4.0 Summary of Watershed Restoration Strategies

Watershed restoration strategies to address stormwater problems and to improve water quality were developed for the Nichol Run and Pond Branch watersheds. The strategies recommended in this plan were developed by identifying priority subwatersheds and then identifying candidate restoration projects within them. The top 36 projects were selected for implementation within the next 10 years, and an additional 34 projects were selected for implementation within the next 25 years. A brief description of the methodology used to select priority subwatersheds and candidate restoration projects and the actual prioritization process is provided in this section. Detailed information on this process is provided in Technical Memos 3.2 and 3.4/3.5 found in Appendix B.

This section also includes a description of watershed restoration strategies, along with several examples of the types of projects that have been proposed. The end result of this work can be found in the list of 10-year and 25-year projects provided at the conclusion of this section.

4.1 Priority Subwatershed Identification

Priority subwatersheds and candidate restoration areas were identified based on the results of final subwatershed ranking, priority restoration elements from the Stream Physical Assessment (SPA), problem areas identified during subwatershed characterization and field reconnaissance, and input from the Watershed Advisory Group (WAG). These areas were targeted for implementation of structural Best Management Practices (BMPs), or restoration strategies.

There are also areas within the Nichol Run and Pond Branch watersheds that would benefit from preservation strategies rather than solely restorative strategies. Preservation strategies target the less impacted subwatersheds and key areas such as headwaters to prevent future degradation of the subwatershed and downstream areas. By evaluating subwatershed ranking, results of the pollutant loading model STEPL, and the total impervious area of the subwatershed, priority areas for preservation strategies were identified. These areas were targeted for the implementation of non-structural BMPs.

4.2 Description of Prioritization Process

The prioritization process that was used to select priority subwatersheds, identify candidate restoration projects, and determine final restoration projects consisted of four steps as outlined below. Detailed information and data regarding the prioritization process can be found in Technical Memos 3.4 and 3.5 located in Appendix B.

Step 1: The potential "universe" of structural projects was narrowed down by identifying priority subwatersheds, evaluating candidate restoration projects, soliciting comments from the WAG and determining which projects were viable.

Step 2: The watershed management plan prioritization scheme was used to perform the initial project ranking using the Spreadsheet Tool for Estimating Pollutant Load (STEPL) and

watershed indicators for all structural candidate projects within the 0-25-year implementation time frame. STEPL is a spreadsheet tool that uses simple algorithms to calculate nutrient and sediment loads from various land uses and determines the pollutant load reductions that would occur from implementing various BMPs.

Structural candidate projects were scored from 1 to 5 points, with 5 points representing the highest priority and 1 point representing the lowest priority. The five factors included:

- **Effect on watershed impact indicators (30%)** – Watershed impact indicators provide an overall picture of the condition of the watershed using a variety of quantitative indicators. Candidate projects that have a greater positive effect on the watershed impact indicators are likely to have a greater benefit than projects with a lesser or neutral effect.
- **Effect on source indicators (30%)** – Source indicators provide an overall picture of the stressors within a watershed using a variety of quantitative indicators. Candidate projects that have a greater positive effect on the source indicators are likely to have a greater benefit than projects with a lesser or neutral effect.
- **Location within priority subwatersheds (10%)** – Candidate projects located within poor quality subwatersheds have the potential to provide a greater overall impact than a project located within a high quality subwatershed. Therefore, projects located in poor quality subwatershed received a higher priority and a higher score than projects located in a high quality subwatershed.
- **Sequencing (20%)** – Projects upstream relative to other projects should be completed prior to projects located downstream. Upstream projects will provide protection for future downstream projects and also mitigate sources and stressors that cause cumulative impacts downstream. Therefore, projects in headwater areas were considered the highest priority and received a higher project score.
- **Implementability (10%)** – Less complex projects and projects without land acquisition requirements will be easier to implement and are given higher scores accordingly. Projects that were located on County property or retrofits of County-maintained stormwater facilities were scored higher than projects on private parcels and those with multiple landowners.

Step 3: The proposed 10-year implementation projects were further analyzed and evaluated using both the Storm Water Management Model (SWMM) and the HEC-RAS model. SWMM is a rainfall-runoff simulation model that estimates the quantity and quality of runoff. HEC-RAS is a computer program that models the hydraulics of water flow through watercourses. By utilizing these tools, a determination was made on which projects should be included in the 10-year implementation plan and how they were ranked within it.

Step 4: The final set of recommended projects and final ranking of all projects was determined through close collaboration with the WAG. Project ranking was also adjusted and finalized based on estimated costs and projected benefits of the projects. Projects that had greater projected benefits relative to estimated costs were prioritized. Finally, the ranked structural projects were grouped into the two implementation timeframes - the priority projects within 10 years and the long-term projects within 25 years. Detailed project fact sheets were created for the priority projects and can be found in Section 5.

4.3 Summary of Subwatershed Strategies

Once priority subwatersheds were identified and impairments for each subwatershed were determined, improvement goals and strategies were developed for each priority subwatershed based on the sources of subwatershed impairments. In order to achieve these goals, both structural projects and non-structural practices were developed.

Subwatershed improvement strategies are intended to reduce stormwater impacts for subwatersheds within each watershed. **Stream restoration strategie**s are targeted to improve habitat, to promote stable stream geomorphology, and to reduce in-stream pollutants due to erosion. **Non-structural measures and preservation strategies** can provide significant benefits by improving the water quality of stormwater runoff, by reducing the quantity of stormwater runoff, by improving stream and riparian habitat, and by mitigating the potential impacts of future development. Table 4.1 shows the relationship between the County goals and objectives and the restoration strategies.

Table 4.1
Relationship between County Objectives and Restoration Strategies

	Restoration Strategies		
County Goals & Objectives	**Subwatershed Improvements**	**Stream Restoration**	**Non-Structural & Preservation**
Minimize impacts of stormwater runoff on stream hydrology to promote stable stream morphology, protect habitat, and support biota	✘	✘	✘
Minimize flooding to protect property, human health, and safety	✘		
Provide for healthy habitat through protecting, restoring, and maintaining riparian buffers, wetlands, and in stream habitat	✘	✘	✘
Improve and maintain diversity of native plants and animals in the county	✘	✘	✘
Minimize impacts to stream water quality from pollutants in stormwater runoff	✘		✘
Minimize impacts to drinking water sources from pathogens, nutrients, and toxics in stormwater runoff	✘		✘
Minimize impacts to drinking water storage capacity from sediment in stormwater runoff	✘	✘	✘
Encourage the public to participate in watershed stewardship	✘	✘	✘
Coordinate with regional jurisdictions on watershed management and restoration efforts such as Chesapeake Bay initiatives	✘	✘	✘
Improve watershed aesthetics in Fairfax County	✘	✘	✘

The following table includes a summary of project types that may be included for the various improvement goals and strategies.

Table 4.2 Summary of Subwatershed Strategies & Project Types	
Strategies	**Project Types**
Subwatershed Improvements	Stormwater Pond Retrofits New Stormwater Ponds Low Impact Development Retrofits Culvert Retrofits, including Road Crossing Improvements Outfall Improvements Area-wide Drainage Improvements
Stream Restoration	Streambank Stabilization Natural Channel Restoration
Non-Structural Measures and Preservation Strategies	Buffer restoration Rain barrel programs Dumpsite/Obstruction removal Community outreach/Public education Conservation acquisition/easements Street sweeping Storm drain stenciling

Each of the subwatershed strategies are briefly described below along with information on sample project types.

4.3.1 Subwatershed Improvement Strategies

Subwatershed improvement strategies are intended to reduce stormwater impacts. Project types for subwatershed improvement strategies include:

- Retrofits to existing stormwater ponds
- New stormwater ponds
- Low impact development projects,
- Culvert retrofits
- Outfall improvements
- Area-wide drainage improvements

Low impact development (LID) projects are Best Management Practices (BMPs) designed to provide water quality and quantity benefits for stormwater management on the site where stormwater is generated. Possible LID projects include:

- Sand Filters and Sand/Peat Filters
- Rain Gardens/Bioretention
- Infiltration Basins/Trenches
- Vegetated Rooftops
- Porous/Permeable Paving
- Underground or Rooftop Storage

4.3.2 Stream Restoration Strategies

Stream restoration strategies are targeted at improving stream and riparian buffer habitat, promoting stable stream geomorphology, and reducing in-stream pollutants due to erosion. Regional pond alternative strategies and subwatershed improvement strategies are critical to the success of stream restoration strategies by improving drainage and reducing peak flows. A major component of stream restoration strategies is identifying and addressing the source of the impairments.

Stream restoration can be accomplished by installing streambank stabilization measures, installing and/or maintaining riparian buffers, or implementing natural channel restoration measures. Structural streambank stabilization measures include riprap or other "hard" engineering stabilization measures such as concrete, sheet piling or gabions. Non-structural streambank stabilization measures, which are preferred, can include the following:

- Cedar tree revetments
- Root wad revetments
- Rock toe revetments
- Live crib walls
- Natural fiber rolls
- Live fascines
- Brush mattresses
- Live stakes

Streambank stabilization projects can be expensive and are more likely to succeed when upstream stormwater problems are addressed prior to the installation of streambank stabilization measures.

4.3.3 Non-Structural Measures and Preservation Strategies

Non-structural projects do not require traditional construction measures to be implemented and may be programmatic in nature. These projects include but are not limited to the following practices:

- Buffer restorations
- Rain barrel programs
- Dumpsite and obstruction removals
- Community outreach and public education
- Land conservation coordination projects
- Inspection and enforcement projects
- Street sweeping programs
- Recommendation of additional studies, surveys and assessments

These projects, in concert with the structural projects, represent a holistic approach to watershed management. Since much of the land area in Fairfax County is privately owned, there is a strong need to work with local communities to promote environmental awareness and recommend projects that can be implemented by residents and other groups.

