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Acknowledgements

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Thomas Wasaff, VDOT

The Nichol Run and Pond Branch Watershed Management Plan was initiated by the Fairfax County Stormwater Planning Division and the Project Team consists of:

Fairfax County Staff

- **Fred Rose, P.E**., Branch Chief, Watershed Planning and Assessment Branch
- **Joe Sanchirico**, Project Manager, Watershed Planning and Assessment Branch
- **Takisha Cannon**, Assistant Project Manager, Watershed Planning and Assessment Branch
- **Darold Burdick**, P.E., Technical Lead, Watershed Planning and Assessment Branch

Watershed Consultant – F. X. Browne, Inc.

- **Dr. Frank X. Browne, P.E.**, Project Director
- **Marlene Martin, P.E.**, Project Manager
- **Melissa S. Taibi,** Project Scientist
- **Jon-Paul Do**, EIT, Engineering Associate
- **Marc Toth**, Sr. Designer
- **Dr. Deborah Slawson**, Sr. Project Scientist
- **Lisen Cummings**, Project Scientist
- **Martin, Reap**, EIT, Engineering Associate
- **Rebecca Buerkett**, Project Scientist

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Technical Consultant – Tetra Tech, Inc., Water Resources Group

- **Clint Boschen**, Project Manager
- **Rachel Wiese**, Environmental Scientist
- **Guoshun Zhang**, Water Resources Engineer
- **Tham Saravanapavan**, Principal Environmental Engineer
- **Mustafa Faizullabhoy**, Senior Environmental Engineer
- **Peter Cada**, Environmental Scientist
- **Heather Fisher**, Environmental Planner

Public Involvement Consultant – RESOLVE, Inc.

- **Dr. Juliana Birkhoff**, Public Involvement Coordinator
- **Debbie Lee**, Program Associate
- **Jason Gershowitz**, Program Associate

Surveyor – Rice Associates, Inc.

Charlie Rice, LPS, Surveyor

Executive Summary

The *Nichol Run and Pond Branch Watershed Management Plan* presents a strategy for preserving healthy ecosystems and improving the streams and natural environment within the watersheds. This plan was initiated by Fairfax County and developed with input from residents of these watersheds as part of a county-wide planning effort.

Background

The Nichol Run and Pond Branch watersheds are located in northern Virginia, in the northern-most corner of Fairfax County. Both watersheds drain directly into the Potomac River, and are located within the larger Chesapeake Bay watershed.

Figure ES.1 Nichol Run and Pond Branch

In 1900 Fairfax County was largely agricultural, with dairy farming being the most important single industry. The population was just over 12,000. Beginning in the early 1940s, the County's economy shifted from agriculture to largely commercial. After World War II the population grew rapidly from roughly 50,000 to 500,000. By the mid-1990s the population of Fairfax grew to almost 900,000 residents, driven by technology-based businesses which were less dependent on urban centers than conventional industry, resulting in suburban expansion (Fairfax County, 2001). Today, Fairfax County is the most populous jurisdiction in Virginia as well as the Washington D.C. metropolitan area. The 2005 population was estimated at 1,047,500 and included 387,700 households (Fairfax County, 2006a). Most of the population expansion and associated development in Fairfax County occurred prior to the development and implementation of stormwater regulations that were promulgated to prevent flooding and protect water quality.

The Nichol Run and Pond Branch Watershed Management Plan was developed in response to the watersheds' continuing growth and need for updated stormwater and overall watershed management. This plan presents issues affecting the quality of the watersheds, builds on previous management efforts and presents a comprehensive strategy for mitigating and reducing the impacts of development.

Purpose

Fairfax County has developed three primary goals to guide the progress of all county watershed management plans in the second phase of plan development. These goals were drafted by Fairfax County staff based on the goals and visions conceived by the watershed steering committees and watershed planning teams during the completion of the initial phase of watershed management plans. The countywide watershed planning goals are to:

1) Improve and maintain watershed functions in Fairfax County, including water quality, habitat, and hydrology.
2) Protect human health, safety, and property by reducing stormwater impacts.
3) Involve stakeholders in the protection, maintenance and restoration of county watersheds.

The *Nichol Run and Pond Branch Watershed Management Plan* provides a plan of action to meet these goals by identifying watershed impairments, evaluating solutions for watershed restoration and preservation and involving a Watershed Advisory Group in plan development and project selection and prioritization.

Existing Watershed Conditions

The Nichol Run watershed was divided into four watershed management areas for watershed assessment purposes. Watershed management areas, or WMAs, are smaller subdivisions of a watershed used for planning and management purposes and typically range from two to five square miles in size. The Nichol Run watershed was further broken down into 29 subwatersheds for more detailed analysis. Subwatersheds are the smallest watershed division used in this watershed management plan and range in size from 100 to 300 acres. The Pond Branch watershed was divided into four WMAs and 33 subwatersheds for watershed management purposes.

Land use within Nichol Run and Pond Branch watersheds is primarily residential in nature with open space dominating the subwatersheds along the Potomac River. Low residential densities and high forest cover dominate the watersheds. However, few of the Resource Protection Areas (RPAs) within Nichol Run and Pond Branch watersheds are preserved by the County as open space. Resource Protection Areas are protected buffer areas established along the perennial streams in Fairfax County under the Chesapeake Bay Preservation Ordinance to improve the quality of streams and waterways draining to the Chesapeake Bay.

The Fairfax County Stream Protection Strategy (SPS) program was completed in 2001 and included detailed biological and habitat data for six locations within Nichol Run and Pond Branch watersheds. All of the sites surveyed received ratings of good, with the exception of the Mine Run Branch in the Pond Branch Watershed which received a rating of excellent. The watersheds represent some of the least degraded systems in Fairfax County. The goal for these watersheds is to preserve biological integrity by taking active measures to identify and protect, as much as possible, the conditions responsible for the high quality of this area of the County.

Fairfax County conducted a stream physical assessment (SPA) in 2005 to obtain baseline data for the County's streams (CH2MHill, 2005). The streams were evaluated based on habitat conditions,

impacts to the stream from infrastructure and problem areas, general stream characteristics and geomorphic classification. The overall goal of the stream assessment program was to provide a consistent basis for protecting and restoring the receiving water systems and other natural resources in Fairfax County. Approximately 14 miles of stream were assessed in Nichol Run watershed and approximately 17 miles of stream were assessed in the Pond Branch watershed. Nichol Run was given a good overall habitat rating and Pond Branch was given fair overall ratings. Most of the streams in both Nichol Run watershed and Pond Branch watershed are classified as Stage 3 for stream morphology and show signs of active erosion. Stage 3 streams are the most unstable and typically exhibit steep banks, bank failures, channel widening and deepening.

Section 303(d) of the Clean Water Act requires a list of waters with impaired water quality for each state. Waters that are impaired due to human activities and pollutants require a total maximum daily load (TMDL) plan to restore their water quality. Once a TMDL is approved, a TMDL Implementation Plan is developed to restore impaired waters and maintain their improved water quality. A total of 0.9 miles of Mine Run Branch along the main stem and continuing downstream until the confluence with the Potomac River was listed as impaired for *Escherichia coli* bacteria (*E. coli*) in 2006.

Planning Process

Additional field reconnaissance was conducted to update and supplement existing Fairfax County GIS data so current field conditions were accurately represented. The reconnaissance effort included the identification of pollution sources, current stormwater management practices and potential restoration opportunities across the various watersheds. There are 16 existing stormwater management facilities in the Nichol Run watershed; however, 85 percent of this area is untreated by any stormwater facilities. Correspondingly, there are 22 existing stormwater management facilities in the Pond Branch watershed, yet more than 90 percent of this area is without stormwater controls.

Successful management of a watershed requires the assessment of the interactions between pollutant sources, watershed stressors, and conditions within streams and other waterbodies. In addition to field reconnaissance and previous watershed assessments, water quality and water quantity modeling was conducted for existing and forecasted future conditions. The goal of watershed characterization is to identify existing and potential problem areas and evaluate subwatershed restoration and preservation opportunities.

A standardized method of subwatershed ranking was conducted as a means to provide a systematic method of compiling available water quality and natural resources information. Ranking subwatersheds based on watershed characterization and modeling results provides a tool for planners and managers to set priorities and identify candidate restoration and preservation areas.

Subwatershed ranking indicators were developed to assess the condition of the environment, as early-warning signals of changes in the environment, and to diagnose causes of ecological problems. The indicators used by Fairfax County may be grouped into the following categories:

- **Watershed Impact Indicators –** Measure the extent that reversal or prevention of a particular watershed impact, sought by the goals and objectives, has been achieved ("What's there now, and how is it doing?").
- **Source Indicators –** Quantify the presence of a potential stressor or pollutant source ("Is there a problem, and what's causing it?").
- **Programmatic Indicators** –After the plans are adopted, these will assess outcomes of resource protection and restoration activities ("What's the County doing about the problem, and how is it doing?").

Watershed impact indicators and source indicators were evaluated based on existing conditions. Future condition metrics and scores were also evaluated for a sub-set of predictive indicators and reflect the simulated conditions at ultimate build-out based on the County's Comprehensive Plan. The resulting scores from the existing condition and future without projects condition were used to rank subwatersheds according to their problems and needs and to assist with candidate project identification.

Watershed Restoration Strategies

Priority subwatersheds were identified based on the results of final subwatershed ranking, priority restoration elements from the SPA, problem areas identified during subwatershed characterization and field reconnaissance and input from the Watershed Advisory Group (WAG). General subwatershed characteristics and impairments were recorded for each priority subwatershed. Sources of subwatershed impairments were identified where evident and improvement goals/strategies were developed for each priority subwatershed.

Subwatershed improvement strategies are intended to reduce stormwater impacts for subwatersheds. Subwatershed improvement strategies may include a variety of project types including new stormwater ponds, stormwater pond retrofits, low impact development retrofits, culvert retrofits, outfall improvements and area-wide drainage improvements. **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.

A universe of potential projects was complied as a result of these efforts. Watershed advisory group (WAG) members reviewed proposed candidate projects and discussed overall project selection methods and the location and scope of individual proposed projects. Field visits to candidate sites were conducted for all potential candidate structural projects to determine feasibility and modify project scopes based on site conditions.

An initial feasibility analysis was conducted to reduce the initial list of candidate structural projects. Factors considered during the initial feasibility analysis included constraints identified during field reconnaissance, the size and scale of the projects, the location and distribution of projects within a subwatershed, existing stormwater treatment in the subwatershed, project

drainage area and specific WAG member comments. Candidate projects deemed viable were those which had few, if any, site constraints, would provide significant additional stormwater treatment to a subwatershed, and were considered to be of significant size and scope.

Project Prioritization

Viable structural projects were prioritized and ranked according to a standardized method developed by Fairfax County in order to ensure that all projects across the County could be compared and ranked in a County-wide fashion. Structural projects were scored based on five factors:

1. Effect on watershed impact indicators
2. Effect on source indicators
3. Location within priority subwatersheds
4. Sequencing
5. Implementability

An initial ranking composite score was calculated for each project based on the weighted average of the five project scores described above. This score was used to determine the overall initial rank of each project.

In addition to the quantitative project prioritization method developed by the County, WAG member comments, evaluation of projects in water quality modeling, cost benefit analysis and best professional judgment were integrated into the final project scoring and ranking. The final ranking scores were used to determine the priority of each project for the implementation process.

The 36 projects ranked most beneficial comprise the 10-year "Priority" Implementation Plan. The remaining 34 projects make up the 11-25 year "Long-Term" Implementation Plan. The 10-year projects were further analyzed with water quality modeling and a detailed cost benefit analysis to refine the priority ranking within the 10-year implementation plan.

Project fact sheets were created for each of the 10-year projects and include basic information about the project location, a description of the project scope, project benefits, design considerations, itemized cost estimates and detailed project maps. Some projects contain multiple parts or sub-projects; these project "suites" are summarized and contained on a single project fact sheet.

Plan Costs and Benefits

An integral element to evaluating the benefits of restoration strategies and projects is associated costs. Detailed cost estimates, as shown on the project fact sheets, were determined for structural projects in the 0-10 year implementation phase. The total cost of the 10-year implementation plan is $9 million. Associated costs for structural projects in the 11-25 year implementation phase were roughly approximated based on the overall costs associated with similar projects in the 10 year implementation plan and are estimated at approximately $4 million. Cost estimates were not calculated for non-structural projects, as they do not require traditional construction measures to be implemented and may be programmatic in nature. The 10-year implementation plan consists of

36 total structural projects. The 11-25 year implementation plan consists of 34 additional structural projects. There are 10 non-structural projects identified in the plan. The total cost for all structural projects in the plan is $13 million.

Implementation of all projects and restoration strategies in the 10-year priority list will result in significant overall reductions in stormwater flows and pollutant loads with associated improvements to habitat and stream quality. Stormwater runoff volume from the 2-year and 10-year storm events would decrease by approximately 24 percent or 0.66 inches and 14 percent or 0.82 inches, respectively. The peak flow rates would also decrease by 34 percent, resulting in a reduction of 0.140 CFS per acre for the 2-year storm event, and 27 percent or 0.260 CFS per acre for the 10-year storm event. Total suspended solids would be reduced by 28 percent overall or 167 tons per year. Total nitrogen would be reduced by 5 percent or 1,113 pounds per year, and total phosphorus would be reduced by 9 percent or 290 pounds per year.

Implementation of all projects within the plan, including projects in the 25-year implementation plan will result in additional reductions in stormwater flows and pollutant loads. Total suspended solids would be reduced by 32 percent overall or 192 tons per year. Total nitrogen would be reduced by 8 percent or 1,714 pounds per year and total phosphorus would be reduced by 12 percent or 433 pounds per year.

The following provisions address the funding and implementation of projects and programs in Fairfax County watershed plans. These provisions as recommended by the Board were developed for the Popes Head Creek Watershed Management Plan in February 2006 and have been applied to the Sugarland Run and Horsepen Creek Watershed Management Plan:

i. Projects and programs (both structural and non-structural) will first undergo appropriate review by County staff and the Board (please see iii below) prior to implementation. Board adoption of the Watershed Management Plan will not set into motion automatic implementation of projects, programs or initiatives that have not first been subject to sufficient scrutiny to ensure that the projects that are funded give the County the greatest environmental benefit for the cost.

ii. Road projects not related to protection of streambeds or banks or water quality will not be funded out of the stormwater and watershed budget.

iii. The Watershed Management Plan provides a conceptual master-list of structural capital projects and a list of potential non-structural projects for the watershed. Staff will, on a fiscal year basis, prepare and submit to the Board a detailed work plan to include a description of proposed projects and an explanation of their ranking, based on specific criteria. Criteria used to assemble this list will include, but are not limited to, cost-effectiveness as compared to alternative projects, a clear public benefit, a need to protect public or private lands from erosion or flooding, a need to meet a specific watershed or water quality goal and ability to be implemented within the same fiscal year that funding is provided. Staff also intends to track the progress of implementation and report back to the Board periodically.

iv. Each project on the annual list of structural projects will be evaluated using basic value-engineering cost effectiveness principles before implementation and the

consideration of alternative structural and non-structural means for accomplishing the purposes of the project will be considered before implementation. This process will ensure the County's commitment to being a fiscally responsible public entity.

v. Obstruction removal projects on private lands will be evaluated on a case-by-case basis for referral to the Zoning Administrator and/or County Attorney for action as public nuisances; and otherwise to determine appropriate cost-sharing by any parties responsible for the obstructions.

Stream restoration projects on private lands will be evaluated to determine means for cost-sharing by land owners directly responsible for degradation due to their land uses.

Table ES.1 provides a list of all projects in the 10-year implementation plan, the 25-year implementation plan and the non-structural projects.

Table ES.1 Master Project List

Priority Structural Projects (10 Year Implementation Plan)

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

Table ES.1 Master Project List				
Priority Structural Projects (10 Year Implementation Plan)				
Project #	**Project Type**	**WMA**	**Location**	**Cost**
PN9109	New Stormwater Pond, Stormwater Pond Retrofit, BMP/LID	Pond Branch - Mine Run	Deerfield Pond Subdivision	$280,000.00
PN9110	BMP/LID, Education	Pond Branch - Mine Run	Great Falls Elementary School	$90,000.00
PN9111	New Stormwater Pond, Stormwater Pond Retrofit, Culvert Retrofit, Stream Restoration	Pond Branch - Mine Run	Marmota Farm Subdivision	$830,000.00
PN9112	Stormwater Pond Retrofit	Pond Branch - Mine Run	Near Rossmore Court cul-de-sac	$240,000.00
PN9113	New Stormwater Pond	Pond Branch - Mine Run	Arnon Lake Subdivision	$100,000.00
PN9114	Stormwater Pond Retrofit, BMP/LID	Pond Branch - Mine Run	Arnon Ridge Subdivision	$190,000.00
PN9116	Stormwater Pond Retrofit, Culvert Retrofit	Pond Branch	Near Beach Mill Road & Springvale Road	$400,000.00
PN9117	New Stormwater Pond, Stormwater Pond Retrofit	Pond Branch - Mine Run	Monalaine Court & River Bend Road	$360,000.00
PN9118	Stormwater Pond Retrofit, Culvert Retrofit	Pond Branch - Mine Run	Near River Bend Road & Hidden Springs Road	$130,000.00
PN9119	Stormwater Pond Retrofit	Pond Branch - Mine Run	Fallswood Subdivision	$100,000.00
PN9120	Stormwater Pond Retrofit	Pond Branch - Mine Run	Cornwell Farm Subdivision	$150,000.00
PN9122	Stormwater Pond Retrofit, Stream Restoration	Pond Branch - Mine Run	Jackson Hills Subdivision	$490,000.00
PN9123	Stormwater Pond Retrofit	Pond Branch	Near Bliss Lane & Commonage Drive	$90,000.00
PN9124	Stormwater Pond Retrofit	Pond Branch - Mine Run	Jackson Hills Subdivision	$80,000.00
PN9126	Stormwater Pond Retrofit	Pond Branch - Clark	Squire's Haven Section 2 Subdivision	$250,000.00
PN9127	Stormwater Pond Retrofit, BMP/LID	Pond Branch - Clark	Eagon Hills & River Bend Estates Subdivision	$340,000.00
PN9200	Stream Restoration	Pond Branch - Mine Run	Arnon Lake Subdivision	$350,000.00
PN9201	Stream Restoration	Pond Branch	Riverbend Knolls Subdivision	$160,000.00
PN9400	Culvert Retrofit	Pond Branch - Clark	Potomac Forest Subdivision	$120,000.00
PN9408	Stream Restoration	Pond Branch - Clark	Fitz Folly Farms Subdivision & Riverside Manor Subdivision	$510,000.00
			Total Cost:	***$9,070,000.00***

Table ES.1 Master Project List			
Long Term Structural Projects (25 Year Implementation Plan)			
Project #	**Project Type**	**WMA**	**Location**
NI9100	New Stormwater Pond	Nichol Run - Lower	Near High Hill Court & Falcon Ridge Road
NI9102	Stormwater Pond Retrofit	Nichol Run - Lower	Southdown Subdivision

Table ES.1 Master Project List			
NI9103	Stormwater Pond Retrofit	Nichol Run - Lower	Near Springvale Road & Allenwood Lane
NI9104	Stormwater Pond Retrofit	Nichol Run - Upper	Near Beach Mill Road & Springvale Road
NI9105	Stormwater Pond Retrofit	Nichol Run - Upper	Near Beach Mill Road & Springvale Road
NI9107	Stormwater Pond Retrofit	Nichol - Jefferson	Near Potowmack Street & Montpelier Road
NI9108	New Stormwater Pond	Nichol Run - Upper	Mulmary Subdivision
NI9109	Stormwater Pond Retrofit	Nichol - Jefferson	Near Montpelier Road & Potowmack Street
NI9110	Stormwater Pond Retrofit	Nichol Run - Upper	Near Creamcup Lane cul-de-sac
NI9112	New Stormwater Pond	Nichol - Jefferson	Near Richland Grove Drive & Donmore Drive
NI9115	Stormwater Pond Retrofit, BMP/LID	Nichol - Jefferson	Near Elmview Place & Seneca Knoll Drive
NI9116	Stormwater Pond Retrofit	Nichol Run - Upper	Near Woodland Falls Drive cul-de-sac
NI9117	Stormwater Pond Retrofit	Nichol Run - Upper	Green Branch Court & Utterback Store Road
NI9120	Stormwater Pond Retrofit, BMP/LID	Nichol Run - Upper	Near Farm Road & Utterback Store Road
NI9200	Stream Restoration	Nichol Run - Lower	Great Falls Hills Subdivision
NI9300	Culvert Retrofit	Nichol - Jefferson	Near Rich Meadow Drive & Richland Valley Drive
NI9301	Stream Restoration	Nichol - Jefferson	Richland Meadows Subdivision
NI9400	Culvert Retrofit	Nichol Run - Upper	Springvale Knolls Subdivision
NI9402	Culvert Retrofit	Nichol Run - Upper	Martin Redmon Subdivision
NI9403	Culvert Retrofit	Nichol Run - Upper	Ross F. Rogers Subdivision
NI9404	Stormwater Pond Retrofit, Culvert Retrofit	Nichol Run - Upper	Near Utterback Store Road & Wolfe Hill Lane
NI9405	BMP/LID	Nichol Run - Upper	Springvale Knolls Subdivision
NI9500	BMP/LID	Nichol Run - Lower	Near Patowmack Drive cul-de-sac
PN9106	Stormwater Pond Retrofit	Pond Branch - Potomac	Riverbend Subdivision
PN9107	Stormwater Pond Retrofit	Pond Branch - Potomac	St. Francis Episcopal Church
PN9121	Stormwater Pond Retrofit	Pond Branch - Mine Run	Jackson Hills Subdivision
PN9125	Stormwater Pond Retrofit, Culvert Retrofit	Pond Branch - Clark	Near Walker Road & Forest Brook Lane
PN9401	Culvert Retrofit	Pond Branch - Clark	Near Carrwood Road & Bell Drive
PN9402	Stream Restoration, Culvert Retrofit	Pond Branch - Clark	Near Potomac Ridge Road & Potomac Forest Drive
PN9403	Culvert Retrofit	Pond Branch - Potomac	Great Falls Heights Subdivision
PN9404	Culvert Retrofit	Pond Branch - Mine Run	Great Falls Park
PN9405	Culvert Retrofit	Pond Branch - Clark	Near Walker Road & Forest Brook Lane
PN9406	New Stormwater Pond	Pond Branch - Clark	Riverside Manor Subdivision
PN9407	Culvert Retrofit	Pond Branch	Near River Park Drive & River Park Lane

Table ES.1 Master Project List			
Non-Structural Projects			
Project #	**Project Type**	**WMA**	**Location**
NI9900	Buffer Restoration	Nichol - Jefferson	Patowmack Farm
NI9901	Conservation	Nichol Run - Lower	Riparian Areas in Lower Reaches of Nichol Run
NI9902	Buffer Restoration, Conservation	Nichol Run - Upper	Gas Line Eeasement between Patowmack Drive & Beach Mill Road
PN9900	Conservation, Buffer Restoration	Pond Branch	Riparian Areas along Headwaters of Pond Branch
PN9901	Rain Barrel Program	Pond Branch	Deepwoods Hollow, Riverbend Knolls, Riverbend Farm, Riverbend Farm Sec. 1, Merryelle Acres, Rector, & Falcon Ridge Subdivisions
PN9902	Conservation, Buffer Restoration	Pond Branch - Clark	Riparian Areas along Lower Reaches of Clarks Branch
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
PN9904	Conservation, Buffer Restoration	Pond Branch - Mine Run	Riparian Areas along Headwaters of Mine Run Branch
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
PN9906	Obstruction Removal	Pond Branch - Mine Run	Cornwell Farm Subdivision

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1.0 Introduction

1.1 Introduction to Watersheds

A watershed is an area of land that drains all of its water to a specific lake or river. As rainwater and melting snow run downhill, they carry sediment and other materials into our streams, lakes, wetlands and groundwater.

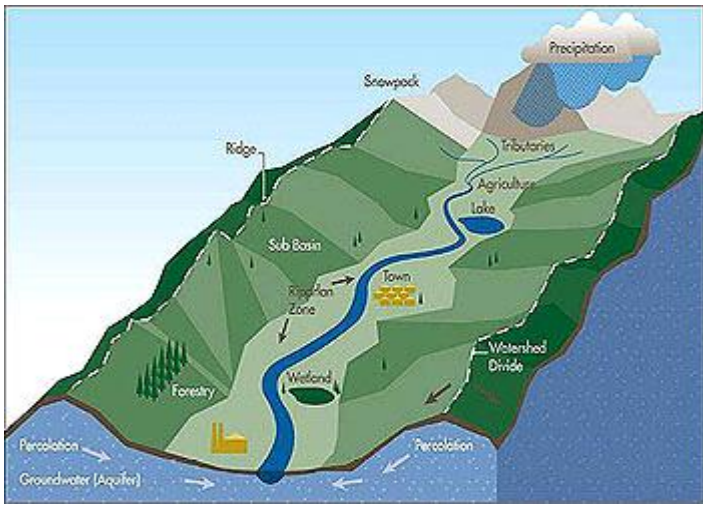

Figure 1.1 Diagram of a watershed

The boundary of a watershed is defined by the watershed divide, which is the ridge of highest elevation surrounding a given stream or network of streams. A drop of rainwater falling outside of this boundary will enter a different watershed and will flow to a different body of water.

Streams and rivers may flow through many different types of land use in their paths to the ocean. In the above illustration from the U.S. Environmental Protection Agency, water flows from agricultural lands to residential areas to industrial zones as it moves downstream. Each land use presents unique impacts and challenges on water quality.

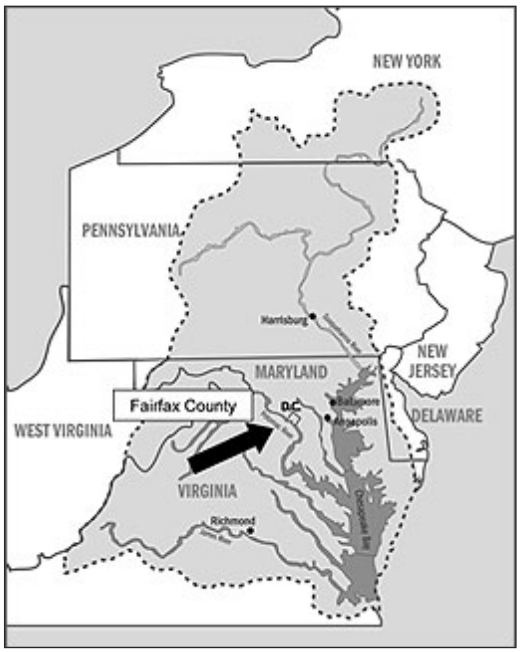

Figure 1.2 The Chesapeake Bay watershed

The size of a watershed can be subjective; it depends on the scale that is being considered.

The image to the left depicts the extent of the Chesapeake Bay watershed, "the big picture" that is linked to our local concerns. This watershed covers 64,000 square miles and crosses into six states: New York, Pennsylvania, Delaware, West Virginia, Maryland, Virginia and the District of Columbia.

One of the watersheds that comprise the Chesapeake Bay watershed is the Potomac River watershed. Fairfax County, as shown on the map, occupies approximately 400 square miles of the Potomac River watershed. This area contains 30 smaller watersheds. Think of watersheds as being "nested" within each successively larger one.

Each watershed in Fairfax County was subdivided to facilitate data management and to promote local

awareness of the streams. Watersheds were divided into Watershed Management Areas (WMAs) approximately four square miles in size. WMAs are usually named for the local major tributary. These areas are further divided into subwatersheds, ranging in size from 100 to 300 acres. Subwatersheds represent the smallest modeling unit for watershed planning.

Beginning in the early 1940's, Fairfax County shifted from an agricultural community to an urbanized one whose population exceeds that of several states. While the County continued to develop, the condition of streams and aquatic life declined. In 1999, a Stream Protection Strategy (SPS) was initiated to monitor stream health and establish a baseline of countywide stream conditions. The results of the baseline monitoring effort indicated that only 25 percent of the County's streams were in good to excellent biological health. Stream condition is determined using an Index of Biological Integrity (IBI) that evaluates ecological health based on the community structure of bottom-dwelling aquatic invertebrates.

The baseline study found that roughly 75 percent of streams within the County had areas negatively impacted by impervious conditions within their watersheds. Due to increasing urbanization prior to implementation of modern stormwater controls, impervious land area rapidly increased, contributing to the degradation of the streams.

1.2 Introduction to Watershed Planning

The County's comprehensive stormwater management program is currently undergoing a transformation that addresses watershed health using a holistic approach. The mission for the stormwater program is dictated by the need to preserve and restore the natural environment and aquatic resources, which is consistent with the Fairfax County Board of Supervisors' Environmental Agenda adopted in June 2004. The County must also comply with all applicable local, state and federal laws and mandates. These include County ordinances and policies, Virginia's Chesapeake Bay Initiatives and the federal Clean Water Act. Under the Virginia Pollutant Discharge Elimination System (VPDES) the County has an individual Municipal Separate Storm Sewer System (MS4) Permit. This permit requires the creation of watershed management plans to facilitate compliance with the Clean Water Act. In addition, the County is doing its part to fulfill Virginia's commitment to the Chesapeake Bay 2000 Agreement to restore the ecological health of the Chesapeake Bay Watershed.

Fairfax County's first set of watershed plans were completed in the 1970s. Land use has changed significantly since that time. Additionally, there have been many advances in technology and development in the field of stormwater management which have resulted in updates to stormwater policies and regulations. New plans were needed to reflect these changes and to plan for a future in which Fairfax County recognizes that there is a direct link between the vitality of ecological resources and the quality of life for our citizens.

The current watershed plans provide more targeted strategies for addressing stream health given current and future land uses and evolving regulations. These plans are one of several tools that enable the County to address program requirements and to improve and maintain watershed health. Each watershed plan includes a prioritized 25-year list of proposed capital improvement projects in addition to non-structural programs and projects. These projects and programs may

lead to new and/or revised ordinances, public facilities manual requirements and policies. The plans promote the use of new and innovative practices in stormwater management such as Low Impact Development (LID) techniques and stream restoration using natural channel design. To maximize the effectiveness of these plans, community engagement and involvement from diverse interests were emphasized during the development process.

Watershed management plans were developed by grouping the County's 30 watersheds into 13 planning units (Figure 1.3). Watershed planning began in 2003. By 2007, roughly 50 percent of the County land area had completed watershed plans. This plan is part of the second group of watershed plans, which was initiated in 2007 for the remaining land area.

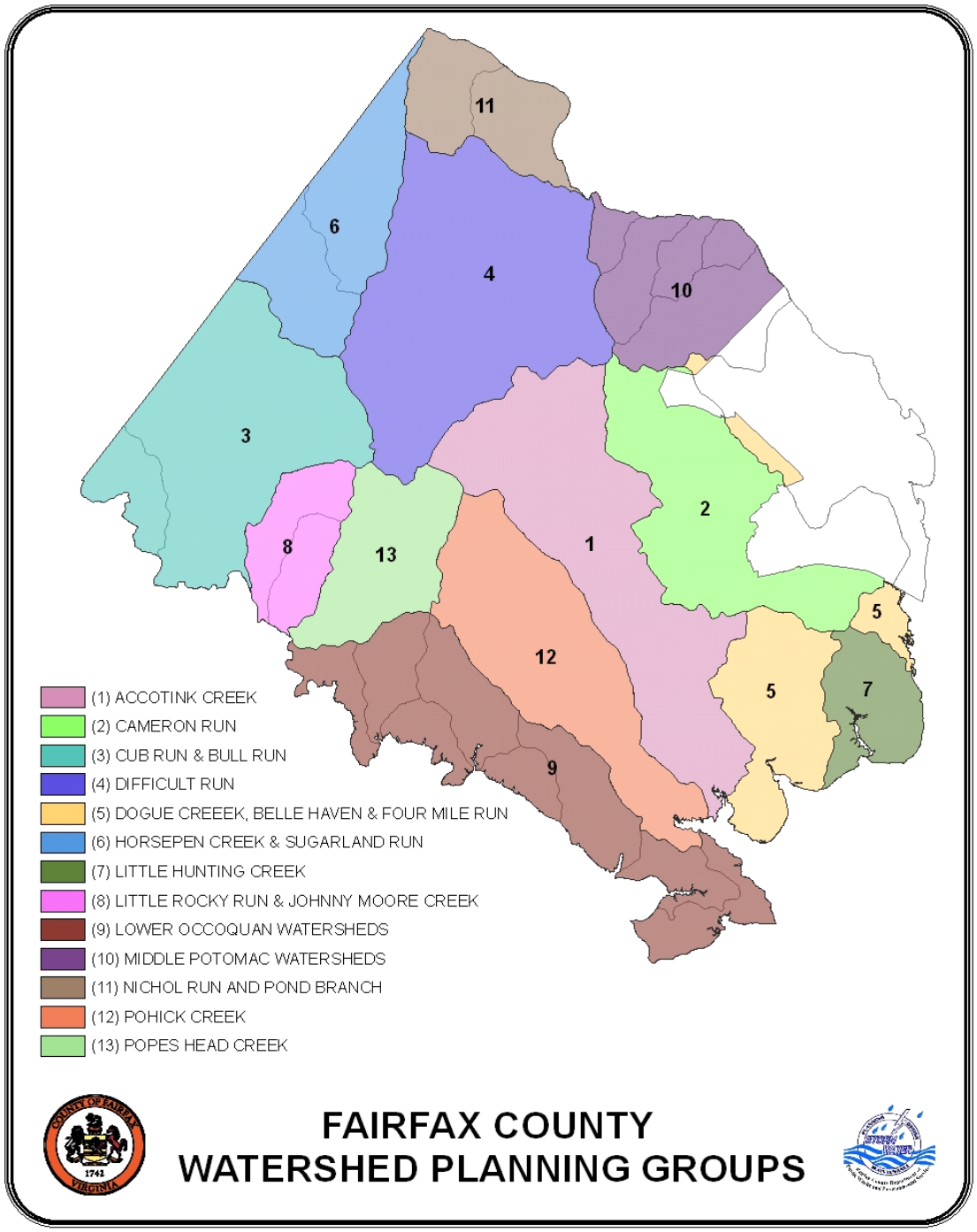

Figure 1.3 Watershed planning groups in Fairfax County

In general, the watershed management planning process consists of the following steps:

1. Review and synthesis of previous studies and data compilation
2. Public involvement to gain input, provide education and build community support
3. Evaluation of current watershed conditions and projection of stormwater runoff from present and ultimate development conditions
4. Development of non-structural and structural watershed improvement projects
5. Development of preliminary cost estimates, cost/benefit analysis and prioritization of capital projects
6. Adoption of the final watershed management plan by the Board of Supervisors

The watershed management planning process has been supported by the Board of Supervisors since its inception in 2003. In fiscal year 2006, the Board of Supervisors dedicated $0.01 per $100 of assessed value from the County's real estate tax revenue towards the overall stormwater management program. This supported the ongoing development and implementation of watershed plans and eventually evolved into the adoption of a stormwater service district starting in fiscal year 2010. The Board recently approved increasing the dedicated amount to a penny and a half for fiscal year 2011.

The following provisions address the funding and implementation of projects and programs in Fairfax County watershed plans. These provisions as recommended by the Board were developed for the Popes Head Creek Watershed Management Plan in February 2006 and have been applied to the Sugarland Run and Horsepen Creek Watershed Management Plan:

i. Projects and programs (both structural and non-structural) will first undergo appropriate review by County staff and the Board (please see iii below) prior to implementation. Board adoption of the Watershed Management Plan will not set into motion automatic implementation of projects, programs or initiatives that have not first been subject to sufficient scrutiny to ensure that the projects that are funded give the County the greatest environmental benefit for the cost.

ii. Road projects not related to protection of streambeds or banks or water quality will not be funded out of the stormwater and watershed budget.

iii. The Watershed Management Plan provides a conceptual master-list of structural capital projects and a list of potential non-structural projects for the watershed. Staff will, on a fiscal year basis, prepare and submit to the Board a detailed work plan to include a description of proposed projects and an explanation of their ranking, based on specific criteria. Criteria used to assemble this list will include, but are not limited to, cost-effectiveness as compared to alternative projects, a clear public benefit, a need to protect public or private lands from erosion or flooding, a need to meet a specific watershed or water quality goal and ability to be implemented within the same fiscal year that funding is provided. Staff also intends to track the progress of implementation and report back to the Board periodically.

iv. Each project on the annual list of structural projects will be evaluated using basic value-engineering cost effectiveness principles before implementation and the consideration of alternative structural and non-structural means for accomplishing the

purposes of the project will be considered before implementation. This process will ensure the County's commitment to being a fiscally responsible public entity.

v. Obstruction removal projects on private lands will be evaluated on a case-by-case basis for referral to the Zoning Administrator and/or County Attorney for action as public nuisances; and otherwise to determine appropriate cost-sharing by any parties responsible for the obstructions.

Stream restoration projects on private lands will be evaluated to determine means for cost-sharing by land owners directly responsible for degradation due to their land uses.

2.0 Watershed Planning Process

2.1 Watershed Goals and Objectives

The County's first six comprehensive watershed management plans outlined intentions for protecting, maintaining or improving streams and the measures that could be taken to meet them. Although the plans conveyed similar aims overall, there were some differences in the way goals and objectives were developed. As a result of these differences, the initial six plans were analyzed to identify common themes in order to create standardized goals and objectives for the remaining watershed management plans. Standardization improved efficiency in the planning process and achieved greater consistency among the plans.

As part of the standardization process, the County selected three overarching goals, or intended outcomes of the watershed management plans:

1. Improve and maintain watershed functions in Fairfax County, including water quality, habitat and hydrology
2. Protect human health, safety and property by reducing stormwater impacts
3. Involve stakeholders in the protection, maintenance and restoration of County watersheds

Ten objectives were developed related to the three goals. Each objective may achieve one or more goals, and each goal may be achieved by one or more objectives. These ten objectives were grouped into five categories based on certain aspects of watershed management the objectives could influence:

1. **Hydrology** - healthy movement and distribution of water through the environment in a way that is protective of streams and human dwellings
2. **Habitat** - suitable environment for sustaining plants and animals
3. **Stream water quality** - general chemical and physical properties of surface waters
4. **Drinking water quality** - quality of water used for human consumption
5. **Stewardship** - the roles the County, other jurisdictions and members of the general public can play in caring for the environment

Under the new approach, County staff and the public had the flexibility to add objectives that were unique and important to a particular watershed, but all plans included the standard goals and objectives as a baseline as presented in Table 2.1

Table 2.1
Countywide Objectives

Objective	Linked to Goal(s)
CATEGORY 1. HYDROLOGY	
1A. Minimize impacts of stormwater runoff on stream hydrology to promote stable stream morphology, protect habitat, and support biota.	1
1B. Minimize flooding to protect property and human health and safety.	2

Table 2.1 Countywide Objectives	
Objective	**Linked to Goal(s)**
CATEGORY 2. HABITAT	
2A. Provide for healthy habitat through protecting, restoring, and maintaining riparian buffers, wetlands, and instream habitat.	1
2B. Improve and maintain diversity of native plants and animals in the County.	1
CATEGORY 3. STREAM WATER QUALITY	
3A. Minimize impacts to stream water quality from pollutants in stormwater runoff.	1, 2
CATEGORY 4. DRINKING WATER QUALITY	
4A. Minimize impacts to drinking water sources from pathogens, nutrients, and toxics in stormwater runoff.	2
4B. Minimize impacts to drinking water storage capacity from sediment in stormwater runoff.	2
CATEGORY 5 STEWARDSHIP	
5A. Encourage the public to participate in watershed stewardship.	3
5B. Coordinate with regional jurisdictions on watershed management and restoration efforts such as Chesapeake Bay initiatives.	3
5C. Improve watershed aesthetics in Fairfax County.	1, 3

Standardizing the goals and objectives made it easier to integrate plan recommendations into a countywide data management system for prioritizing projects, tracking implementation and evaluating the long-term influence of the plans on the health of County streams.

