Soil bioengineering is an integrated technology that uses sound engineering practices in conjunction with integrated ecological principles, to assess, design, construct, and maintain living vegetative systems and to repair damage done by erosion and failures by the land to create a healthy and functioning riparian ecosystem. This technique can be used successfully in conjunction with other stream restoration techniques, such as floodplain creation, channel reconfiguration, and riparian revegetation. Many techniques are available depending on the specific goals of each stream reach under consideration as well as economic issues and specific land use adjacent to the existing stream.

Selective Placement of In-Stream Habitat Structures

The most common type of stream habitat improvement is the placement of specific in-stream structures within the existing stream channel, in order to address a specific problem at a precise location within a stream reach. This technique is advantageous because it is relatively inexpensive and it can be performed in distinct phases over time, as money and other resources become available. This technique also generally requires limited amounts of hydrologic and hydraulic modeling and can be completed within a relatively short time frame. The disadvantage of this method is that it generally results in stream improvement only in the general vicinity of the in-stream structure, and it does little to reduce or correct long-term stream problems that are the result of profound changes within the overall watershed. This method has the best long-term effect when combined with other more holistic restoration techniques. Often, this technique is selected for a particular stream reach when other more elaborate or detailed restoration efforts are not possible or are considered too expensive.

There are numerous in-stream structures that can be constructed within stream channels, depending on the desired goals. Certain structures, such as the Newbury riffle, the w-weir, and the J-hook weir, are useful in reducing shear strength within the channel, thus reducing channel downcutting and bank erosion. This is particularly useful when channel downcutting has exposed man-made structures such as sewer lines or culvert inverts. Other structures, such as rock cross-vane wing deflectors, are useful as grade control structures or for channel modification. Soft structure stream banks, such as live fascines, vegetated geogrids, and brush mattresses develop a root network in the stream bank which provides stability and prevents erosion. Bank revetments such as log-vanes and root wads are useful in improving the microhabitat of the stream.

Trash / Debris Removal

The presence of trash, litter, and other debris of man-made origin is unsightly, acts to degrade habitat value within the stream channel, results in obstructions to the proper flow within the stream, and actively degrades water quality. Accordingly, routine trash and litter removal serves as an important stream restoration activity. This technique can often be achieved cheaply, provides an excellent volunteer opportunity, and is useful in providing community support for stream restoration activities.