The fundamental difference between structural and non-structural projects is the ability to predict the result of the project implementation through models. For example, the nitrogen removal of a wet pond may be calculated; however, there is no way to predict the reduction in nitrogen from an outreach campaign on proper fertilizer use. Additionally, these projects and programs should not be confined to any single watershed but could be implemented throughout the County as opportunities occur. Because of these differences, non-structural projects were evaluated and will be implemented using a different process than the structural projects.

There are many advantages of non-structural projects. Some of the key advantages to this projects type are:

- Less costly
- Less disruptive
- Promotes public and community awareness

In general, non-structural projects represent opportunities to proactively pursue stormwater issues that more traditional structural practices cannot address. The use of non-structural practices fulfills Fairfax County's MS4 permit requirements and environmental initiatives. The full potential of these projects will be realized through partnerships with county agencies, residents and other interested parties.

4.4 Project Type Descriptions

A detailed description of the project types included in the WMP and their benefits are provided below.

New Stormwater Ponds and Stormwater Pond Retrofits

Extended Detention (ED) Basin

An extended detention basin is a stormwater management facility that temporarily stores stormwater runoff and discharges it at a slower rate through a hydraulic outlet structure. It is typically dry during non-rainfall periods. The purpose of this BMP is to enhance water quality and decrease downstream flooding and channel erosion. Water quality is enhanced through gravitational settling, though settled pollutants may become re-suspended with frequent high inflow velocities.

Photo 4.1 Extended Detention Basin Full of Stormwater
Source: Virginia Stormwater Management Handbook

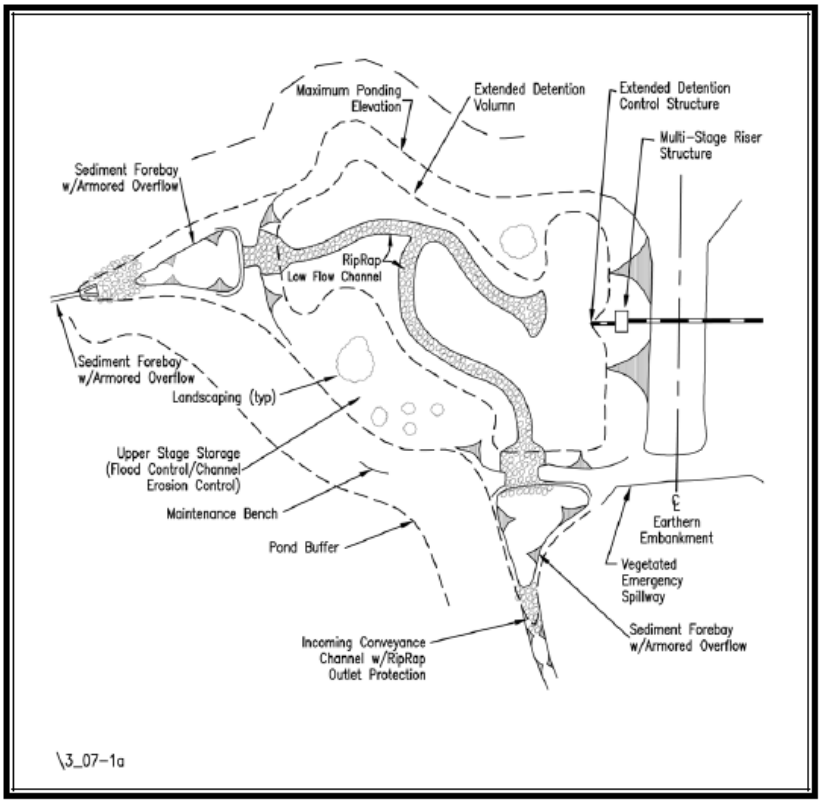

Figure 4.1 Plan View of Extended Detention Basin
Source: Virginia Stormwater Management Handbook

Photo 4.1 shows an extended detention basin full of stormwater runoff. The circuitous path slows stormwater and allows for the settling of sediments.

Figure 4.1 shows a typical plan view of an extended detention basin.

Enhanced Extended Detention (EED) Basin

An enhanced extended detention basin has a similar design to an extended detention basin, though it incorporates a shallow marsh along the bottom. The shallow marsh improves water quality through wetland plant uptake, absorption, physical filtration, and decomposition. Wetland vegetation also traps settled pollutants, reducing the re-suspension that can be found in extended detention basins. The purpose of this BMP is to enhance water quality and decrease downstream flooding and channel erosion.

Photo 4.2 Enhanced Extended Detention Basin Full of Stormwater
Source: Virginia Stormwater Management Handbook

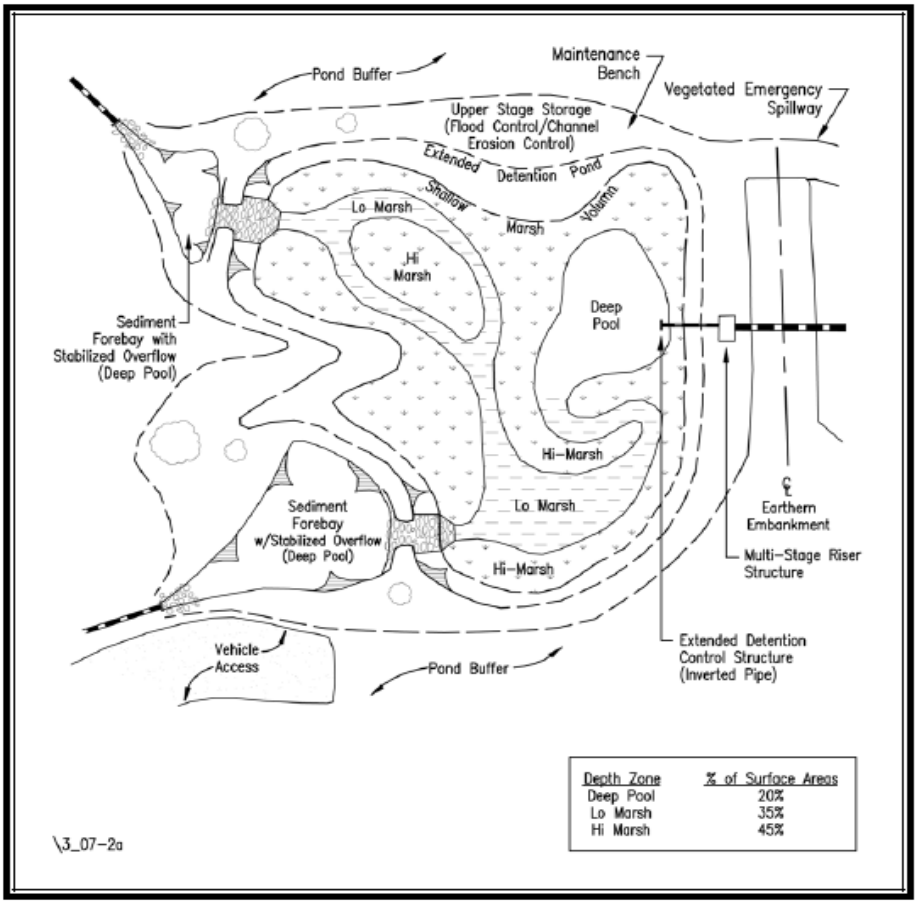

Figure 4.2 Plan view of Enhanced Extended Detention Basin
Source: Virginia Stormwater Management Handbook

Photo 4.2 shows a multi-stage weir principal spillway and deep water pool (18”-48” depth) in an enhanced extended detention basin.

Figure 4.2 shows a plan view of an enhanced extended detention basin.

Retention Basin (Wet Pond)

A retention basin (wet pond) is a stormwater facility that has a permanent pool of water, which means it is normally wet all the time. The purpose of this BMP is to provide storage for stormwater runoff, to alleviate downstream flooding and channel erosion, and to improve water quality. A retention basin may be used to temporarily store stormwater runoff above the permanent pool elevation and release it at lower rates. Water quality can be improved through gravitational settling, biological uptake and decomposition.