2.2 Indicators

Since accomplishment of objectives cannot be directly measured, indicators that are able to detect changes in the watershed were developed. Indicators are used to assess the condition of the environment, as early-warning signals of changes in the environment, and to diagnose causes of ecological problems. *Observed* indicators are based upon data and observations collected in the field/area of interest, and are useful in assessing existing watershed conditions. *Predictive* indicators respond in a predictable manner to ecosystem stressors, and can be used in models of hydrologic and ecosystem processes (such as soil erosion, pollutant loading, etc.) to compare existing and future conditions.

Each indicator was measured by one or more metrics. A metric is an analytical benchmark that responds in a predictable way to increasing human, climatic or other environmental stress. Metrics may be actual numeric values (such as pH or Dissolved Oxygen values) or parameters that have been scored to a numeric scale (such as 1 – 10).

The indicators used by Fairfax County may be grouped into the following categories:

- **Watershed Impact Indicators –** Measure the extent that reversal or prevention of a particular watershed impact, sought by the goals and objectives, has been achieved ("What's there now, and how is it doing?").
- **Source Indicators –** Quantify the presence of a potential stressor or pollutant source ("Is there a problem, and what's causing it?").
- **Programmatic Indicators** –After the plans are adopted, these will assess outcomes of resource protection and restoration activities ("What's the County doing about the problem, and how is it doing?").

2.2.1 Watershed Impact Indicators

One or more watershed impact indicators for each objective were identified, including predictive and observed indicators. These indicators and the objectives to which they are linked are shown in Table 2.2.

Table 2.2
Watershed Impact Indicators

Objective	Indicators
1A Stormwater Runoff	Observed: Benthic Communities, Fish Communities, Aquatic Habitat Predictive: Channel Morphology, Instream Sediment, Hydrology
1B Flooding Hazards	Observed: Flood Complaints Predictive: Number of Road Hazards, Magnitude of Road Hazards, Residential Building Hazards, Non-residential Building Hazards
2A Habitat Health	Observed: Aquatic Habitat Predictive: RPA Riparian Habitat, Headwater Riparian Habitat, Protected Wetland Habitat
2B Habitat Diversity	Observed: Benthic Communities, Fish Communities Predictive: None
3A Stream Water Quality	Observed: *E. coli*, Benthic Communities, Fish Communities Predictive: Upland Sediment, Instream Sediment, Nitrogen, Phosphorus
4A Drinking Water Quality	Observed: *E. coli* Predictive: Nitrogen, Phosphorus, Upland Sediment
4B Storage Capacity	Observed: None Predictive: Upland Sediment, Instream Sediment
5A Public Participation	Programmatic Indicators to be tracked by the County

Table 2.2 Watershed Impact Indicators	
Objective	**Indicators**
5B Regional Coordination	Programmatic Indicators to be tracked the County
5C Aesthetics	Programmatic Indicators to be tracked the County

For predictive indicators, three scenarios were considered. Metrics and scores were calculated for:

- Existing conditions
- Future without project implementation
- Future with project implementation

The future condition metrics and scores reflect the simulated conditions at ultimate build-out based on the County's Comprehensive Plan.

The watershed impact indicator scores were used at multiple stages of watershed planning. First, they were used to assess current and future conditions without project implementation in the watershed. Indicator scores were then used to identify management needs and problem areas during subwatershed ranking (see Section 2.3). Once candidate projects were identified, the indicators were used to prioritize projects alongside cost and feasibility.

2.2.2 Source Indicators

Source indicators were used to evaluate the sources and stressors that impact watershed processes. Examples include:

- Numeric Source Indicators
    - Amount of Channelized/Piped Streams
    - Amount of Directly Connected Impervious Area (DCIA) (predictive)
    - Amount of Impervious Surface (predictive)
    - Number of Stormwater Outfalls
    - Number of Sanitary Sewer Crossings
    - Streambank Buffer Deficiency
    - Total amount of Nitrogen (predictive)
    - Total amount of Phosphorus (predictive)
    - Total Suspended Solids (predictive)
- Field Reconnaissance Observations
    - Hot Spot Investigations
    - Neighborhood Source Assessments
    - All other field reconnaissance observations

The contributions of these indicators to existing and future watershed impacts were evaluated. Metrics and scores were developed for all source indicators under existing conditions. In addition, three scenarios were considered for the predictive indicators, as noted in the list above. Metrics and scores were calculated for these scenarios:

- Existing conditions
- Future without project implementation
- Future with project implementation

The future condition metrics and scores reflect the simulated conditions at ultimate build-out based on the County's Comprehensive Plan.

Like the watershed impact indicators, source indicator scores were used to rank subwatersheds according to their problems and needs and to assist with candidate project identification.

2.2.3 Programmatic Indicators

Programmatic indicators will be used by the County to help evaluate watershed management needs. These indicators illustrate the extent and location of existing and past management efforts. The following types of management in the watershed were inventoried during plan development:

- Detention Facilities
- Stream Restoration
- Riparian Buffer Restoration
- BMP Facilities
- Low Impact Development
- Inspection and Maintenance of Stormwater Management Facilities
- Inspection and Repair of Stormwater Infrastructure and Outfalls
- Dumpsite Removal
- Regional Ponds
- Volunteer Monitoring
- Subarea Treatment (used in watershed modeling studies)

Information for these indicators will be considered to identify and evaluate watershed management needs for individual watersheds and for the County as a whole.

2.2.4 Composite Scores

After metric values were translated into scores, objective, composite and overall composite scores were calculated for use in subwatershed ranking. Weighting factors were used when calculating composite scores to give more importance to certain indicators and objectives. First, watershed impact indicators were grouped by objective. Each metric score was multiplied by a predetermined weighting factor specific to that indicator, and the products were summed within objectives to generate an objective composite score for each objective. Each objective composite score was then multiplied by a predetermined weighting factor specific to that objective, and the products were summed to generate an overall composite score. A similar process was used for source

indicators, but without an objective composite score (since source indicators are not directly linked to objectives).

2.3 Subwatershed Ranking

The composite scores calculated under the methods previously described were used to identify problem areas in the watershed and rank subwatersheds for management priority. Subwatersheds were further categorized based on which management opportunities were most likely to restore functions to the problem areas identified. The resulting data were then utilized to identify key issues and select projects that would achieve the watershed planning goals and objectives.

The subwatershed ranking procedure involved reviewing watershed impact objective, composite, overall composite and source indicator scores. Since some of the indicators are predictive, i.e. based on modeling, it was possible to pose "what if?" questions and test future scenarios with and without management actions. Existing management facilities and programs which were inventoried for programmatic indicators and data collected during field reconnaissance were also considered. The ranking process consisted of the following steps:

1. Used the watershed impact overall composite scores and identified subwatersheds that were potential problem areas under existing and future conditions.
2. Used the watershed impact objective composite scores and identified subwatersheds that were potential problem areas under existing and future conditions for each objective.
3. Reviewed source indicator composite scores and identified additional problem areas.
4. Used individual source indicator scores to identify potential sources of impacts in downstream problem areas.
5. In combination with the above data, used the programmatic indicator data inventory to identify subwatersheds where management was most needed.
6. Consulted available field reconnaissance data throughout the above steps to confirm that results reflected conditions in the field.

All this information was combined to rank subwatersheds in order from the most problematic (higher priority for management actions) to the least problematic (lower priority for management actions). Subwatershed ranking provided guidance as to where management was most needed and could be applied successfully, but the final determination was ultimately based on best professional judgment.

2.4 Stormwater Modeling

Storm events are classified by the amount of rainfall, in inches, that occurs over the duration of a storm. The amount of rainfall depends on how frequently the storm will statistically occur and how long the storm lasts. Based on many years of rainfall data collected, storms of varying strength have been established based on the duration and probability of that event occurring within any given year. In general, smaller storms occur more frequently than larger storms of equal duration. Hence, a 2-year, 24hr storm (having a 50 percent chance of happening in a given year) has less rainfall than a 10-year, 24hr storm (having a 10 percent chance of happening in a given

year). Stormwater runoff (which is related to the strength of the storm) is surplus rainfall that does not soak into the ground. This surplus rainfall flows (or 'runs off') from roof tops, parking lots and other impervious surfaces and is ultimately received by storm drainage systems, culverts and streams.

Modeling is a way to mathematically predict and spatially represent what will occur with a given rainfall event. There are two primary types of models that are used to achieve this goal; hydrologic and hydraulic:

- *Hydrologic models* take into account several factors; the particular rainfall event of interest, the physical nature of the land area where the rainfall occurs and how quickly the resulting stormwater runoff drains this given land area. Hydrologic models can describe both the quantity of stormwater runoff and resulting pollution, such as nutrients (nitrogen and phosphorus) and sediment that are transported by the runoff.

- *Hydraulic models* represent the effect the stormwater runoff from a particular rainfall event has on both man-made and natural systems. These models can both predict the ability man-made culverts/channels have in conveying stormwater runoff and the spatial extent of potential flooding.

Table 2.3 shows three storm events and the rationale for being modeled:

Table 2.3
Modeling Rationale

Storm Event	Modeling Rationale
2-year, 24hr	Represents the amount of runoff that defines the shape of the receiving streams.
10-year, 24hr	Used to determine which road culverts will have adequate capacity to convey this storm without overtopping the road.
100-year, 24hr	Used to define the limits of flood inundation zones

2.4.1 Hydrologic Model (SWMM)

The Environmental Protection Agency (EPA) Storm Water Management Model (SWMM) was first developed in the early 1970s. Over the past 30 years, the model has been updated and refined and is now used throughout the country as a design and planning tool for stormwater runoff. Specifically, SWMM is a dynamic rainfall-runoff simulation model used for single event or long-term (continuous) simulation of runoff quantity and quality from primarily urban areas.

The runoff component of SWMM operates on a collection of subwatershed areas where rain falls and runoff is generated. The routing (or hydraulic) portion of SWMM transports this runoff through a conveyance system of pipes, channels and storage/treatment devices. SWMM tracks the quantity and quality of runoff generated within each subwatershed, and the flow rate and depth of water in the conveyance system during a simulation period.

2.4.2 Pollution Model (STEPL)

While the SWMM model can calculate pollutant loads, the Spreadsheet Tool for Estimating Pollutant Load (STEPL) was used to determine pollutant loads for the watershed planning effort. Also developed by EPA, STEPL employs simple algorithms to calculate surface runoff. This includes nutrient loads, such as nitrogen and phosphorus, and sediment loads from various land uses. STEPL also calculates load reductions that would result from the implementation of various Best Management Practices (BMPs). The nutrient loading is calculated based on the runoff volume and the pollutant concentrations in the runoff as influenced by factors such as land use distribution and management practices. Sediment loads are calculated based on the Universal Soil Loss Equation (USLE) and the sediment delivery ratio. The sediment and pollutant load reductions that result from the implementation of BMPs are computed using known BMP efficiencies.

2.4.3 Hydraulic Model (HEC-RAS)

The Hydrologic Engineering Centers River Analysis System (HEC-RAS) hydraulic model was initially developed by the U.S. Army Corps of Engineers (USACE) in the early 1990s as a tool to manage the rivers and harbors in their jurisdiction. HEC-RAS has found wide acceptance as the standard for simulating the hydraulics of water flow through natural and/or manmade channels and rivers. HEC-RAS is commonly used for modeling water flowing through a system of open channels with the objective of computing water surface elevations.

The geographic input data for the HEC-RAS model was extracted using HEC-GeoRAS. HEC-GeoRAS is a tool that processes the geospatial data within the County's Geographic Information System, specifically as it pertains to physical features such as stream geometry and flow path so that these features can be represented in the model.

Using available County or Virginia Department of Transportation (VDOT) engineering data, bridge and culvert crossings were coded into the model to simulate the effect these facilities have on the water surface elevations or profile. Where data were not available, field reconnaissance was performed to obtain the crossing elevation data. This crossing data was determined relative to a point where the elevation could be estimated accurately from the County's topographic data. Manning's 'n' values, which represent surface roughness, were assigned to the channel and overbank portions of the studied streams based on field visits and aerial photographs.

The hydrologic flow input data and the locations where the flows change were extracted from SWMM. The 2-yr, 10-yr and 100-yr storm flow outputs were determined at several locations in order to provide a detailed flow profile for input into the HEC-RAS hydraulic model.

As stated previously, the 2-year storm discharge is regarded as the channel-forming or dominant discharge that transports the majority of a stream's sediment load and therefore actively forms and maintains the channel. A comparison of stream dynamics and channel geometry for the 2-year discharge provides insight regarding the relative stability of the system and helps to identify areas in need of restoration.

The 10-year storm discharge was included to analyze the level of service of bridge and culvert stream crossings. Occurring less frequently than the 2-year storm, the flood stage associated with this storm can result in more significant safety hazards to residents. All stream crossings (bridges and culverts) were analyzed against this storm to see if they performed at safe levels.

The 100-year storm discharge is used by the Federal Emergency Management Agency (FEMA) to delineate floodplain inundation zones in order to establish a Flood Insurance Rate Map (FIRM) for a given area. The 100-yr HEC-RAS models were built in compliance with FEMA standards and were included to map the limits of these floodplain inundation zones. This mapping provided a means to assess which properties are at risk to flooding by the 100-yr storm event.

2.5 Public Involvement Plan

A consistent approach for public involvement was important to enable comparisons among planning processes and final watershed management plans. Conversely, as each watershed has unique characteristics, the strategies employed must also address the diverse needs, interests and conditions of the watershed and its community. The principal goals for public involvement were:

- Increase community awareness and understanding of stormwater management
- Provide meaningful participation options for a diversity of stakeholders
- Incorporate community ideas into the scope of the watershed plans
- Strive for community support for the final plans

Recognizing the need for public acceptance of the final plans, County staff created a public involvement process with multiple feedback loops to facilitate informed participation by the public and key stakeholder groups at all development stages. The first step of the public involvement process was to host an Introductory and Issues Scoping forum that was open to all residents. The primary purpose of this forum was to solicit informed input on the development of the watershed management plan. Other objectives were to explain the planning process to the community and develop an initial list of watershed issues and concerns.

After the forum, stakeholder groups were invited to be part of a Watershed Advisory Group (WAG) for each plan. These were comprised of local stakeholders who represented various interests (HOA representatives, environmental groups, etc) and advised County staff about community outreach opportunities and key issues affecting their watershed and potential projects. They also were invited to comment on draft and final versions of the watershed management plan. Each WAG met with County staff five to six times throughout the plan development in order to provide guidance and comments at critical junctures of the process.

The WAG also provided support at the second public forum, the Draft Plan Review Workshop. The workshop provided the extended community with an opportunity to review the first draft of the watershed plan and provide input. Comments were collected at the end of a 30-day period and addressed as appropriate. The final plan was then adopted by the Board of Supervisors.

More information on the public involvement process including WAG meeting minutes, public forum meeting minutes and public comments and responses can be found in Volume 2, Appendix C.

3.0 Summary of Watershed Conditions

Section 3.0 is a summary of the watershed conditions found in the Nichol Run and Pond Branch watersheds. Detailed information regarding watershed conditions in the Nichol Run watershed and the Pond Branch watershed can be found in the Draft Nichol Run and Pond Branch Watershed Workbook, dated January 2009, located in Appendix A.

The Nichol Run and Pond Branch watersheds are located in the northern portion of Fairfax County. Fairfax County is broken into 30 watersheds. Each watershed is defined by the topography of the area and does not follow county, state or national boundaries. The watersheds within Fairfax County are part of the larger Potomac River Basin. The Potomac River Basin, in turn, is part of the even larger Chesapeake Bay Watershed, which drains 64,000 square miles and extends from New York through Pennsylvania, Delaware, West Virginia, Maryland, Virginia, and the District of Columbia. For management and planning purposes, watersheds are further broken down into watershed management areas (WMAs) and subwatersheds. A WMA is generally four square miles (2,560 acres) in size and is the contributing drainage area to a major tributary or a group of subwatersheds with similar characteristics. A subwatershed ranges in size from 100 to 300 acres.

Table 3.1 identifies the total area and perennial stream miles for each watershed and each watershed management area that comprise Nichol Run and Pond Branch watersheds.

Table 3.1
Summary of Watershed Management Areas

Watershed Management Area	Total Acres	Total Sq-mi	Total Perennial Stream Miles
Jefferson	1,185	1.85	6.7
Lower Nichol	821	1.28	7.6
Potomac (Nichol)	697	1.09	4.6
Upper Nichol	2,548	3.98	12.9
Nichol Run Watershed Total	**5,250**	**8.2**	**31.8**
Clark	1,759	2.75	8.4
Mine Run	1,633	2.55	6.9
Pond	742	1.16	4.1
Potomac	1,270	1.98	4.4
Pond Branch Watershed Total	**5,404**	**8.4**	**23.8**
Nichol Run and Pond Branch Watersheds Total	**10,654**	**16.6**	**55.6**

The Fairfax County Stormwater Planning Division has created standard land use categories to unify watershed management planning throughout the county. The categories are assigned a code for easy identification. The Fairfax County land use categories are presented in Table 3.2.

Table 3.2
Generalized Land Use Categories

Land Use	Code	Description
Open Space	OS	Open space, parkland, or vacant land
Estate Residential	ESR	Single-family detached greater than 2 acres per residence
Low Density Residential	LDR	Single-family detached 0.5-2 acres per residence
Medium Density Residential	MDR	Single-family detached less than 0.5 acres per residence and multifamily residential less than 8 dwelling units per acre
High Density Residential	HDR	All residential less than 0.125 acre per residence (8 or greater dwelling units per acre)
Institutional	INT	School or institutions, originally considered LIC
Low Intensity Commercial	LIC	Commercial uses including low rise and limited offices and neighborhood retail
High Intensity Commercial	HIC	Commercial uses including high density offices and highway retail
Industrial	IND	Industrial uses
Golf Course	GC	Golf courses, originally considered open space
Water	WATER	Perennial streams buffered 10’
Transportation	TRANS	Transportation, areas not represented by parcels

3.1 Nichol Run Watershed

The Nichol Run watershed includes Nichol Run, Harkney Branch, Jefferson Branch, and the Potomac Headwaters. It has a drainage area of approximately 8.2 square miles and contains 31.8 miles of perennial streams. The Nichol Run watershed consists of four watershed management areas (WMAs) including Jefferson, Lower Nichol, Potomac, and Upper Nichol as shown in Map 3.1.

Assessments were made of each WMA based on information supplied by the County and field reconnaissance. Each WMA was assessed for factors such as drainage complaints, proposed county projects, existing stormwater management facilities, on-site septic systems, Neighborhood Source Assessments (NSA), Hot Spot Investigations (HIS) and Stream Physical Assessments (SPA).

The water quality and quantity was modeled for each WMA by assessing land use, impervious coverage, topography, vegetative cover, stream health, and stormwater management. Each WMA was evaluated using STEPL modeling and HEC-RAS modeling to determine the WMA subwatershed ranking of watershed impacts. Each WMA was also evaluated using source indicators to identify potential WMA stressors or pollutant sources. For more detailed information, see the Nichol Run and Pond Branch Watersheds Draft Watershed Workbook, dated January 2009, located in Appendix A.

Overall, Nichol Run watershed streams displayed a wide range in quality, from poor to excellent. Poor quality reaches are concentrated in the upstream area and good quality reaches are generally located in the tributaries draining into the downstream area. The upstream area is characterized mainly by low density residential development.

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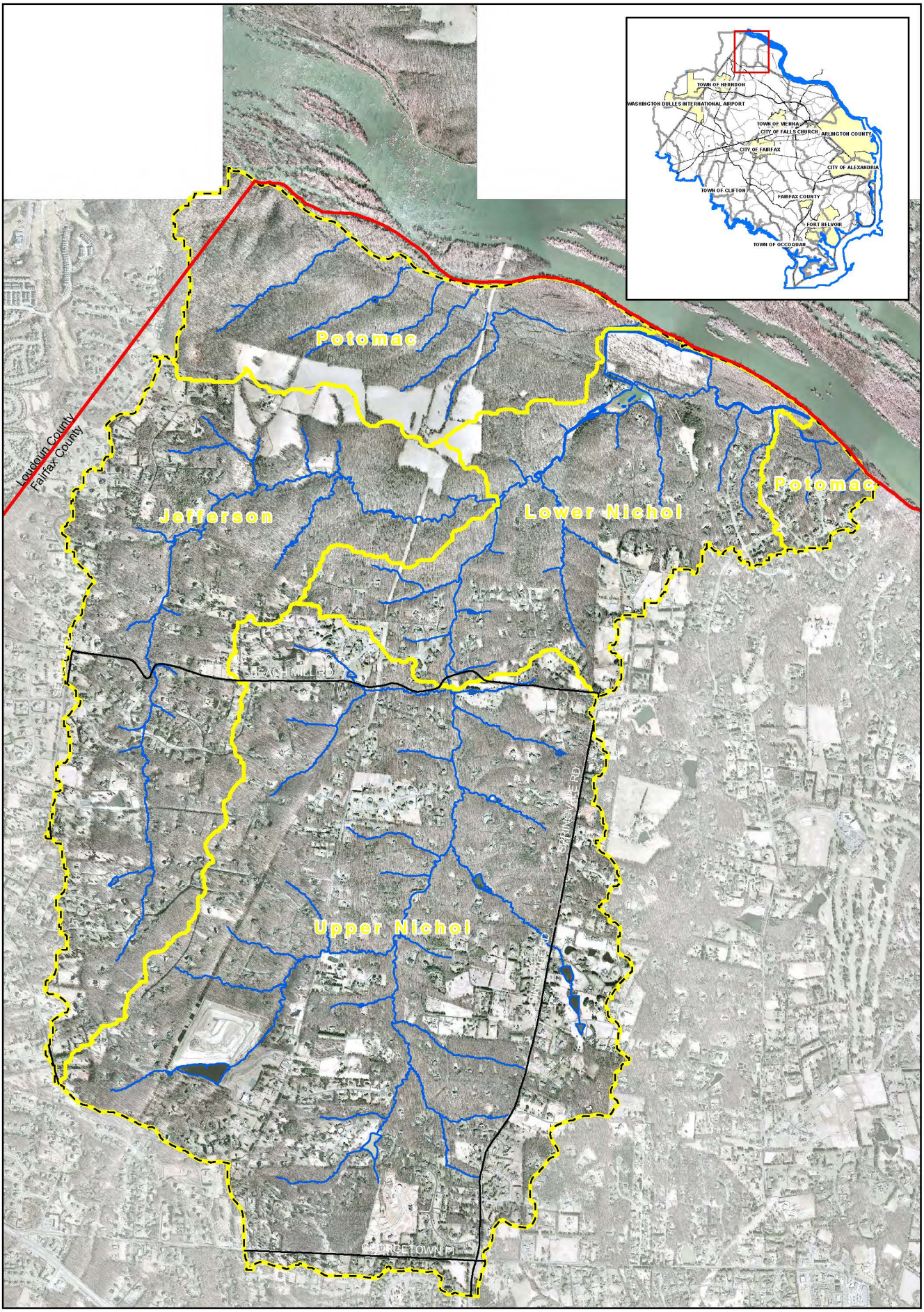


N

0 0.15 0.3 Miles

- Perennial Streams
- Roads
- WMA Boundary
- Nichol Run Watershed
- County Boundary

Map 3.1
Nichol Run
Watershed Management Area
Map

3.1.1 Jefferson WMA

The Jefferson WMA is located in the Western portion of the Nichol Run Watershed. The WMA is 1,185 acres in size (1.5 square miles). Approximately 6.7 miles of perennial streams are located within the Jefferson WMA. The majority of the streams are in good to excellent condition, with a few small portions in fair condition. The WMA consists primarily of estate and low density residential land uses with a section of open space in the northeast, as shown in Map 3.2. According to the HEC-RAS modeling, two of the culverts in the WMA do not carry the 100-year stormflow, and will pond upstream.

None of the subwatersheds within the Jefferson WMA have been identified as potential problem areas in the subwatershed ranking of watershed impacts. Based upon existing conditions, the southern portion of the WMA is in good condition but conditions deteriorate slightly when traveling north toward the confluence with Nichol Run.

None of the subwatersheds within the Jefferson WMA have been identified as potential problem areas in the subwatershed ranking of source indicators to identify potential stressors or pollutant sources. The southern portion of the WMA shows moderate levels of stressors and pollutant sources.

3.1.2 Lower Nichol WMA

The Lower Nichol WMA is located in the northeastern portion of the Nichol Run watershed. The WMA is 821 acres in size (1.28 square miles). Approximately 7.6 miles of perennial streams are located within the Lower Nichol WMA. The majority of streams range from good to excellent condition. The WMA consists primarily of open space and estate residential land uses with some low density residential land uses to the east and south, as shown in Map 3.2. According to the HEC-RAS modeling, one of the bridges in the WMA does not carry the 100-year stormflow, and will overtop the roadway. Also, one of the culverts in the WMA does not carry the 100-year stormflow and may increase flooding upstream.

None of the subwatersheds within the Lower Nichol WMA have been identified as potential problem areas in the subwatershed ranking of watershed impacts. Based upon existing conditions, the entirety of the WMA is in good condition.

None of the subwatersheds within the Lower Nichol WMA have been identified as potential problem areas in the subwatershed ranking of source indicators to identify potential stressors or pollutant sources. Most of the WMA shows low to moderate levels of stressors and pollutant sources.

3.1.3 Potomac (Nichol) WMA

The Potomac WMA is broken into two subwatersheds, both of which lie along the northern border of the Nichol Run watershed. The WMA is 697 acres in size (1.09 square miles), of which 27.6 acres (0.04 square miles) lie within Loudoun County. Approximately 4.6 miles of perennial

streams are located within the Potomac WMA. The WMA consists primarily of open space with some estate and low density residential land uses in the south, as shown in Map 3.2. The WMA is composed of small tributaries that drain directly to the Potomac River where stream segments and drainage areas are small and development is minimal, therefore HEC-RAS modeling was not completed for the Potomac WMA.

None of the subwatersheds within the Potomac WMA have been identified as potential problem areas in the subwatershed ranking of watershed impacts. Based upon existing conditions, the entirety of the WMA is in good condition.

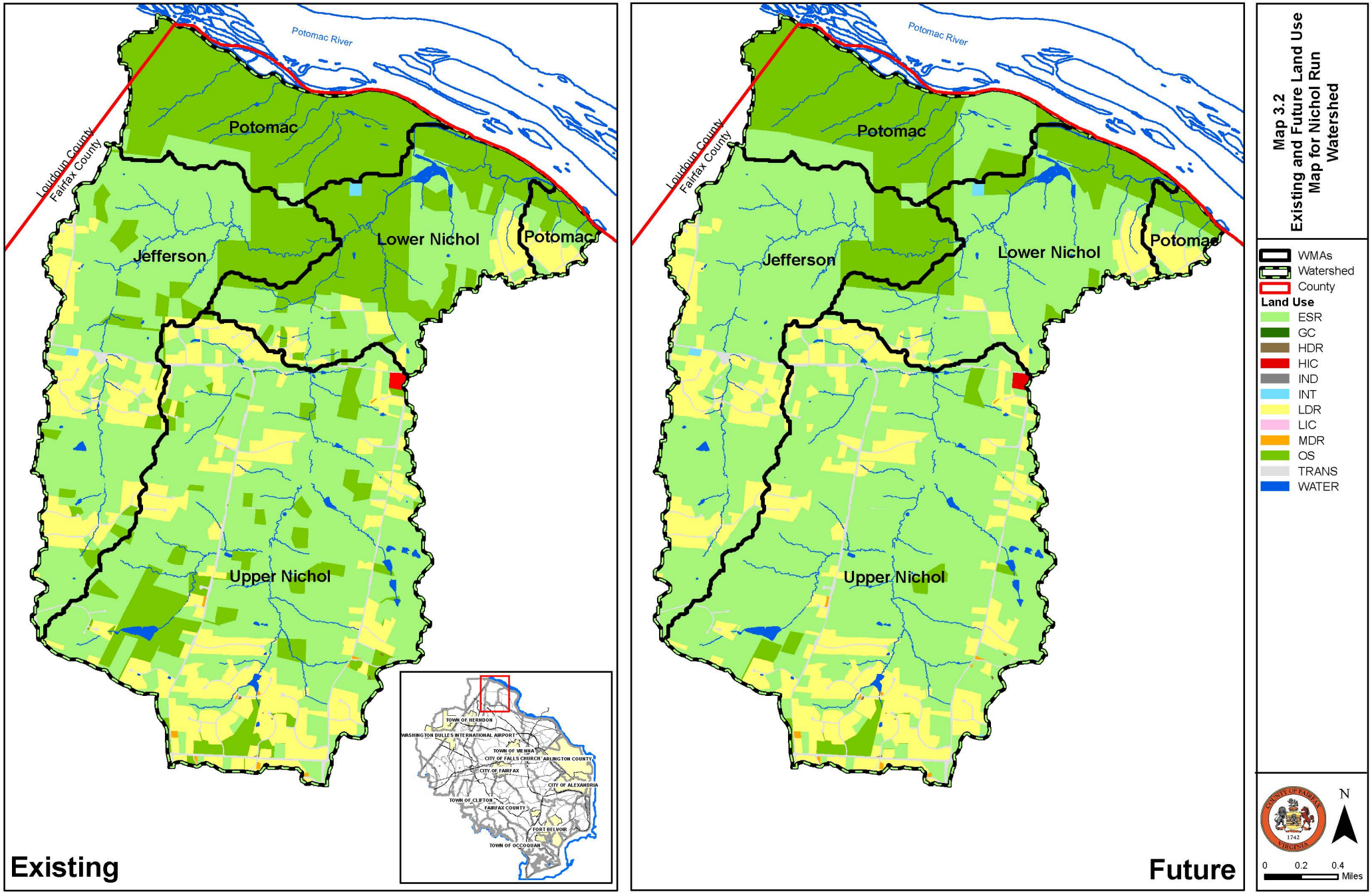
None of the subwatersheds within the Lower Nichol WMA have been identified as potential problem areas in the subwatershed ranking of source indicators to identify potential stressors or pollutant sources. All of the WMA shows low levels of stressors and pollutant sources.

3.1.4 Upper Nichol WMA

The Upper Nichol WMA is located in the southern portion of the Nichol Run watershed. The WMA is 2,549 acres in size (3.98 square miles). Approximately 12.9 miles of perennial streams exist within the Upper Nichol WMA. The streams range from good to poor condition. The WMA consists primarily of estate residential land uses with low density land uses around the perimeter, as shown in Map 3.2. According to the HEC-RAS modeling, four culverts do not carry the 10-year stormflow and overtop the road and/or increase flooding upstream. Also, one culvert in the WMA does not carry the 100-year stormflow and will overtop the road.

None of the subwatersheds within the Upper Nichol WMA have been identified as potential problem areas in the subwatershed ranking of watershed impacts. Based upon existing conditions, the WMA is in good condition.

Two of the subwatersheds within the Upper Nichol WMA have been identified as potential problem areas in the subwatershed ranking of source indicators to identify potential stressors or pollutant sources. The WMA has a range of stressors and pollutant sources, ranging from low to moderate levels.


Potomac River
Loudoun County
Fairfax County
Potomac
Jefferson
Lower Nichol
Potomac
Upper Nichol
Existing
TOWN OF HERNDON
WASHINGTON DULLES INTERNATIONAL AIRPORT
TOWN OF VIENNA
CITY OF FALLS CHURCH
ARLINGTON COUNTY
CITY OF FAIRFAX
CITY OF ALEXANDRIA
TOWN OF CLIFTON
FAIRFAX COUNTY
FORT BELVOIR
TOWN OF OCCOQUAN
Potomac River
Loudoun County
Fairfax County
Potomac
Jefferson
Lower Nichol
Potomac
Upper Nichol
Future
Map 3.2
Existing and Future Land Use
Map for Nichol Run
Watershed
WMAs
Watershed
County
Land Use
ESR
GC
HDR
HIC
IND
INT
LDR
LIC
MDR
OS
TRANS
WATER
N
0
0.2
0.4
Miles

3.2 Pond Branch Watershed

The Pond Branch watershed includes Pond Branch, Mine Run Branch, Clarks Branch, and Potomac Headwaters. It has a drainage area of approximately 8.5 square miles and contains 23.8 miles of perennial streams. The Pond Branch watershed consists of four WMAs including Clark, Mine Run, Pond, and Potomac as shown in Map 3.3.

Assessments were made of each WMA based on information supplied by the county and field reconnaissance. Each WMA was assessed for factors such as drainage complaints, proposed county projects, existing stormwater management facilities, on-site septic systems, Neighborhood Source Assessments Hot Spot Investigations and Stream Physical Assessments.

The water quality and quantity was modeled for each WMA by assessing land uses, impervious coverage, topography, vegetative cover, the health of streams, and stormwater management. Each WMA was evaluated using STEPL modeling and HEC-RAS modeling to determine the WMA subwatershed ranking of watershed impacts. Each WMA was also evaluated using source indicators to identify potential WMA stressors or pollutant sources. For more detailed information, see the Nichol Run and Pond Branch Watersheds Draft Watershed Workbook, dated January 2009, located in Appendix A.

Pond Branch watershed streams range from good to very poor. Poor and very poor reaches are concentrated around the upstream area and good reaches are generally located in the tributaries draining into the downstream area. The upstream area is characterized mainly by low density residential development and the downstream area is characterized mainly by estate residential development and open space.

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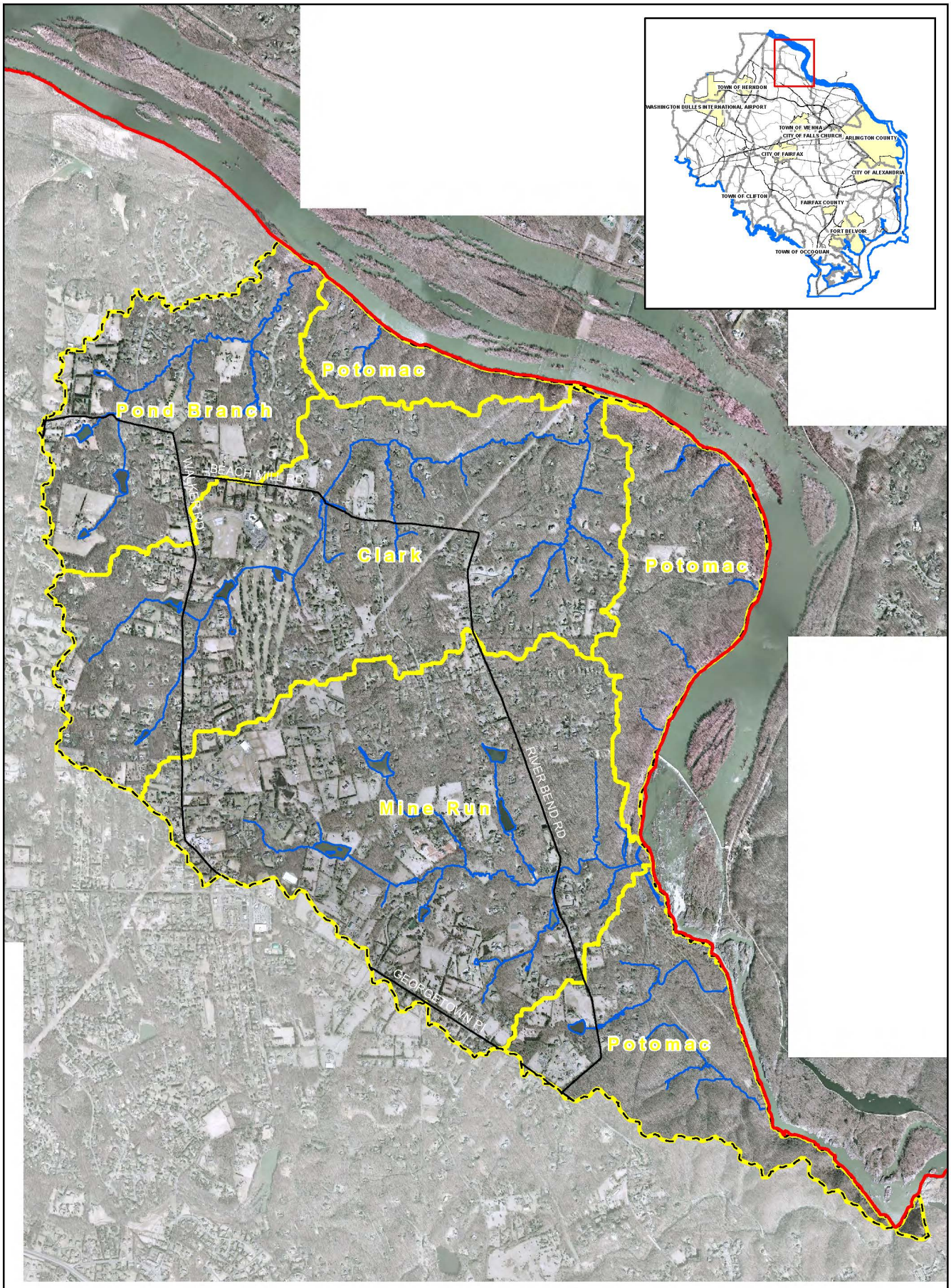


N

0 0.1 0.2 0.3 0.4 Miles

Roads
Perennial Streams
WMA Boundary
Pond Branch Watershed Boundary
County Boundary

Map 3.3
Pond Branch Watershed Management Area Map

3.2.1 Clark WMA

The Clark WMA is located in the central portion of the Pond Branch watershed. The WMA is 1,759 acres in size (2.7 square miles). Approximately 8.4 miles of perennial streams exist within the Clark WMA. Most of these streams are in fair condition, with portions of the headwaters in poor and very poor condition. The WMA consists primarily of estate and low density residential land uses with a golf course near the center, as shown in Map 3.4. According to the HEC-RAS modeling, two of the culverts in the WMA do not carry the 100-year stormflow and may increase flooding upstream.

Two of the subwatersheds within the Clark WMA have been identified as potential problem areas in the subwatershed ranking of watershed impacts. Based upon existing conditions, the upper portion of the WMA is in fair condition, while the lower portion is in good condition.

None of the subwatersheds within the Clark WMA have been identified as potential problem areas in the subwatershed ranking of source indicators to identify potential stressors or pollutant sources. The WMA has low to moderate levels of stressors and pollutant sources.

3.2.2 Mine Run WMA

The Mine Run WMA is located along the southern border of the Pond Branch watershed, and is bordered by the Difficult Run watershed. The WMA is 1,634 acres in size (2.6 square miles). Approximately 6.9 miles of perennial streams exist within the Mine Run WMA. Habitat conditions range from good to very poor. The WMA consists primarily of estate residential land use with open space and low density residential land uses to the north, as shown in Map 3.4 According to the HEC-RAS modeling, three of the culverts in the WMA do not carry the 100-year stormflow and may increase flooding upstream.

Three of the subwatersheds within the Mine Run WMA have been identified as potential problem areas in the subwatershed ranking of watershed impacts. Based upon existing conditions, the WMA has fair conditions.

None of the subwatersheds within the Mine Run WMA have been identified as potential problem areas in the subwatershed ranking of source indicators to identify potential stressors or pollutant sources. The WMA has low to moderate levels of stressors and pollutant sources.

3.2.3 Pond WMA

The Pond WMA is located in the northwestern corner of the Pond Branch watershed and is bordered on the west by the Nichol Run watershed. The WMA is 741 acres in size (1.2 square miles). Approximately 4.1 miles of perennial steams exist within the Pond WMA. The WMA consists primarily of estate and low density residential land uses, as shown in Map 3.4. According

to the HEC-RAS modeling, one of the culverts in the WMA does not carry the 100-year stormflow and may increase flooding upstream.