Photo 4.3 Retention Basin
Source: Virginia Stormwater Management Handbook

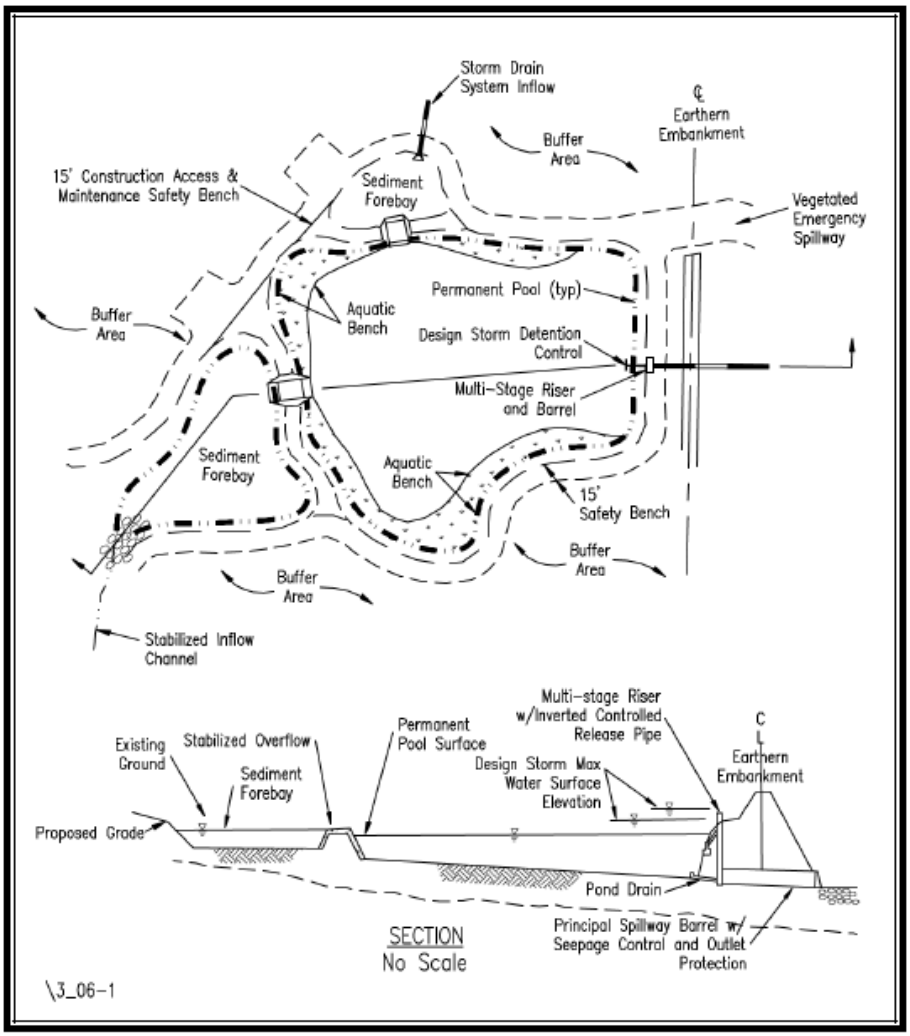

Figure 4.3 Retention Basin – Plan and Section
Source: Virginia Stormwater Management Handbook

Photo 4.3 shows a typical stormwater retention basin in a residential community. The aquatic bench is important for public safety, the biological health of the facility, and is aesthetically pleasing.

Figure 4.3 shows a typical plan view and section of a retention basin.

Constructed Stormwater Wetlands

Constructed stormwater wetlands are shallow pools that are created to provide growing conditions suitable for both emergent and aquatic vegetation. They are constructed to replicate natural wetland ecosystems. Constructed wetlands are installed to enhance the water quality of stormwater runoff through gravitational settling, nutrient uptake by wetland vegetation, absorption, physical filtration, and biological decomposition.

Photo 4.4 Constructed Stormwater Wetlands
Source: Virginia Stormwater Management Handbook

Photo 4.4 shows a constructed stormwater wetland. The vegetation is protected from waterfowl by a netting system. Figure 4.4 shows a plan view of constructed stormwater wetlands.

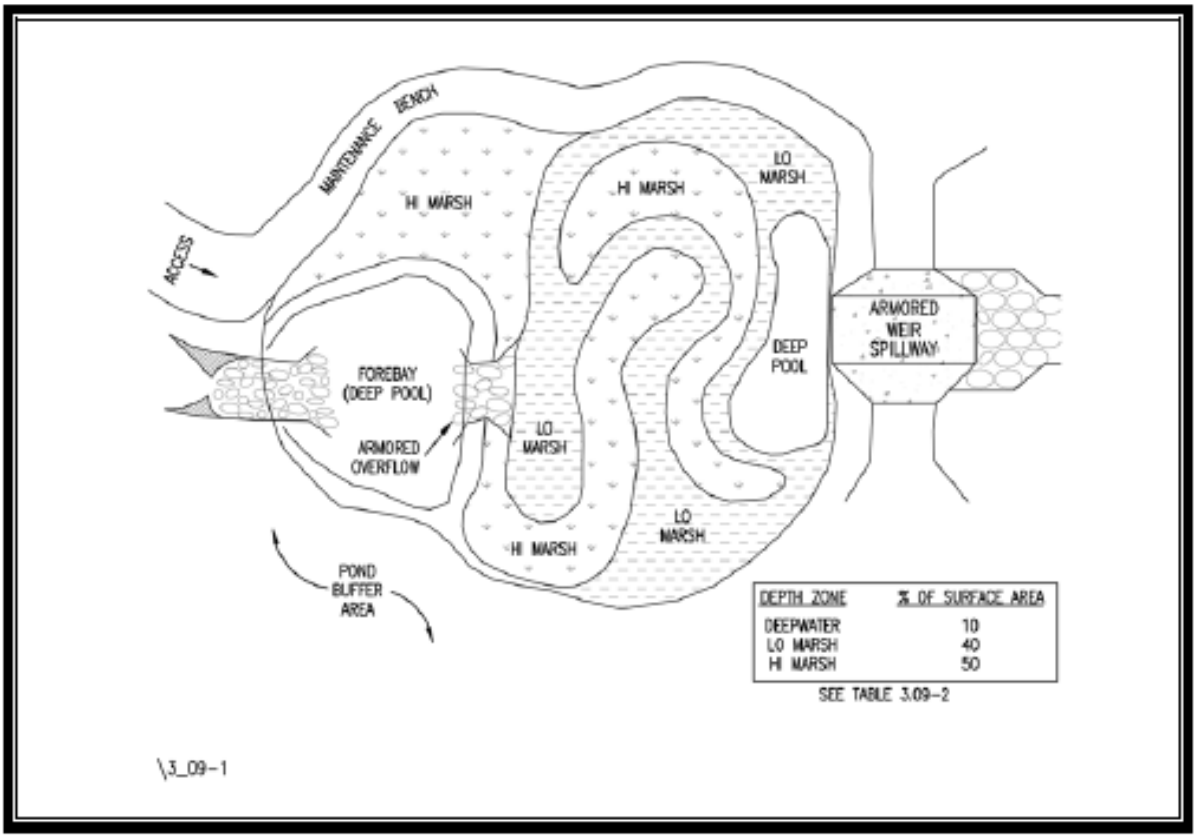

Figure 4.4 Constructed Stormwater Wetlands – Plan
Source: Virginia Stormwater Management Handbook

Culvert Retrofits

A culvert is a conduit through which surface water can flow under or across a road, railway, trail, or embankment. A culvert retrofit involves the replacement or modification of an existing culvert. This can be necessary due to many factors such as a culvert being undersized for the amount of stormwater it carries or if the culvert has been damaged.

Culvert Retrofits with Micro-pools

Culvert retrofits with micro-pools involve the measures stated above plus the addition of shallow depressions that hold stormwater, known as micro-pools. The purpose of this BMP is to slow down stormwater in order to enhance water quality through infiltration, sedimentation, and filtration and to decrease downstream flooding and erosion. Stormwater runoff volumes are decreased through infiltration and by uptake of the plant material. Culvert retrofits with micro-pools improve water quality, reduce stormwater runoffs and peak volumes, increase groundwater recharge, provide wildlife habitat, and are aesthetically pleasing. Figure 4.5 shows a typical plan and profile of a crossing retrofit showing a secondary embankment.

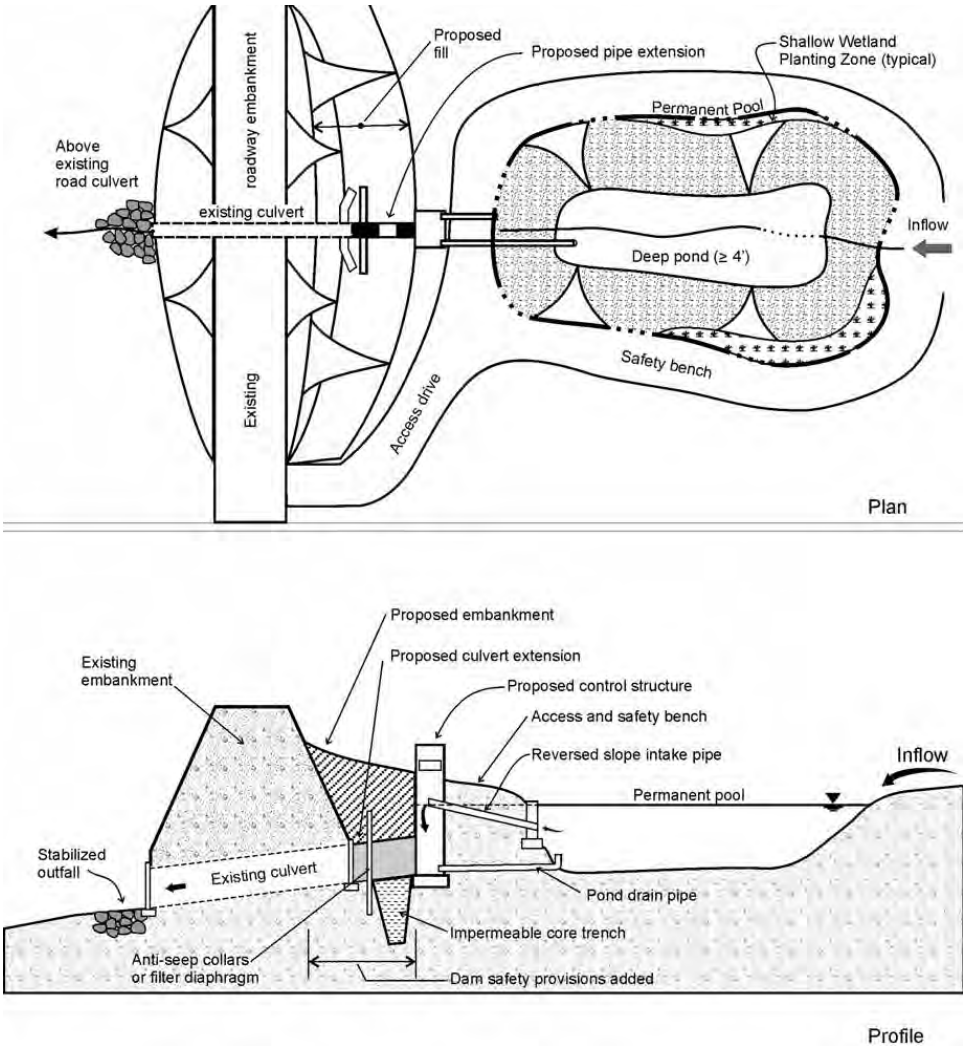

Figure 4.5 Typical Culvert Retrofit with Micro-pool Configuration
Source: Center for Watershed Protection

Best Management Practices/Low Impact Development Retrofits (BMPs/LIDs)

Rain Garden (Bioretention Basin)

A rain garden (bioretention basin) is a shallow surface depression planted with native vegetation to capture and treat stormwater runoff. The purpose of this BMP is to capture, treat, and infiltrate stormwater. Rain gardens store and infiltrate stormwater runoff, which increases groundwater recharge and may decrease downstream erosion and flooding. Stormwater runoff water quality is improved by filtration through the soil media and biological and biochemical reactions with the soil and around the root zones of plants. Rain gardens improve water quality, reduce stormwater runoff and peak volumes, increase groundwater recharge, provide wildlife habitat and are aesthetically pleasing.