None of the subwatersheds within the Pond WMA have been identified as potential problem areas in the subwatershed ranking of watershed impacts. Based upon existing conditions, the WMA is in excellent condition.

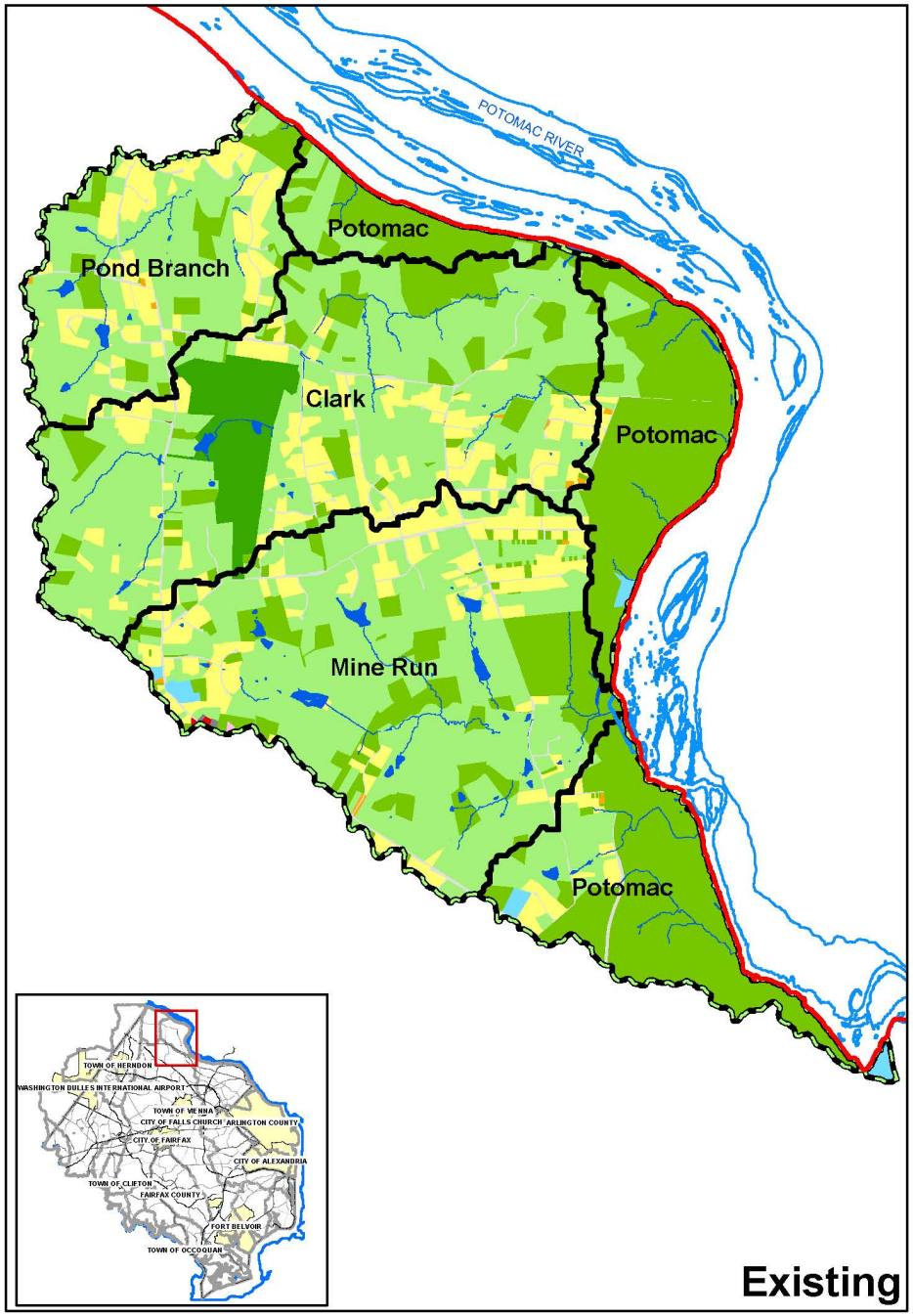
None of the subwatersheds within the Pond WMA have been identified as potential problem areas in the subwatershed ranking of source indicators to identify potential stressors or pollutant sources. The WMA was ranked as having low to moderate levels of stressors and pollutant sources.

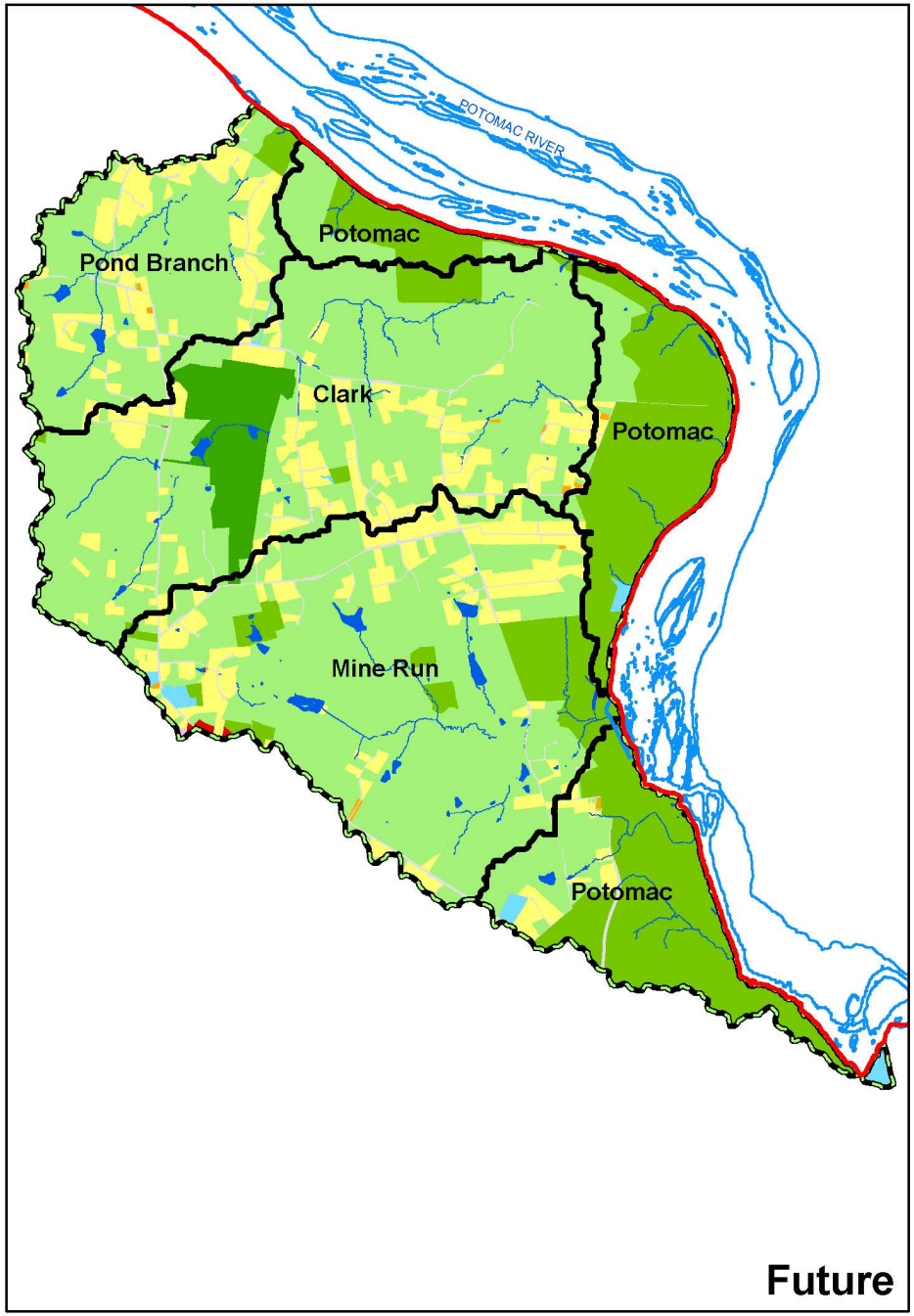
3.2.4 Potomac (Pond) WMA

The Potomac WMA is broken into three subwatersheds, all of which lie along the Potomac River. Two subwatersheds are located along the northern border of the WMA and the third encompasses the southeastern tip. Approximately 4.4 miles of perennial streams exits within the Potomac WMA. The WMA consists primarily of open space with some estate and low density residential land uses closest to the center of the Pond Branch watershed, as shown in Map 3.4. The WMA is composed of small tributaries that drain directly to the Potomac River where stream segments and drainage areas are small and development is minimal, therefore HEC-RAS modeling was not completed for the Potomac WMA.

None of the subwatersheds within the Potomac WMA have been identified as potential problem areas in the subwatershed ranking of watershed impacts. Based upon existing conditions, the WMA ranges from a poor to good condition.

None of the subwatersheds within the Potomac WMA have been identified as potential problem areas in the subwatershed ranking of source indicators to identify potential stressors or pollutant sources. The WMA was ranked as having low levels of stressors and pollutant sources.





Map 3.4
Existing and Future Land Use for Pond Branch Watershed

WMAs
Watersheds
County

Land Use
ESR
GC
HDR
HIC
IND
INT
LDR
LIC
MDR
OS
TRANS
WATER

N

0 0.25 0.5 Miles

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

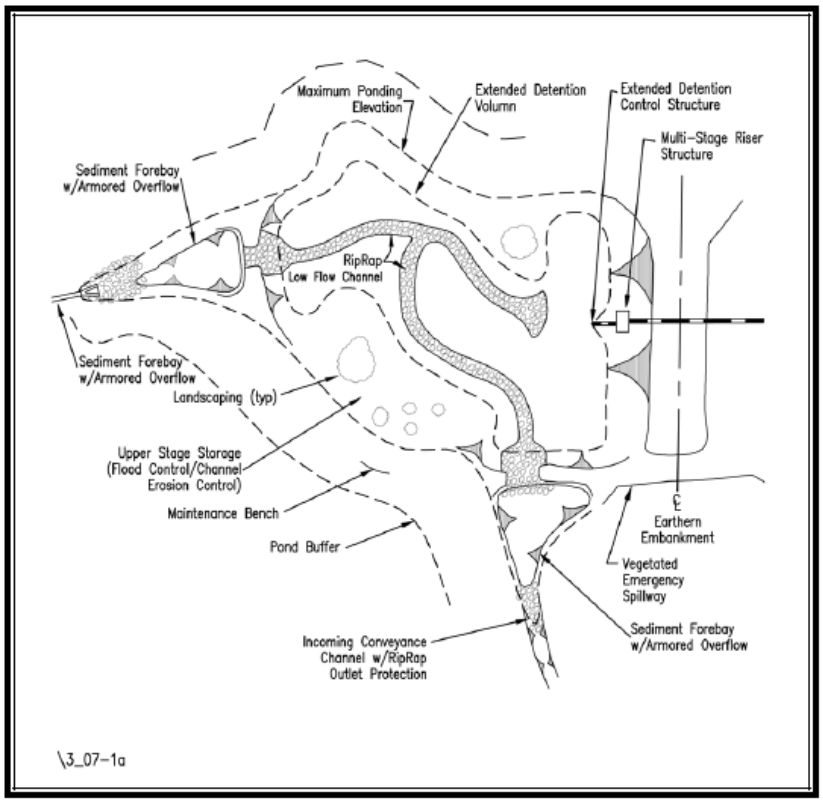


Figure 4.1 Plan View of Extended Detention Basin
Source: Virginia Stormwater Management Handbook

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

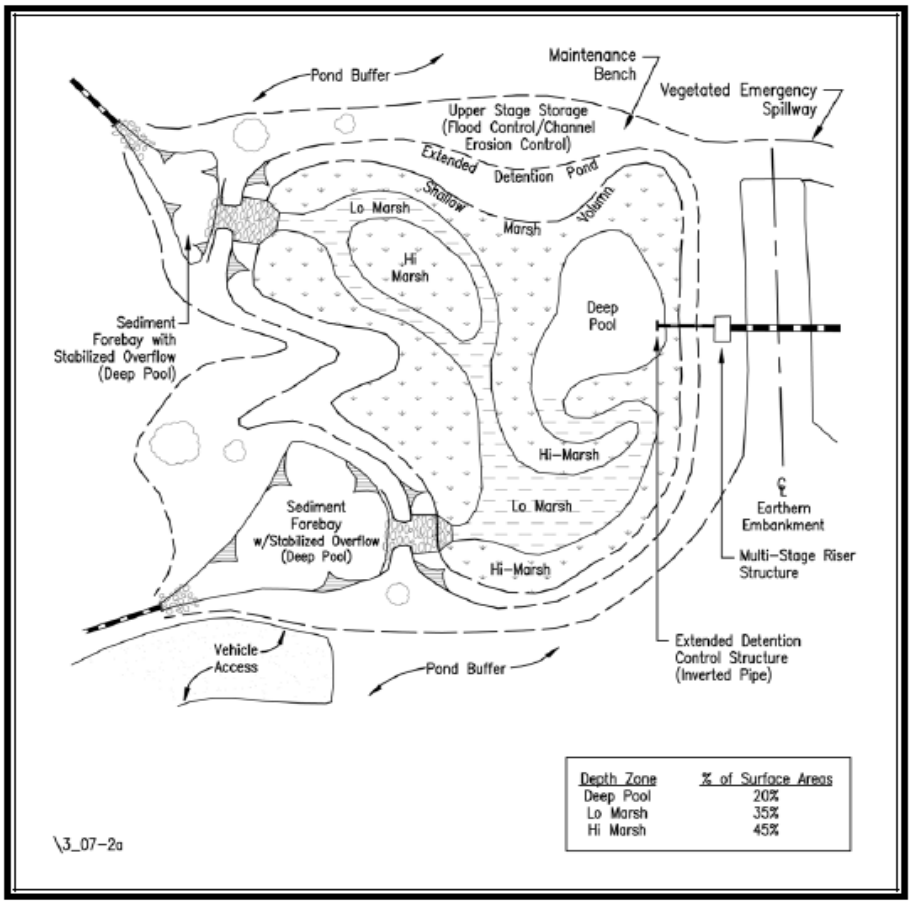


Figure 4.2 Plan view of Enhanced Extended Detention Basin
Source: Virginia Stormwater Management Handbook

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

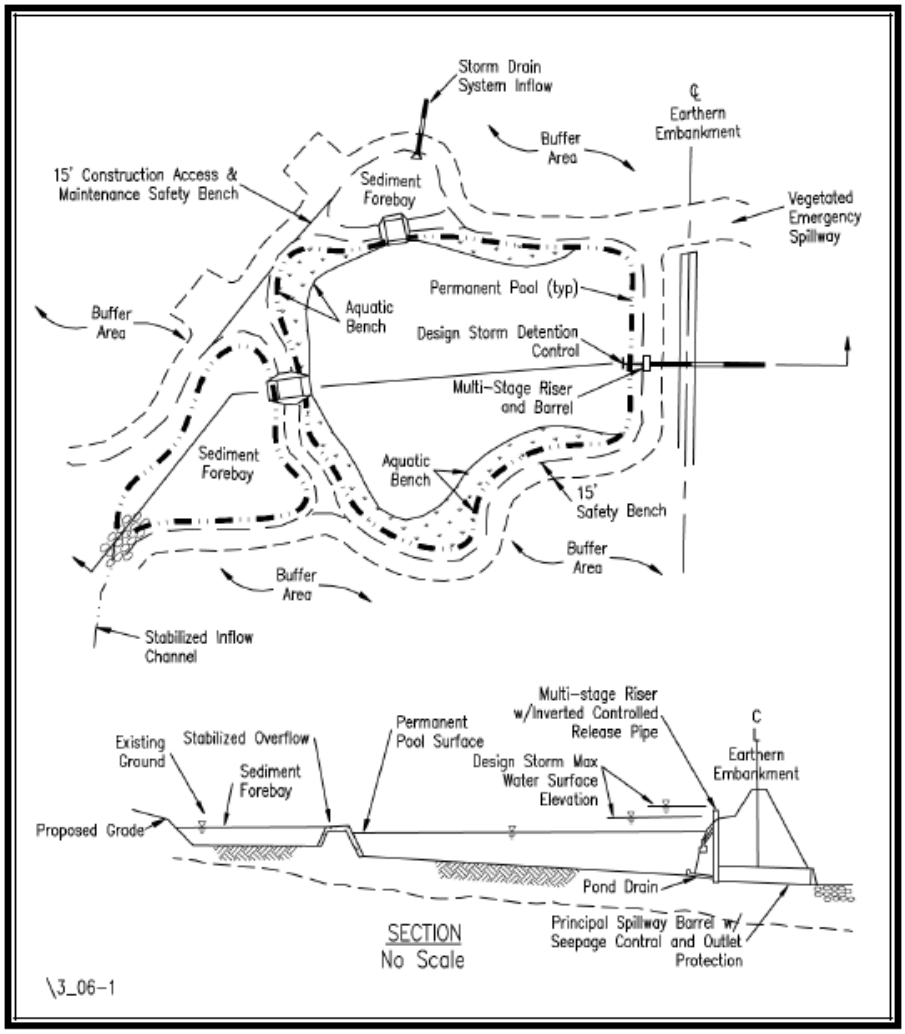


Figure 4.3 Retention Basin – Plan and Section
Source: Virginia Stormwater Management Handbook

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.

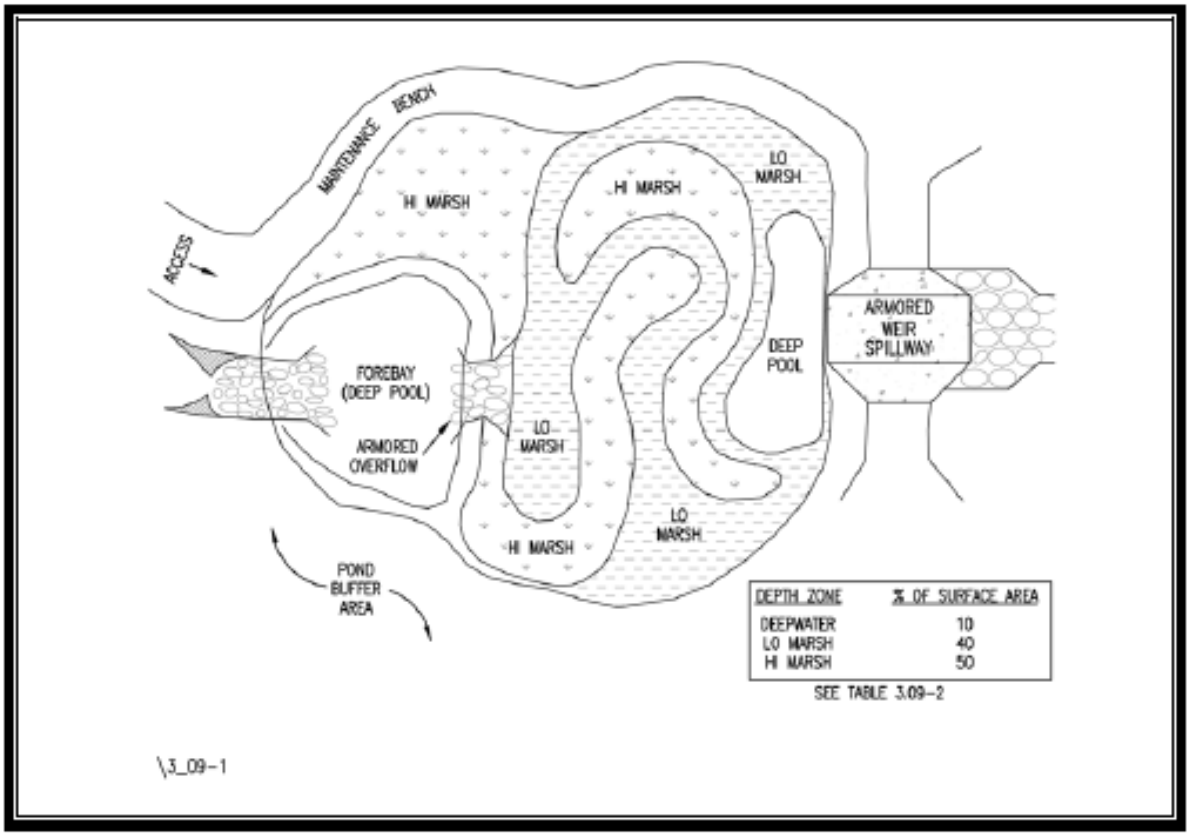


Figure 4.4 Constructed Stormwater Wetlands – Plan
Source: Virginia Stormwater Management Handbook

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.

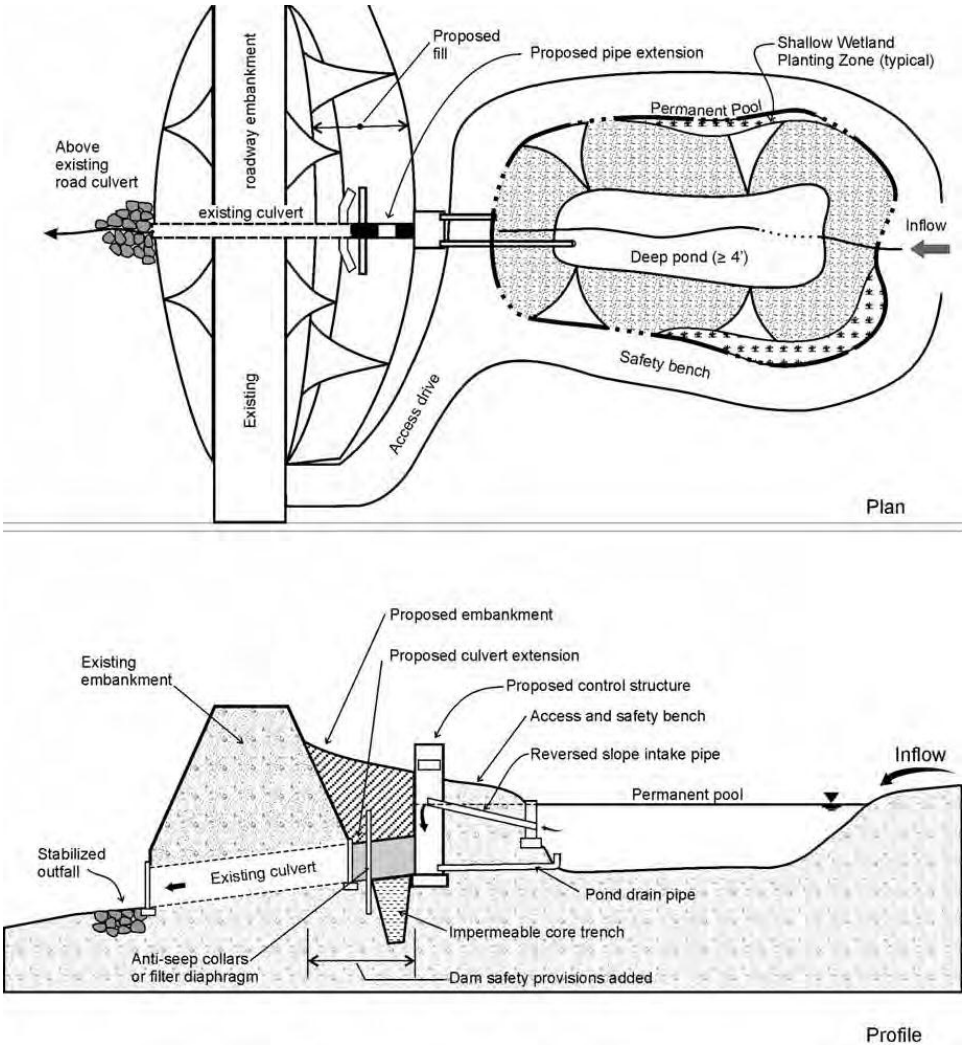


Figure 4.5 Typical Culvert Retrofit with Micro-pool Configuration
Source: Center for Watershed Protection

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

Rain Garden (Bioretention Basin)

Photo 4.5 Rain Garden
Source: Virginia Stormwater Management Handbook

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 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.

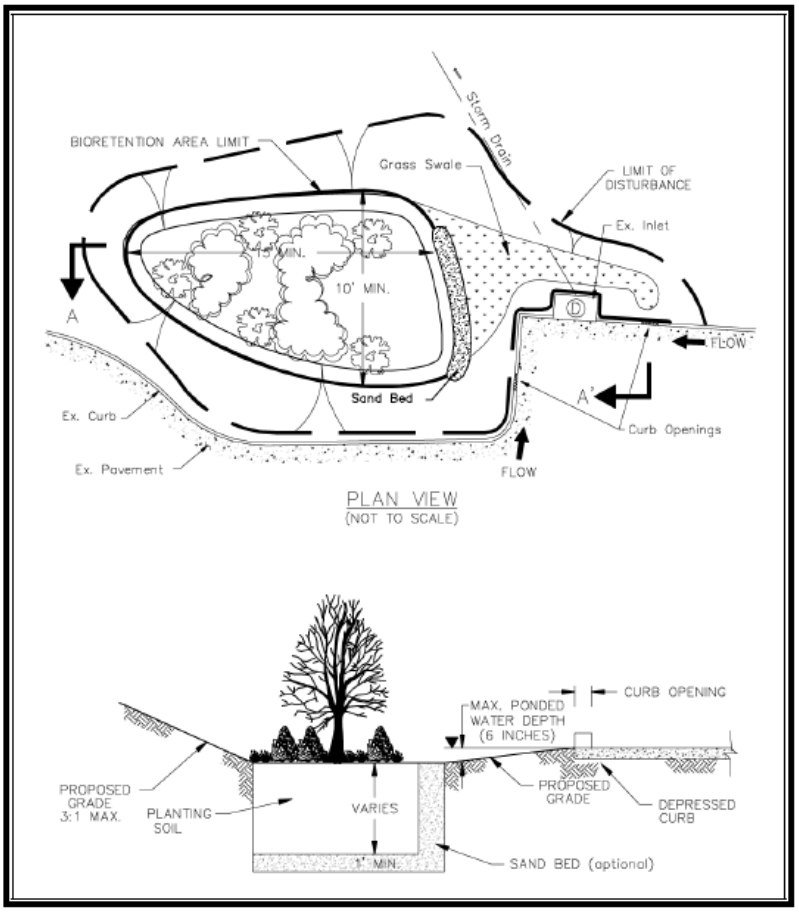


Figure 4.6 Rain Garden at Edge of Parking Lot, Plan View Source: Virginia Stormwater Management Handbook)

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

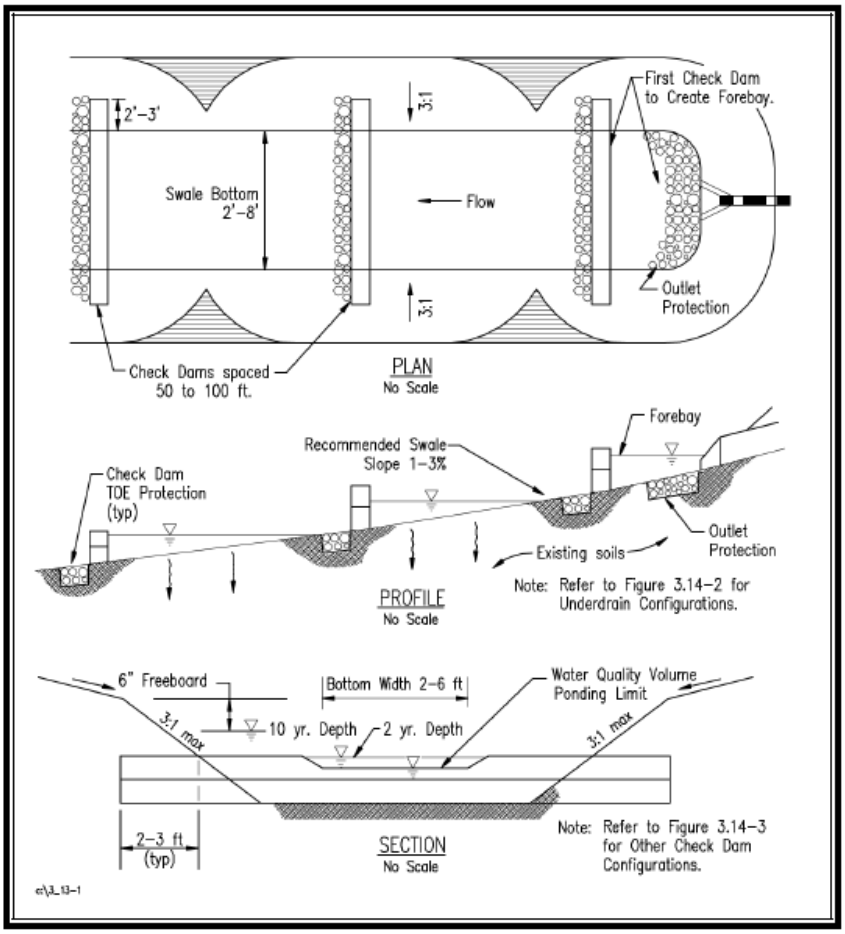


Figure 4.7 Typical Vegetated Swale Configuration
Source: Virginia Stormwater Management Handbook

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. Infiltration trenches may also be designed with a gravel surface.

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

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.

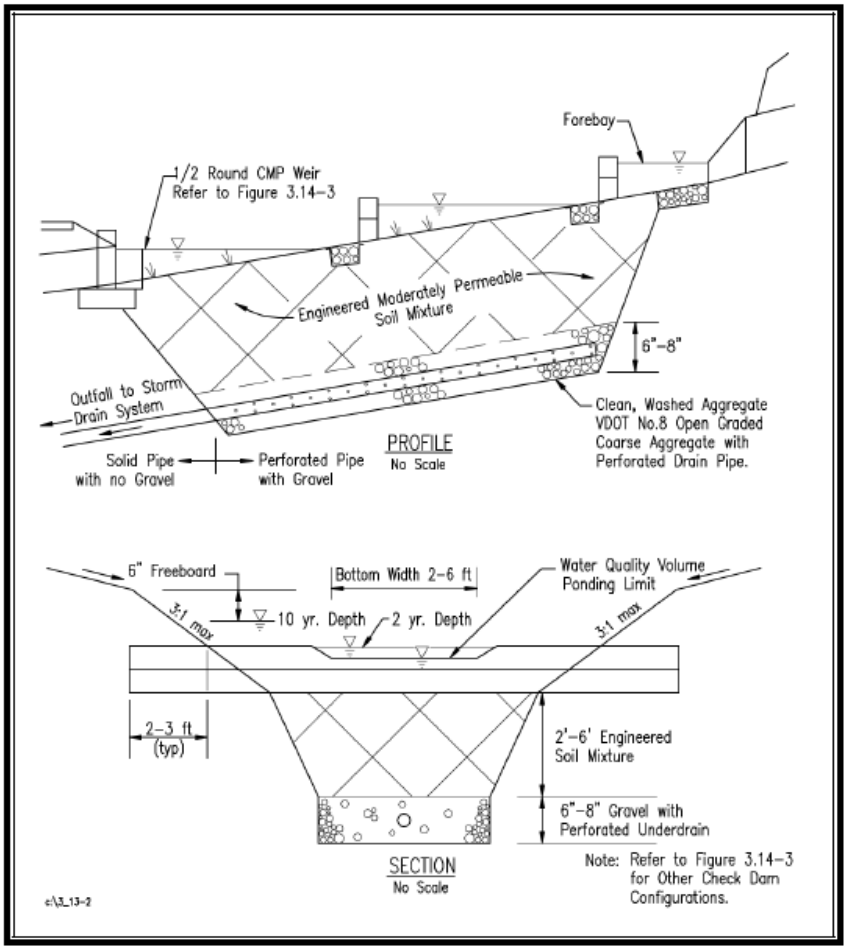


Figure 4.8 Typical Water Quality Swale Configuration
Source: Virginia Stormwater Management Handbook

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.

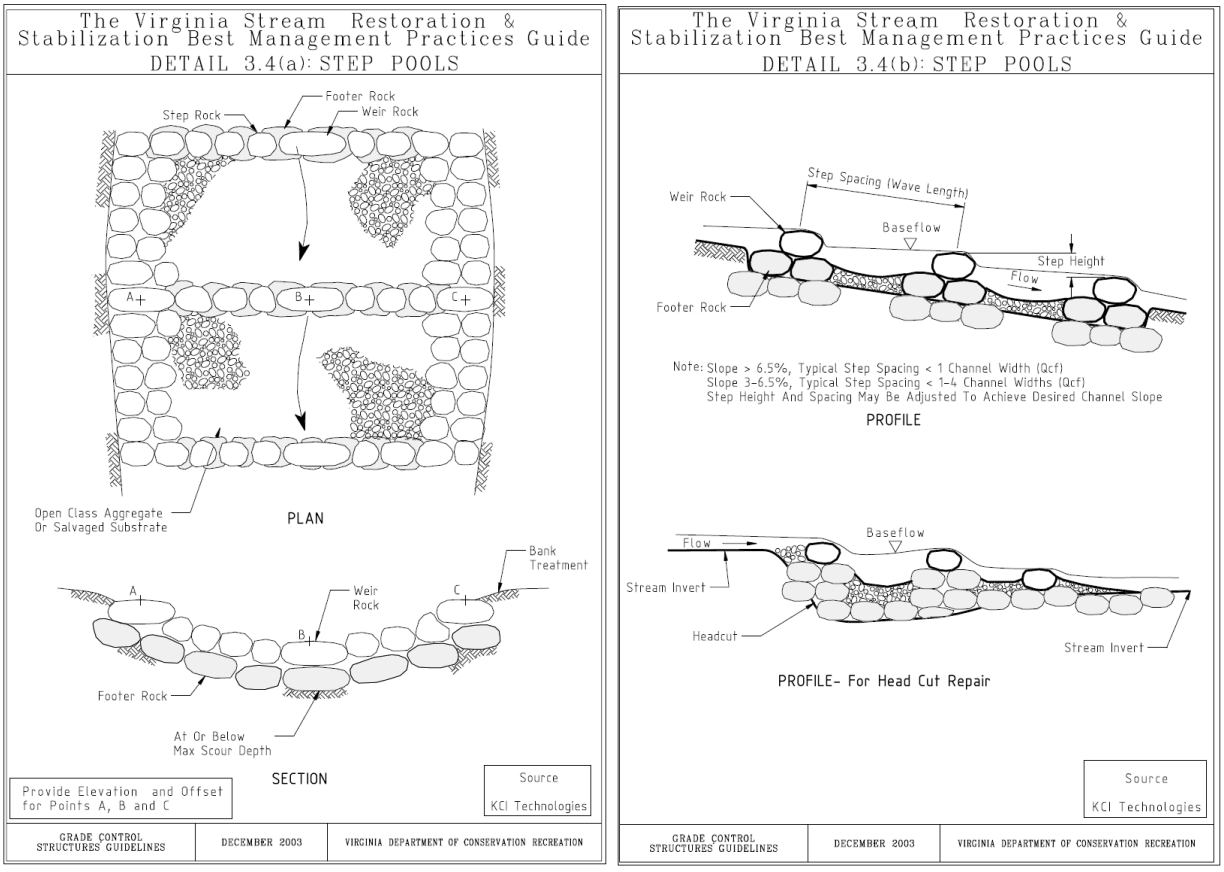


Figure 4.11 Step Pool Plan and Profile
Source: Virginia Stormwater Management Handbook

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

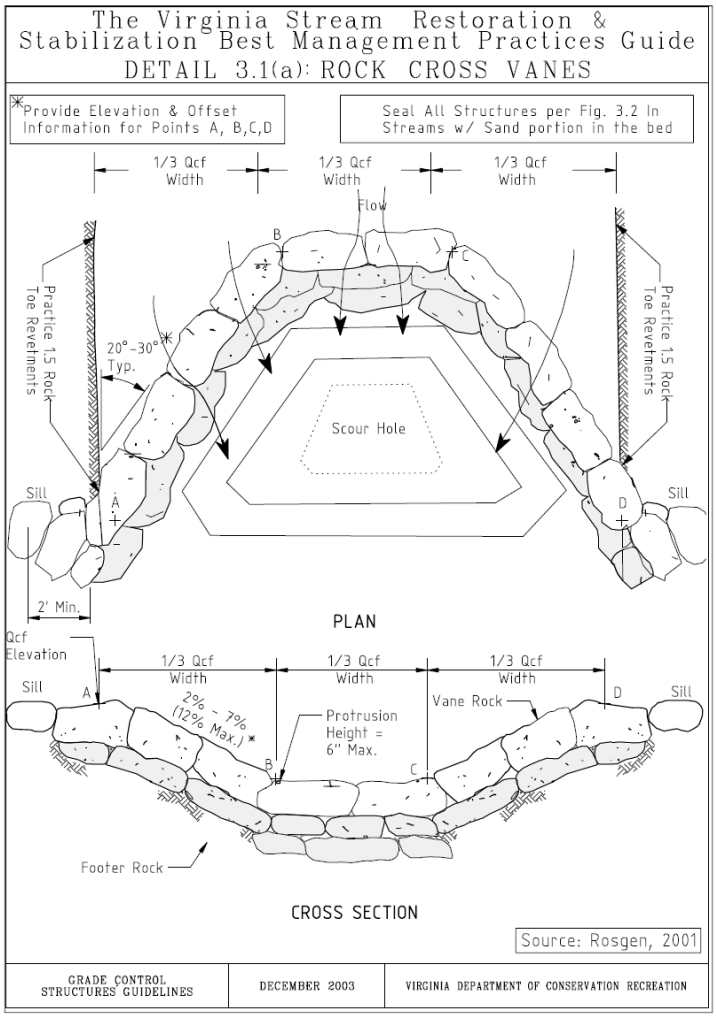


Figure 4.12 Detail Plan Rock Vane

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

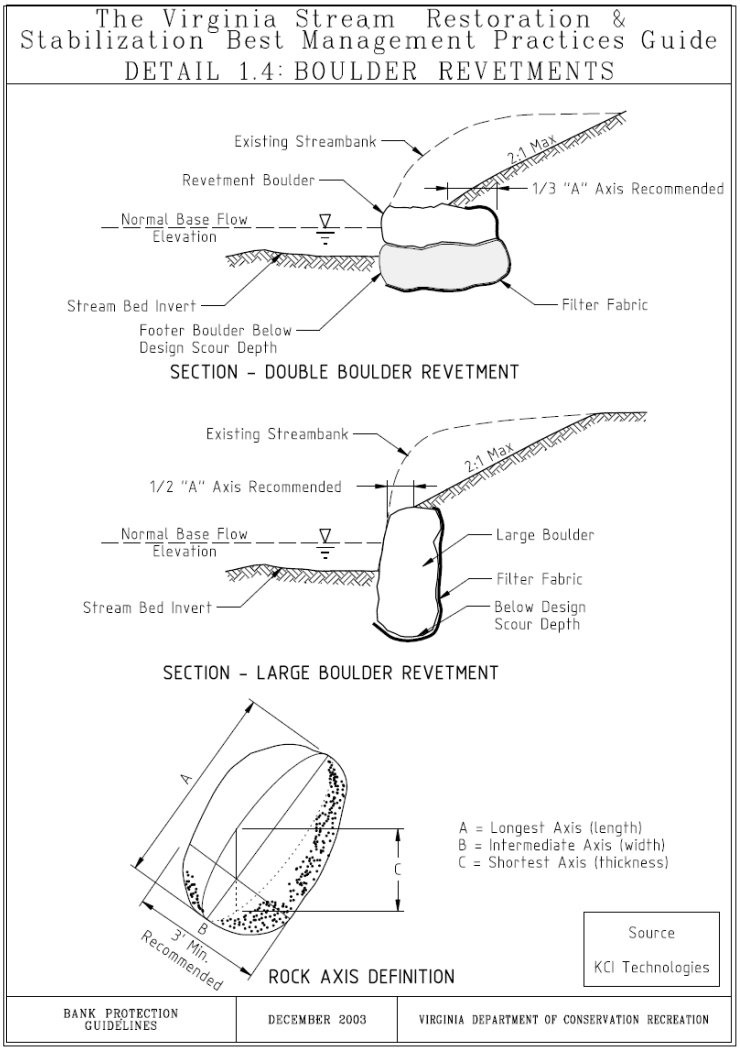


Figure 4.13 Detail Plan Boulder Revetment

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

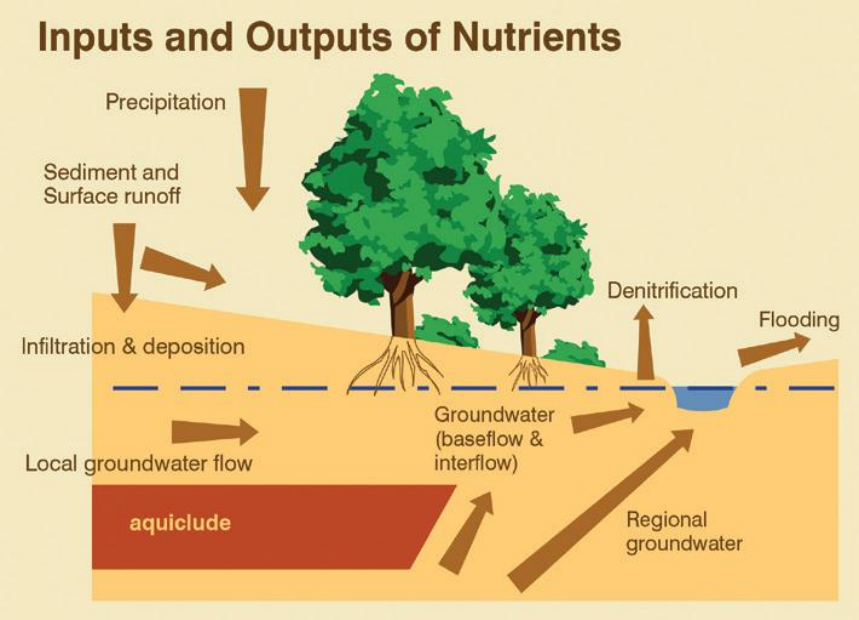


Figure 4.14 Riparian Buffer Nutrient Inputs and Outputs
Source: Chesapeake Bay Program

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.