Photo 4.5 Rain Garden
Source: Virginia Stormwater Management Handbook

Photo 4.5 shows the application of a rain garden in a multifamily residential area.

Figure 4.6 shows a plan view of shows a rain garden at the edge of a parking lot with curbing.

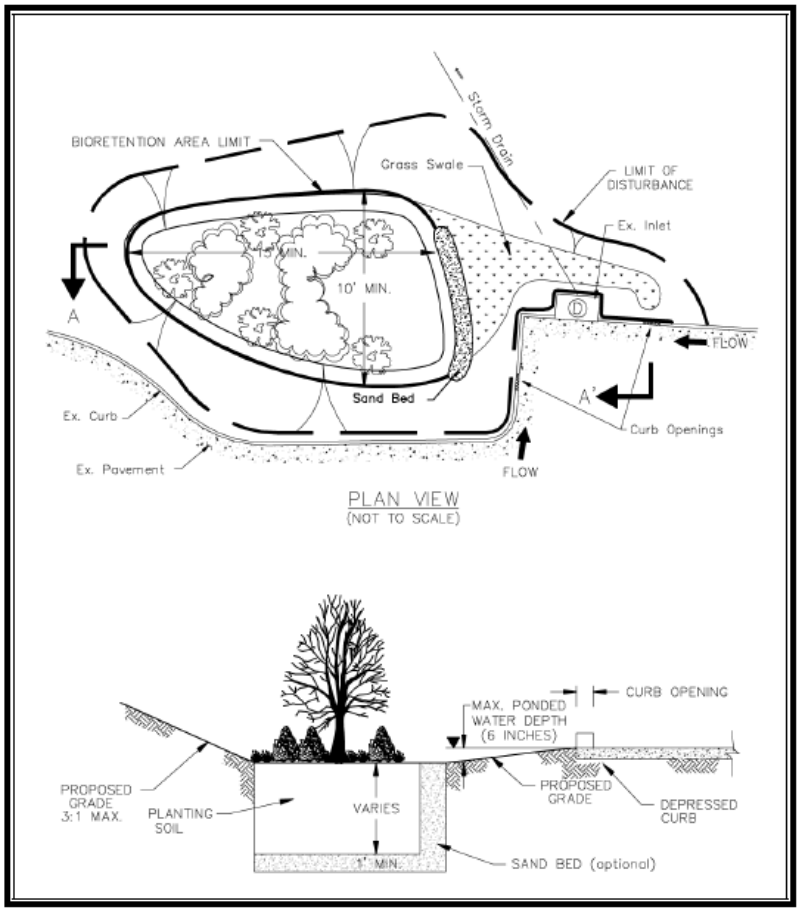

Figure 4.6 Rain Garden at Edge of Parking Lot, Plan View Source: Virginia Stormwater Management Handbook)

Vegetated/Grassed Swale

A vegetated/grassed swale is a broad and shallow channel vegetated with erosion resistant and flood-tolerant grasses and/or herbaceous vegetation. Sometimes, check dams are placed within the swale to encourage ponding behind them. The purpose of this BMP is to convey and slow down stormwater in order to enhance water quality through sedimentation and filtration. Check dams slow the flow rate and create small, temporary ponding areas. Stormwater runoff volumes may be decreased through infiltration and/or evapo-transpiration and water quality is improved by nutrient uptake of the plant material and settling of soil particles.

Photo 4.6 Grassed Swale with Check Dams
Source: Virginia Stormwater Management Handbook

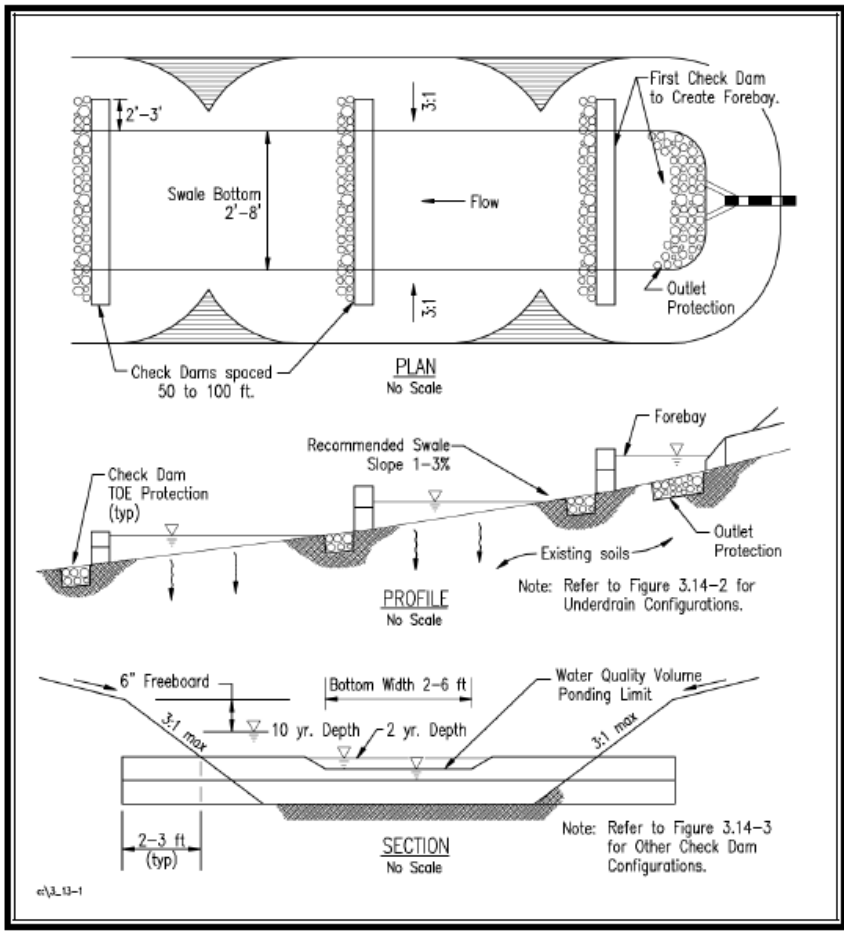

Figure 4.7 Typical Vegetated Swale Configuration
Source: Virginia Stormwater Management Handbook

Photo 4.6 shows a grassed swale with check dams. The area behind the check dams is used for storage of stormwater runoff. The notched center of the check dams allows for safe overflow of stormwater without scouring the sides of the channel.

Figure 4.7 shows a typical vegetated swale configuration.

Water Quality Swale/ Infiltration Trench

A water quality swale is a vegetated/grassed swale that is underlain by an engineered soil mixture designed to promote infiltration. The purpose of this BMP is to convey and slow down stormwater in order to enhance water quality through infiltration, sedimentation, and filtration. Stormwater runoff volumes are decreased through infiltration and water quality is improved by nutrient uptake of the plant material and settling of soil particles.

Photo 4.7 Vegetated Water Quality Swale
Source: F. X. Browne, Inc.

Infiltration trenches may also be designed with a gravel surface.

Photo 4.7 shows a vegetated swale connecting a drainage outlet and a stormwater basin. The swale was planted with a combination of native trees, shrubs and herbaceous plants that provide nutrient uptake, habitat for organisms like birds and butterflies, and are aesthetically pleasing.

Figure 4.8 shows a typical water quality swale configuration.

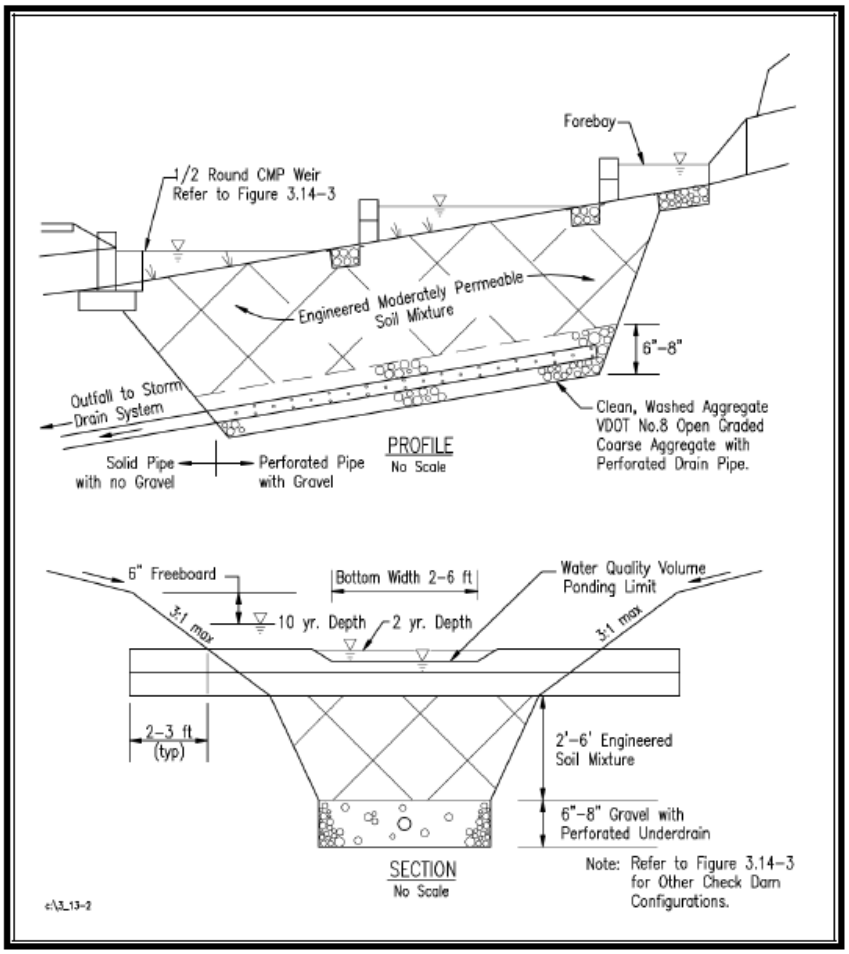

Figure 4.8 Typical Water Quality Swale Configuration
Source: Virginia Stormwater Management Handbook

Stream Restoration

Photo 4.9 Restored Channel in Snakeden Watershed, Reston, Virginia
Source: Reston Association

A healthy stream is one that is in its natural condition, does not have a disproportionate amount of stormwater runoff contributing to the stream flows, meanders, has a healthy riparian buffer with native vegetation and supports aquatic life. Straightened streams with smoothed channels, typically man-made or altered, have increased velocities which can cause substantial erosion and flooding to downstream areas. The purpose of a stream restoration is to return the stream to its healthy, natural condition. Stream restoration includes many types of improvements such as re-grading stream banks to enhance the floodplain, re-grading the stream to create a meander or step pool system, stabilizing stream banks with "soft" measures, stabilizing stream banks with "hard" measures and building in-stream structures to protect the stream banks and streambed.

Figure 4.10 Comprehensive Stream Restoration Project
Source: F. X. Browne, Inc.

Stabilizing stream banks with "soft" measures such as vegetation, brush layering and fascines protect stream banks from scour and erosion caused by large velocities. Healthy vegetation will also slow velocities, decrease flows, and provide wildlife habitat. Building in-stream structures such as rock cross vanes and step pools and stabilizing stream banks with "hard" measures like boulder revetments also protect the stream banks from scour and erosion caused by large velocities. Restored streams have reduced soil erosion, reduced stormwater runoffs and peak volumes, provide aquatic habitat, provide recreational activities and are aesthetically pleasing.

In some cases, localized streambank stabilization measures are not sufficient to restore stream channel structure and functions. For severely impaired streams, a more comprehensive restoration project may be warranted that involves reconstructing the channel and/or floodplain. Re-grading of the stream banks or streambed is done to mimic the natural shape and direction of a healthy stream. Re-grading stream banks to connect with the floodplain allows large flows access over the floodplain, which can decrease velocities and volumes. Creating a meander in the stream can slow flows to reduce downstream flooding.

Step Pools

Step pools are rock grade control structures that recreate the natural step-pool channel morphology and gradually lower the elevation of a stream in a series of steps. They are constructed in steeper channels where a fixed bed elevation is required, and are typically used in streams with a slope greater than three percent. They are built in the stream channel and allow for "stepping down" the channel over a series of drops. As water flows over the step, energy is dissipated into the plunge pool. Step pools can connect reaches of different elevations, dissipate the energy of high-velocity flows, and improve aquatic habitat.

Photo 4.10 Step Pool Channel
Source: Arlington County, VA

Photo 4.10 shows a close-up of step pools in Donaldson Run in Arlington, VA. Figure 4.11 shows a typical plan and profile for step pool structures.

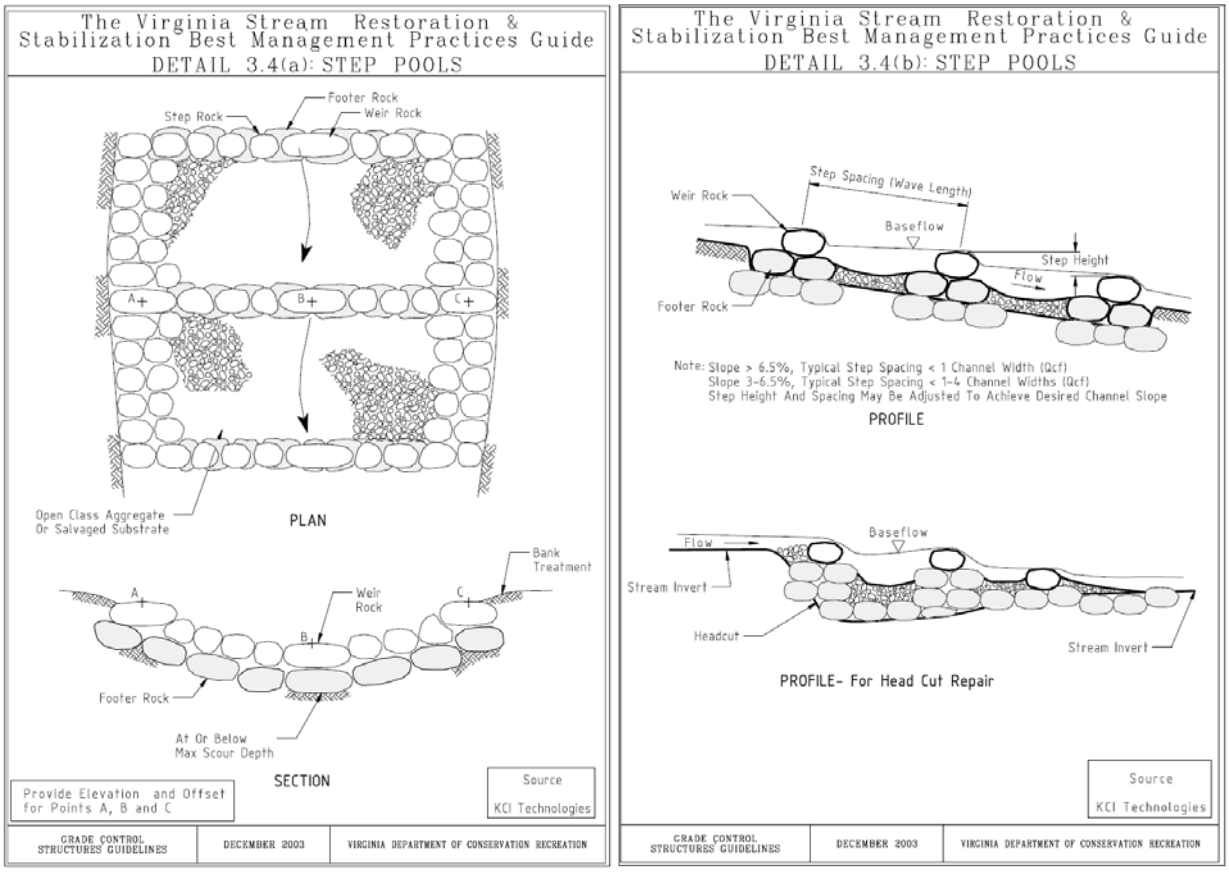

Figure 4.11 Step Pool Plan and Profile
Source: Virginia Stormwater Management Handbook

Rock Vanes

A rock cross vane is an in-stream stone structure that provides grade control and reduces streambank erosion. Rock cross vanes are placed at an angle to direct flow to the center of the stream over the cross vane, capture sediment, and create a scour pool downstream of the structure. They are used to direct flows toward the center of the channel which decreases stress on the stream banks and reduces bank erosion. The narrower flow path and decreased stress on stream banks is also beneficial for protecting bridges and maintaining streambed elevation.

Photo 4.11 Rock Vane in Completed Stream Restoration in Reston, Virginia

Source: Reston Association

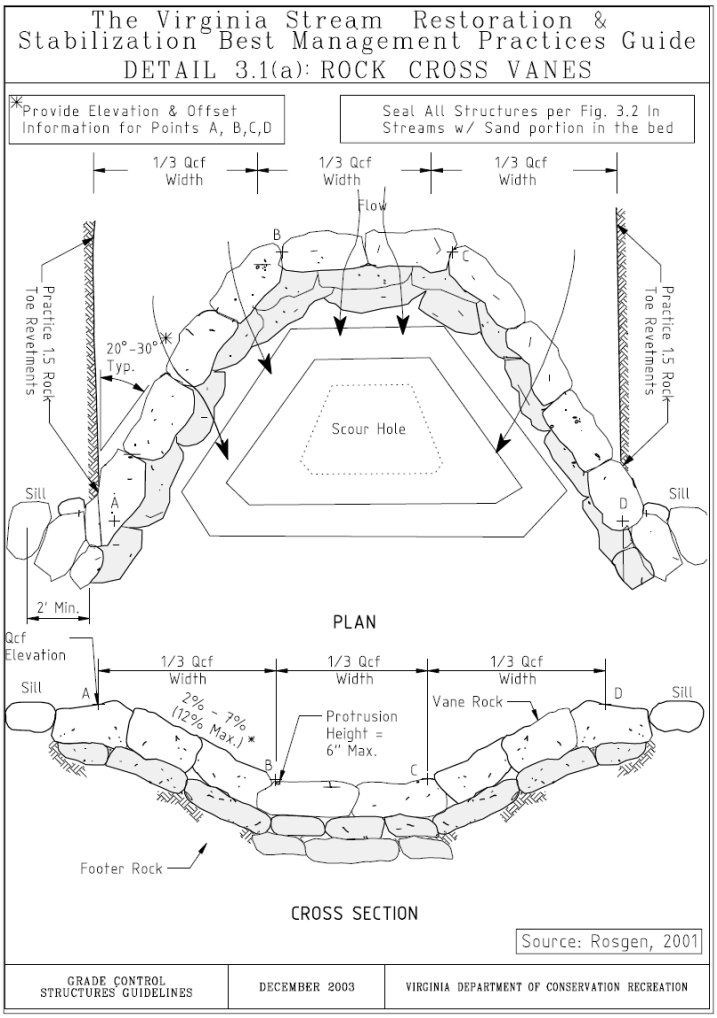

Figure 4.12 Detail Plan Rock Vane

Rock vanes also increase the flow depth downstream from the structure which enhances fish habitat.