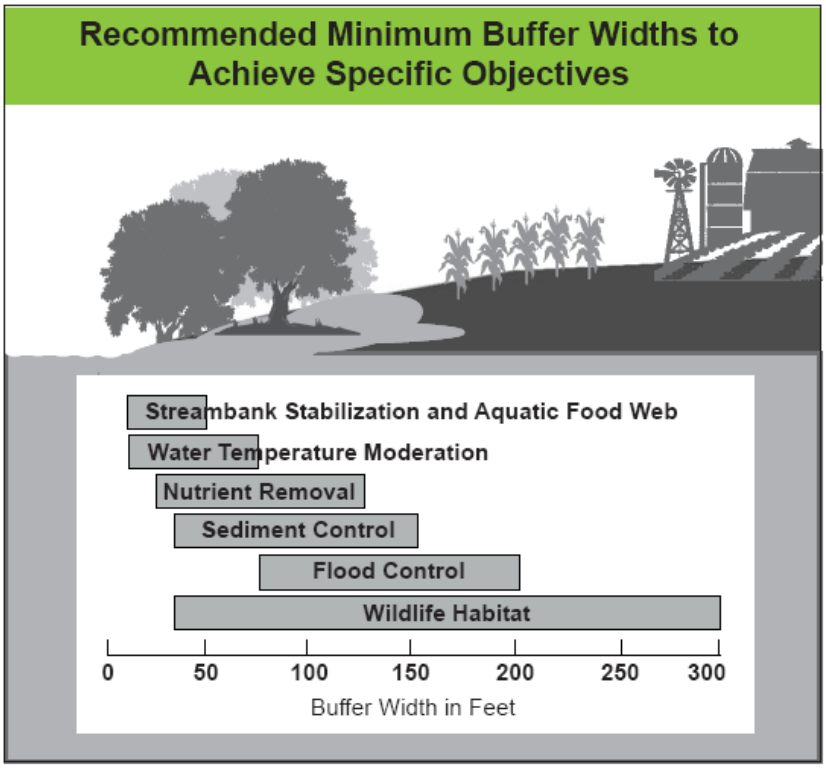


Figure 4.15 Buffer Widths and Objectives
Source: Chesapeake Bay Program

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.

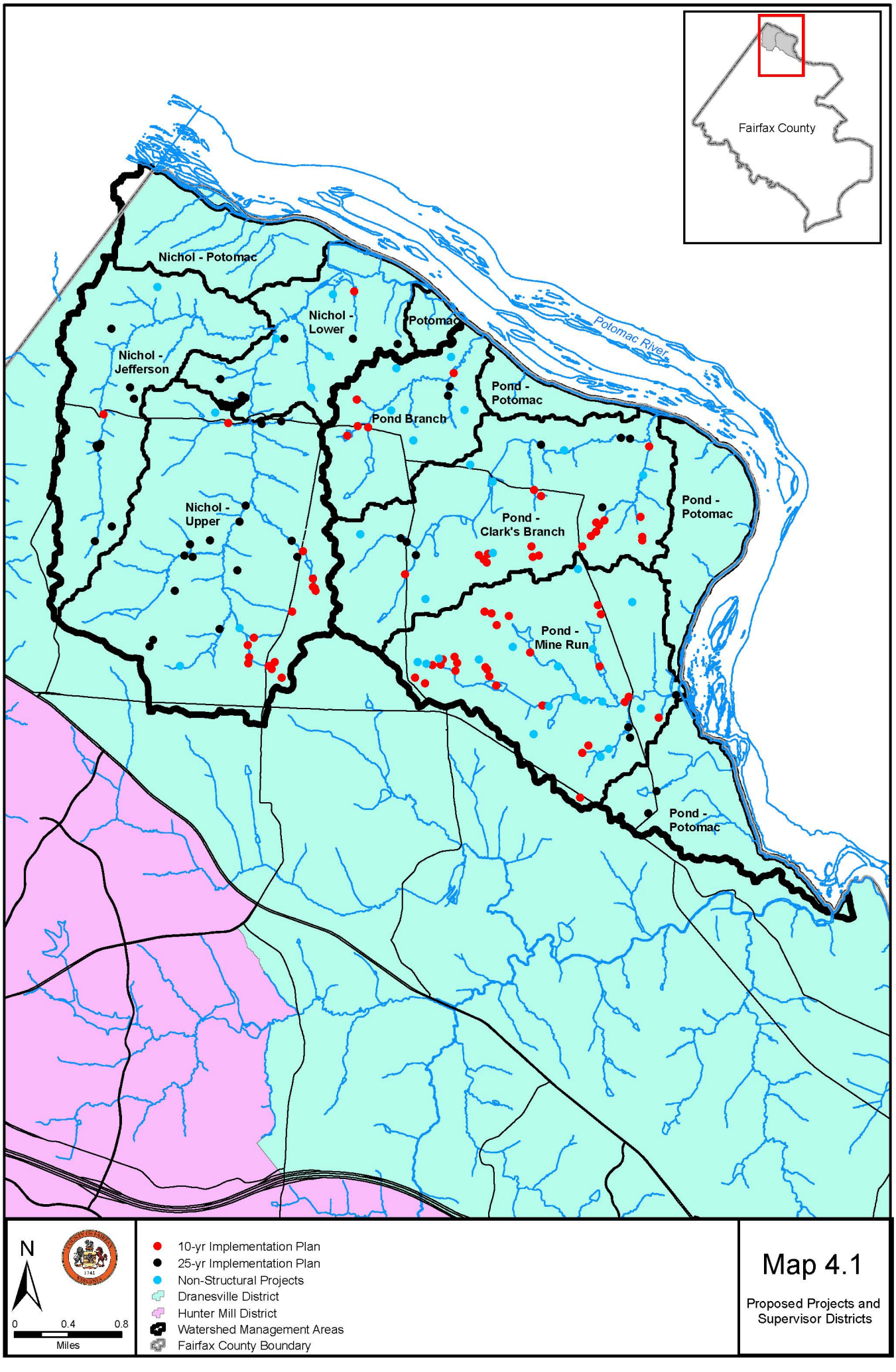

Fairfax County
Potomac River
Nichol - Potomac
Nichol - Lower
Potomac
Nichol - Jefferson
Pond - Potomac
Pond Branch
Nichol - Upper
Pond - Clark's Branch
Pond - Potomac
Pond - Mine Run
Pond - Potomac
N
0
0.4
0.8
Miles
10-yr Implementation Plan
25-yr Implementation Plan
Non-Structural Projects
Dranesville District
Hunter Mill District
Watershed Management Areas
Fairfax County Boundary
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***

Table 4.3
Master Project List

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
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

Table 4.3 Master Project List					
Long-Term Structural Projects (25 Year Implementation Plan)					
Project #	**Project Type**	**WMA**	**Location**	**Watershed Benefit**	**Land Owner**
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
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

Table 4.3 Master Project List					
Long-Term Structural Projects (25 Year Implementation Plan)					
Project #	**Project Type**	**WMA**	**Location**	**Watershed Benefit**	**Land Owner**
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

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5.0 WMA Area Restoration Strategies for Nichol Run and Pond Branch Watershed

Section 5.0 provides descriptions of the restoration strategies proposed for the Nichol Run and Pond Branch watersheds. Restoration strategies were chosen based on needs of each WMA.

A majority of the Nichol Run watershed is rural. The majority of open space is located along the stream corridors and along the northern edge of the watershed. The central and southern portion of the watershed contains mostly estate and low density residential land uses. The expected changes in land use show decreases in open space and increases in estate residential land uses.

There are 16 existing stormwater facilities located in the Nichol Run watershed. Approximately 86 percent of Nichol Run watershed is not treated by an existing stormwater facility. This large area of the Nichol Run watershed that lacks existing stormwater controls indicates the need for new watershed management projects.

A majority of the Pond Branch watershed is also rural. The majority of open space is located along stream corridors and along the northeastern edge of the watershed. The central and southwestern portion of the watershed contains mostly estate and low density residential land uses. A golf course is located near the center of the watershed. As with Nichol Run, the expected changes in land use show decreases in open space and increases in estate residential land uses.

There are 22 existing stormwater facilities located in the Pond Branch watershed. Approximately 92 percent of the Pond Branch watershed is not treated by an existing stormwater facility. This large area of the Pond Branch watershed that lacks existing stormwater controls indicates the need for new watershed management projects.

5.1 Nichol Run Watershed WMAs

Each subsection of Section 5.1 includes a description of key WMA conditions, a description of proposed structural and non-structural projects in the WMA, a listing of 10-year and 25-year projects for the WMA and a map showing the types and locations of all 10-year and 25-year projects within the WMA. Each WMA in the Nichol Run watershed is described separately in alphabetical order. Additional project details, benefits, and design considerations for the projects in the 10-year implementation plan are included on the project fact sheets located in Section 5.3.

5.1.1 Jefferson WMA

Description of Key WMA Conditions

Approximately 17 percent of the Jefferson WMA consists of undeveloped open space. The expected changes in land use show a decrease in this open space and an increase in estate residential land uses. The development of green spaces causes greater volumes of stormwater run off and more intense peak flows. Loss of open space also leads to degraded wildlife habitat, increased pollutants in stormwater runoff and worsening stream conditions.

The Jefferson WMA contains 3 existing stormwater facilities. Approximately 81 percent of this WMA is not treated by an existing stormwater facility. According to the existing condition STEPL model results, the Jefferson WMA contributes approximately 20 percent of the total suspended

solids, 25 percent of the total nitrogen and 24 percent of the total phosphorus annual loads to the Nichol Run Watershed.

Jefferson WMA 10-Year Projects

The following structural project is designed to reduce stormwater runoff volumes, decrease peak flows, reduce pollutants in stormwater runoff, and improve overall habitat and stream quality in the Jefferson WMA.

NI9113 This culvert at Beach Mill Road is obstructed with debris, stream banks are eroding due to high energy storm flows through the culvert which may flood the road. Construct a micropool with an outlet structure upstream of the culvert in Beach Mill Road.

Jefferson WMA 25-Year Projects

The following structural projects are designed to reduce stormwater runoff volumes, decrease peak flows, reduce pollutants in stormwater runoff, and improve overall habitat and stream quality in the Jefferson WMA.

NI9107 Retrofit existing farm pond near Potowmack Street and Montpelier Road to provide storage and water quality benefits by installing an outlet structure and planting pond edges with emergent and riparian vegetation.

NI9109 Retrofit existing farm pond near Montpelier Road and Potowmack Street to provide storage and water quality benefits by installing an outlet structure and planting pond edges with emergent and riparian vegetation.

NI9112 Seneca Farms subdivision is in need of additional stormwater treatment. Install a naturalized extended detention dry pond within a small clearing in a natural drainage area.

NI9115 Retrofit existing dry pond near Elmview Place and Seneca Knoll Drive to enhanced extended detention dry pond with low marsh areas to provide additional water quality and quantity controls.

NI9300 Culvert under Rich Meadow Drive is clogged with sediment. Clear sediment from culvert and install rain garden to provide quality control and promote infiltration.

NI9301 Remove concrete obstruction in stream in Richland Meadows subdivision. Repair and stabilize stream erosion impacts and restore riparian buffer.

Jefferson WMA Non-Structural Projects

The following non-structural project is designed to improve water quality and wildlife habitat in areas with no existing stormwater management and no opportunity for new structural stormwater controls.

NI9900 Restore riparian buffer along stream in Potowmack Farm subdivision.

10-Year and 25-Year Project Information Tables for Jefferson WMA

Table 5.1 lists all structural and non-structural projects proposed in the Jefferson WMA. Project locations for all structural and non-structural projects are shown on Map 5.1.

Table 5.1 Project List – Jefferson WMA						
Structural Projects						
Project #	**Project Type**	**Subwatershed**	**Location**	**Watershed Benefit**	**Land Owner**	**Phase**
NI9113	Culvert Retrofit	NI-JB-0004	Near Beach Mill Road & Pipestem	Quality/ Quanity	State/ County/ Private	0 - 10
NI9107	Stormwater Pond Retrofit	NI-JB-0003	Near Potowmack Street & Montpelier Road	Quality/ Quanity	Private	11 - 25
NI9109	Stormwater Pond Retrofit	NI-JB-0003	Near Montpelier Road & Potowmack Street	Quality/ Quanity	Private	11 - 25
NI9112	New Stormwater Pond	NI-JB-0003	Near Richland Grove Drive & Donmore Drive	Quality/ Quanity	Private	11 - 25
NI9115	Stormwater Pond Retrofit, BMP/LID	NI-JB-0005	Near Elmview Place & Seneca Knoll Drive	Quality/ Quanity	County/ Private	11 - 25
NI9300	Culvert Retrofit	NI-JB-0006	Near Rich Meadow Drive & Richland Valley Drive	Quality	Private	11 - 25
NI9301	Stream Restoration	NI-JB-0006	Richland Meadows Subdivision	Quality	Private	11 - 25
Non-Structural Projects						
Project #	**Project Type**	**Subwatershed**	**Location**	**Watershed Benefit**	**Land Owner**	
NI9900	Buffer Restoration	NI-JB-0002	Patowmack Farm	N/ A	Private	

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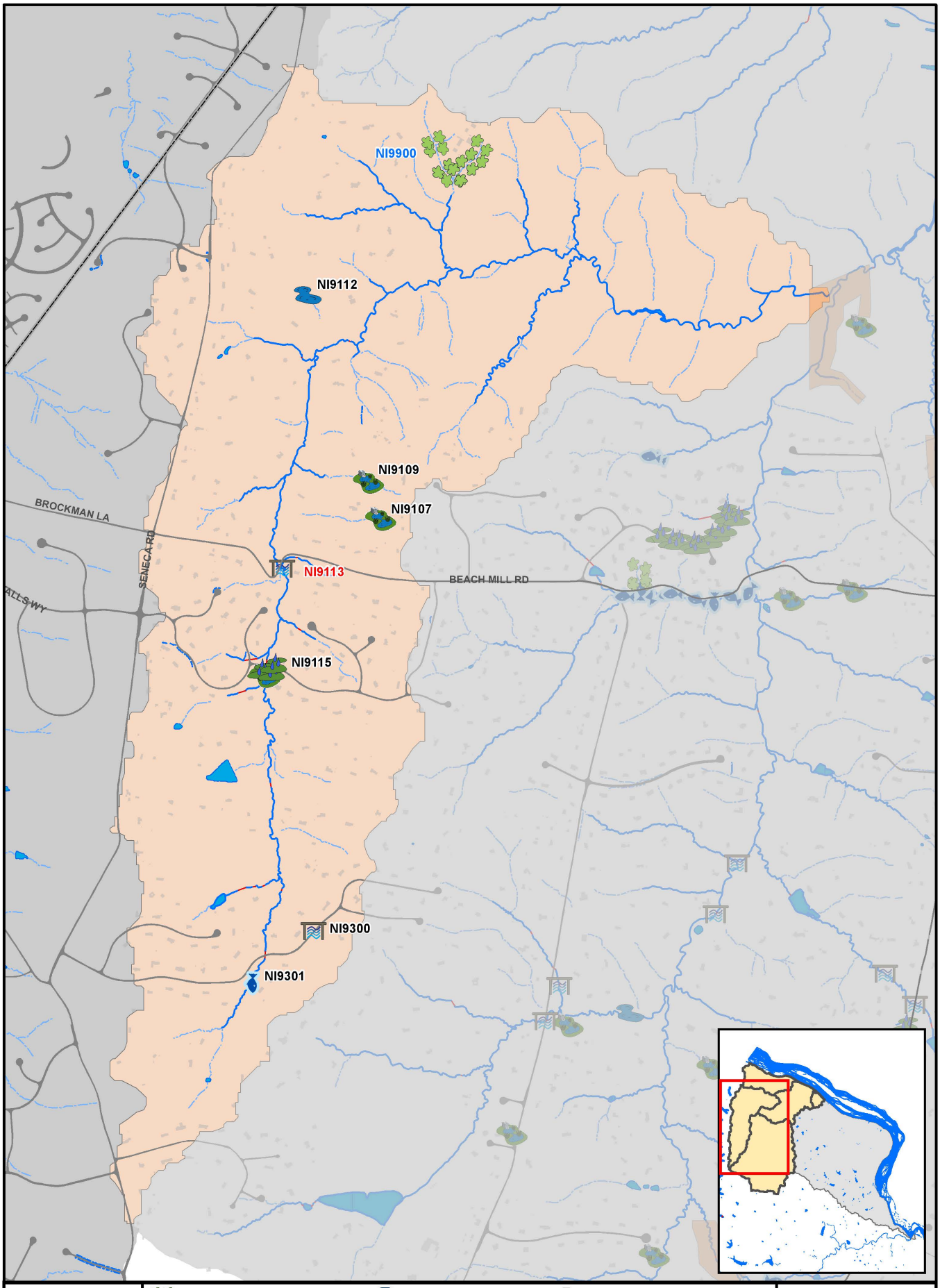

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Buffer Restoration

Stream Restoration

BMP/LID

Culvert Retrofit

Dumpsite/Obstruction Removal

New Stormwater Pond

Outfall Improvement

Stormwater Pond Retrofit

Other

Area-wide Drainage Improvement

Community Outreach/Public Education

Land Conservation Project

Flood Protection/Mitigation

Inspection/Enforcement Enhancement

Rain Barrel Program

Street Sweeping Program

Studies, Surveys and Assessments

Implementation timeframe denoted by project label color. Red = 0-10 years Black = 11-25 years Blue = Non-Structural.

Map 5.1

WMA: Nichol - Jefferson Proposed Projects

5.1.2 Lower Nichol WMA

Description of Key WMA Conditions

Approximately 48 percent of the Lower Nichol WMA consists of undeveloped open space. The expected changes in land use show a decrease in this open space and an increase in estate residential land uses. The development of green spaces causes greater volumes of stormwater run off and more intense peak flows. Loss of open space also leads to degraded wildlife habitat, increased pollutants in stormwater runoff and worsening stream conditions.

The Lower Nichol WMA contains 2 existing stormwater facilities. Approximately 79 percent of this WMA is not treated by an existing stormwater facility. According to the existing condition STEPL model results, the Lower Nichol WMA contributes approximately 17 percent of the total suspended solids, 12 percent of the total nitrogen and 13 percent of the total phosphorus annual loads to the Nichol Run Watershed.

Lower Nichol WMA 10-Year Projects

The following structural project is designed to reduce stormwater runoff volumes, decrease peak flows, reduce pollutants in stormwater runoff and improve overall habitat and stream quality in the Lower Nichol WMA.

NI9101 The area near Jefferson Run Road does not have existing stormwater treatment or controls. Improve existing wet pond (WP0200) by installing an outlet structure to increase capacity. Repair overflow spillway to prevent breach, vegetate sides of the pond and improve wetlands.

Lower Nichol WMA 25-Year Projects

The following structural projects are designed to reduce stormwater runoff volumes, decrease peak flows, reduce pollutants in stormwater runoff and improve overall habitat and stream quality in the Lower Nichol WMA.

NI9100 Expand existing natural wetland area near High Hill Court and Falcon Ridge Road and stabilize and vegetate eroded channel.

NI9102 This area does not have existing stormwater treatment or controls. Improve existing non-stormwater farm pond to a constructed wetland and install an outlet structure. Inspect the dam for seepage/breach and repair. Repair downstream streambank erosion.

NI9103 Retrofit existing wet pond near Springvale Road and Allenwood Lane to provide additional storage and water quality benefits by installing an outlet structure and planting pond edges with emergent and riparian vegetation.

NI9200 The dam of a former in-line farm pond in Great Falls Hills subivision was breached and the pond was washed out causing erosion and headcuts to the channel downstream. Repair head-cut and stabilize stream banks.

NI9500 The Beach Mill Downs subdivision is in need of stormwater controls. Intstall terraced rain garden on steep slopes near Patowmack Drive cul-de-sac and retrofit road-side swales to bioretention to improve water quality and promote infiltration.

Lower Nichol WMA Non-Structural Projects

The following non-structural project is designed to improve water quality and wildlife habitat in areas with no existing stormwater management and no opportunity for new structural stormwater controls.

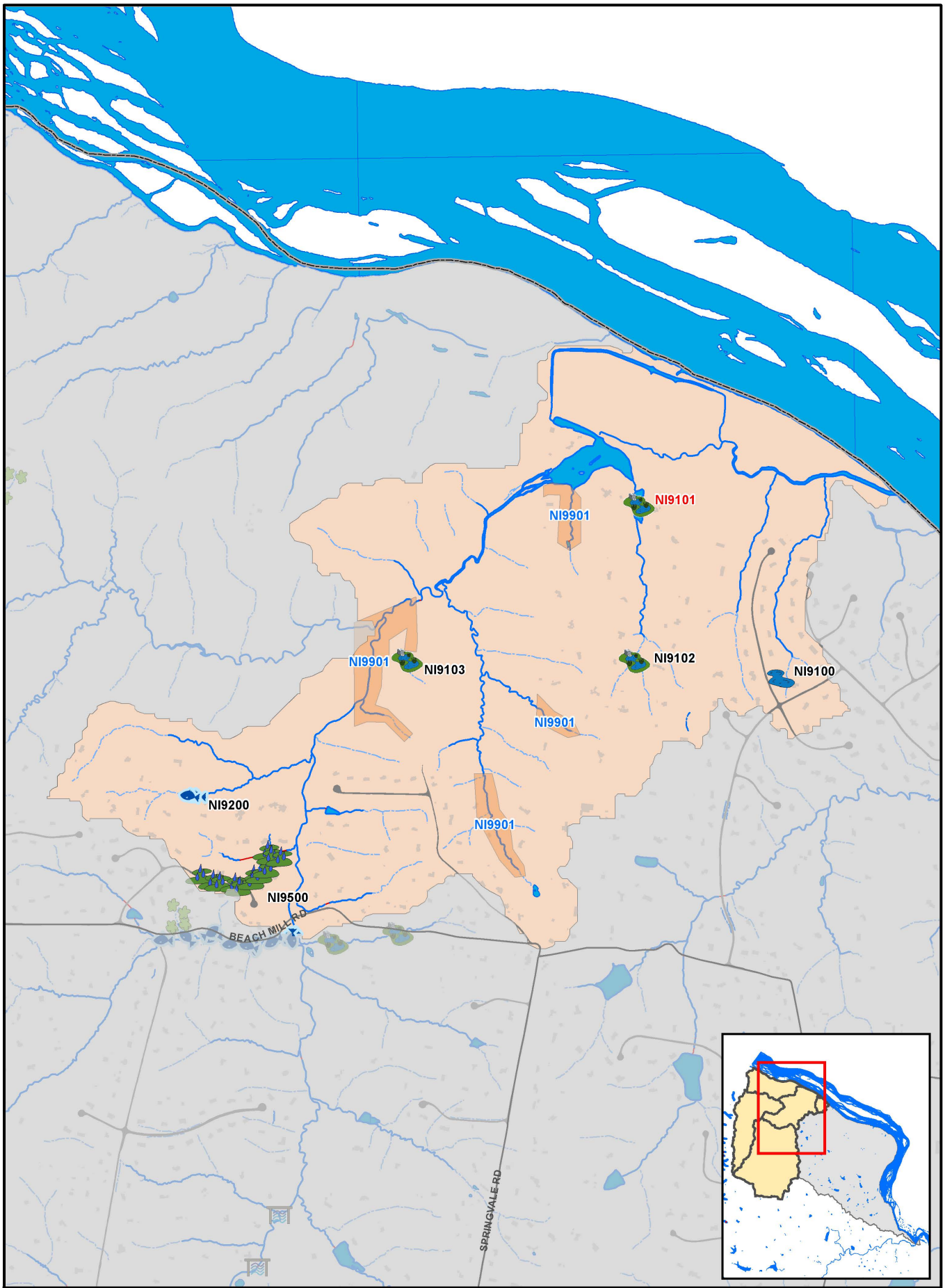
NI9901 Preserve open space and riparian buffers with conservation easement throughout lower reaches of Nichol Run.

10-Year and 25-Year Project Information Tables for Lower Nichol WMA

Table 5.2 lists all structural and non-structural projects proposed in the Lower Nichol WMA. Project locations for all structural and non-structural projects are shown on Map 5.2.

Table 5.2
Project List – Lower Nichol WMA

Structural Projects						
Project #	**Project Type**	**Subwatershed**	**Location**	**Watershed Benefit**	**Land Owner**	**Phase**
NI9101	Stormwater Pond Retrofit	NI-NI-0002	Near the end of Jefferson Run Road	Quality/ Quanity	Private	0 - 10
NI9100	New Stormwater Pond	NI-NI-0001	Near High Hill Court & Falcon Ridge Road	Quality	Private	11 - 25
NI9102	Stormwater Pond Retrofit	NI-NI-0002	Southdown Subdivision	Quality	Private	11 - 25
NI9103	Stormwater Pond Retrofit	NI-NI-0002	Near Springvale Road & Allenwood Lane	Quality/ Quanity	Private	11 - 25
NI9200	Stream Restoration	NI-NI-0004	Great Falls Hills Subdivision	Quality	Private	11 - 25
NI9500	BMP/LID	NI-NI-0004	Near Patowmack Drive cul-de-sac	Quality	County/ Private	11 - 25
Non-Structural Projects						
Project #	**Project Type**	**Subwatershed**	**Location**	**Watershed Benefit**	**Land Owner**	
NI9901	Conservation	NI-NI-0002	Riparian Areas in Lower Reaches of Nichol Run	N/ A	Private	



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Miles

Buffer Restoration
Stream Restoration
BMP/LID
Culvert Retrofit
Dumpsite/Obstruction Removal
New Stormwater Pond
Outfall Improvement
Stormwater Pond Retrofit
Other
Area-wide Drainage Improvement
Community Outreach/Public Education
Land Conservation Project
Flood Protection/Mitigation
Inspection/Enforcement Enhancement
Rain Barrel Program
Street Sweeping Program
Studies, Surveys and Assessments

Implementation timeframe denoted by project label color. Red = 0-10 years Black = 11-25 years Blue = Non-Structural.

Map 5.2

WMA: Nichol - Lower
Proposed Projects

5.1.3 Potomac (Nichol) WMA

Description of Key WMA Conditions

Approximately 82 percent of the Potomac WMA consists of undeveloped open space. The expected changes in land use show a decrease in this open space and an increase in estate residential land uses. The development of green spaces causes greater volumes of stormwater run off and more intense peak flows. Loss of open space also leads to degraded wildlife habitat, increased pollutants in stormwater runoff and worsening stream conditions.

The Potomac WMA does not contain any existing stormwater facilities, and therefore has no stormwater treatment. According to the existing condition STEPL model results, the Potomac WMA contributes approximately 20 percent of the total suspended solids, seven percent of the total nitrogen and nine percent of the total phosphorus annual loads to the Nichol Run Watershed.

There are no projects proposed in Potomac (Nichol) WMA. The majority of land area within this WMA is protected as park land.

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5.1.4 Upper Nichol WMA

Description of Key WMA Conditions

Approximately 11 percent of the Upper Nichol WMA consists of undeveloped open space. The expected changes in land use show a decrease in this open space and increases in estate residential land uses. The development of green spaces causes greater volumes of stormwater run off and more intense peak flows. Loss of open space also leads to degraded wildlife habitat, increased pollutants in stormwater runoff and worsening stream conditions.

The Upper Nichol WMA contains 11 existing stormwater facilities. Approximately 79 percent of this WMA is not treated by an existing stormwater facility. According to the existing condition STEPL model results, the Upper Nichol WMA contributes approximately 43 percent of the total suspended solids, 56 percent of the total nitrogen and 53 percent of the total phosphorus annual loads to the Nichol Run Watershed.

Upper Nichol WMA 10-Year Projects

The following structural projects are designed to reduce stormwater runoff volumes, decrease peak flows, reduce pollutants in stormwater runoff and improve overall habitat and stream quality in the Upper Nichol WMA.

NI9106 Finger Lakes Estates does not have any stormwater treatment. Improve two existing non-stormwater ponds to wet retention ponds; naturalize existing swales directing water to ponds and construct rain gardens at the swale outlets.

NI9111 Patrician Woods is in need of additional stormwater treatment. Improve existing dry pond (1412DP) to an enhanced extended detention dry pond including removal of concrete trickle ditch, introduction of wetland vegetation and new outlet structure.

NI9118 Dogwood Farm subdivision is in need of water quality treatment. Retrofit existing dry pond (0857DP) to enhanced extended detention dry pond with low marsh areas and replace concrete trickle ditches within and draining to the pond with vegetated swales.

NI9119 Falls Point and Forestville Estates are in need of additional water quality treatment. Improve existing dry pond (0797DP) to enhanced extended detention dry pond with low marsh areas. Repair eroded streambanks and restore riparian buffers upstream.

NI9201 The lower portion of Harkney Branch is trying to lengthen and is actively eroding meanders, threatening Beach Mill Road between Utterbach Store Road and its confluence with Nichol Run. Install cross vanes and J-hooks to direct stream energy away from Beach Mill Road.

NI9202 Nichol Run streambanks are eroded downstream of a culvert and driveway bridge. Install plunge pool below culvert and replace driveway bridge at 732 Springvale Road. Construct new stream channels with step pools and access to floodplain.

NI9401 Sediment is collecting upstream of a culvert on Springvale Road. Construct a micropool with outlet structure upstream of the culvert and encourage wetland vegetation growth.

Upper Nichol WMA 25-Year Projects

The following structural projects are designed to reduce stormwater runoff volumes, decrease peak flows, reduce pollutants in stormwater runoff and improve overall habitat and stream quality in the Upper Nichol WMA.

NI9104 Retrofit existing farm pond near Beach Mill Road and Springvale Road to constructed wetland with proper outlet structure, repair eroded spillway and stabilize downstream erosion impacts.

NI9105 Retrofit existing farm pond Near Beach Mill Road and Springvale Road to provide storage and water quality benefits by installing an outlet structure and planting pond edges with emergent and riparian vegetation.

NI9108 The area around Mulmary subdivision is in need of additional stormwater treatment. Construct new naturalized extended detention dry basin above culvert to provide quantity and quality stormwater controls.

NI9110 Erosive impacts are occurring on and downstream of gravel drive off of Creamcup Lane. Retrofit existing pond above drive to a micropool with outlet structure to improve quality and reduce erosion. Stabilize erosion impacts downstream and repair gravel drive.

NI9116 Retrofit existing dry pond near Woodland Falls Drive cul-de-sac with improved outlet structure for extended detention and continue to allow pond to naturalize.

NI9117 Retrofit existing dry pond near Green Branch Court and Utterback Store Road with improved outlet structure, removal of concrete channel and natural vegetation to provide additional water quality and water quantity controls.

NI9120 Retrofit existing dry pond near Farm Road and Utterback Store Road with improved outlet structure and natural vegetation to provide additional water quality and water quantity controls. Naturalize swale below pond to promote infiltration and improve water quality.

NI9400 Culvert under unnamed road off of Springvale Road is clogged and damaged. Clean out and repair or replace culvert.

NI9402 Culvert under Fawn Drive is clogged with debris and too small to properly convey water through the culvert during storm events. Increase culvert size, create engineered plunge pool at outfall and create micropool with outlet structure upstream.

NI9403 Stream is incised and culvert below unnamed road off of Utterback Store Road is too small to properly convey water throughout the culvert during storm events. Increase culvert size and install second, higher, floodplain culvert on the east side of the main culvert to help develop floodplain. Regrade stream banks above and below culvert to create a new floodplain bench.

NI9404 The area around Running Brook Estates and Beckmans Hills subdivisions is in need of additional stormwater control and improved road crossings. Install plunge pool downstream of culvert on Wolfe Hill Lane. Install micropool above culvert on Utterback Store Road. Retrofit existing farm pond to a wet retention pond with proper

outlet structure and improved vegetation to provide water quality and water quantity treatment.

NI9405 Springvale Knolls Subdivision is in need of additional water quality controls. Install rain garden at the end of the existing swale along Down Patrick Road and naturalize swale to provide water quality control and promote infiltration.

Upper Nichol WMA Non-Structural Projects

The following non-structural project is designed to improve water quality and wildlife habitat in areas with no existing stormwater management and no opportunity for new structural stormwater controls.

NI9902 Stop mowing gas line easement between Patowmack Drive & Beach Mill Road and naturalize to wildflower meadow. Preserve open space and riparian buffers with conservation easement on two headwater reaches of Nichol Run.

10-Year and 25-Year Project Information Tables for Upper Nichol WMA

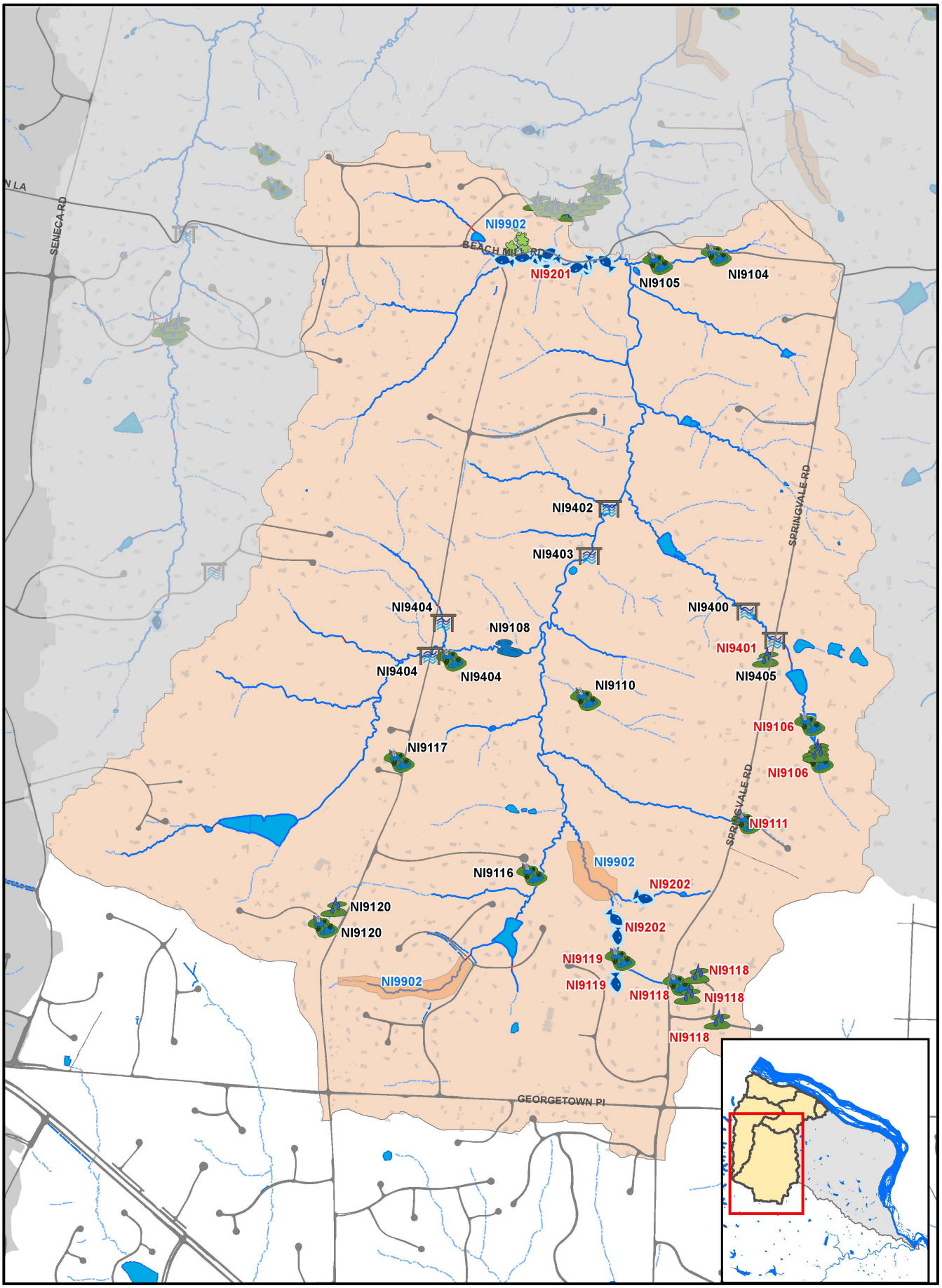
Table 5.3 lists all structural and non-structural projects proposed in the Upper Nichol WMA. Project locations for all structural and non-structural projects are shown on Map 5.3.

Table 5.3
Project List – Upper Nichol WMA

Structural Projects

Project #	Project Type	Subwatershed	Location	Watershed Benefit	Land Owner	Phase
NI9106	Stormwater Pond Retrofit, BMP/LID	NI-NI-0009	Finger Lakes Estates Subdivision	Quality/ Quanity	County/ Private	0 - 10
NI9111	Stormwater Pond Retrofit	NI-NI-0014	Patrician Woods Subdivision, Patrician Woods Court & Springvale Road	Quality/ Quanity	County	0 - 10
NI9118	Stormwater Pond Retrofit, BMP/LID	NI-NI-0015	Dogwood Farm Section 2 Subdivision	Quality/ Quanity	County/ Private	0 - 10
NI9119	Stormwater Pond Retrofit, Stream Restoration	NI-NI-0015	Near Falls Pointe Drive cul-de-sac	Quality/ Quanity	County	0 - 10
NI9201	Stream Restoration	NI-HB-0001	Woodleaf Subdivision	Quality	State/ County/ Private	0 - 10
NI9202	Stream Restoration	NI-NI-0015	Spring Valley Woods Subdivision	Quality	Private	0 - 10
NI9401	Culvert Retrofit	NI-NI-0009	Down Patrick Farms Subdivision	Quality/ Quanity	Private	0 - 10
NI9104	Stormwater Pond Retrofit	NI-NI-0005	Near Beach Mill Road & Springvale Road	Quality/ Quanity	Private	11 - 25
NI9105	Stormwater Pond Retrofit	NI-NI-0005	Near Beach Mill Road & Springvale Road	Quality/ Quanity	Private	11 - 25
NI9108	New Stormwater Pond	NI-NI-0010	Mulmary Subdivision	Quality/ Quanity	Private	11 - 25
NI9110	Stormwater Pond Retrofit	NI-NI-0013	Near Creamcup Lane cul-de-sac	Quality/ Quanity	Private	11 - 25

Table 5.3 Project List – Upper Nichol WMA						
Structural Projects						
Project #	**Project Type**	**Subwatershed**	**Location**	**Watershed Benefit**	**Land Owner**	**Phase**
NI9116	Stormwater Pond Retrofit	NI-NI-0016	Near Woodland Falls Drive cul-de-sac	Quality/ Quanity	County	11 - 25
NI9117	Stormwater Pond Retrofit	NI-NI-0013	Green Branch Court & Utterback Store Road	Quality/ Quanity	Private	11 - 25
NI9120	Stormwater Pond Retrofit, BMP/LID	NI-NI-0016	Near Farm Road & Utterback Store Road	Quality/ Quanity	County/ Private	11 - 25
NI9400	Culvert Retrofit	NI-NI-0008	Springvale Knolls Subdivision	N/ A	County/ Private	11 - 25
NI9402	Culvert Retrofit	NI-NI-0007	Martin Redmon Subdivision	Quality/ Quanity	County/ Private	11 - 25
NI9403	Culvert Retrofit	NI-NI-0007	Ross F. Rogers Subdivision	Quality	County/ Private	11 - 25
NI9404	Stormwater Pond Retrofit, Culvert Retrofit	NI-NI-0010	Near Utterback Store Road & Wolfe Hill Lane	Quality/ Quanity	County/ Private	11 - 25
NI9405	BMP/LID	NI-NI-0008	Springvale Knolls Subdivision	Quality	County/ Private	11 - 25
Non-Structural Projects						
Project #	**Project Type**	**Subwatershed**	**Location**	**Watershed Benefit**	**Land Owner**	
NI9902	Buffer Restoration, Conservation	NI-HB-0001	Gas Line Eeasement between Patowmack Drive & Beach Mill Road	N/ A	Private	



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- Buffer Restoration
- Stream Restoration
- BMP/LID
- Culvert Retrofit
- Dumpsite/Obstruction Removal
- New Stormwater Pond
- Outfall Improvement
- Stormwater Pond Retrofit
- Other

- Area-wide Drainage Improvement
- Community Outreach/Public Education
- Land Conservation Project
- Flood Protection/Mitigation
- Inspection/Enforcement Enhancement
- Rain Barrel Program
- Street Sweeping Program
- Studies, Surveys and Assessments

Implementation timeframe denoted by project label color. Red = 0-10 years Black = 11-25 years Blue = Non-Structural.

Map 5.3

WMA: Nichol - Upper
Proposed Projects

5.2 Pond Branch Watershed WMAs

Each subsection of Section 5.2 includes a description of key WMA conditions, a description of proposed structural and non-structural projects in the WMA, a listing of 10-year and 25-year projects for the WMA and a map showing the types and locations of all 10-year and 25-year projects within the WMA. Each WMA in the Pond Branch watershed is described separately in alphabetical order. Additional project details, benefits and design considerations for the projects in the 10-year implementation plan are included on the project fact sheets located in Section 5.3.

5.2.1 Clark WMA

Description of Key WMA Conditions

Approximately 13 percent of the Clark WMA consists of undeveloped open space. The expected changes in land use show a decrease in this open space and an increase in estate residential land uses. The development of green spaces causes greater volumes of stormwater run off and more intense peak flows. Loss of open space also leads to degraded wildlife habitat, increased pollutants in stormwater runoff and worsening stream conditions.

The Clark WMA contains 7 existing stormwater facilities. Approximately 88 percent of this WMA is not treated by an existing stormwater facility. According to the existing condition STEPL model results, the Clark WMA contributes approximately 28 percent of the total suspended solids, 34 percent of the total nitrogen and 34 percent of the total phosphorus annual loads to the Pond Branch Watershed.

Clark WMA 10-Year Projects

The following structural projects are designed to reduce stormwater runoff volumes, decrease peak flows, reduce pollutants in stormwater runoff and improve overall habitat and stream quality in the Clark WMA.

PN9100 Riverside Manor does not have any stormwater treatment. Install a new naturalized extended detention basin in existing depression with mature trees. Replace concrete trickle ditch and grass swale along Chesapeake Drive with vegetated swales.

PN9101 Eaton Park subdivision has no existing stormwater treatment. Install a new constructed wetland to capture drainage from Eaton Court and Eaton Park Road.

PN9102 The area around River Bend Road and Oak Falls Court has no existing stormwater treatment. Retrofit breached farm pond to a new constructed wetland. Repair earthen dam, install outlet structure and vegetate with wetland plants.

PN9103 Fitz Folly Farms is in need of additional water quality treatment. Construct enhanced extended detention dry pond in empty lot and terraced rain gardens on steeper slopes. Intercept overland flow and stabilize overland and in-stream erosion impacts.

PN9104 Golden Woods and Crampton subdivisions are in need of additional water quality treatment. Enlarge and retrofit dry pond (0649DP) to enhanced extended detention dry pond with low marsh areas. Replace concrete swale with vegetated swale and check dams.

PN9105 The Morrison Estate is in need of additional water quality treatment. Retrofit existing dry pond (0677DP) to enhanced extended detention dry pond with low marsh areas. Install rain gardens in two natural drainage areas.

PN9126 A culvert under Walker Road is collapsed or completely blocked with sediment. Replace road culvert and retrofit upstream pond to a wet retention pond to provide storage and water quality treatment for Squire's Haven subdivision.

PN9127 Riverbend Estates and Dogwood Hills are in need of water quality treatment. Retrofit two dry ponds to enhanced extended detention dry ponds. Install rain garden around existing inlet. Daylight storm sewer and install vegetated swale with check dams.

PN9400 Culvert at Potomac Forest Drive is clogging with debris and causing severe erosion downstream. Install micropool with control structure to reduce clogging upstream; install energy dissipation and stabilize stream banks downstream.

PN9408 Stream is eroded below a shared driveway culvert. Construct micropool above culvert; replace culvert and direct pipe toward new stream channel. Relocate stream channel below culvert away from steep bank; stabilize banks with boulder toe and live stakes.

Clark WMA 25-Year Projects

The following structural projects are designed to reduce stormwater runoff volumes, decrease peak flows, reduce pollutants in stormwater runoff and improve overall habitat and stream quality in the Clark WMA.

PN9125 Flooding is overtopping road. Improve existing farm pond (FM0029) to a stormwater wet pond, lower water level, install outlet structure and aeration, and improve riparian buffer. Replace culvert, raise road bed and stabilize streambanks.

PN9401 Construct micropool with outlet structure above culvert at Carrwood Road.

PN9402 Potomac Ridge Road is threatened by an inadequate culvert and resulting stream erosion. Install micropool above culvert, repair damaged culvert and repair stream erosion downstream.

PN9405 Improve culvert at Forest Brook Lane by constructing a micropool with outlet structure above culvert to provide water quality and water quantity controls.

PN9406 Streambanks are eroded downstream of the culvert. Retrofit culvert with control structure to create micro-pool. Repair and stabilize eroded streambanks. Replace concrete trickle ditches with vegetated swales with check dams.

Clark WMA Non-Structural Projects

The following non-structural projects are designed to reduce stormwater flow volume and decrease peak flows in areas with no existing stormwater management and no opportunity for new structural stormwater controls.

PN9902 Preserve open space and riparian buffers with conservation easement on lower reaches of Clarks Branch. Restore degraded riparian buffers along Clarks Branch.

PN9903 Targeted Rain Barrel and Homeowner Education Programs at the Beach Mill Farms Subdivision, Club View Ridge Subdivision, Eagon Hills Subdivision, Dogwood Hills Subdivision, Riverbend Estates Subdivision, Walker Hill Estates Subdivision, Arnon Meadow Subdivision and along Club View Drive.

10-Year and 25-Year Project Information Tables for Clark WMA

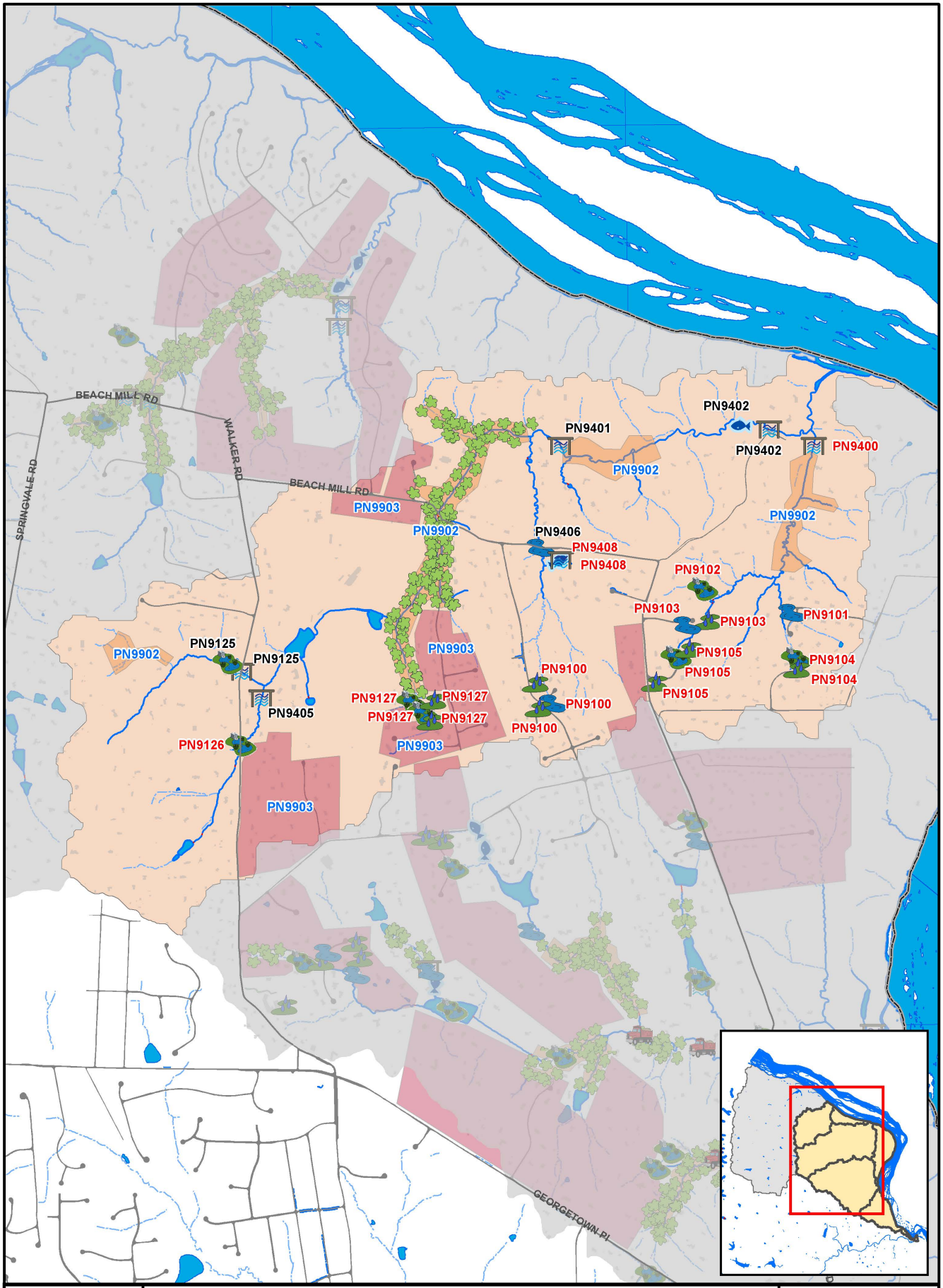
Table 5.4 lists all structural and non-structural projects proposed in the Clark WMA. Project locations for all structural and non-structural projects are shown on Map 5.4.

Table 5.4
Project List – Clark WMA

Structural Projects

Project #	Project Type	Subwatershed	Location	Watershed Benefit	Land Owner	Phase
PN9100	New Stormwater Pond, BMP/LID	PN-CL-0004	Riverside Manor Subdivision	Quality/ Quanity	State/ Private	0 - 10
PN9101	New Stormwater Pond	PN-CL-0003	Eaton Court & Eaton Park Road	Quality	Private	0 - 10
PN9102	Stormwater Pond Retrofit	PN-CL-0003	Near River Bend Road & Oak Falls Court	Quality	Private	0 - 10
PN9103	New Stormwater Pond, BMP/LID, Stream Restoration	PN-CL-0003	Fitz Folly Farms Subdivision	Quality/ Quanity	County/ Private	0 - 10
PN9104	Stormwater Pond Retrofit, BMP/LID	PN-CL-0003	Golden Woods Subdivision	Quality/ Quanity	County	0 - 10
PN9105	Stormwater Pond Retrofit, BMP/LID	PN-CL-0003	Morison Estate Subdivision	Quality/ Quanity	County/ Private	0 - 10
PN9126	Stormwater Pond Retrofit	PN-CL-0008	Squire's Haven Section 2 Subdivision	Quality/ Quanity	Private	0 - 10
PN9127	Stormwater Pond Retrofit, BMP/LID	PN-CL-0006	Eagon Hills & River Bend Estates Subdivision	Quality/ Quanity	County/ Private	0 - 10
PN9400	Culvert Retrofit	PN-CL-0002	Potomac Forest Subdivision	Quality/ Quanity	County/ Private	0 - 10
PN9408	Stream Restoration	PN-CL-0004	Fitz Folly Farms Subdivision & Riverside Manor Subdivision	Quality/ Quanity	Private	0 - 10
PN9125	Stormwater Pond Retrofit, Culvert Retrofit	PN-CL-0009	Near Walker Road & Forest Brook Lane	Quality/ Quanity	State/ Private	11 - 25
PN9401	Culvert Retrofit	PN-CL-0001	Near Carrwood Road & Bell Drive	Quality/ Quanity	County/ Private	11 - 25

Table 5.4 Project List – Clark WMA						
Structural Projects						
Project #	**Project Type**	**Subwatershed**	**Location**	**Watershed Benefit**	**Land Owner**	**Phase**
PN9402	Stream Restoration, Culvert Retrofit	PN-CL-0001	Near Potomac Ridge Road & Potomac Forest Drive	Quality/ Quanity	County/ Private	11 - 25
PN9405	Culvert Retrofit	PN-CL-0008	Near Walker Road & Forest Brook Lane	Quality/ Quanity	County/ Private	11 - 25
PN9406	New Stormwater Pond	PN-CL-0004	Riverside Manor Subdivision	Quality/ Quanity	State/ County/ Private	11 - 25
Non-Structural Projects						
Project #	**Project Type**	**Subwatershed**	**Location**	**Watershed Benefit**	**Land Owner**	
PN9902	Conservation, Buffer Restoration	PN-CL-0001/ 02/05/09	Riparian Areas along Lower Reaches of Clarks Branch	Quality/ Quanity	Private	
PN9903	Rain Barrel Program	PN-CL-0005/ 06/08	Club View Ridge, Beach Mill Farms, Eagon Hills, Dogwood Hills, Riverbend Estates, Walker Hill Estates, & Arnon Meadow Subdivisions	Quality	Private	



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Buffer Restoration
Stream Restoration
BMP/LID
Culvert Retrofit
Dumpsite/Obstruction Removal
New Stormwater Pond
Outfall Improvement
Stormwater Pond Retrofit
Other

Area-wide Drainage Improvement
Community Outreach/Public Education
Land Conservation Project
Flood Protection/Mitigation
Inspection/Enforcement Enhancement
Rain Barrel Program
Street Sweeping Program
Studies, Surveys and Assessments

Implementation timeframe denoted by project label color. Red = 0-10 years Black = 11-25 years Blue = Non-Structural.

Map 5.4

WMA: Pond - Clark
Proposed Projects

5.2.2 Mine Run WMA

Description of Key WMA Conditions

Approximately 18 percent of the Mine Run WMA consists of undeveloped open space. The expected changes in land use show a decrease in this open space and an increase in estate residential land uses. The development of green spaces causes greater volumes of stormwater run off and more intense peak flows. Loss of open space also leads to degraded wildlife habitat, increased pollutants in stormwater runoff and worsening stream conditions.

The Mine Run WMA contains 11 existing stormwater facilities. Approximately 96 percent of this WMA is not treated by an existing stormwater facility. According to the existing condition STEPL model results, the Mine Run WMA contributes approximately 26 percent of the total suspended solids, 34 percent of the total nitrogen and 32 percent of the total phosphorus annual loads to the Pond Branch Watershed.

Mine Run WMA 10-Year Projects

The following structural projects are designed to reduce stormwater runoff volumes, decrease peak flows, reduce pollutants in stormwater runoff, and improve overall habitat and stream quality in the Mine Run WMA.

PN9108 The area near the northern Deerfield Court cul-de-sac is in need of additional water quality treatment. Construct new enhanced extended detention dry pond. Replace rip-rap swale with vegetated infiltration trench and check dams and install a new rain garden upstream of driveway culvert.

PN9109 Retrofit an existing non-stormwater pond in Deerfield Pond Subdivision to wet retention pond with increased storage. Improve wetland vegetation above road culvert and add outlet structure to create a new constructed wetland. Install a rain garden around existing inlet on corner.

PN9110 Install a bioretention area behind the Great Falls Elementary School, along the lower end of the basketball courts. Install educational signage and institute educational programs.

PN9111 Retrofit existing non-stormwater wet pond (WP0209) located in the Marmota Farm Subdivision to wet retention pond by installing proper outlet structure, constructing sediment forebay in western inlet and lowering water level slightly to provide storage. Repair stream erosion above pond. Install a micropool upstream of road culvert and a constructed wetland below culvert.

PN9112 The area around the Rossmore Court cul-de-sac does not have existing stormwater treatment. Retrofit existing farm pond to a wet retention pond and enlarge pond for additional storage capacity. Restore riparian buffer around pond and upstream.

PN9113 Arnon Lake Subdivision does not have existing stormwater treatment. Install a new constructed wetland in a low clearing within the forested area adjacent to a private driveway.

PN9114 The Arnon Ridge area is in need of additional water quality treatment. Retrofit naturalized dry pond (0182DP) to enhanced extended detention dry pond by installing

outlet structure. Replace concrete and grass swales with vegetated swales and check dams.

PN9117 Expand existing dry pond (0303DP) to intercept drainage from Monalaine Court; retrofit to naturalized extended detention dry pond. Construct new naturalized extended detention basin in existing depression near Lagovista Ct. and daylight stormwater pipe from Riverbend Road.

PN9118 Retrofit existing farm pond (FM0002) near River Bend Road & Hidden Springs Road to wet retention pond; install outlet structure and lower water level for additional storage. Repair and stabilize erosion impacts to spillway and downstream channel and culvert at River Bend Road.

PN9119 Fallswood subdivision is in need of additional water quality treatment. Retrofit existing dry pond (1443DP) to naturalized extended detention dry pond with a new outlet structure and naturalized vegetation.

PN9120 This area of Cornwell Farm subdivision does not have existing stormwater treatment. Retrofit two existing ponds to wet retention ponds; install outlet structures and lower water levels for additional storage, plant emergent and riparian vegetation.

PN9122 Streambanks of the Mine Run Branch in the Jackson Hills Subdivision are incised and undercut. Re-grade and stabilize erosion impacts upstream of Riverbend Road. Retrofit nearby farm pond to wet retention pond to provide storage and water quality treatment for homes along Riverbend Road.

PN9124 This area of Jackson Hills does not have existing stormwater treatment. Retrofit existing pond to a wet retention pond; install outlet structure and lower the water level for additional storage, and plant emergent and riparian vegetation.

PN9200 A tributary of the Mine Run Branch in the Arnon Lake Subdivision is lengthening and eroding meanders. Re-construct stream channel to start meander below Arnon Chapel Road and lengthen stream more evenly to reduce potential for erosion at downstream tight meanders and sediment deposition in the downstream pond.

Mine Run WMA 25-Year Projects

The following structural projects are designed to reduce stormwater runoff volumes, decrease peak flows, reduce pollutants in stormwater runoff, and improve overall habitat and stream quality in the Mine Run WMA.

PN9121 Improve existing farm pond (FM0009) to stormwater wet pond, install outlet structure, lower water level, install aeration, and encourage wetland growth. Improve existing farm pond to constructed wetland, install outlet structure and wetland vegetation.

PN9404 Culvert at Old Dominion Drive is too small to properly convey stormwater flows. Increase culvert size and repair stream erosion above and below culvert using instream structures to direct the stream energy away from streambanks.

Mine Run WMA Non-Structural Projects

The following non-structural projects are designed to reduce stormwater flow volume and decrease peak flows in areas with no existing stormwater management and no opportunity for new structural stormwater controls.

PN9904 Preserve open space and riparian buffers with conservation easement along headwater reaches of Mine Run Branch. Restore degraded riparian buffers along Mine Run Branch throughout Mine Run watershed.

PN9905 Targeted Rain Barrel and Homeowner Education Programs at the Jackson Hills Subdivision, Cornwell Farm Subdivision, Weant Subdivision, Washington Great Falls Survey Subdivision, Great Falls Estates Sec. 2 Subdivision, Maria Avenue Subdivision, Deer Park Subdivision, Riverside Meadows Subdivision, Laylin Family Trust, Arnon Ridge Subdivision, Chamborley subdivision, John W. Hanes Jr. Gunnell Run Farm, Deerfield Pond Subdivision and Deerfield Farm Subdivision.
Educate homeowners regarding riparian buffers and landscaping in headwaters areas at the John W. Hanes Jr. Gunnell Run Farm, Deerfield Pond, and Deerfield Farm Subdivisions.

PN9906 Remove obstructions at SPA points PNMR5-2-O5, PNMR5-2-O8 to O10 and PNMR004-T002 in the Cornwell Farm Subdivision.

10-Year and 25-Year Project Information Tables for Mine Run WMA

Table 5.5 lists all structural and non-structural projects proposed in the Mine Run WMA. Project locations for all structural and non-structural projects are shown on Map 5.5.

Table 5.5
Project List – Mine Run WMA

Structural Projects

Project #	Project Type	Subwatershed	Location	Watershed Benefit	Land Owner	Phase
PN9108	New Stormwater Pond, BMP/LID	PN-MR-0008	Near northern Deerfield Court cul-de-sac	Quality/ Quanity	County/ Private	0 - 10
PN9109	New Stormwater Pond, Stormwater Pond Retrofit, BMP/LID	PN-MR-0008	Deerfield Pond Subdivision	Quality/ Quanity	County/ Private	0 - 10
PN9110	BMP/LID, Education	PN-MR-0008	Great Falls Elementary School	Quality	County	0 - 10
PN9111	New Stormwater Pond, Stormwater Pond Retrofit, Culvert Retrofit, Stream Restoration	PN-MR-0008	Marmota Farm Subdivision	Quality/ Quanity	Private	0 - 10
PN9112	Stormwater Pond Retrofit	PN-MR-0007	Near Rossmore Court cul-de-sac	Quality/ Quanity	Private	0 - 10
PN9113	New Stormwater Pond	PN-MR-0006	Arnon Lake Subdivision	Quality	Private	0 - 10
PN9114	Stormwater Pond Retrofit, BMP/LID	PN-MR-0006	Arnon Ridge Subdivision	Quality/ Quanity	County/ Private	0 - 10
PN9117	New Stormwater Pond, Stormwater Pond Retrofit	PN-MR-0005	Monalaine Court & River Bend Road	Quality/ Quanity	County/ Private	0 - 10

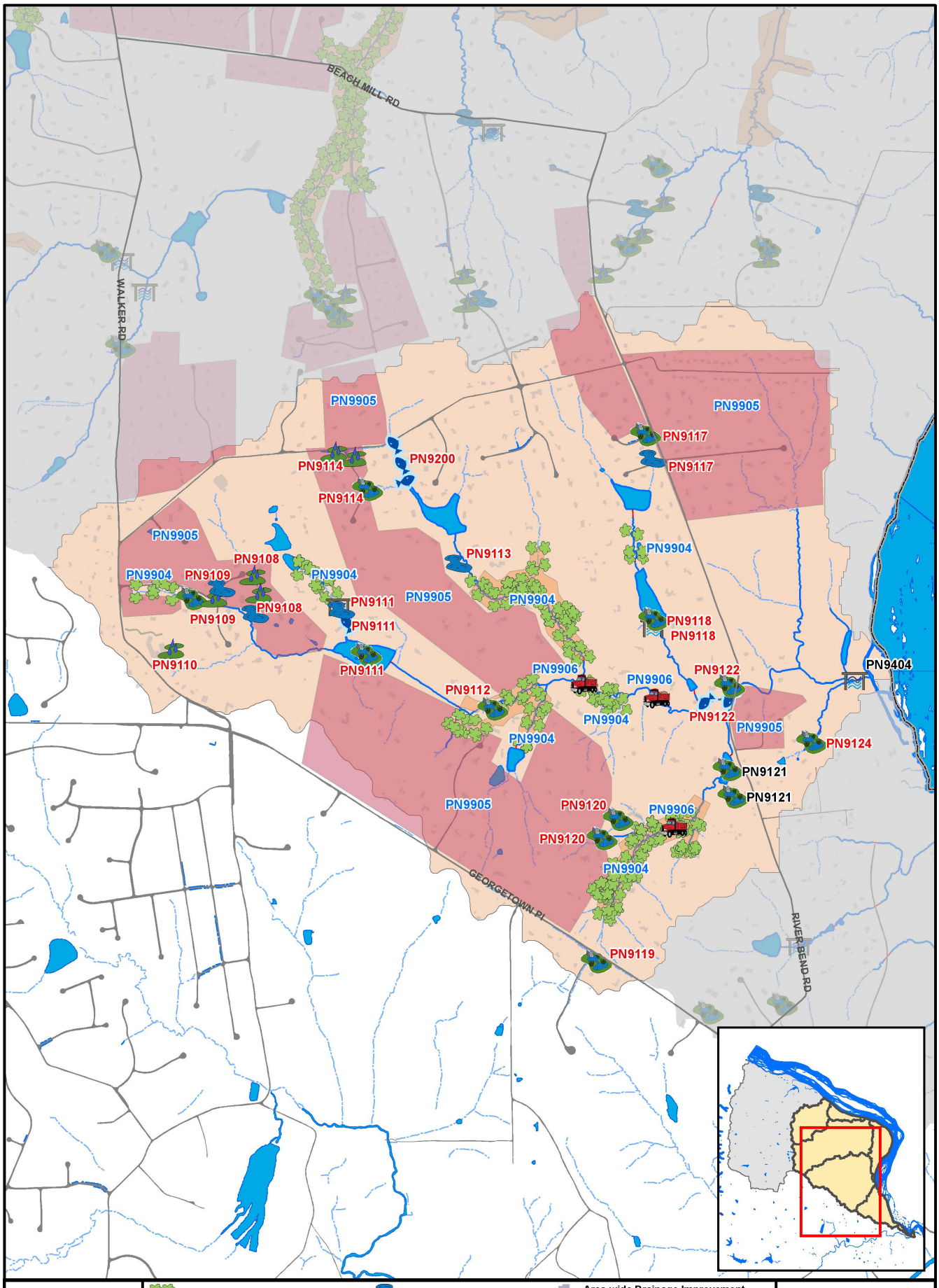
Table 5.5
Project List – Mine Run WMA

Structural Projects

Project #	Project Type	Subwatershed	Location	Watershed Benefit	Land Owner	Phase
PN9118	Stormwater Pond Retrofit, Culvert Retrofit	PN-MR-0005	Near River Bend Road & Hidden Springs Road	Quality/ Quanity	Private	0 - 10
PN9119	Stormwater Pond Retrofit	PN-MR-0004	Fallswood Subdivision	Quality/ Quanity	Private	0 - 10
PN9120	Stormwater Pond Retrofit	PN-MR-0004	Cornwell Farm Subdivision	Quality/ Quanity	Private	0 - 10
PN9122	Stormwater Pond Retrofit, Stream Restoration	PN-MR-0003	Jackson Hills Subdivision	Quality/ Quanity	Private	0 - 10
PN9124	Stormwater Pond Retrofit	PN-MR-0001	Jackson Hills Subdivision	Quality/ Quanity	Private	0 - 10
PN9200	Stream Restoration	PN-MR-0006	Arnon Lake Subdivision	Quality	Private	0 - 10
PN9121	Stormwater Pond Retrofit	PN-MR-0004	Jackson Hills Subdivision	Quality/ Quanity	Private	11 - 25
PN9404	Culvert Retrofit	PN-MR-0001	Great Falls Park	Quality	Federal	11 - 25

Non-Structural Projects

Project #	Project Type	Subwatershed	Location	Watershed Benefit	Land Owner
PN9904	Conservation, Buffer Restoration	PN-MR-0003/ 04/05/06/07/08	Riparian Areas along Headwaters of Mine Run Branch	Quality/ Quanity	County/ Private
PN9905	Rain Barrel Program	PN-MR-0001/ 02/03/04/05/ 06/07/08	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	PN-MR-0003/04	Cornwell Farm Subdivision	N/ A	County/ Private


BEACH MILL RD
WALKER RD
GEORGETOWN PI
RIVER BEND RD
PN9905
PN9114
PN9200
PN9114
PN9905
PN9108
PN9904
PN9109
PN9904
PN9108
PN9109
PN9111
PN9905
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PN9112
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PN9122
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PN9904
PN9904
PN9905
PN9404
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PN9121
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PN9904
PN9119
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0.25
Miles
N
Buffer Restoration
Stream Restoration
BMP/LID
Culvert Retrofit
Dumpsite/Obstruction Removal
New Stormwater Pond
Outfall Improvement
Stormwater Pond Retrofit
Other
Area-wide Drainage Improvement
Community Outreach/Public Education
Land Conservation Project
Flood Protection/Mitigation
Inspection/Enforcement Enhancement
Rain Barrel Program
Street Sweeping Program
Studies, Surveys and Assessments
Implementation timeframe denoted by project label color. Red = 0-10 years Black = 11-25 years
Blue = Non-Structural.
Map 5.5
WMA: Pond - Mine Run
Proposed Projects

5.2.3 Pond WMA

Description of Key WMA Conditions

Approximately 12 percent of the Pond WMA consists of undeveloped open space. The expected changes in land use show a decrease in this open space and an increase in estate residential land uses. The development of green spaces causes greater volumes of stormwater run off and more intense peak flows. Loss of open space also leads to degraded wildlife habitat, increased pollutants in stormwater runoff and worsening stream conditions.

The Pond WMA contains 2 existing stormwater facilities. Approximately 97 percent of this WMA is not treated by an existing stormwater facility. According to the existing condition STEPL model results, the Pond WMA contributes approximately 12 percent of the total suspended solids, 17 percent of the total nitrogen and 16 percent of the total phosphorus annual loads to the Pond Branch Watershed.

Pond WMA 10-Year Projects

The following structural projects are designed to reduce stormwater runoff volumes, decrease peak flows, reduce pollutants in stormwater runoff, and improve overall habitat and stream quality in the Pond WMA.

PN9116 Flooding is overtopping Beach Mill Road near Springvale Road and causing erosion at two road culverts. Install outlet structure in wet pond (WP0202) to provide storage. Raise the road bed, install larger culverts, and stabilize streambanks above and below the culverts.

PN9123 This area of Southdown Farm Subdivision does not have existing stormwater treatment. Retrofit an existing pond to a wet retention pond; install outlet structure and lower the water level for additional storage, and plant emergent and riparian vegetation.

PN9201 High energy stormflows and obstructions have caused severe erosion and washed out a pedestrian bridge near River Park Drive in the Riverbend Knolls Subdivision. Replace bridge; stabilize banks; install step pools and instream structures to dissipate energy and direct energy away from banks.

Pond WMA 25-Year Projects

The following structural project is designed to reduce stormwater runoff volumes, decrease peak flows, reduce pollutants in stormwater runoff, and improve overall habitat and stream quality in the Pond WMA.

PN9407 Driveway culvert to 198 River Park Drive is undersized; replace culvert with bridge to allow proper conveyance of stormwater flows and reduce liklihood of clogging with debris. Stormwater behind 180 River Park Drive is bypassing blocked/damaged stormwater culvert; replace culvert, re-direct stormwater into culvert and repair damage to gravel road.

Pond WMA Non-Structural Projects

The following non-structural projects are designed to reduce stormwater flow volume and decrease peak flows in areas with no existing stormwater management and no opportunity for new structural stormwater controls.

PN9900 Preserve open space and riparian buffers with conservation easement along headwater reaches of Pond Branch. Restore degraded riparian buffers along Pond Branch.

PN9901 Targeted Rain Barrel Program at the Deepwoods Hollow Subdivision, Riverbend Knolls Subdivision, Riverbend Farms Subdivision, Merryelle Acres Subdivision, Falcon Ridge Subdivision and adjacent to Beach Mill Road.

10-Year and 25-Year Project Information Tables for Pond WMA

Table 5.6 lists all structural and non-structural projects proposed in the Pond WMA. Project locations for all structural and non-structural projects are shown on Map 5.6.

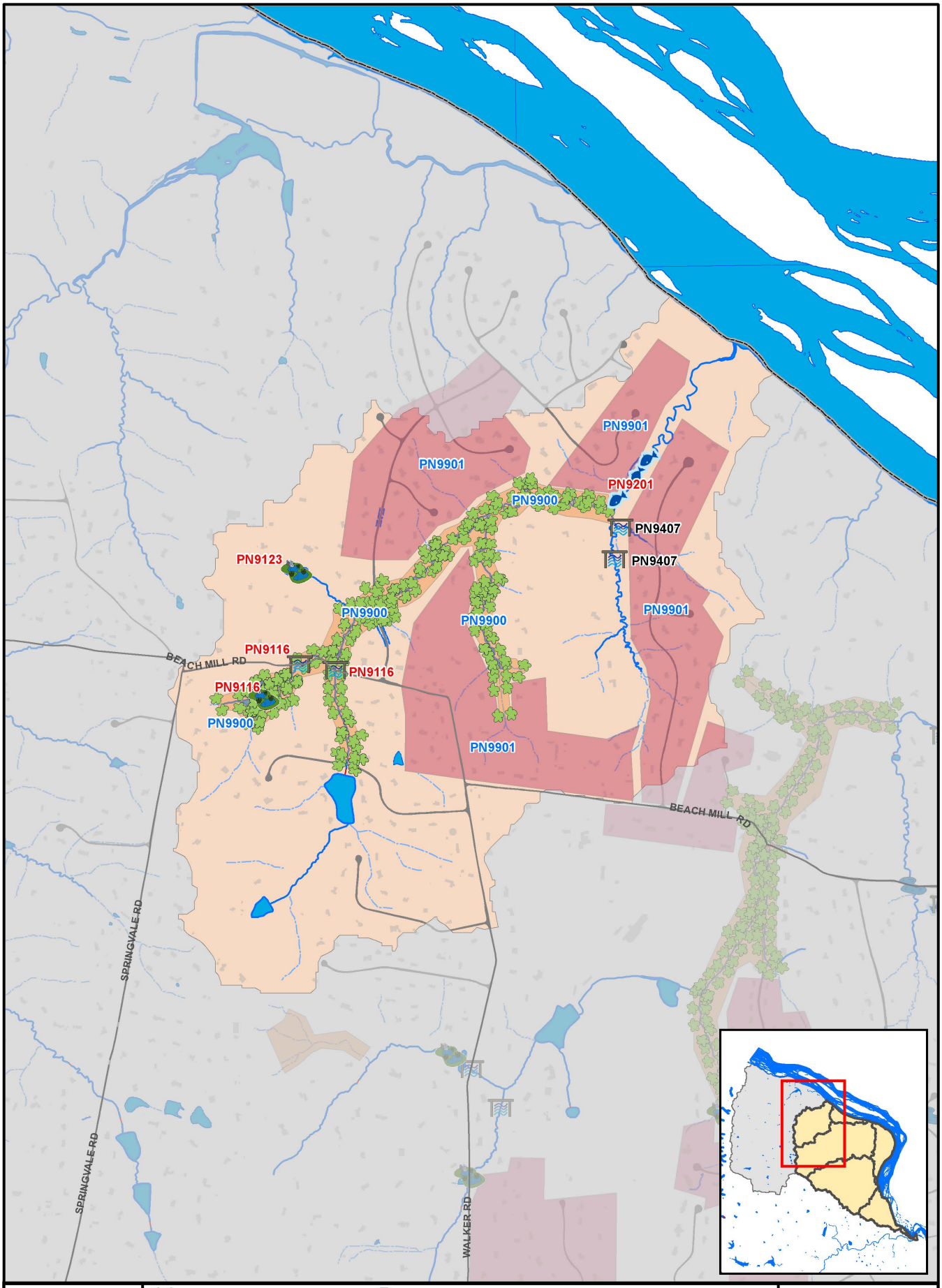
Table 5.6
Project List – Pond WMA

Structural Projects

Project #	Project Type	Subwatershed	Location	Watershed Benefit	Land Owner	Phase
PN9116	Stormwater Pond Retrofit, Culvert Retrofit	PN-PN-0004	Near Beach Mill Road & Springvale Road	Quality/ Quanity	County/ Private	0 - 10
PN9123	Stormwater Pond Retrofit	PN-PN-0003	Near Bliss Lane & Commonage Drive	Quality/ Quanity	Private	0 - 10
PN9201	Stream Restoration	PN-PN-0001	Riverbend Knolls Subdivision	Quality	County/ Private	0 - 10
PN9407	Culvert Retrofit	PN-PN-0002	Near River Park Drive & River Park Lane	N/ A	County/ Private	11 - 25

Non-Structural Projects

Project #	Project Type	Subwatershed	Location	Watershed Benefit	Land Owner
PN9900	Conservation, Buffer Restoration	PN-PN-0004	Riparian Areas along Headwaters of Pond Branch	Quality/ Quanity	Private
PN9901	Rain Barrel Program	PN-PN-0001	Deepwoods Hollow, Riverbend Knolls, Riverbend Farm, Riverbend Farm Sec. 1, Merryelle Acres, Rector, & Falcon Ridge Subdivisions	Quality	Private



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0 0.125 0.25

Miles

- Buffer Restoration
- Stream Restoration
- BMP/LID
- Culvert Retrofit
- Dumpsite/Obstruction Removal
- New Stormwater Pond
- Outfall Improvement
- Stormwater Pond Retrofit
- Other
- Area-wide Drainage Improvement
- Community Outreach/Public Education
- Land Conservation Project
- Flood Protection/Mitigation
- Inspection/Enforcement Enhancement
- Rain Barrel Program
- Street Sweeping Program
- Studies, Surveys and Assessments

Implementation timeframe denoted by project label color. Red = 0-10 years Black = 11-25 years Blue = Non-Structural.

Map 5.6

WMA: Pond Branch
Proposed Projects

5.2.4 Potomac (Pond) WMA

Description of Key WMA Conditions

Approximately 78 percent of the Potomac WMA consists of undeveloped open space. The expected changes in land use show a decrease in this open space and an increase in estate residential land uses. The development of green spaces causes greater volumes of stormwater run off and more intense peak flows. Loss of open space also leads to degraded wildlife habitat, increased pollutants in stormwater runoff and worsening stream conditions.

The Potomac WMA contains 2 existing stormwater facilities. Approximately 97 percent of this WMA is not treated by an existing stormwater facility. According to the existing condition STEPL model results, the Potomac WMA contributes approximately 33 percent of the total suspended solids, 15 percent of the total nitrogen and 18 percent of the total phosphorus annual loads to the Pond Branch Watershed.