Photo 4.11 shows a rock vane structure in a completed stream restoration in the Snakeden Watershed in Reston, Virginia. Figure 4.12 shows a detailed sketch for a typical rock vane.

Boulder Revetments/Boulder Toe

Boulder revetments, also called boulder toe, consists of placing a boulder or boulders in the toe of a streambank to provide rigid toe protection. The "toe" lies at the bottom of the slope and supports the weight of the streambank. Rigid toe protection is used where the lower streambank and toe are subject to erosion and require permanent protection. They can be placed at near vertical slopes, and are a good option for areas that have limited horizontal space. Boulder revetments protect stream banks from heavy flows and prevent erosion at the base of the streambank.

Photo 4.12 Boulder Revetment
Source: Center for Watershed Protection

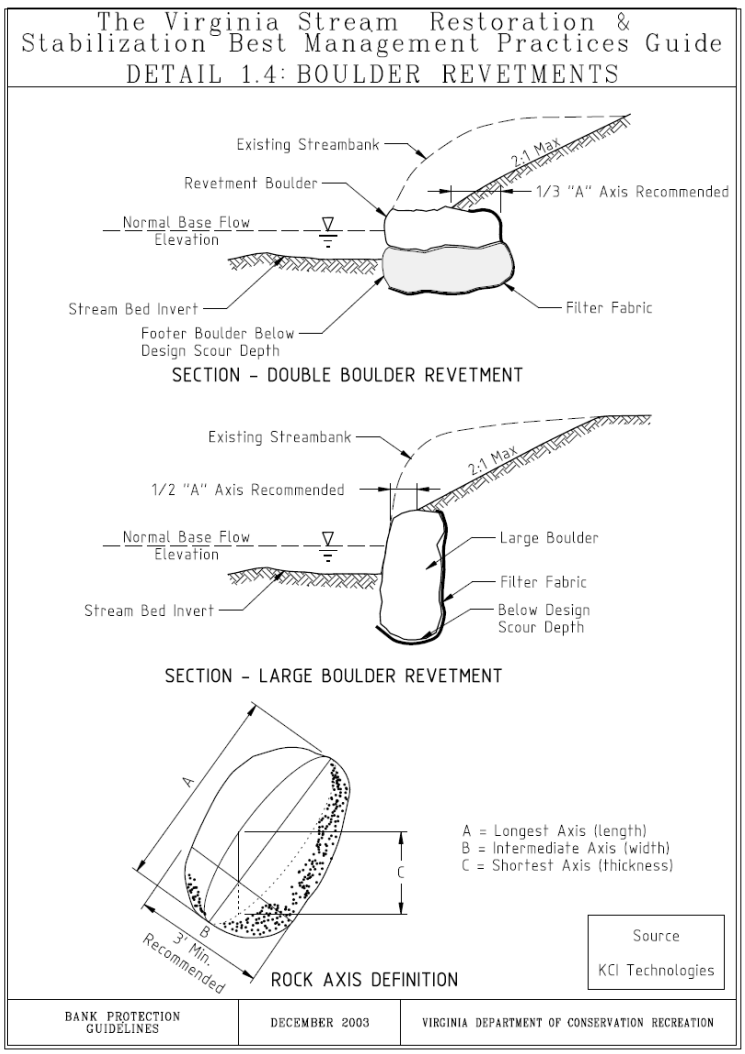

Figure 4.13 Detail Plan Boulder Revetment

Photo 4.12 shows a boulder revetment in a completed stream restoration. Figure 4.13 shows a detailed sketch for a typical boulder revetment.

Non-Structural

Riparian Buffer Restoration

A riparian buffer is the area adjacent to streams, lakes, ponds and wetlands. This area is extremely important to the health of a water body, as it intercepts, slows, and filters stormwater before it reaches the water. A wooded riparian buffer with a shrub and herbaceous layer is the most effective riparian buffer, while the least effective riparian buffer consists of mowed grass or no vegetation. The wider a riparian buffer is, the better it is for the health of a stream.

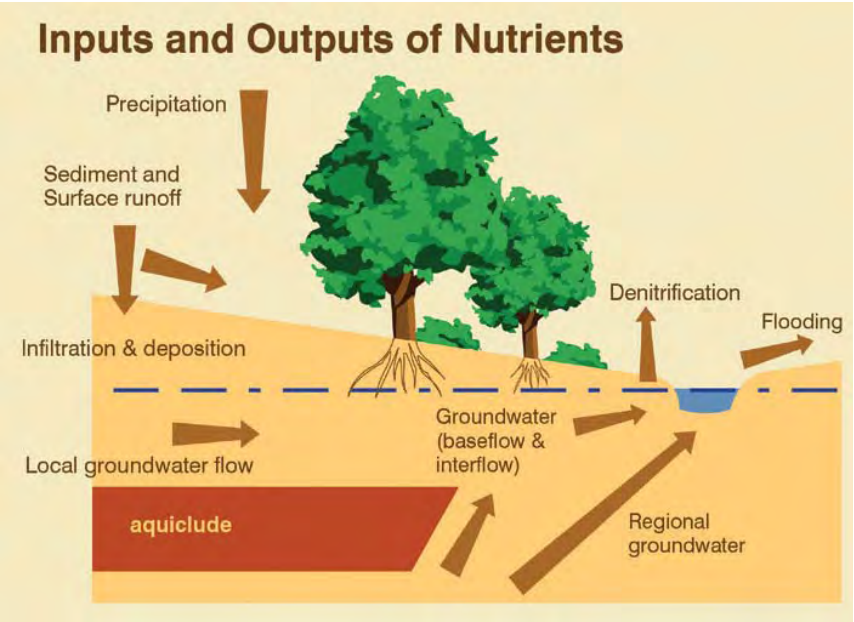

Figure 4.14 Riparian Buffer Nutrient Inputs and Outputs
Source: Chesapeake Bay Program

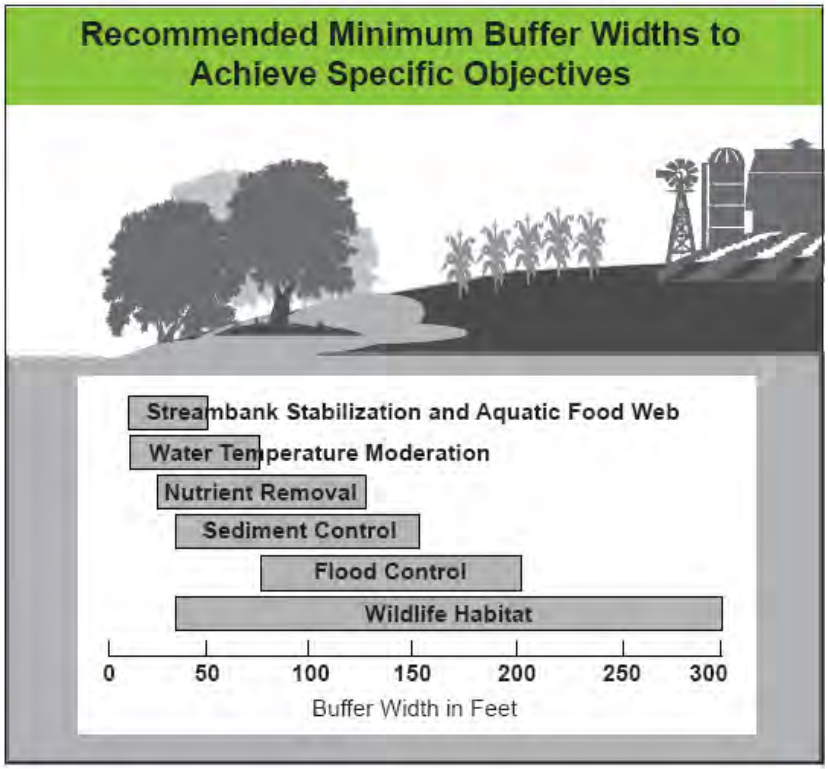

Figure 4.15 Buffer Widths and Objectives
Source: Chesapeake Bay Program

Riparian buffer restoration consists of removing invasive species and/or undesirable vegetation and replanting with native trees, shrubs, and herbaceous species. Among the benefits of these buffers is improved water quality, reduced soil erosion and stormwater runoff and improved wildlife habitat.

Figure 4.14 illustrates the inputs and outputs of nutrients in a riparian buffer.

Figure 4.15 describes the recommended minimum buffer widths to achieve specific objectives.