Potomac WMA 10-Year Projects

There are no 10-year structural projects proposed in the Potomac WMA.

Potomac WMA 25-Year Projects

The following structural projects are designed to reduce stormwater runoff volumes, decrease peak flows, reduce pollutants in stormwater runoff, and improve overall habitat and stream quality in the Potomac WMA.

PN9106 Retrofit dry pond 1197DP to naturalized extended detention dry pond with naturalized basin bottom and improved outlet structure to provide additional water quality and water quantity control.

PN9107 Retrofit Dry Pond DP0245 to extended detention dry pond. Retrofit outlet structure for extended detention, construct berm on south corner for additional capacity, and naturalize basin bottom with aesthetic meadow plants.

PN9403 Culvert at Riverbend Road is too small to properly convey stormwater flows. Raise road bed above flood level, increase culvert size and install micropool with outlet structure above culvert to provide additional stormwater control.

Potomac WMA Non-Structural Projects

There are no non-structural projects proposed in the Potomac WMA.

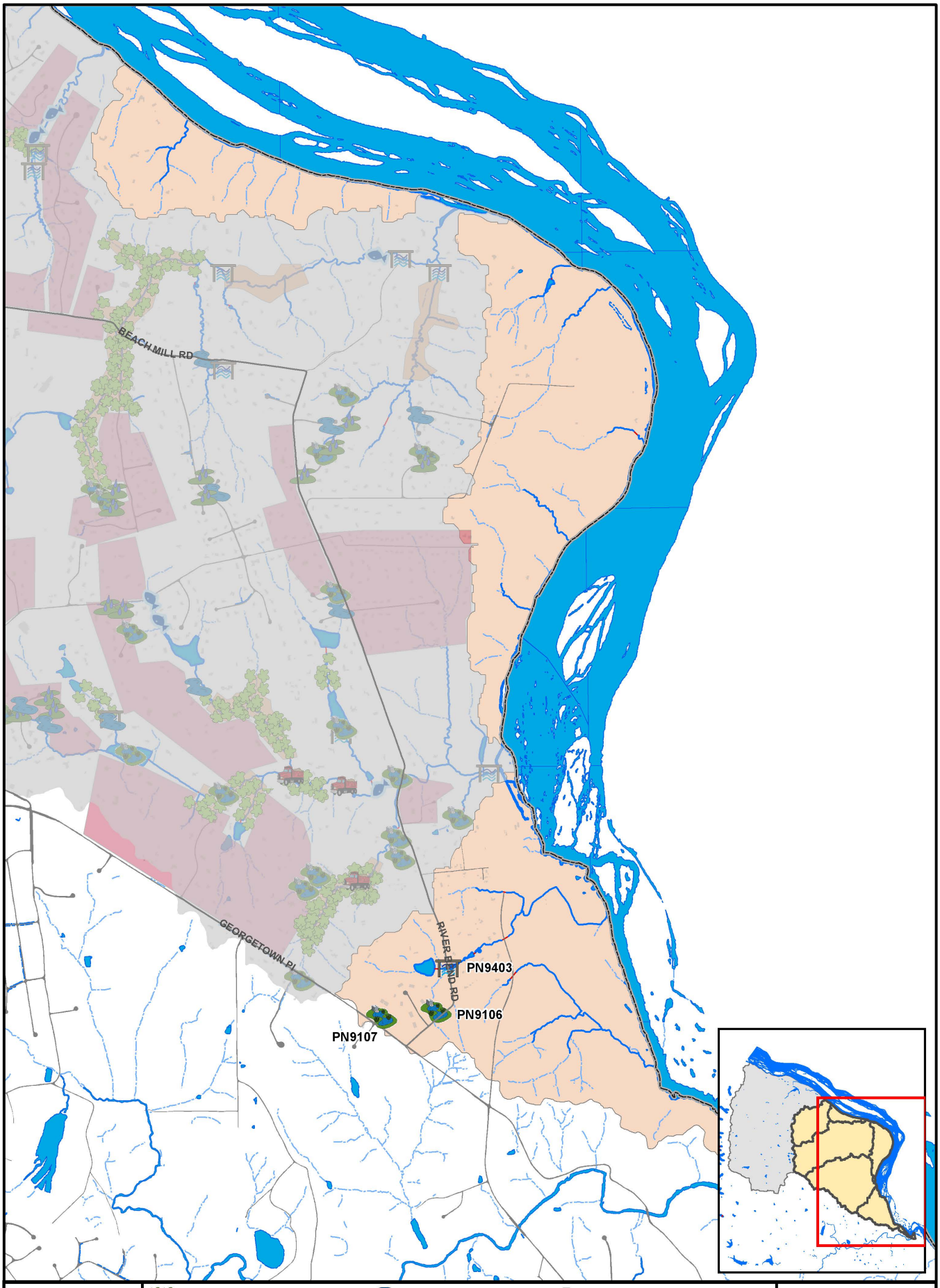
10-Year and 25-Year Project Information Tables for Potomac WMA

Table 5.7 lists all structural and non-structural projects proposed in the Potomac WMA. Project locations for all structural and non-structural projects are shown on Map 5.7.

Table 5.7
Project List – Potomac WMA

Structural Projects

Project #	Project Type	Subwatershed	Location	Watershed Benefit	Land Owner	Phase
PN9106	Stormwater Pond Retrofit	PN-PO-0006	Riverbend Subdivision	Quality/ Quanity	County	11 - 25
PN9107	Stormwater Pond Retrofit	PN-PO-0006	St. Francis Episcopal Church	Quality/ Quanity	County	11 - 25
PN9403	Culvert Retrofit	PN-PO-0005	Great Falls Heights Subdivision	Quality/ Quanity	County/ Private	11 - 25



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Miles

Buffer Restoration
Stream Restoration
BMP/LID
Culvert Retrofit
Dumpsite/Obstruction Removal

New Stormwater Pond
Outfall Improvement
Stormwater Pond Retrofit
Other

Area-wide Drainage Improvement
Community Outreach/Public Education
Land Conservation Project
Flood Protection/Mitigation
Inspection/Enforcement Enhancement
Rain Barrel Program
Street Sweeping Program
Studies, Surveys and Assessments

Implementation timeframe denoted by project label color. Red = 0-10 years Black = 11-25 years Blue = Non-Structural.

Map 5.7

WMA: Pond - Potomac
Proposed Projects

5.3 Project Fact Sheets

Project fact sheets for the 36 top ranked 10-year projects are provided in this section. Each fact sheet includes the following information:

- Project number
- Project location map and address
- Land owner
- Parcel ID numbers
- Stormwater control type
- Drainage area
- Receiving waters
- Project description
- Project area map showing proposed projects
- Project benefits
- Project design considerations
- Project costs

Fact sheets are organized numerically with Nichol Run watershed projects listed before Pond Branch watershed projects.

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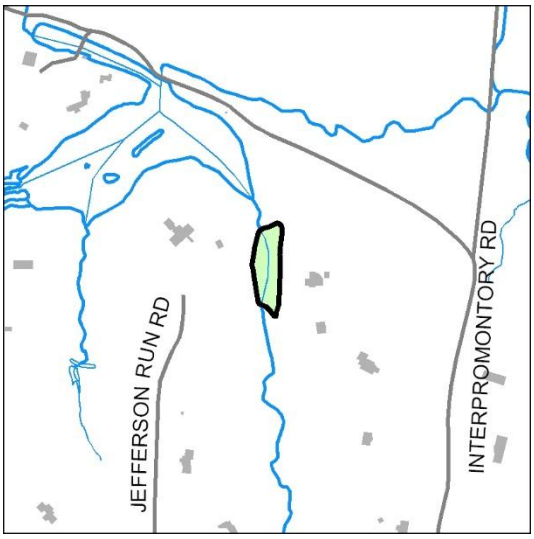
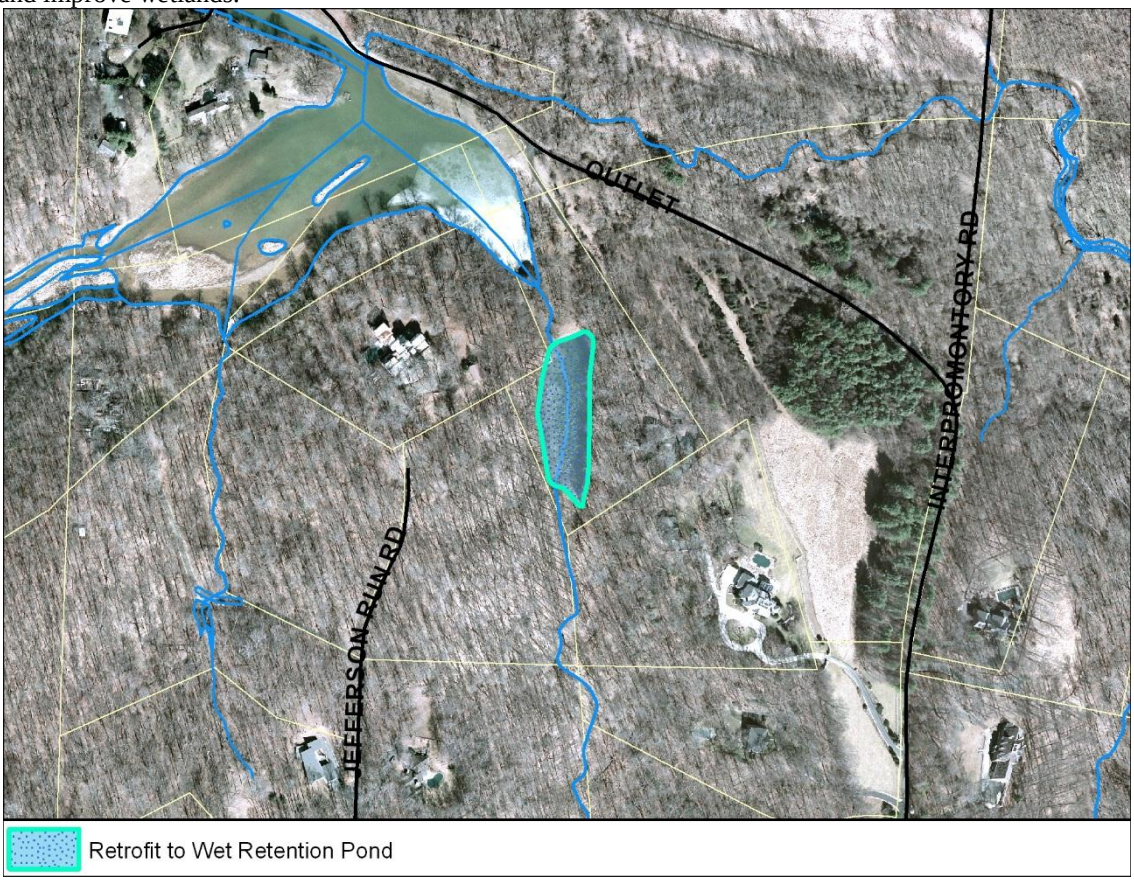
NI9101 Stormwater Pond Retrofit



Address:	5 Jefferson Run Road
Location:	Near the end of Jefferson Run Road
Land Owner:	Private
PIN:	0032 02 0003G
Control Type	Quality/Quanity
Drainage Area	66.2 acres
Receiving Waters	Nichol Run

Description: This area does not have existing stormwater treatment or controls. Improve existing wet pond (WP0200) by installing an outlet structure to increase capacity. Repair overflow spillway to prevent breach, vegetate sides of the pond and improve wetlands.



Project Area Map

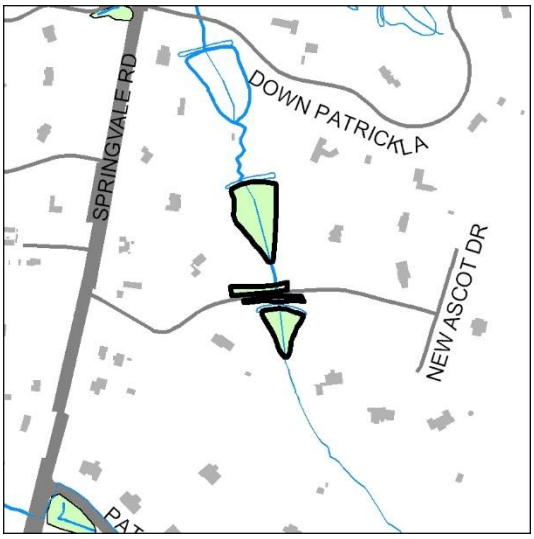
Project Benefits: This project will reduce sediment and nutrient loadings, improve water quality in downstream waterbodies, increase storage volume, reduce peak stormwater flows up to the 10-year event, and provide for evapotranspiration and wildlife habitat. This project will also repair the damaged spillway. An estimated 2,881 lbs/yr of total suspended solids, 34 lbs/yr of nitrogen, and 8 lbs/yr of phosphorus will be removed.

Project Design Considerations: Minimal environmental permitting requirements are anticipated. Additional permitting may be required for a project within a stream or wetland. A dam safety permit may be necessary. Projects in RPAs may require exceptions or waivers. This is a privately owned pond, and will require a storm drainage easement. Accessibility is good from a nearby ingress-egress easement on park lands and the walking trail. There are no tree impacts or significant construction issues anticipated.

Costs:

Item	*Units*	*Quantity*	*Unit Cost*	*Total*
Organic Compost Soil Amendment	CY	40	$40.00	$1,600.00
Plantings	AC	0.1	$25,000.00	$2,500.00
Clear and Grub	AC	0.1	$8,500.00	$850.00
Grading and Excavation	CY	100	$35.00	$3,500.00
Embankment	CY	200	$50.00	$10,000.00
Outflow Pipe	LF	30	$125.00	$3,750.00
RipRap Stabilization	SY	15	$100.00	$1,500.00
Structural BMP Retrofit and Incidentals (Med)	LS	1	$15,000.00	$15,000.00
			Initial Project Costs	**$38,700.00**
Plantings: 5% of project costs (unless incl. as line item)				$0.00
Ancillary Items: 5% of project cost				$1,935.00
Erosion and Sediment Control: 10% of project costs				$3,870.00
			Base Construction Costs	**$44,505.00**
			Mobilization (5%)	$2,225.25
			Subtotal 1	**$46,730.25**
			Contingency (25%)	$11,682.56
			Subtotal 2	**$58,412.81**
			Engineering Design, Surveys, Land Acquisition, Utility Relocation and Permits (45%)	$26,285.77
			Total Costs	**$84,698.58**
			Estimated Project Costs	***$90,000.00***

NI9106 Stormwater Pond Retrofit, BMP/LID



Address:	10440 New Ascot Drive
Location:	Finger Lakes Estates Subdivision
Land Owner:	County/Private
PIN:	0032 02 0003G
Control Type	Quality/Quanity
Drainage Area	73.31 acres
Receiving Waters	Nichol Run

Description: Finger Lakes Estates does not have any stormwater treatment. Improve two existing non-stormwater ponds to wet retention ponds, naturalize existing swales directing water to ponds and construct rain garden at the southern swale outlet.

Project Area Map

Project Benefits: This project will reduce sediment and nutrient loadings, improve water quality in downstream waterbodies, increase storage volume, reduce peak stormwater flows up to the 10-year event, and provide for evapotranspiration and wildlife habitat. In addition, the rain garden will also reduce stormwater runoff volumes by promoting infiltration. An estimated 1,916 lbs/yr of total suspended solids, 23 lbs/yr of nitrogen, and 6 lbs/yr of phosphorus will be removed.

Project Design Considerations: Minimal environmental permitting requirements are anticipated. Additional permitting may be required for a project within a stream or wetland. Projects in RPAs may require exceptions or waivers. The proposed vegetated swales are located within or along an ingress-egress easement. The ponds are privately owned by multiple owners. Storm drainage easements will be necessary. Accessibility is excellent from New Ascot Drive. There are no tree impacts or significant construction issues anticipated.

Costs:

Item	*Units*	*Quantity*	*Unit Cost*	*Total*
Vegetated Swale	SY	130	$50.00	$6,500.00
Bioretention Filters & Basin	SY	275	$150.00	$41,250.00
Organic Compost Soil Amendment	CY	130	$40.00	$5,200.00
Plantings	AC	0.2	$25,000.00	$5,000.00
Clear and Grub	AC	0.2	$8,500.00	$1,700.00
Grading and Excavation	CY	150	$35.00	$5,250.00
Embankment	CY	250	$50.00	$12,500.00
Outflow Pipe	LF	50	$125.00	$6,250.00
RipRap Stabilization	SY	35	$100.00	$3,500.00
Structural BMP Retrofit and Incidentals (Med)	LS	2	$15,000.00	$30,000.00
			Initial Project Costs	**$117,150.00**
Plantings: 5% of project costs (unless incl. as line item)				$0.00
Ancillary Items: 5% of project cost				$5,857.50
Erosion and Sediment Control: 10% of project costs				$11,715.00
			Base Construction Costs	**$134,722.50**
			Mobilization (5%)	$6,736.13
			Subtotal 1	**$141,458.63**
			Contingency (25%)	$35,364.66
			Subtotal 2	**$176,823.28**
			Engineering Design, Surveys, Land Acquisition, Utility Relocation and Permits (45%)	$79,570.48
			Total Costs	**$256,393.76**
			Estimated Project Costs	***$260,000.00***

NI9111 Stormwater Pond Retrofit

Address:	10507 Patrician Woods Court
Location:	Patrician Woods Subdivision, Patrician Woods Court & Springvale Road
Land Owner:	County
PIN:	0074 17 A, VDOT
Control Type	Quality/Quanity
Drainage Area	29.44 acres
Receiving Waters	Nichol Run

Description: Patrician Woods is in need of additional stormwater treatment. Improve existing dry pond (1412DP) to an enhanced extended detention dry pond including removal of concrete trickle ditch, introduction of wetland vegetation and new outlet structure.

Project Area Map

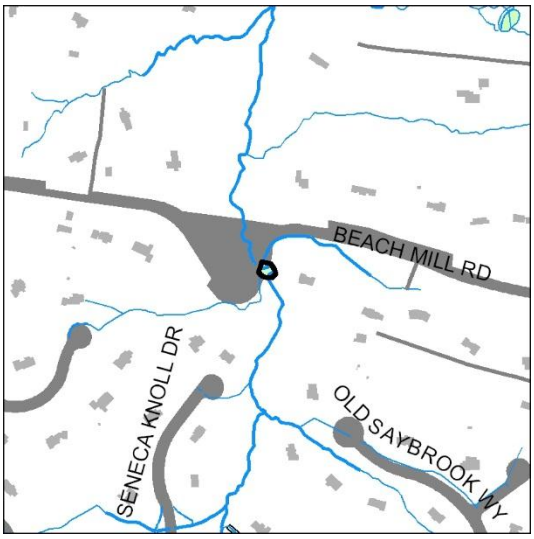
Project Benefits: This project will improve water quality by reducing sediment and nutrient loadings, reduce peak stormwater flows for storms up to the 10-year event, and provide for evapotranspiration and wildlife habitat. In addition, the new outlet structure will allow for a more controlled stormwater discharge to enhance the performance of the pond. Removal of the trickle ditch will reduce stormwater velocities. An estimated 1,141 lbs/yr of total suspended solids, 13 lbs/yr of nitrogen, and 2 lbs/yr of phosphorus will be removed.

Project Design Considerations: Minimal environmental permitting requirements are anticipated. Projects in RPAs may require exceptions or waivers. This is an existing county facility, and is located within a storm drainage easement. Accessibility is excellent from Patrician Woods Court or Springvale Road. There are no tree impacts or significant construction issues anticipated.

Costs:

Item	*Units*	*Quantity*	*Unit Cost*	*Total*
Organic Compost Soil Amendment	CY	200	$40.00	$8,000.00
Plantings	AC	0.75	$25,000.00	$18,750.00
Clear and Grub	AC	0.1	$8,500.00	$850.00
Grading and Excavation	CY	870	$35.00	$30,450.00
Embankment	CY	300	$50.00	$15,000.00
Outflow Pipe	LF	30	$125.00	$3,750.00
RipRap Stabilization	SY	20	$100.00	$2,000.00
Structural BMP Retrofit and Incidentals (Med)	LS	1	$15,000.00	$15,000.00
			Initial Project Costs	**$93,800.00**
Plantings: 5% of project costs (unless incl. as line item)				$0.00
Ancillary Items: 5% of project cost				$4,690.00
Erosion and Sediment Control: 10% of project costs				$9,380.00
			Base Construction Costs	**$107,870.00**
			Mobilization (5%)	$5,393.50
			Subtotal 1	**$113,263.50**
			Contingency (25%)	$28,315.88
			Subtotal 2	**$141,579.38**
			Engineering Design, Surveys, Land Acquisition, Utility Relocation and Permits (45%)	$63,710.72
			Total Costs	**$205,290.09**
			Estimated Project Costs	***$210,000.00***

NI9113 Culvert Retrofit



Address:	11295 Beach Mill Road
Location:	Near Beach Mill Road & Pipestem
Land Owner:	State/County/Private
PIN:	0024 01 0024A, 0024 07 0003A, VDOT
Control Type	Quality/Quanity
Drainage Area	432 acres
Receiving Waters	Jefferson Branch

Description: This culvert at Beach Mill Road is obstructed with debris, stream banks are eroding due to high energy storm flows through the culvert which may flood the road. Construct a micropool with an outlet structure upstream of the culvert in Beach Mill Road.

Project Area Map

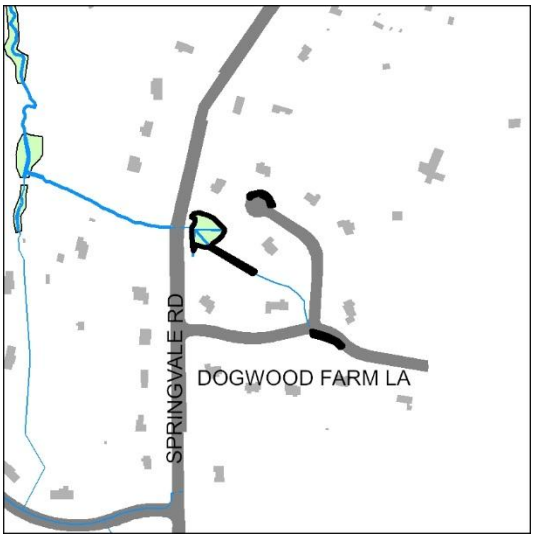
Project Benefits: This project will improve water quality by reducing sediment and nutrient loadings, reduce peak stormwater flows for storms up to the 10-year event, and provide for evapotranspiration and wildlife habitat. The new outlet structure will allow for a more controlled stormwater discharge to enhance the performance of the micropool. An estimated 1,083 lbs/yr of total suspended solids and 13 lbs/yr of nitrogen will be removed.

Project Design Considerations: Minimal environmental permitting requirements are anticipated. Additional permitting may be required for a project within a stream or wetland. Projects in RPAs may require exceptions or waivers. The micropool is located partially within a right-of-way, a conservation easement, and on private land. A storm drainage easement will be necessary. Accessibility is excellent from Beach Mill Road. There are minimal tree impacts and no significant construction issues anticipated.

Costs:

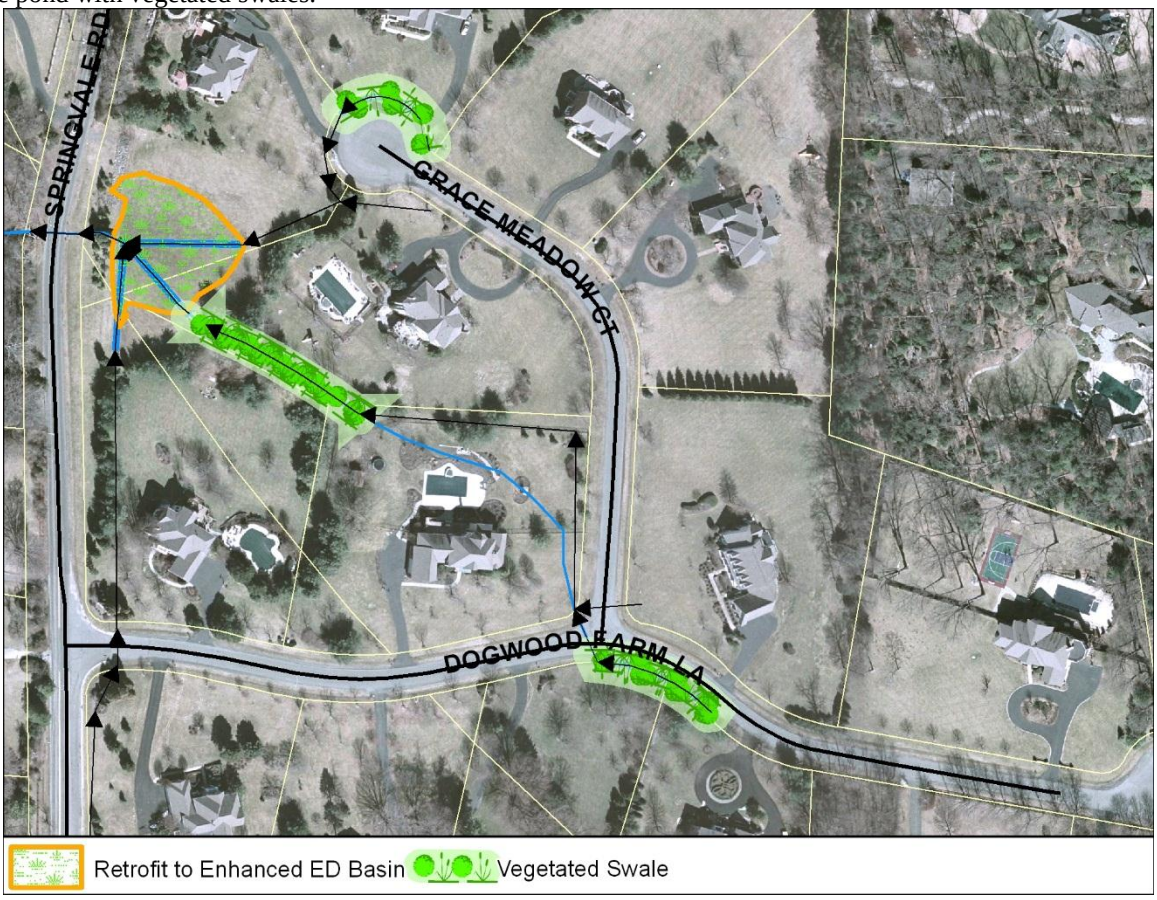
Item	*Units*	*Quantity*	*Unit Cost*	*Total*
Organic Compost Soil Amendment	CY	30	$40.00	$1,200.00
Plantings	AC	0.1	$25,000.00	$2,500.00
Clear and Grub	AC	0.12	$8,500.00	$1,020.00
Grading and Excavation	CY	250	$35.00	$8,750.00
Earthen Berm	CY	100	$35.00	$3,500.00
			Initial Project Costs	**$16,970.00**
Plantings: 5% of project costs (unless incl. as line item)				$0.00
Ancillary Items: 5% of project cost				$848.50
Erosion and Sediment Control: 10% of project costs				$1,697.00
			Base Construction Costs	**$19,515.50**
			Mobilization (5%)	$975.78
			Subtotal 1	**$20,491.28**
			Contingency (25%)	$5,122.82
			Subtotal 2	**$25,614.09**
			Engineering Design, Surveys, Land Acquisition, Utility Relocation and Permits (45%)	$11,526.34
			Total Costs	**$37,140.44**
			Estimated Project Costs	***$40,000.00***

NI9118 Stormwater Pond Retrofit, BMP/LID



Address:	800 Grace Meadow Court
Location:	Dogwood Farm Section 2 Subdivision
Land Owner:	County/Private
PIN:	0073 12 0010, 0073 12 0011, 0073 12 0012, 0073 12 0014, 0074 15 0003, 0074 15 0004, 0074 15 0013, VDOT
Control Type	Quality/Quanity
Drainage Area	23.45 acres
Receiving Waters	Nichol Run

Description: Dogwood Farm subdivision is in need of water quality treatment. Retrofit existing dry pond (0857DP) to enhanced extended detention dry pond with low marsh areas and replace concrete trickle ditches within and draining to the pond with vegetated swales.



Project Area Map

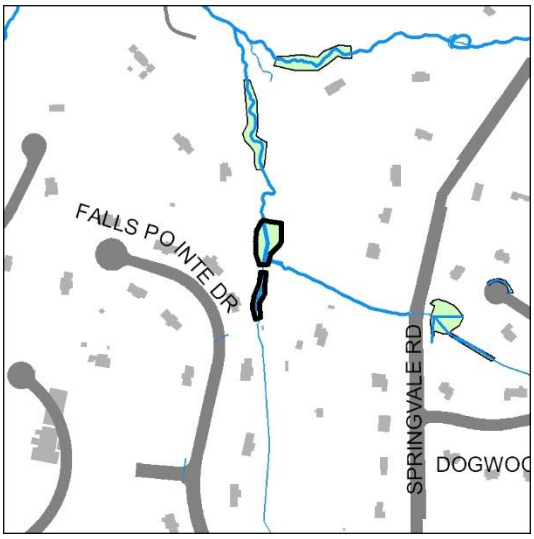
Project Benefits: This project will improve water quality by reducing sediment and nutrient loadings, reduce peak stormwater flows for storms up to the 10-year event, and provide for evapotranspiration and wildlife habitat. The new outlet structure will allow for a more controlled stormwater discharge to enhance the performance of the pond. Removal of the trickle ditches will reduce stormwater velocities. An estimated 1,445 lbs/yr of total suspended solids, 16 lbs/yr of nitrogen, and 3 lbs/yr of phosphorus will be removed.

Project Design Considerations: Minimal environmental permitting requirements are anticipated. Additional permitting may be required for a project within a stream or wetland. Projects in RPAs may require exceptions or waivers. Dry pond 0857DP is an exiting county facility, and is located in a storm drainage easement. Additional storm drainage easements will be necessary for the two trickle ditches located within or along the street rights-of-way. Accessibility is excellent from nearby roads. There are no tree impacts or significant construction issues anticipated.

Costs:

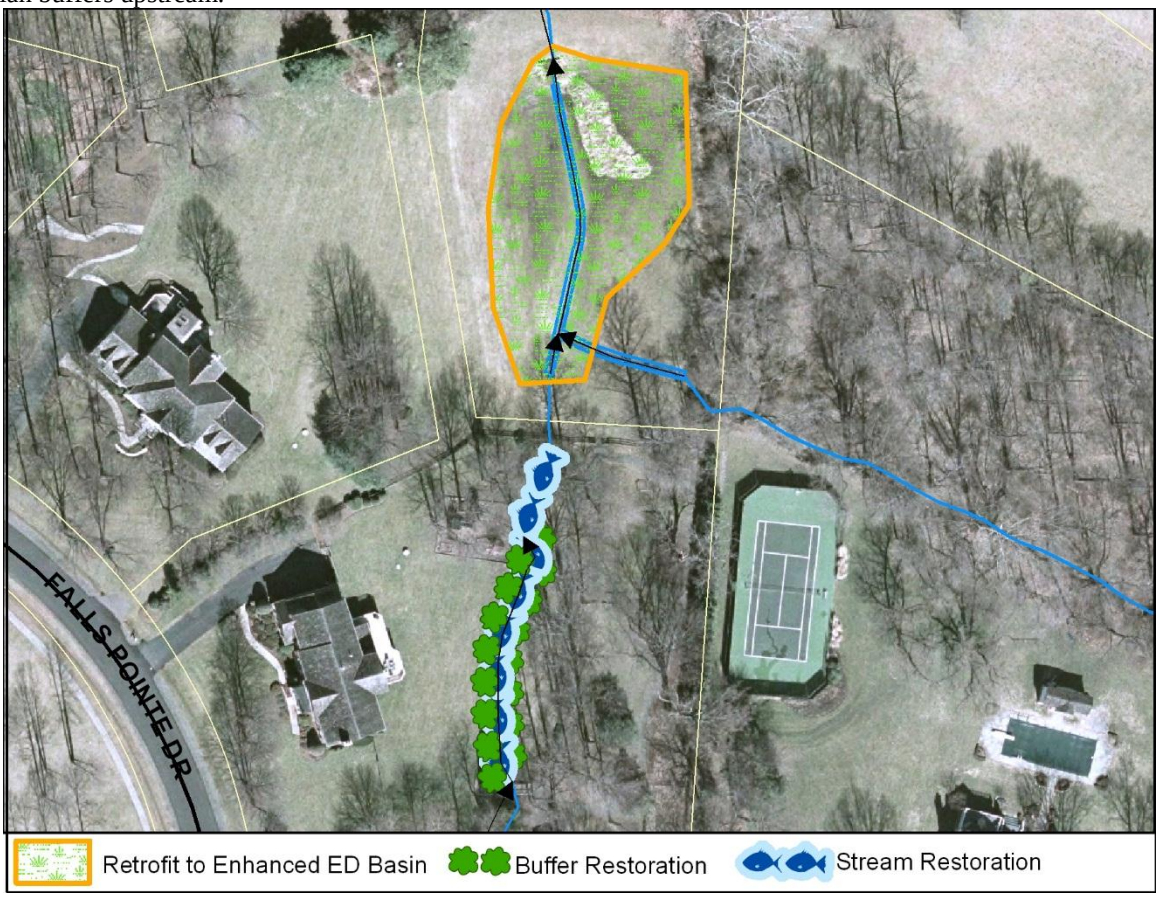
Item	*Units*	*Quantity*	*Unit Cost*	*Total*
Vegetated Swale	SY	805	$50.00	$40,250.00
Organic Compost Soil Amendment	CY	150	$40.00	$6,000.00
Plantings	AC	0.3	$25,000.00	$7,500.00
Clear and Grub	AC	0	$8,500.00	$0.00
Grading and Excavation	CY	650	$35.00	$22,750.00
Embankment	CY	100	$50.00	$5,000.00
Outflow Pipe	LF	30	$125.00	$3,750.00
RipRap Stabilization	SY	25	$100.00	$2,500.00
Structural BMP Retrofit and Incidentals (Med)	LS	1	$15,000.00	$15,000.00
			Initial Project Costs	**$102,750.00**
Plantings: 5% of project costs (unless incl. as line item)				$0.00
Ancillary Items: 5% of project cost				$5,137.50
Erosion and Sediment Control: 10% of project costs				$10,275.00
			Base Construction Costs	**$118,162.50**
			Mobilization (5%)	$5,908.13
			Subtotal 1	**$124,070.63**
			Contingency (25%)	$31,017.66
			Subtotal 2	**$155,088.28**
			Engineering Design, Surveys, Land Acquisition, Utility Relocation and Permits (45%)	$69,789.73
			Total Costs	**$224,878.01**
			Estimated Project Costs	***$230,000.00***

NI9119 Stormwater Pond Retrofit, Stream Restoration



Address:	10720 Falls Pointe Drive
Location:	Near Falls Pointe Drive cul-de-sac
Land Owner:	County
PIN:	0073 11 A, 0073 11 0016
Control Type	Quality/Quanity
Drainage Area	162.94 acres
Receiving Waters	Nichol Run

Description: Falls Point and Forestville Estates are in need of additional water quality treatment. Improve existing dry pond (0797DP) to enhanced extended detention dry pond with low marsh areas. Repair eroded streambanks and restore riparian buffers upstream.



Project Area Map

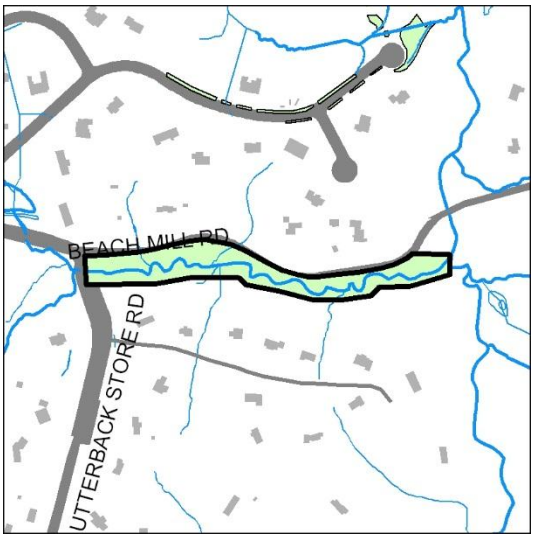
Project Benefits: This project will improve water quality by reducing sediment and nutrient loadings, reduce peak stormwater flows for storms up to the 10-year event, and provide for evapotranspiration and wildlife habitat. The new outlet structure will allow for a more controlled stormwater discharge to enhance the performance of the pond. Removal of the trickle ditch will reduce stormwater velocities. This project will also repair the eroded streambanks. Restoring the riparian buffer will help to slow down stormwater velocities, improve water quality, reduce stream temperatures, and provide for additional evapotranspiration and wildlife habitat. An estimated 4,694 lbs/yr of total suspended solids, 54 lbs/yr of nitrogen, and 10 lbs/yr of phosphorus will be removed.

Project Design Considerations: Minimal environmental permitting requirements are anticipated. Additional permitting may be required for a project within a stream or wetland. Projects in RPAs may require exceptions or waivers. This is an existing county facility, and is located within a storm drainage easement. Accessibility is good from Falls Pointe Drive. There are no tree impacts or significant construction issues anticipated.

Costs:

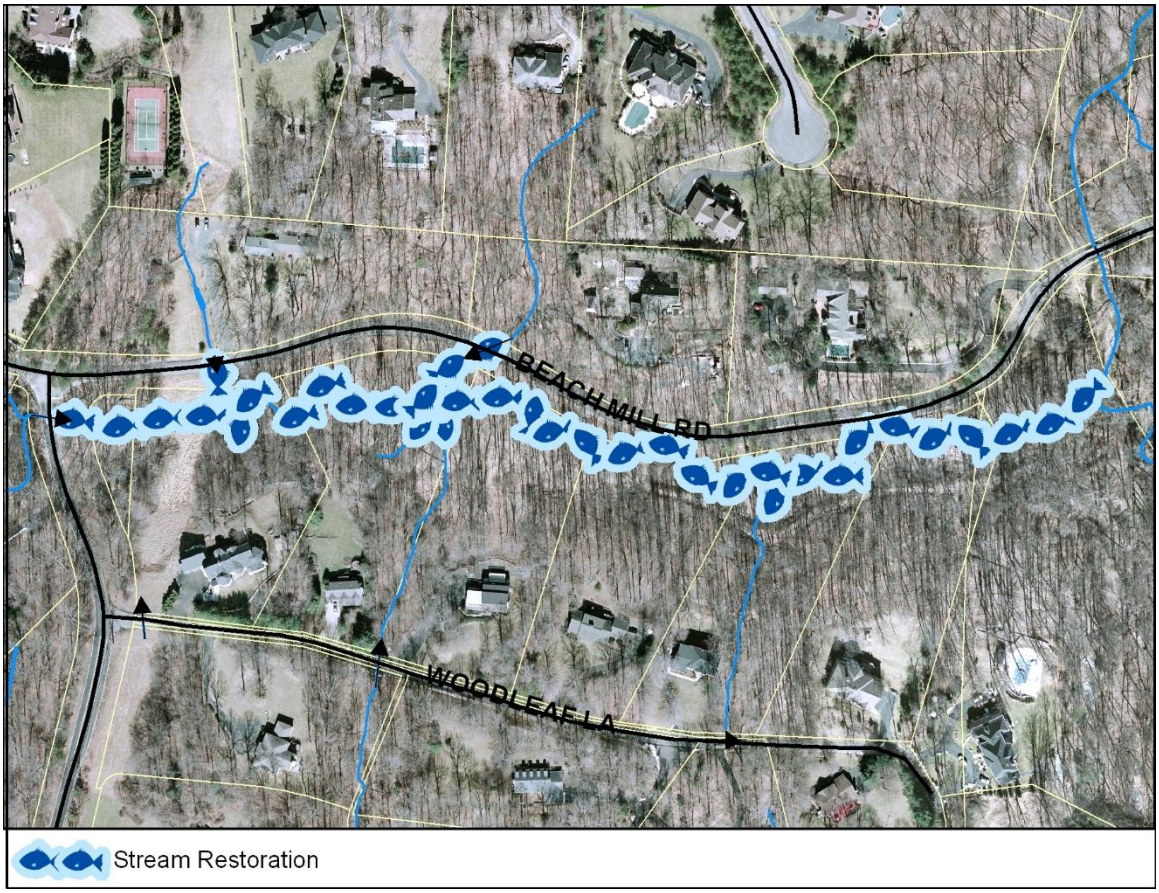
Item	*Units*	*Quantity*	*Unit Cost*	*Total*
Organic Compost Soil Amendment	CY	100	$40.00	$4,000.00
Plantings	AC	0.15	$25,000.00	$3,750.00
Clear and Grub	AC	0.2	$8,500.00	$1,700.00
Grading and Excavation	CY	800	$35.00	$28,000.00
Embankment	CY	150	$50.00	$7,500.00
Outflow Pipe	LF	30	$125.00	$3,750.00
RipRap Stabilization	SY	30	$100.00	$3,000.00
Construct New Channel	LF	210	$200.00	$42,000.00
Additional Cost (first 500LF)	LF	210	$200.00	$42,000.00
Structural BMP Retrofit and Incidentals (Med)	LS	1	$15,000.00	$15,000.00
			Initial Project Costs	**$150,700.00**
Plantings: 5% of project costs (unless incl. as line item)				$0.00
Ancillary Items: 5% of project cost				$7,535.00
Erosion and Sediment Control: 10% of project costs				$15,070.00
			Base Construction Costs	**$173,305.00**
			Mobilization (5%)	$8,665.25
			Subtotal 1	**$181,970.25**
			Contingency (25%)	$45,492.56
			Subtotal 2	**$227,462.81**
			Engineering Design, Surveys, Land Acquisition, Utility Relocation and Permits (45%)	$102,358.27
			Total Costs	**$329,821.08**
			Estimated Project Costs	***$330,000.00***

NI9201 Stream Restoration



Address:	10894 Woodleaf Lane
Location:	Woodleaf Subdivision
Land Owner:	State/County/Private
PIN:	0033 01 0035A, 0033 11 0001, 0033 11 0002, 0033 11 0003, 0033 11 0004, 0033 11 0005, 0033 11 0006, 0033 11 0008, VDOT
Control Type	Quality
Drainage Area	176.11 acres
Receiving Waters	Harkney Branch

Description: Stream is trying to lengthen and is actively eroding meanders, threatening Beach Mill Road between Utterbach Store Road and its confluence with Nichol Run. Install cross vanes and J-hooks to direct stream energy away from Beach Mill Road.