Targeted Rain Barrel Program

Rain barrels are tanks/containers that collect and store stormwater runoff from a roof by connecting to rain gutters/downspouts. The purpose of a rain barrel is to slow down and capture stormwater runoff to reduce stormwater runoff volumes and peak rates and to decrease flooding and erosion. Utilizing the rainwater for irrigation improves water quality by filtration through the soil and increases groundwater recharge. Utilizing rainwater also reduces the need to use well water or municipal water.

Photo 4.13 shows a typical rain barrel that can be assembled at home or bought from a retail center.

Photo 4.13 Typical Rain Barrel
Source: Northern Virginia Soil and Water Conservation District, Fairfax County, VA

4.5 Overall List of Projects

Map 4.1 shows all structural and non-structural project locations throughout Nichol Run and Pond Branch watersheds as they are distributed within the Dranesville supervisor district.

Table 4.3 is the Master Project List, which contains all projects, organized by implementation plan and project number. The 10-year implementation projects have associated project fact sheets that are located in Section 5.

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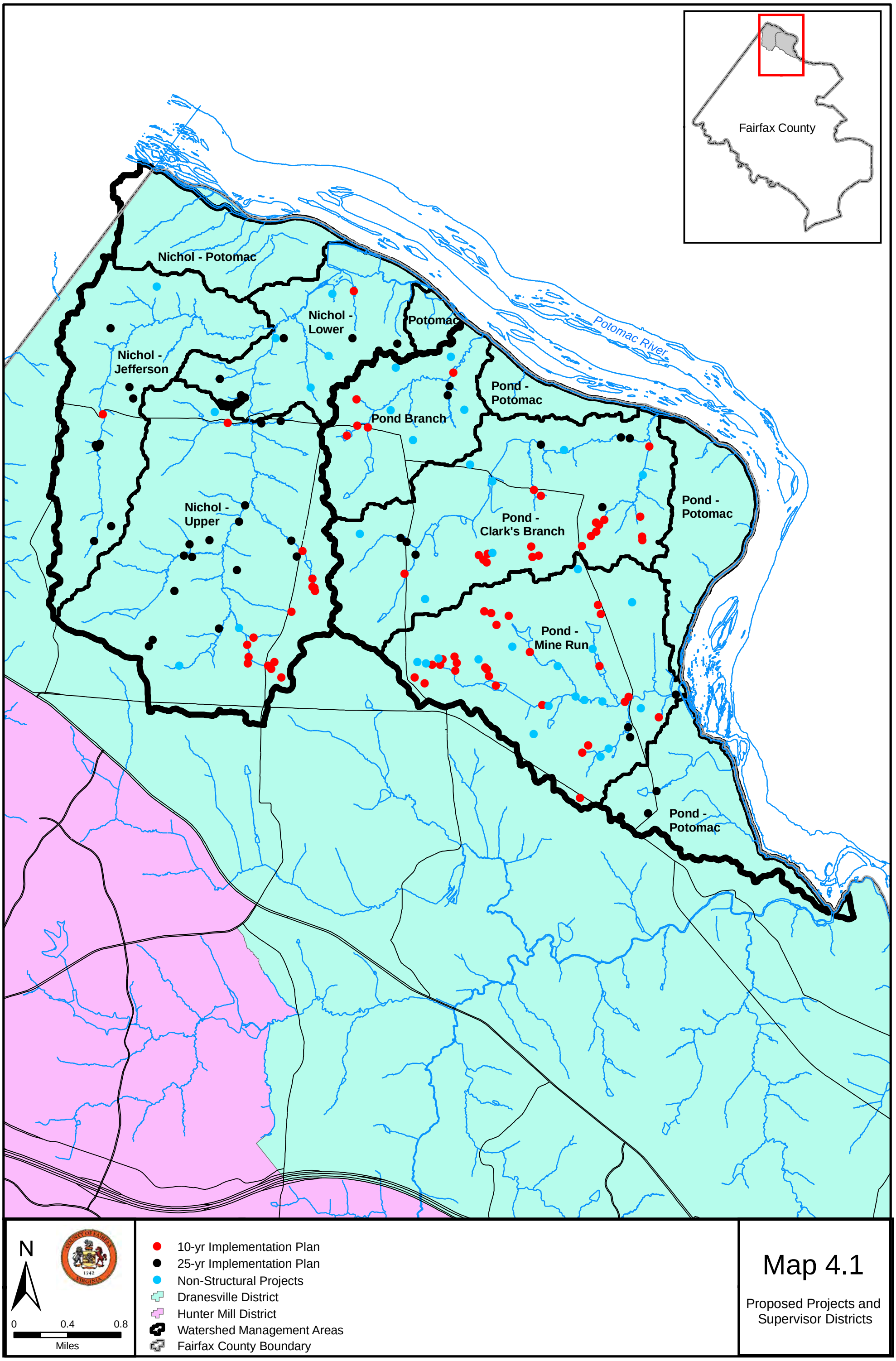

Map 4.1

Proposed Projects and Supervisor Districts

Table 4.3 Master Project List						
Priority Structural Projects (10 Year Implementation Plan)						
Project #	**Project Type**	**WMA**	**Location**	**Watershed Benefit**	**Land Owner**	**Cost**
NI9101	Stormwater Pond Retrofit	Nichol Run - Lower	Near the end of Jefferson Run Road	Quality/ Quantity	Private	$90,000.00
NI9106	Stormwater Pond Retrofit, BMP/LID	Nichol Run - Upper	Finger Lakes Estates Subdivision	Quality/ Quantity	County/ Private	$260,000.00
NI9111	Stormwater Pond Retrofit	Nichol Run - Upper	Patrician Woods Subdivision, Patrician Woods Court & Springvale Road	Quality/ Quantity	County	$210,000.00
NI9113	Culvert Retrofit	Nichol - Jefferson	Near Beach Mill Road & Pipestem	Quality/ Quantity	State/ County/ Private	$40,000.00
NI9118	Stormwater Pond Retrofit, BMP/LID	Nichol Run - Upper	Dogwood Farm Section 2 Subdivision	Quality/ Quantity	County/ Private	$230,000.00
NI9119	Stormwater Pond Retrofit, Stream Restoration	Nichol Run - Upper	Near Falls Pointe Drive cul-de-sac	Quality/ Quantity	County	$330,000.00
NI9201	Stream Restoration	Nichol Run - Upper	Woodleaf Subdivision	Quality	State/ County/ Private	$100,000.00
NI9202	Stream Restoration	Nichol Run - Upper	Spring Valley Woods Subdivision	Quality	Private	$580,000.00
NI9401	Culvert Retrofit	Nichol Run - Upper	Down Patrick Farms Subdivision	Quality/ Quantity	Private	$160,000.00
PN9100	New Stormwater Pond, BMP/LID	Pond Branch - Clark	Riverside Manor Subdivision	Quality/ Quantity	State/ Private	$170,000.00
PN9101	New Stormwater Pond	Pond Branch - Clark	Eaton Court & Eaton Park Road	Quality	Private	$80,000.00
PN9102	Stormwater Pond Retrofit	Pond Branch - Clark	Near River Bend Road & Oak Falls Court	Quality	Private	$130,000.00
PN9103	New Stormwater Pond, BMP/LID, Stream Restoration	Pond Branch - Clark	Fitz Folly Farms Subdivision	Quality/ Quantity	County/ Private	$620,000.00
PN9104	Stormwater Pond Retrofit, BMP/LID	Pond Branch - Clark	Golden Woods Subdivision	Quality/ Quantity	County	$200,000.00
PN9105	Stormwater Pond Retrofit, BMP/LID	Pond Branch - Clark	Morison Estate Subdivision	Quality/ Quantity	County/ Private	$200,000.00
PN9108	New Stormwater Pond, BMP/LID	Pond Branch - Mine Run	Near northern Deerfield Court cul-de-sac	Quality/ Quantity	County/ Private	$410,000.00

Table 4.3 Master Project List						
Priority Structural Projects (10 Year Implementation Plan)						
Project #	**Project Type**	**WMA**	**Location**	**Watershed Benefit**	**Land Owner**	**Cost**
PN9109	New Stormwater Pond, Stormwater Pond Retrofit, BMP/LID	Pond Branch - Mine Run	Deerfield Pond Subdivision	Quality/ Quantity	County/ Private	$280,000.00
PN9110	BMP/LID, Education	Pond Branch - Mine Run	Great Falls Elementary School	Quality	County	$90,000.00
PN9111	New Stormwater Pond, Stormwater Pond Retrofit, Culvert Retrofit, Stream Restoration	Pond Branch - Mine Run	Marmota Farm Subdivision	Quality/ Quantity	Private	$830,000.00
PN9112	Stormwater Pond Retrofit	Pond Branch - Mine Run	Near Rossmore Court cul-de-sac	Quality/ Quantity	Private	$240,000.00
PN9113	New Stormwater Pond	Pond Branch - Mine Run	Arnon Lake Subdivision	Quality	Private	$100,000.00
PN9114	Stormwater Pond Retrofit, BMP/LID	Pond Branch - Mine Run	Arnon Ridge Subdivision	Quality/ Quantity	County/ Private	$190,000.00
PN9116	Stormwater Pond Retrofit, Culvert Retrofit	Pond Branch	Near Beach Mill Road & Springvale Road	Quality/ Quantity	County/ Private	$400,000.00
PN9117	New Stormwater Pond, Stormwater Pond Retrofit	Pond Branch - Mine Run	Monalaine Court & River Bend Road	Quality/ Quantity	County/ Private	$360,000.00
PN9118	Stormwater Pond Retrofit, Culvert Retrofit	Pond Branch - Mine Run	Near River Bend Road & Hidden Springs Road	Quality/ Quantity	Private	$130,000.00
PN9119	Stormwater Pond Retrofit	Pond Branch - Mine Run	Fallswood Subdivision	Quality/ Quantity	Private	$100,000.00
PN9120	Stormwater Pond Retrofit	Pond Branch - Mine Run	Cornwell Farm Subdivision	Quality/ Quantity	Private	$150,000.00
PN9122	Stormwater Pond Retrofit, Stream Restoration	Pond Branch - Mine Run	Jackson Hills Subdivision	Quality/ Quantity	Private	$490,000.00
PN9123	Stormwater Pond Retrofit	Pond Branch	Near Bliss Lane & Commonage Drive	Quality/ Quantity	Private	$90,000.00
PN9124	Stormwater Pond Retrofit	Pond Branch - Mine Run	Jackson Hills Subdivision	Quality/ Quantity	Private	$80,000.00
PN9126	Stormwater Pond Retrofit	Pond Branch - Clark	Squire's Haven Section 2 Subdivision	Quality/ Quantity	Private	$250,000.00
PN9127	Stormwater Pond Retrofit, BMP/LID	Pond Branch - Clark	Eagon Hills & River Bend Estates Subdivision	Quality/ Quantity	County/ Private	$340,000.00