Project Area Map

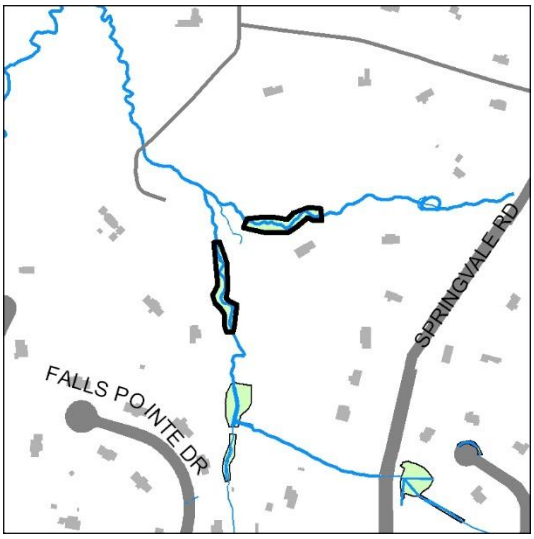
Project Benefits: This project will stabilize streambanks and improve water quality by reducing sediment and nutrient loadings. An estimated 72,260 lbs/yr of total suspended solids, 58 lbs/yr of nitrogen, and 22 lbs/yr of phosphorus will be removed.

Project Design Considerations: Minimal environmental permitting requirements are anticipated. Additional permitting may be required for a project within a stream or wetland. Projects in RPAs may require exceptions or waivers. This project is located on private land and along or within a road right-of-way. A small portion of this project crosses a gas line easement. Accessibility is good from Beach Mill Road but may be difficult due to tree cover. Minimal tree impacts and no significant construction issues anticipated.

Costs:

Item	***Units***	***Quantity***	***Unit Cost***	***Total***
Clear and Grub	AC	0.1	$8,500.00	$850.00
RipRap Stabilization	SY	425	$100.00	$42,500.00
			Initial Project Costs	**$43,350.00**
Plantings: 5% of project costs (unless incl. as line item)				$2,167.50
Ancillary Items: 5% of project cost				$2,167.50
Erosion and Sediment Control: 10% of project costs				$4,335.00
			Base Construction Costs	**$52,020.00**
			Mobilization (5%)	$2,601.00
			Subtotal 1	**$54,621.00**
			Contingency (25%)	$13,655.25
			Subtotal 2	**$68,276.25**
			Engineering Design, Surveys, Land Acquisition, Utility Relocation and Permits (45%)	$30,724.31
			Total Costs	**$99,000.56**
			Estimated Project Costs	***$100,000.00***

NI9202 Stream Restoration



Address:	732 Springvale Road
Location:	Spring Valley Woods Subdivision
Land Owner:	Private
PIN:	0073 09 0003A, 0073 09 0004A
Control Type	Quality
Drainage Area	177.13 acres
Receiving Waters	Nichol Run

Description: Streambanks are eroded downstream of a culvert and driveway bridge. Install plunge pool below culvert and replace driveway bridge at 732 Springvale Road. Construct new stream channels with step pools and access to floodplain.

Project Area Map

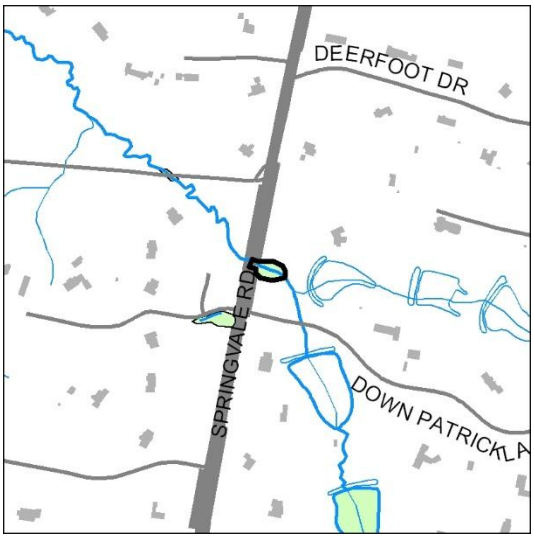
Project Benefits: This project will stabilize streambanks and improve water quality by reducing sediment and nutrient loadings. The plunge pool will reduce stormwater velocities. An estimated 79,560 lbs/yr of total suspended solids, 64 lbs/yr of nitrogen, and 25 lbs/yr of phosphorus will be removed.

Project Design Considerations: Minimal environmental permitting requirements are anticipated. Additional permitting may be required for a project within a stream or wetland. Projects in RPAs may require exceptions or waivers. Storm drainge easements will be necessary. Accessibility is good from residential driveways. Tree impacts are expected. No significant construction issues anticipated.

Costs:

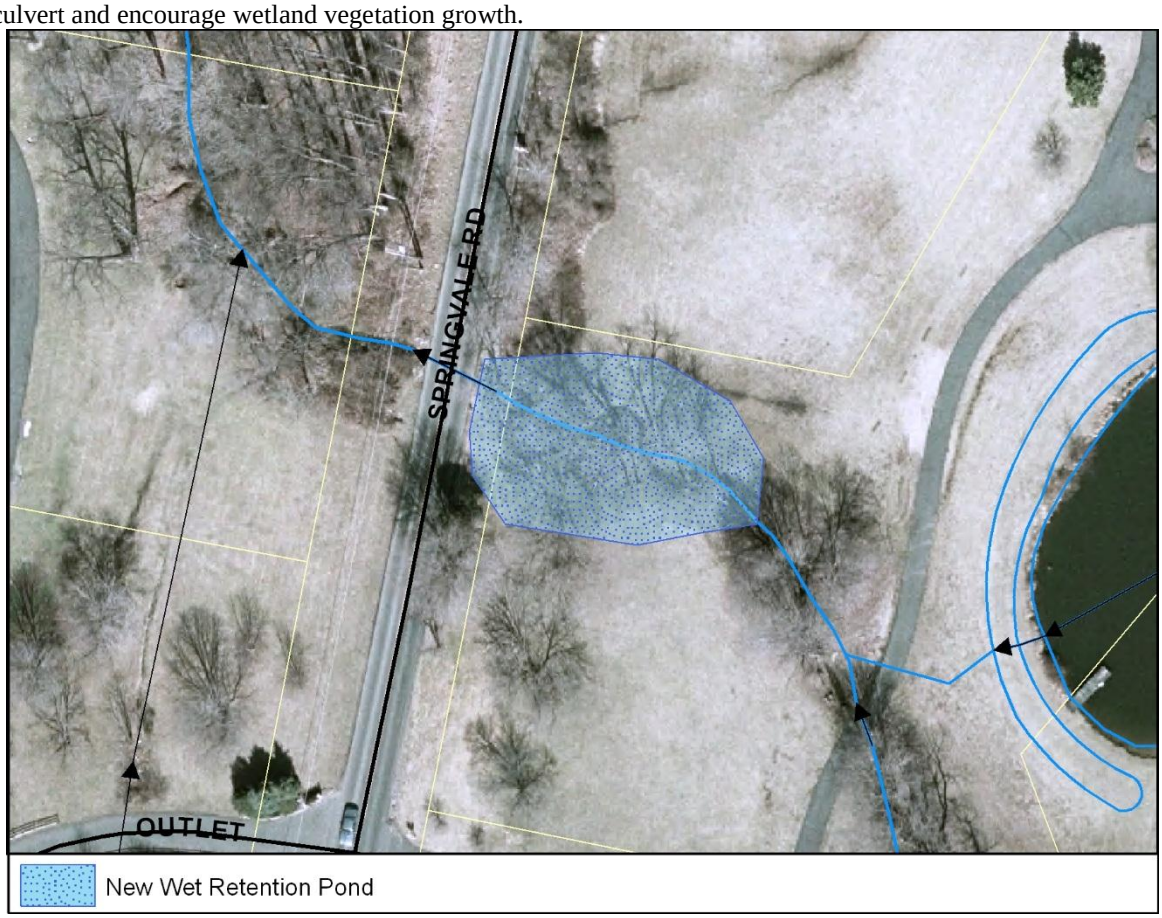
Item	*Units*	*Quantity*	*Unit Cost*	*Total*
Plantings	AC	0.3	$25,000.00	$7,500.00
Clear and Grub	AC	0.35	$8,500.00	$2,975.00
Construct New Channel	LF	750	$200.00	$150,000.00
Additional Cost (first 500LF)	LF	500	$200.00	$100,000.00
			Initial Project Costs	**$260,475.00**
Plantings: 5% of project costs (unless incl. as line item)				$0.00
Ancillary Items: 5% of project cost				$13,023.75
Erosion and Sediment Control: 10% of project costs				$26,047.50
			Base Construction Costs	**$299,546.25**
			Mobilization (5%)	$14,977.31
			Subtotal 1	**$314,523.56**
			Contingency (25%)	$78,630.89
			Subtotal 2	**$393,154.45**
			Engineering Design, Surveys, Land Acquisition, Utility Relocation and Permits (45%)	$176,919.50
			Total Costs	**$570,073.96**
			Estimated Project Costs	***$580,000.00***

NI9401 Culvert Retrofit



Address:	535 Springvale Road
Location:	Down Patrick Farms Subdivision
Land Owner:	Private
PIN:	0072 06 0009A3, 0072 15 0004, VDOT
Control Type	Quality/Quanity
Drainage Area	99.93 acres
Receiving Waters	Nichol Run

Description: Sediment is collecting upstream of the culvert. Construct a micropool with outlet structure upstream of the culvert and encourage wetland vegetation growth.



Project Area Map

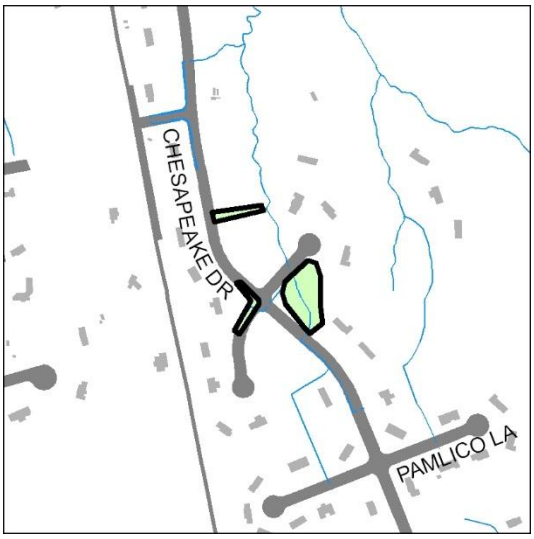
Project Benefits: This project will improve water quality by reducing sediment and nutrient loadings, reducing peak stormwater flows for storms up to the 10-year event, and providing for evapotranspiration and wildlife habitat. An estimated 1,134 lbs/yr of total suspended solids, 13 lbs/yr of nitrogen, and 3 lbs/yr of phosphorus will be removed.

Project Design Considerations: Minimal environmental permitting requirements are anticipated. Additional permitting may be required for a project within a stream or wetland. Projects in RPAs may require exceptions or waivers. Storm drainage easements will be necessary. Accessibility is excellent from Springvale Road. Minimal tree impacts and no significant construction issues anticipated.

Costs:

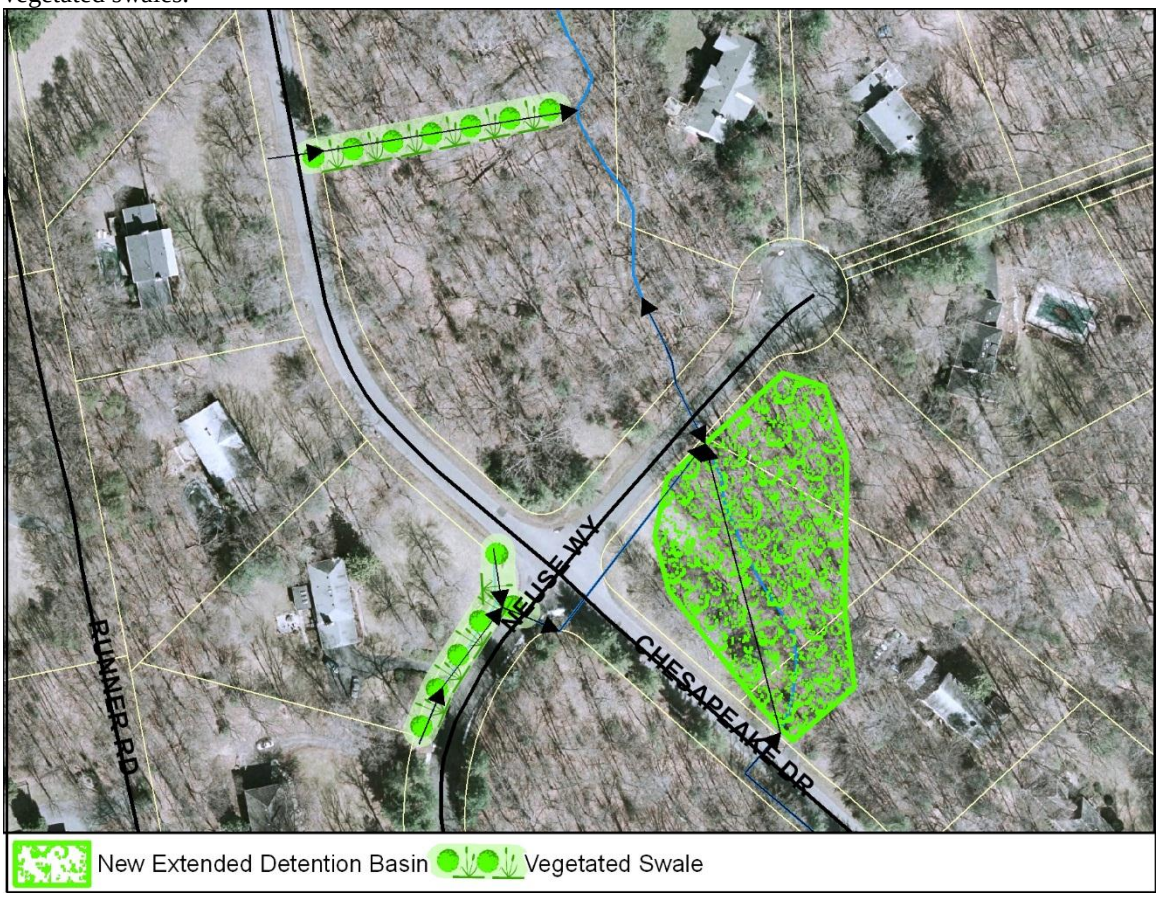
Item	*Units*	*Quantity*	*Unit Cost*	*Total*
Organic Compost Soil Amendment	CY	40	$40.00	$1,600.00
Plantings	AC	0.2	$25,000.00	$5,000.00
Clear and Grub	AC	0.1	$8,500.00	$850.00
Grading and Excavation	CY	900	$35.00	$31,500.00
Access Road	SY	200	$25.00	$5,000.00
Access Road Gate	EA	1	$2,500.00	$2,500.00
Embankment	CY	100	$50.00	$5,000.00
Structural BMP and Incidentals (Med)	LS	1	$15,000.00	$15,000.00
New Storm Pipe (Med)	LF	20	$200.00	$4,000.00
			Initial Project Costs	**$70,450.00**
Plantings: 5% of project costs (unless incl. as line item)				$0.00
Ancillary Items: 5% of project cost				$3,522.50
Erosion and Sediment Control: 10% of project costs				$7,045.00
			Base Construction Costs	**$81,017.50**
			Mobilization (5%)	$4,050.88
			Subtotal 1	**$85,068.38**
			Contingency (25%)	$21,267.09
			Subtotal 2	**$106,335.47**
			Engineering Design, Surveys, Land Acquisition, Utility Relocation and Permits (45%)	$47,850.96
			Total Costs	**$154,186.43**
			Estimated Project Costs	***$160,000.00***

PN9100 New Stormwater Pond, BMP/LID



Address:	9511 Neuse Way
Location:	Riverside Manor Subdivision
Land Owner:	State/Private
PIN:	0081 04 0011, 0081 04 0048C, 0081 04 0049, 0081 04 D, VDOT
Control Type	Quality/Quanity
Drainage Area	20.12 acres
Receiving Waters	Clarks Branch

Description: Riverside Manor does not have any stormwater treatment. Install a new naturalized extended detention basin in existing depression with mature trees. Replace concrete trickle ditch and grass swale along Chesapeake Drive with vegetated swales.



Project Area Map

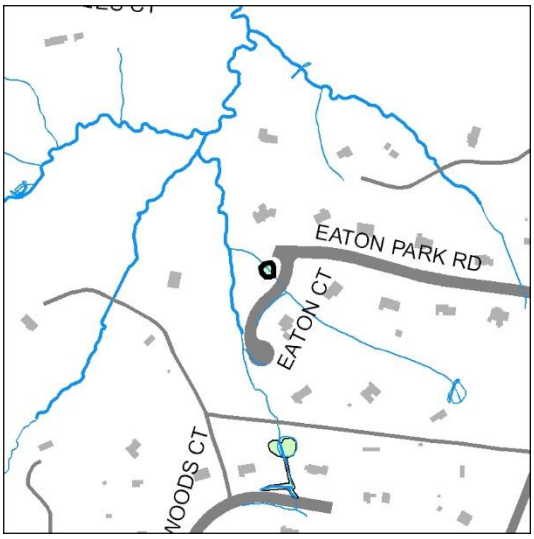
Project Benefits: Naturalized basins ans swales will reduce sediment and nutrient loadings and slow runoff. An estimated 1,288 lbs/yr of total suspended solids, 16 lbs/yr of nitrogen, and 3 lbs/yr of phosphorus will be removed.

Project Design Considerations: Minimal environmental permitting requirements are anticipated. Additional permitting may be required for a project within a stream or wetland. The new basin and grass swale are located on private land, the existing concrete trickle ditch is located within a right-of-way. Storm drainage easements will be necessary. Accessibility is excellent from Chesapeake Drive. Tree impacts are expected. No significant construction issues anticipated.

Costs:

Item	*Units*	*Quantity*	*Unit Cost*	*Total*
Vegetated Swale	SY	540	$50.00	$27,000.00
Organic Compost Soil Amendment	CY	75	$40.00	$3,000.00
Plantings	AC	0.1	$25,000.00	$2,500.00
Clear and Grub	AC	0.1	$8,500.00	$850.00
Grading and Excavation	CY	400	$35.00	$14,000.00
Access Road	SY	280	$25.00	$7,000.00
Access Road Gate	EA	1	$2,500.00	$2,500.00
Structural BMP and Incidentals (Low)	LS	1	$10,000.00	$10,000.00
New Storm Pipe (Low)	LF	20	$100.00	$2,000.00
Embankment	CY	100	$50.00	$5,000.00
			Initial Project Costs	**$73,850.00**
Plantings: 5% of project costs (unless incl. as line item)				$0.00
Ancillary Items: 5% of project cost				$3,692.50
Erosion and Sediment Control: 10% of project costs				$7,385.00
			Base Construction Costs	**$84,927.50**
			Mobilization (5%)	$4,246.38
			Subtotal 1	**$89,173.88**
			Contingency (25%)	$22,293.47
			Subtotal 2	**$111,467.34**
			Engineering Design, Surveys, Land Acquisition, Utility Relocation and Permits (45%)	$50,160.30
			Total Costs	**$161,627.65**
			Estimated Project Costs	***$170,000.00***

PN9101 New Stormwater Pond



Address:	9106 Eaton Park Road
Location:	Eaton Court & Eaton Park Road
Land Owner:	Private
PIN:	0082 11 A, 0082 16 0003
Control Type	Quality
Drainage Area	15.06 acres
Receiving Waters	Clarks Branch

Description: Eaton Park subdivision has no existing stormwater treatment. Install a new constructed wetland to capture drainage from Eaton Court and Eaton Park Road.

Project Area Map

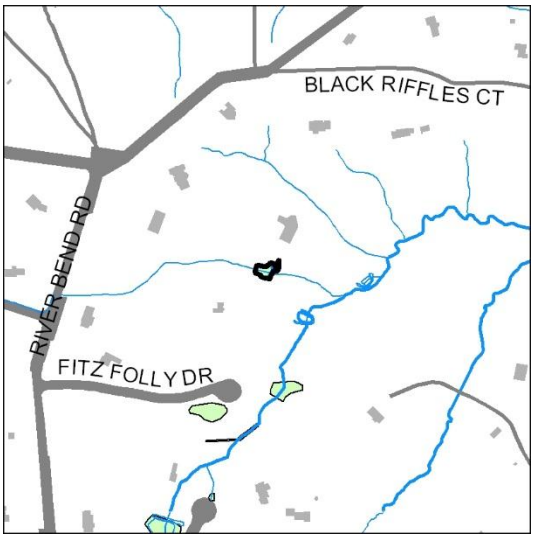
Project Benefits: The constructed wetlands will reduce stormwater peak flows for small storm events, reduce sediment and nutrient loadings, and provide for evaporation, evapotranspiration and wildlife habitat. An estimated 1,328 lbs/yr of total suspended solids, 17 lbs/yr of nitrogen, and 3 lbs/yr of phosphorus will be removed.

Project Design Considerations: Minimal environmental permitting requirements are anticipated. Additional permitting may be required for a project within a stream or wetland. Projects in RPAs may require exceptions or waivers. A storm drainage easement will be necessary. Accessibility is excellent from Eaton Court. Tree impacts are expected. No significant construction issues are anticipated.

Costs:

Item	*Units*	*Quantity*	*Unit Cost*	*Total*
Organic Compost Soil Amendment	CY	40	$40.00	$1,600.00
Plantings	AC	0.09	$25,000.00	$2,250.00
Clear and Grub	AC	0.1	$8,500.00	$850.00
Grading and Excavation	CY	100	$35.00	$3,500.00
Access Road	SY	225	$25.00	$5,625.00
Access Road Gate	EA	1	$2,500.00	$2,500.00
Structural BMP and Incidentals (Low)	LS	1	$10,000.00	$10,000.00
New Storm Pipe (Low)	LF	20	$100.00	$2,000.00
Embankment	CY	100	$50.00	$5,000.00
			Initial Project Costs	**$33,325.00**
Plantings: 5% of project costs (unless incl. as line item)				$0.00
Ancillary Items: 5% of project cost				$1,666.25
Erosion and Sediment Control: 10% of project costs				$3,332.50
			Base Construction Costs	**$38,323.75**
			Mobilization (5%)	$1,916.19
			Subtotal 1	**$40,239.94**
			Contingency (25%)	$10,059.98
			Subtotal 2	**$50,299.92**
			Engineering Design, Surveys, Land Acquisition, Utility Relocation and Permits (45%)	$22,634.96
			Total Costs	**$72,934.89**
			Estimated Project Costs	***$80,000.00***

PN9102 Stormwater Pond Retrofit



Address:	207 River Bend Road
Location:	Near River Bend Road & Oak Falls Court
Land Owner:	Private
PIN:	0082 01 0011D1, 0082 01 0012A1
Control Type	Quality
Drainage Area	15.32 acres
Receiving Waters	Clarks Branch

Description: The area around River Bend Road and Oak Falls Court has no existing stormwater treatment. Retrofit breached farm pond to a new constructed wetland. Repair earthen dam, install outlet structure and vegetate with wetland plants.

Project Area Map

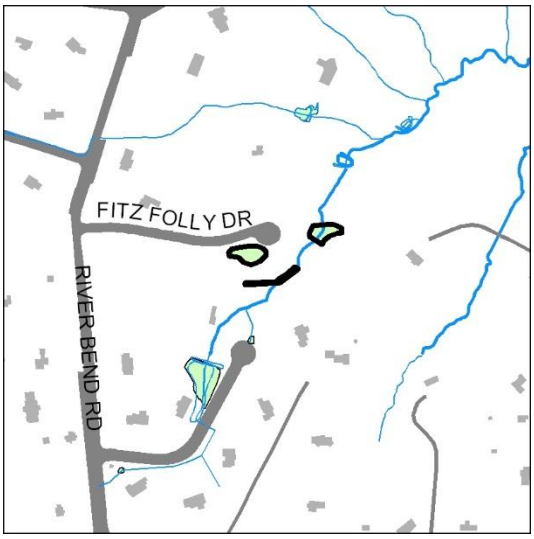
Project Benefits: The constructed wetlands will reduce stormwater peak flows for small storm events, reduce sediment and nutrient loadings, and provide for evaporation, evapotranspiration and wildlife habitat. The new outlet structure will allow for a more controlled stormwater discharge to enhance the performance of the wetland. This project will also repair the earthen dam. An estimated 774 lbs/yr of total suspended solids, 9 lbs/yr of nitrogen, and 2 lbs/yr of phosphorus will be removed.

Project Design Considerations: Minimal environmental permitting requirements are anticipated. Additional permitting may be required for a project within a stream or wetland. A dam safety permit may be necessary. This is a privately owned pond, and will require a storm drainage easement. Accessibility may be difficult due to space constraints and tree cover. Minimal tree impacts and no significant construction issues anticipated.

Costs:

Item	*Units*	*Quantity*	*Unit Cost*	*Total*
Organic Compost Soil Amendment	CY	20	$40.00	$800.00
Plantings	AC	0.1	$25,000.00	$2,500.00
Clear and Grub	AC	0.13	$8,500.00	$1,105.00
Grading and Excavation	CY	1000	$35.00	$35,000.00
Embankment	CY	75	$50.00	$3,750.00
Outflow Pipe	LF	20	$125.00	$2,500.00
RipRap Stabilization	SY	20	$100.00	$2,000.00
Structural BMP Retrofit and Incidentals (Low)	LS	1	$10,000.00	$10,000.00
			Initial Project Costs	**$57,655.00**
Plantings: 5% of project costs (unless incl. as line item)				$0.00
Ancillary Items: 5% of project cost				$2,882.75
Erosion and Sediment Control: 10% of project costs				$5,765.50
			Base Construction Costs	**$66,303.25**
			Mobilization (5%)	$3,315.16
			Subtotal 1	**$69,618.41**
			Contingency (25%)	$17,404.60
			Subtotal 2	**$87,023.02**
			Engineering Design, Surveys, Land Acquisition, Utility Relocation and Permits (45%)	$39,160.36
			Total Costs	**$126,183.37**
			Estimated Project Costs	***$130,000.00***

PN9103 New Stormwater Pond, BMP/LID, Stream Restoration



Address:	9303 Fitz Folly Drive
Location:	Fitz Folly Farms Subdivision
Land Owner:	County/Private
PIN:	0082 17 0003, 0082 17 0004, 0082 01 0019E, 0082 17 0002
Control Type	Quality/Quanity
Drainage Area	45.94 acres
Receiving Waters	Clarks Branch

Description: Fitz Folly Farms is in need of additional water quality treatment. Construct enhanced extended detention dry pond in empty lot and terraced rain gardens on steeper slopes. Intercept overland flow and stabilize overland and in-stream erosion impacts.

Project Area Map

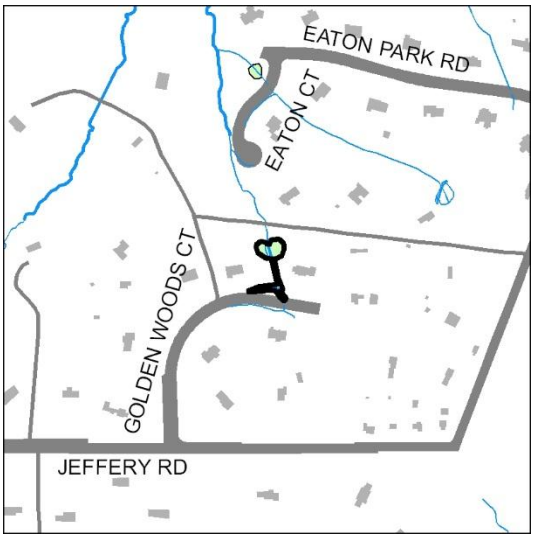
Project Benefits: This project will improve water quality by reducing sediment and nutrient loadings, reduce peak stormwater flows for storms up to the 10-year event, and provide for evapotranspiration and wildlife habitat. The rain garden will also reduce stormwater runoff volumes by promoting infiltration. This project will also repair erosion and stabilize the streambanks. An estimated 308 lbs/yr of total suspended solids, 4 lbs/yr of nitrogen, and 1 lb/yr of phosphorus will be removed.

Project Design Considerations: Minimal environmental permitting requirements are anticipated. Additional permitting may be required for a project within a stream or wetland. Projects in RPAs may require exceptions or waivers. Part of the project is located within storm drainage easements. An additional storm drainage easement will be necessary for the new dry pond. Accessibility is excellent from Fitz Folly Drive. Minimal tree impacts and no significant construction issues anticipated.

Costs:

Item	*Units*	*Quantity*	*Unit Cost*	*Total*
Bioretention Filters & Basin	SY	650	$150.00	$97,500.00
Organic Compost Soil Amendment	CY	120	$40.00	$4,800.00
Plantings	AC	0.31	$25,000.00	$7,750.00
Clear and Grub	AC	0.2	$8,500.00	$1,700.00
Grading and Excavation	CY	1025	$35.00	$35,875.00
Access Road	SY	185	$25.00	$4,625.00
Access Road Gate	EA	1	$2,500.00	$2,500.00
Embankment	CY	125	$50.00	$6,250.00
Construct New Channel	LF	245	$200.00	$49,000.00
Additional Cost (first 500LF)	LF	245	$200.00	$49,000.00
Structural BMP and Incidentals (Med)	LS	1	$15,000.00	$15,000.00
New Storm Pipe (Med)	LF	25	$200.00	$5,000.00
			Initial Project Costs	**$279,000.00**
Plantings: 5% of project costs (unless incl. as line item)				$0.00
Ancillary Items: 5% of project cost				$13,950.00
Erosion and Sediment Control: 10% of project costs				$27,900.00
			Base Construction Costs	**$320,850.00**
			Mobilization (5%)	$16,042.50
			Subtotal 1	**$336,892.50**
			Contingency (25%)	$84,223.13
			Subtotal 2	**$421,115.63**
			Engineering Design, Surveys, Land Acquisition, Utility Relocation and Permits (45%)	$189,502.03
			Total Costs	**$610,617.66**
			Estimated Project Costs	***$620,000.00***

PN9104 Stormwater Pond Retrofit, BMP/LID



Address:	250 Golden Woods Court
Location:	Golden Woods Subdivision
Land Owner:	County
PIN:	0082 12 0004, 0082 12 0005
Control Type	Quality/Quanity
Drainage Area	29.59 acres
Receiving Waters	Clarks Branch

Description: Golden Woods and Crampton subdivisions are in need of additional water quality treatment. Enlarge and retrofit dry pond (0649DP) to enhanced extended detention dry pond with low marsh areas. Replace concrete swale with vegetated swale and check dams.

Project Area Map

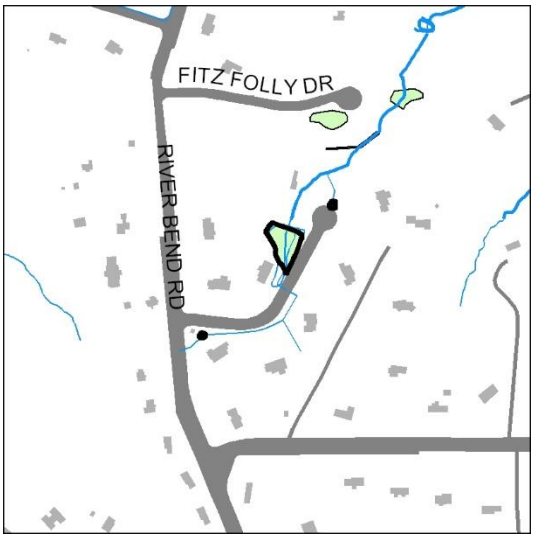
Project Benefits: This project will improve water quality by reducing sediment and nutrient loadings, reduce peak stormwater flows for storms up to the 10-year event, and provide for evapotranspiration and wildlife habitat. This project will also increase the storage capacity for the existing pond. The new outlet structure will allow for a more controlled stormwater discharge to enhance the performance of the pond. Removal of the trickle ditch will reduce stormwater velocities. An estimated 1,987 lbs/yr of total suspended solids, 24 lbs/yr of nitrogen, and 5 lbs/yr of phosphorus will be removed.

Project Design Considerations: Minimal environmental permitting requirements are anticipated. Additional permitting may be required for a project within a stream or wetland. This is an existing county facility, and is located within a storm drainage easement. Accessibility is excellent from Golden Woods Court. There are no tree impacts or significant construction issues anticipated.

Costs:

Item	*Units*	*Quantity*	*Unit Cost*	*Total*
Vegetated Swale	SY	500	$50.00	$25,000.00
Organic Compost Soil Amendment	CY	75	$40.00	$3,000.00
Plantings	AC	0.15	$25,000.00	$3,750.00
Clear and Grub	AC	0.1	$8,500.00	$850.00
Grading and Excavation	CY	925	$35.00	$32,375.00
Embankment	CY	100	$50.00	$5,000.00
Outflow Pipe	LF	20	$125.00	$2,500.00
RipRap Stabilization	SY	30	$100.00	$3,000.00
Structural BMP Retrofit and Incidentals (Med)	LS	1	$15,000.00	$15,000.00
			Initial Project Costs	**$90,475.00**
Plantings: 5% of project costs (unless incl. as line item)				$0.00
Ancillary Items: 5% of project cost				$4,523.75
Erosion and Sediment Control: 10% of project costs				$9,047.50
			Base Construction Costs	**$104,046.25**
			Mobilization (5%)	$5,202.31
			Subtotal 1	**$109,248.56**
			Contingency (25%)	$27,312.14
			Subtotal 2	**$136,560.70**
			Engineering Design, Surveys, Land Acquisition, Utility Relocation and Permits (45%)	$61,452.32
			Total Costs	**$198,013.02**
			Estimated Project Costs	***$200,000.00***

PN9105 Stormwater Pond Retrofit, BMP/LID



Address:	9306 Morison Lane
Location:	Morison Estate Subdivision
Land Owner:	County/Private
PIN:	0082 15 0007A, 0082 15 0009, 0082 15 0002
Control Type	Quality/Quanity
Drainage Area	26.34 acres
Receiving Waters	Clarks Branch

Description: The Morrison Estate is in need of additional water quality treatment. Retrofit existing dry pond (0677DP) to enhanced extended detention dry pond with low marsh areas. Install rain gardens in two natural drainage areas.

Project Area Map

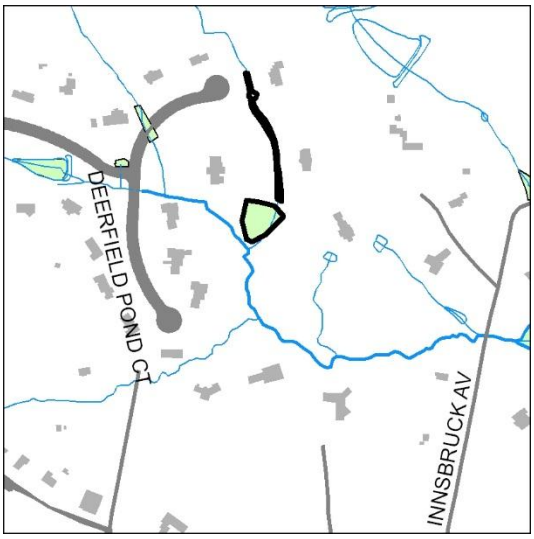
Project Benefits: This project will improve water quality by reducing sediment and nutrient loadings, reducing peak stormwater flows for storms up to the 10-year event, and providing for evapotranspiration and wildlife habitat. The improved outlet structure will allow for a more controlled stormwater discharge to enhance the performance of the pond. Removal of the trickle ditch will reduce stormwater velocities. The rain gardens will also reduce stormwater runoff volumes by promoting infiltration. An estimated 1,690 lbs/yr of total suspended solids, 21 lbs/yr of nitrogen, and 4 lbs/yr of phosphorus will be removed.

Project Design Considerations: Minimal environmental permitting requirements are anticipated. Additional permitting may be required for a project within a stream or wetland. Projects in RPAs may require exceptions or waivers. This is an existing county facility, and is located within a storm drainage easement. The rain garden located at the end of Morison Lane is located on private land and will require an additional storm drainage easement. Accessibility is excellent from Morison Lane. There are no tree impacts or significant construction issues anticipated.