Table 4.3 Master Project List						
Priority Structural Projects (10 Year Implementation Plan)						
Project #	**Project Type**	**WMA**	**Location**	**Watershed Benefit**	**Land Owner**	**Cost**
PN9200	Stream Restoration	Pond Branch - Mine Run	Arnon Lake Subdivision	Quality	Private	$350,000.00
PN9201	Stream Restoration	Pond Branch	Riverbend Knolls Subdivision	Quality	County/ Private	$160,000.00
PN9400	Culvert Retrofit	Pond Branch - Clark	Potomac Forest Subdivision	Quality/ Quantity	County/ Private	$120,000.00
PN9408	Stream Restoration	Pond Branch - Clark	Fitz Folly Farms Subdivision & Riverside Manor Subdivision	Quality/ Quantity	Private	$510,000.00
					Total Cost:	***$9,070,000.00***

Long-Term Structural Projects (25 Year Implementation Plan)					
Project #	**Project Type**	**WMA**	**Location**	**Watershed Benefit**	**Land Owner**
NI9100	New Stormwater Pond	Nichol Run - Lower	Near High Hill Court & Falcon Ridge Road	Quality	Private
NI9102	Stormwater Pond Retrofit	Nichol Run - Lower	Southdown Subdivision	Quality	Private
NI9103	Stormwater Pond Retrofit	Nichol Run - Lower	Near Springvale Road & Allenwood Lane	Quality/ Quantity	Private
NI9104	Stormwater Pond Retrofit	Nichol Run - Upper	Near Beach Mill Road & Springvale Road	Quality/ Quantity	Private
NI9105	Stormwater Pond Retrofit	Nichol Run - Upper	Near Beach Mill Road & Springvale Road	Quality/ Quantity	Private
NI9107	Stormwater Pond Retrofit	Nichol - Jefferson	Near Potowmack Street & Montpelier Road	Quality/ Quantity	Private
NI9108	New Stormwater Pond	Nichol Run - Upper	Mulmary Subdivision	Quality/ Quantity	Private
NI9109	Stormwater Pond Retrofit	Nichol - Jefferson	Near Montpelier Road & Potowmack Street	Quality/ Quantity	Private
NI9110	Stormwater Pond Retrofit	Nichol Run - Upper	Near Creamcup Lane cul-de-sac	Quality/ Quantity	Private

Table 4.3 Master Project List					
Long-Term Structural Projects (25 Year Implementation Plan)					
Project #	**Project Type**	**WMA**	**Location**	**Watershed Benefit**	**Land Owner**
NI9112	New Stormwater Pond	Nichol - Jefferson	Near Richland Grove Drive & Donmore Drive	Quality/ Quantity	Private
NI9115	Stormwater Pond Retrofit, BMP/LID	Nichol - Jefferson	Near Elmview Place & Seneca Knoll Drive	Quality/ Quantity	County/ Private
NI9116	Stormwater Pond Retrofit	Nichol Run - Upper	Near Woodland Falls Drive cul-de-sac	Quality/ Quantity	County
NI9117	Stormwater Pond Retrofit	Nichol Run - Upper	Green Branch Court & Utterback Store Road	Quality/ Quantity	Private
NI9120	Stormwater Pond Retrofit, BMP/LID	Nichol Run - Upper	Near Farm Road & Utterback Store Road	Quality/ Quantity	County/ Private
NI9200	Stream Restoration	Nichol Run - Lower	Great Falls Hills Subdivision	Quality	Private
NI9300	Culvert Retrofit	Nichol - Jefferson	Near Rich Meadow Drive & Richland Valley Drive	Quality	Private
NI9301	Stream Restoration	Nichol - Jefferson	Richland Meadows Subdivision	Quality	Private
NI9400	Culvert Retrofit	Nichol Run - Upper	Springvale Knolls Subdivision	N/A	County/ Private
NI9402	Culvert Retrofit	Nichol Run - Upper	Martin Redmon Subdivision	Quality/ Quantity	County/ Private
NI9403	Culvert Retrofit	Nichol Run - Upper	Ross F. Rogers Subdivision	Quality	County/ Private
NI9404	Stormwater Pond Retrofit, Culvert Retrofit	Nichol Run - Upper	Near Utterback Store Road & Wolfe Hill Lane	Quality/ Quantity	County/ Private
NI9405	BMP/LID	Nichol Run - Upper	Springvale Knolls Subdivision	Quality	County/ Private
NI9500	BMP/LID	Nichol Run - Lower	Near Patowmack Drive cul-de-sac	Quality	County/ Private
PN9106	Stormwater Pond Retrofit	Pond Branch - Potomac	Riverbend Subdivision	Quality/ Quantity	County
PN9107	Stormwater Pond Retrofit	Pond Branch - Potomac	St. Francis Episcopal Church	Quality/ Quantity	County
PN9121	Stormwater Pond Retrofit	Pond Branch - Mine Run	Jackson Hills Subdivision	Quality/ Quantity	Private

Table 4.3 Master Project List					
Long-Term Structural Projects (25 Year Implementation Plan)					
Project #	**Project Type**	**WMA**	**Location**	**Watershed Benefit**	**Land Owner**
PN9125	Stormwater Pond Retrofit, Culvert Retrofit	Pond Branch - Clark	Near Walker Road & Forest Brook Lane	Quality/ Quantity	State/ Private
PN9401	Culvert Retrofit	Pond Branch - Clark	Near Carrwood Road & Bell Drive	Quality/ Quantity	County/ Private
PN9402	Stream Restoration, Culvert Retrofit	Pond Branch - Clark	Near Potomac Ridge Road & Potomac Forest Drive	Quality/ Quantity	County/ Private
PN9403	Culvert Retrofit	Pond Branch - Potomac	Great Falls Heights Subdivision	Quality/ Quantity	County/ Private
PN9404	Culvert Retrofit	Pond Branch - Mine Run	Great Falls Park	Quality	Federal
PN9405	Culvert Retrofit	Pond Branch - Clark	Near Walker Road & Forest Brook Lane	Quality/ Quantity	County/ Private
PN9406	New Stormwater Pond	Pond Branch - Clark	Riverside Manor Subdivision	Quality/ Quantity	State/ County/ Private
PN9407	Culvert Retrofit	Pond Branch	Near River Park Drive & River Park Lane	N/A	County/ Private

Table 4.3 Master Project List					
Non-Structural Projects					
Project #	**Project Type**	**WMA**	**Location**	**Watershed Benefit**	**Land Owner**
NI9900	Buffer Restoration	Nichol - Jefferson	Patowmack Farm	N/A	Private
NI9901	Conservation	Nichol Run - Lower	Riparian Areas in Lower Reaches of Nichol Run	N/A	Private
NI9902	Buffer Restoration, Conservation	Nichol Run - Upper	Gas Line Eeasement between Patowmack Drive & Beach Mill Road	N/A	Private
PN9900	Conservation, Buffer Restoration	Pond Branch	Riparian Areas along Headwaters of Pond Branch	Quality/ Quantity	Private
PN9901	Rain Barrel Program	Pond Branch	Deepwoods Hollow, Riverbend Knolls, Riverbend Farm, Riverbend Farm Sec. 1, Merryelle Acres, Rector, & Falcon Ridge Subdivisions	Quality	Private
PN9902	Conservation, Buffer Restoration	Pond Branch - Clark	Riparian Areas along Lower Reaches of Clarks Branch	Quality/ Quantity	Private
PN9903	Rain Barrel Program	Pond Branch - Clark	Club View Ridge, Beach Mill Farms, Eagon Hills, Dogwood Hills, Riverbend Estates, Walker Hill Estates, & Arnon Meadow Subdivisions	Quality	Private
PN9904	Conservation, Buffer Restoration	Pond Branch - Mine Run	Riparian Areas along Headwaters of Mine Run Branch	Quality/ Quantity	County/ Private
PN9905	Rain Barrel Program	Pond Branch - Mine Run	Jackson Hills, Great Falls Estates, Weant, Riverside Meadow, Potomac Meadows, Laylin Family Trust, John W. Hanes Jr. Gunnell's Run Farm, Arnon Ridge, River Bend Forest Sec. 2, Cornwell Farm, Marmota Farm, Deerfield Farm & Deerfield Pond Subdivisions	Quality	County/ Private
PN9906	Obstruction Removal	Pond Branch - Mine Run	Cornwell Farm Subdivision	N/A	County/ Private