Costs:

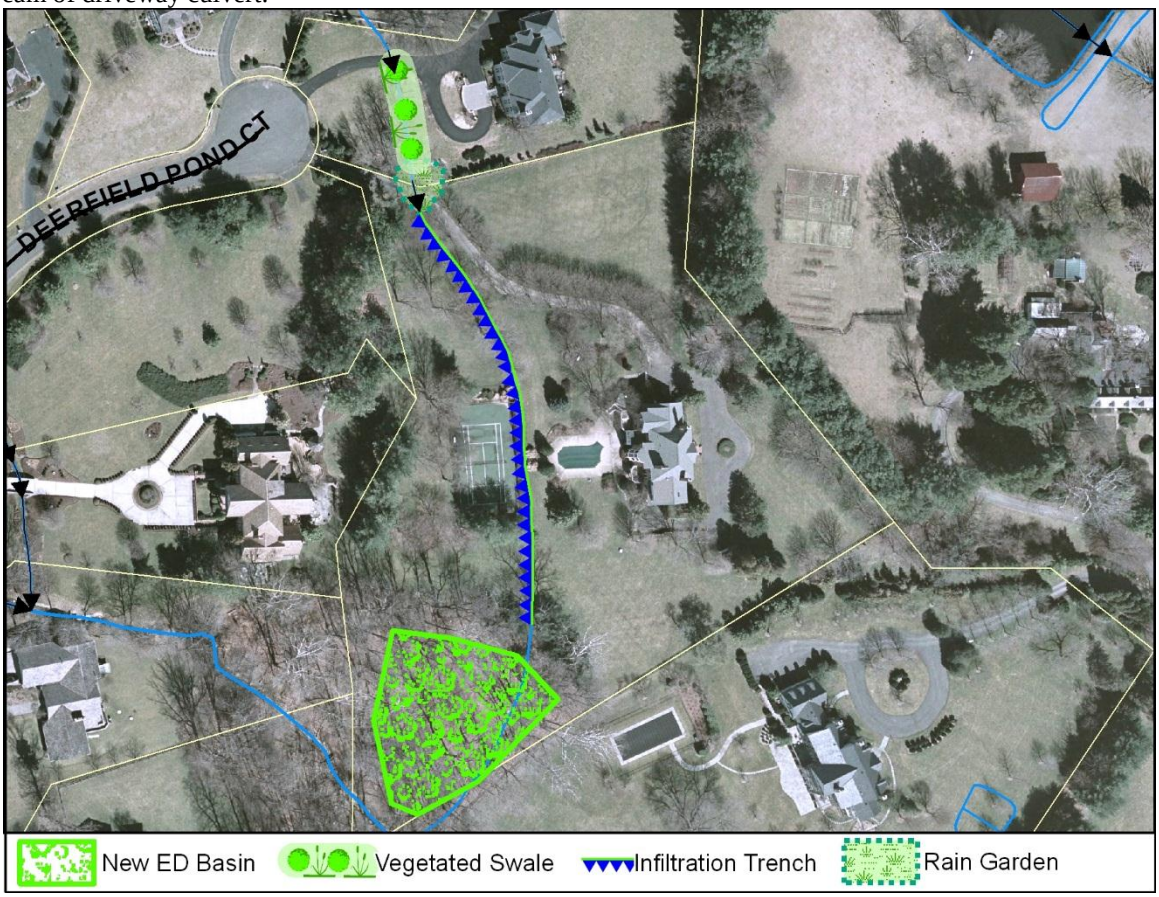
Item	*Units*	*Quantity*	*Unit Cost*	*Total*
Bioretention Filters & Basin	SY	80	$150.00	$12,000.00
Organic Compost Soil Amendment	CY	120	$40.00	$4,800.00
Plantings	AC	0.5	$25,000.00	$12,500.00
Clear and Grub	AC	0.1	$8,500.00	$850.00
Grading and Excavation	CY	950	$35.00	$33,250.00
Embankment	CY	100	$50.00	$5,000.00
Outflow Pipe	LF	30	$125.00	$3,750.00
RipRap Stabilization	SY	20	$100.00	$2,000.00
Structural BMP Retrofit and Incidentals (Med)	LS	1	$15,000.00	$15,000.00
			Initial Project Costs	**$89,150.00**
Plantings: 5% of project costs (unless incl. as line item)				$0.00
Ancillary Items: 5% of project cost				$4,457.50
Erosion and Sediment Control: 10% of project costs				$8,915.00
			Base Construction Costs	**$102,522.50**
			Mobilization (5%)	$5,126.13
			Subtotal 1	**$107,648.63**
			Contingency (25%)	$26,912.16
			Subtotal 2	**$134,560.78**
			Engineering Design, Surveys, Land Acquisition, Utility Relocation and Permits (45%)	$60,552.35
			Total Costs	**$195,113.13**
			Estimated Project Costs	***$200,000.00***

PN9108 New Stormwater Pond, BMP/LID



Address:	601 Deerfield Pond Court
Location:	Near northern Deerfield Court cul-de-sac
Land Owner:	County/Private
PIN:	0083 13 0020, 0083 14 0019, 0083 14 0029
Control Type	Quality/Quanity
Drainage Area	25.29 acres
Receiving Waters	Mine Run Branch

Description: This area is in need of additional water quality treatment. Construct new enhanced extended detention dry pond. Replace rip-rap swale with vegetated infiltration trench and check dams and install a new rain garden upstream of driveway culvert.



Project Area Map

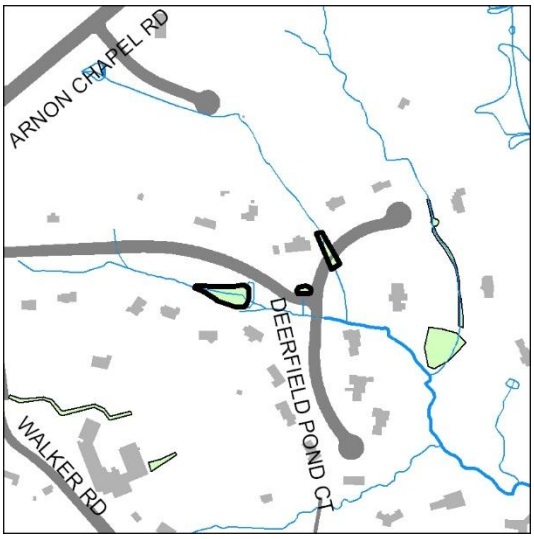
Project Benefits: This project will improve water quality by reducing sediment and nutrient loadings, reduce peak stormwater flows for storms up to the 10-year event, and provide for evapotranspiration and wildlife habitat. The rain garden and infiltration trench will also reduce stormwater runoff volumes by promoting infiltration. An estimated 2,500 lbs/yr of total suspended solids, 38 lbs/yr of nitrogen, and 7 lbs/yr of phosphorus will be removed.

Project Design Considerations: Minimal environmental permitting requirements are anticipated. Additional permitting may be required for a project within a stream or wetland. Projects in RPAs may require exceptions or waivers. The majority of the project is located within a storm drainage easement, which may need to be enlarged to include the entirey of the new dry basin. Accessibility is good from Deerfield Pond Court, but may be difficult due to residential properties, access easements will be needed for future maintenance. Minimal tree impacts and no significant construction issues anticipated.

Costs:

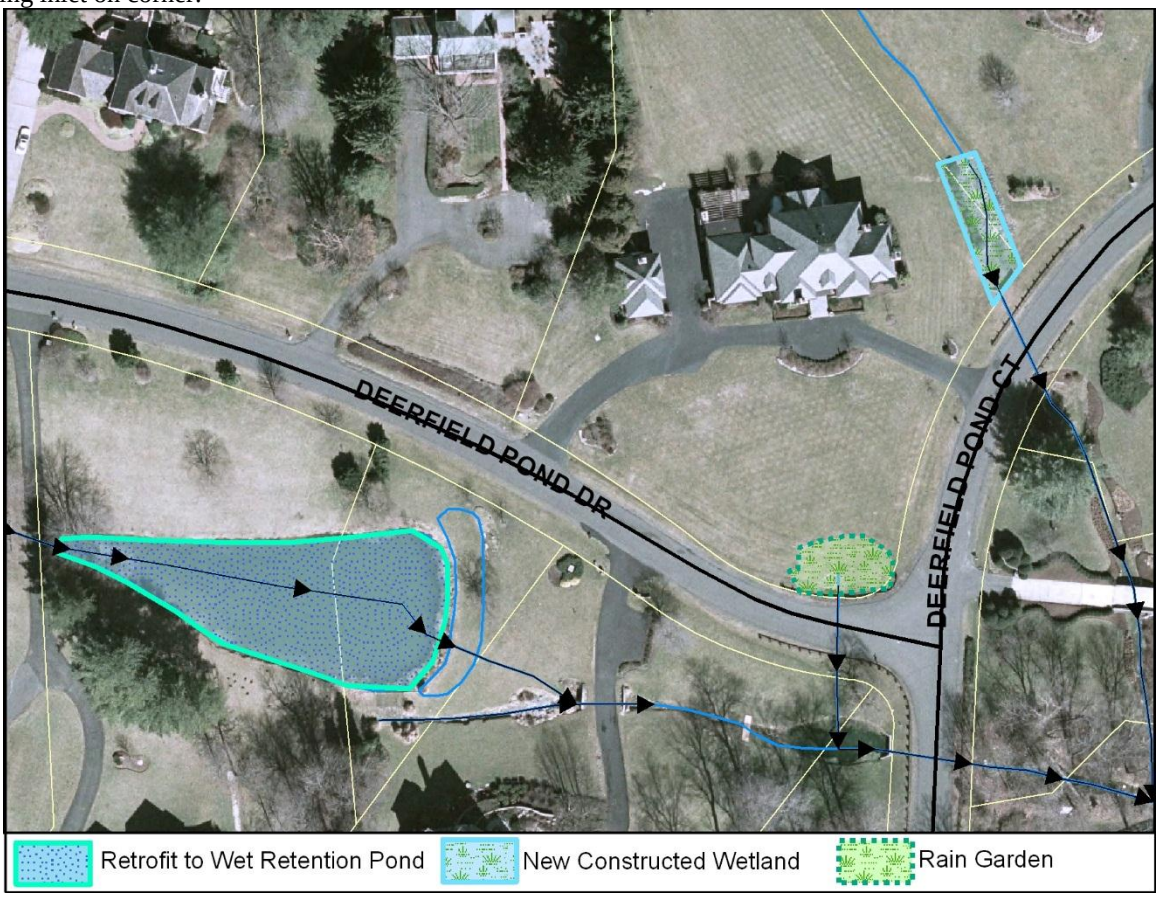
Item	*Units*	*Quantity*	*Unit Cost*	*Total*
Vegetated Swale	SY	120	$50.00	$6,000.00
Percolation/Infiltration Trench	SY	500	$75.00	$37,500.00
Organic Compost Soil Amendment	CY	155	$40.00	$6,200.00
Plantings	AC	0.5	$25,000.00	$12,500.00
Clear and Grub	AC	0.75	$8,500.00	$6,375.00
Grading and Excavation	CY	2000	$35.00	$70,000.00
Access Road	SY	775	$25.00	$19,375.00
Access Road Gate	EA	1	$2,500.00	$2,500.00
Embankment	CY	120	$50.00	$6,000.00
Structural BMP and Incidentals (Med)	LS	1	$15,000.00	$15,000.00
New Storm Pipe (Med)	LF	25	$200.00	$5,000.00
			Initial Project Costs	**$186,450.00**
Plantings: 5% of project costs (unless incl. as line item)				$0.00
Ancillary Items: 5% of project cost				$9,322.50
Erosion and Sediment Control: 10% of project costs				$18,645.00
			Base Construction Costs	**$214,417.50**
			Mobilization (5%)	$10,720.88
			Subtotal 1	**$225,138.38**
			Contingency (25%)	$56,284.59
			Subtotal 2	**$281,422.97**
			Engineering Design, Surveys, Land Acquisition, Utility Relocation and Permits (45%)	$126,640.34
			Total Costs	**$408,063.30**
			Estimated Project Costs	***$410,000.00***

PN9109 New Stormwater Pond, Stormwater Pond Retrofit, BMP/LID



Address:	9903 Deerfield Pond Drive
Location:	Deerfield Pond Subdivision
Land Owner:	County/Private
PIN:	0083 13 B, 0083 13 0006, 0083 13 0007, 0083 13 0018A, 0083 13 0022
Control Type	Quality/Quanity
Drainage Area	92.88 acres
Receiving Waters	Mine Run Branch

Description: Retrofit existing non-stormwater pond to wet retention pond with increased storage. Improve wetland vegetation above road culvert and add outlet structure to create a new constructed wetland. Install a rain garden around existing inlet on corner.



Project Area Map

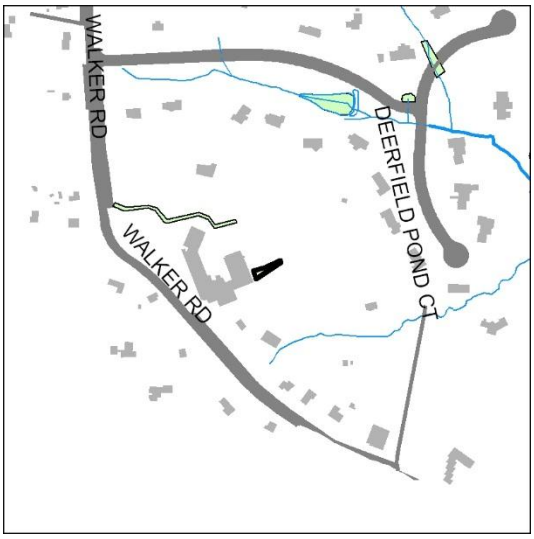
Project Benefits: This project will reduce sediment and nutrient loadings, improve water quality in downstream waterbodies, increase storage volume, reduce peak stormwater flows up to the 10-year event, and provide for evapotranspiration and wildlife habitat. The rain garden will also reduce stormwater runoff volumes by promoting infiltration. An estimated 2,025 lbs/yr of total suspended solids, 24 lbs/yr of nitrogen, and 6 lbs/yr of phosphorus will be removed.

Project Design Considerations: Minimal environmental permitting requirements are anticipated. Additional permitting may be required for a project within a stream or wetland. The existing pond and new constructed wetland are located within storm drainage easements. The rain garden at the corner of Deerfield Pond Court and Deerfield Pond Drive is located on private land and will require an additional storm drainage easement. Accessibility is excellent from nearby roads. There are no tree impacts or significant construction issues anticipated.

Costs:

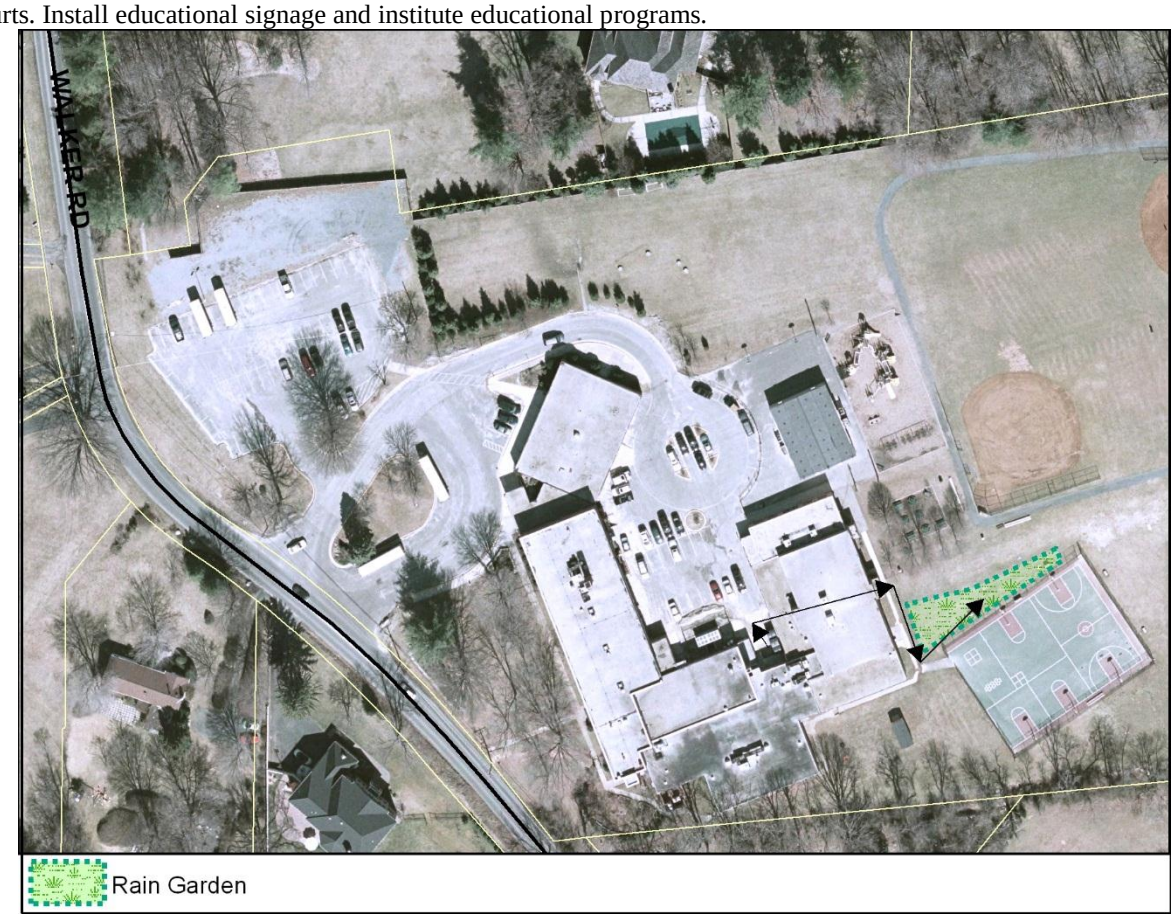
Item	*Units*	*Quantity*	*Unit Cost*	*Total*
Bioretention Filters & Basin	SY	200	$150.00	$30,000.00
Organic Compost Soil Amendment	CY	80	$40.00	$3,200.00
Plantings	AC	0.16	$25,000.00	$4,000.00
Clear and Grub	AC	0.1	$8,500.00	$850.00
Grading and Excavation	CY	925	$35.00	$32,375.00
Access Road	SY	150	$25.00	$3,750.00
Access Road Gate	EA	1	$2,500.00	$2,500.00
New Storm Pipe (Low)	LF	20	$100.00	$2,000.00
Embankment	CY	175	$50.00	$8,750.00
Outflow Pipe	LF	30	$125.00	$3,750.00
RipRap Stabilization	SY	30	$100.00	$3,000.00
Structural BMP and Incidentals (Med)	LS	1	$15,000.00	$15,000.00
Structural BMP Retrofit and Incidentals (Med)	LS	1	$15,000.00	$15,000.00
			Initial Project Costs	**$124,175.00**
Plantings: 5% of project costs (unless incl. as line item)				$0.00
Ancillary Items: 5% of project cost				$6,208.75
Erosion and Sediment Control: 10% of project costs				$12,417.50
			Base Construction Costs	**$142,801.25**
			Mobilization (5%)	$7,140.06
			Subtotal 1	**$149,941.31**
			Contingency (25%)	$37,485.33
			Subtotal 2	**$187,426.64**
			Engineering Design, Surveys, Land Acquisition, Utility Relocation and Permits (45%)	$84,341.99
			Total Costs	**$271,768.63**
			Estimated Project Costs	***$280,000.00***

PN9110 BMP/LID, Education



Address:	701 Walker Road
Location:	Great Falls Elementary School
Land Owner:	County
PIN:	0074 01 0055A, 0074 14 0003A
Control Type	Quality
Drainage Area	3.84 acres
Receiving Waters	Mine Run Branch

Description: Install a bioretention area behind the Great Falls Elementary School, along the lower end of the basketball courts. Install educational signage and institute educational programs.



Project Area Map

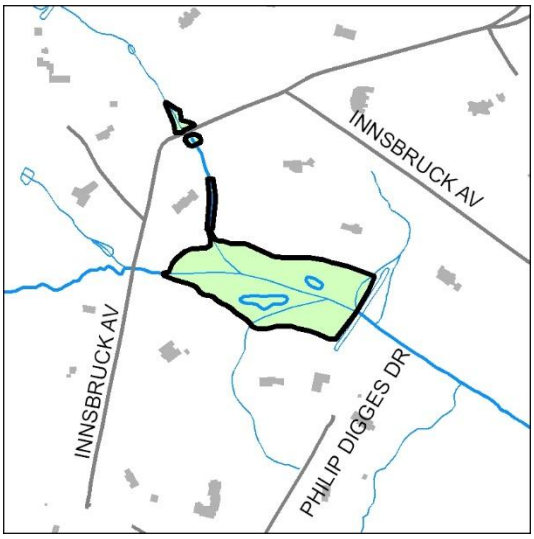
Project Benefits: This project will improve water quality by reducing sediment and nutrient loadings, reduce stormwater peak flows for small storm events, reduce stormwater runoff volumes by promoting infiltration, and provide for evapotranspiration and wildlife habitat. An estimated 1,080 lbs/yr of total suspended solids, 13 lbs/yr of nitrogen, and 3 lbs/yr of phosphorus will be removed. This project provides an excellent opportunity for educational programs.

Project Design Considerations: Minimal environmental permitting requirements are anticipated. A portion of the project is located in a Transco Gas easement. The property is owned by the county, so no storm drainage easements are necessary. Accessibility is excellent from the parking lot. There are no tree impacts or significant construction issues anticipated.

Costs:

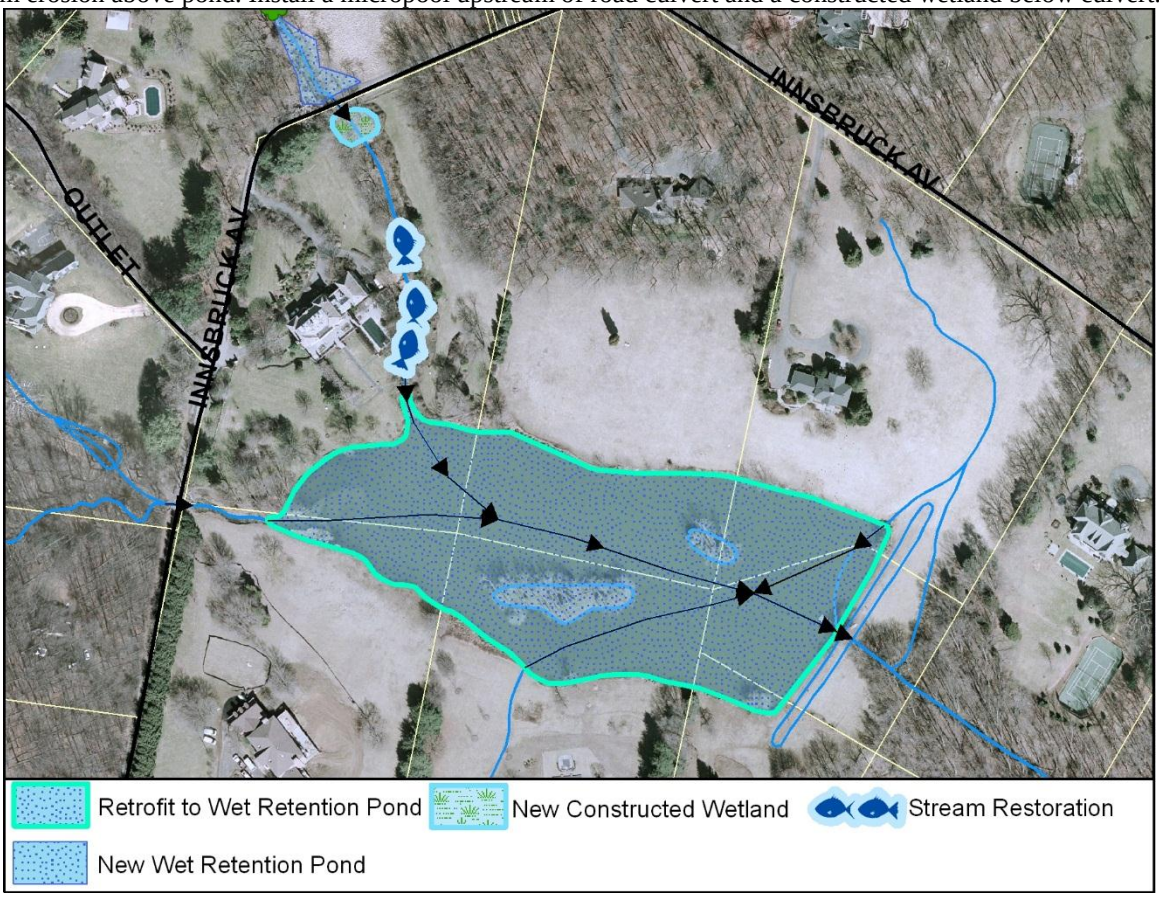
Item	*Units*	*Quantity*	*Unit Cost*	*Total*
Percolation/Infiltration Trench	SY	0	$75.00	$0.00
Bioretention Filters & Basin	SY	250	$150.00	$37,500.00
Organic Compost Soil Amendment	CY	15	$40.00	$600.00
			Initial Project Costs	**$38,100.00**
Plantings: 5% of project costs (unless incl. as line item)				$1,905.00
Ancillary Items: 5% of project cost				$1,905.00
Erosion and Sediment Control: 10% of project costs				$3,810.00
			Base Construction Costs	**$45,720.00**
			Mobilization (5%)	$2,286.00
			Subtotal 1	**$48,006.00**
			Contingency (25%)	$12,001.50
			Subtotal 2	**$60,007.50**
			Engineering Design, Surveys, Land Acquisition, Utility Relocation and Permits (45%)	$27,003.38
			Total Costs	**$87,010.88**
			Estimated Project Costs	***$90,000.00***

PN9111 Stormwater Pond (New/Retrofit),Culvert Retrofit, Stream Restoration



Address:	619 Insbruck Avenue
Location:	Marmota Farm Subdivision
Land Owner:	Private
PIN:	0083 12 0011, 0083 08 B3, 0083 08 0002, 0083 08 0003, 0083 08 0004, 0131 06 A, 0131 06 0005, 0083 08 0001
Control Type	Quality/Quanity
Drainage Area	485.29 acres
Receiving Waters	Mine Run Branch

Description: Retrofit existing non-stormwater wet pond (WP0209) to wet retention pond by installing proper outlet structure, constructing sediment forebay in western inlet and lowering water level slightly to provide storage. Repair stream erosion above pond. Install a micropool upstream of road culvert and a constructed wetland below culvert.



Project Area Map

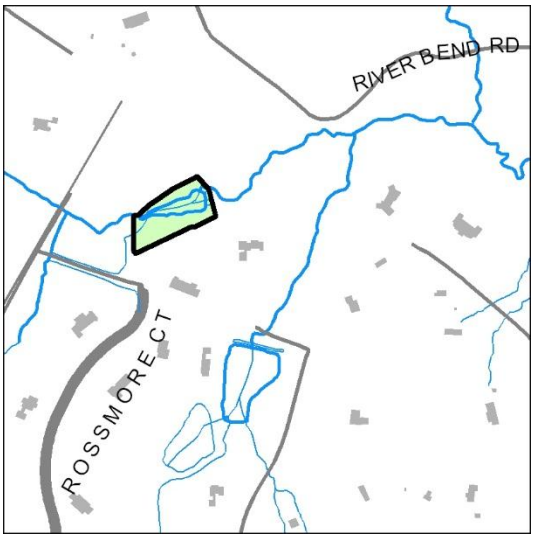
Project Benefits: This project will reduce sediment and nutrient loadings, improve water quality in downstream waterbodies, increase storage volume, reduce peak stormwater flows up to the 10-year event, and provide for evapotranspiration and wildlife habitat. The new outlet structure will allow for a more controlled stormwater discharge to enhance the performance of the pond. Aeration increases the level of dissolved oxygen to balance normal biological processes, circulates water to deter algae, and improves water quality within a pond. This project will also repair eroded streambanks. An estimated 2,500 lbs/yr of total suspended solids, 38 lbs/yr of nitrogen, and 7 lbs/yr of phosphorus will be removed.

Project Design Considerations: Minimal environmental permitting requirements are anticipated. Additional permitting may be required for a project within a stream or wetland. Projects in RPAs may require exceptions or waivers. This is an existing stormwater facility but is not located within a County storm drainage easement. Storm drainage easements will be necessary. Accessibility is excellent from Insbruck Avenue. Tree impacts are expected. No significant construction issues are anticipated.

Costs:

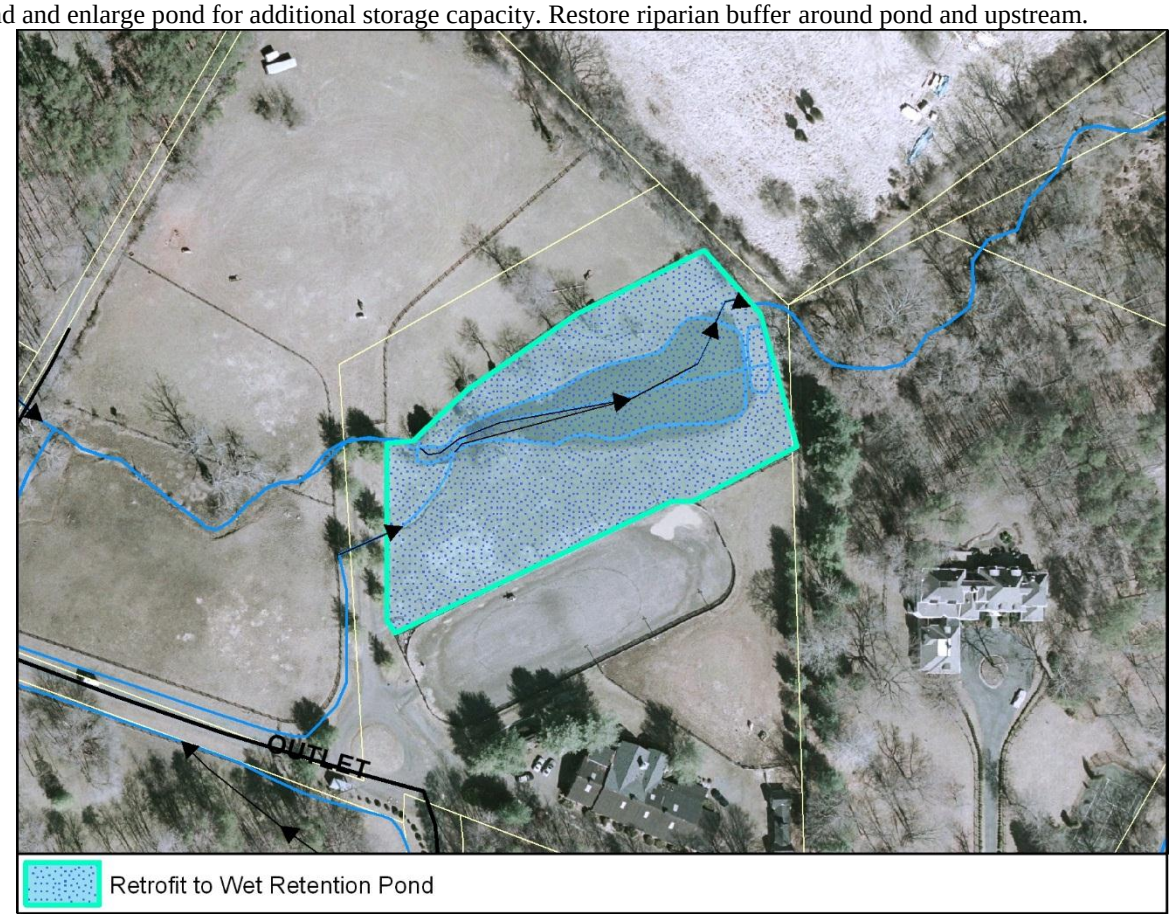
Item	*Units*	*Quantity*	*Unit Cost*	*Total*
Organic Compost Soil Amendment	CY	95	$40.00	$3,800.00
Plantings	AC	0.3	$25,000.00	$7,500.00
Clear and Grub	AC	0.4	$8,500.00	$3,400.00
Grading and Excavation	CY	4030	$35.00	$141,050.00
Access Road	SY	400	$25.00	$10,000.00
Access Road Gate	EA	2	$2,500.00	$5,000.00
Embankment	CY	500	$50.00	$25,000.00
Outflow Pipe	LF	100	$125.00	$12,500.00
RipRap Stabilization	SY	100	$100.00	$10,000.00
Construct New Channel	LF	240	$200.00	$48,000.00
Additional Cost (first 500LF)	LF	240	$200.00	$48,000.00
Structural BMP and Incidentals (Med)	LS	2	$15,000.00	$30,000.00
New Storm Pipe (Med)	LF	70	$200.00	$14,000.00
Structural BMP Retrofit and Incidentals (High)	LS	1	$20,000.00	$20,000.00
			Initial Project Costs	**$378,250.00**
Plantings: 5% of project costs (unless incl. as line item)				$0.00
Ancillary Items: 5% of project cost				$18,912.50
Erosion and Sediment Control: 10% of project costs				$37,825.00
			Base Construction Costs	**$434,987.50**
			Mobilization (5%)	$21,749.38
			Subtotal 1	**$456,736.88**
			Contingency (25%)	$114,184.22
			Subtotal 2	**$570,921.09**
			Engineering Design, Surveys, Land Acquisition, Utility Relocation and Permits (45%)	$256,914.49
			Total Costs	**$827,835.59**
			Estimated Project Costs	***$830,000.00***

PN9112 Stormwater Pond Retrofit



Address:	9638 Georgetown Pike
Location:	Near Rossmore Court cul-de-sac
Land Owner:	Private
PIN:	0131 01 0050B, 0131 05 0023A
Control Type	Quality/Quanity
Drainage Area	98.31 acres
Receiving Waters	Mine Run Branch

Description: This area does not have existing stormwater treatment. Retrofit existing farm pond to a wet retention pond and enlarge pond for additional storage capacity. Restore riparian buffer around pond and upstream.



Project Area Map

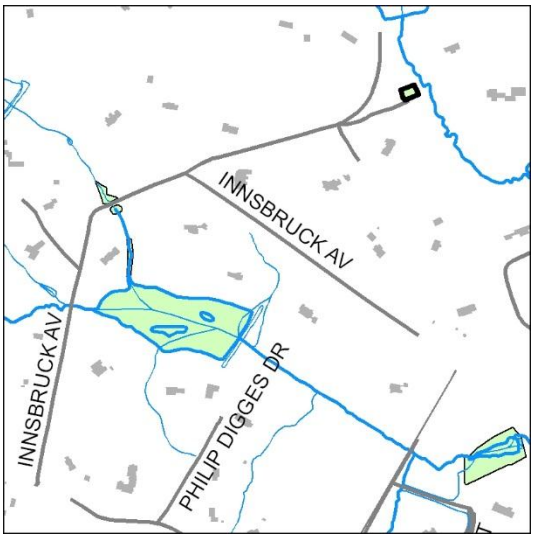
Project Benefits: This project will reduce sediment and nutrient loadings, improve water quality in downstream waterbodies, increase storage volume, reduce peak stormwater flows up to the 10-year event, and provide for evapotranspiration and wildlife habitat. The new outlet structure will allow for a more controlled stormwater discharge to enhance the performance of the pond. This project will also increase the storage capacity for the existing pond. Restoring the riparian buffer will also reduce stream temperatures. An estimated 4,660 lbs/yr of total suspended solids, 56 lbs/yr of nitrogen, and 13 lbs/yr of phosphorus will be removed.

Project Design Considerations: Minimal environmental permitting requirements are anticipated. Additional permitting may be required for a project within a stream or wetland. Projects in RPAs may require exceptions or waivers. This is a privately owned pond, and will require a storm drainage easement. Accessibility is excellent via an ingress-egress easement.. There are no tree impacts or significant construction issues anticipated.

Costs:

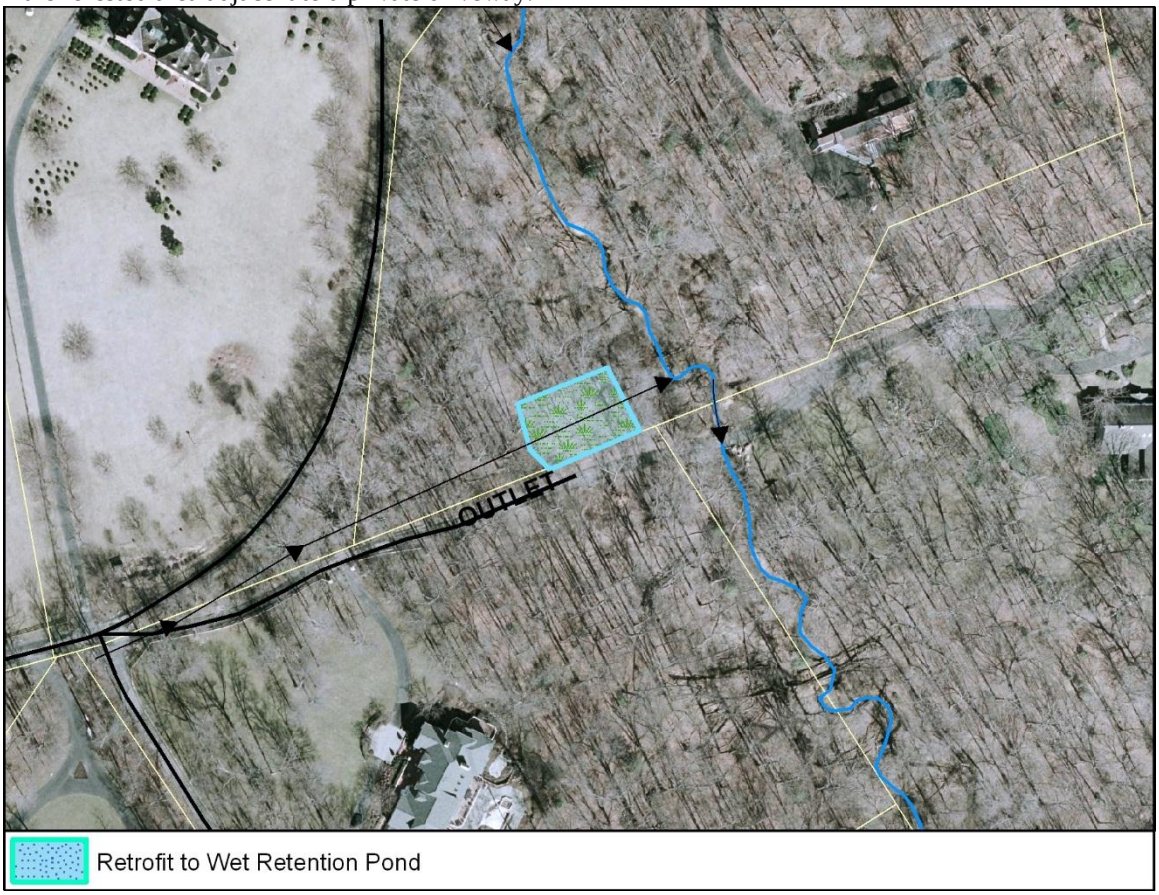
Item	*Units*	*Quantity*	*Unit Cost*	*Total*
Organic Compost Soil Amendment	CY	25	$40.00	$1,000.00
Plantings	AC	0.1	$25,000.00	$2,500.00
Clear and Grub	AC	0.1	$8,500.00	$850.00
Grading and Excavation	CY	2200	$35.00	$77,000.00
Embankment	CY	150	$50.00	$7,500.00
Outflow Pipe	LF	40	$125.00	$5,000.00
RipRap Stabilization	SY	25	$100.00	$2,500.00
Structural BMP Retrofit and Incidentals (Low)	LS	1	$10,000.00	$10,000.00
			Initial Project Costs	**$106,350.00**
Plantings: 5% of project costs (unless incl. as line item)				$0.00
Ancillary Items: 5% of project cost				$5,317.50
Erosion and Sediment Control: 10% of project costs				$10,635.00
			Base Construction Costs	**$122,302.50**
			Mobilization (5%)	$6,115.13
			Subtotal 1	**$128,417.63**
			Contingency (25%)	$32,104.41
			Subtotal 2	**$160,522.03**
			Engineering Design, Surveys, Land Acquisition, Utility Relocation and Permits (45%)	$72,234.91
			Total Costs	**$232,756.95**
			Estimated Project Costs	***$240,000.00***

PN9113 New Stormwater Pond



Address:	550 Insbruck Avenue
Location:	Arnon Lake Subdivision
Land Owner:	Private
PIN:	0083 01 0032, 0083 10 0021
Control Type	Quality
Drainage Area	10.05 acres
Receiving Waters	Mine Run Branch

Description: This area does not have existing stormwater treatment. Install a new constructed wetland in a low clearing within the forested area adjacent to a private driveway.



Project Area Map

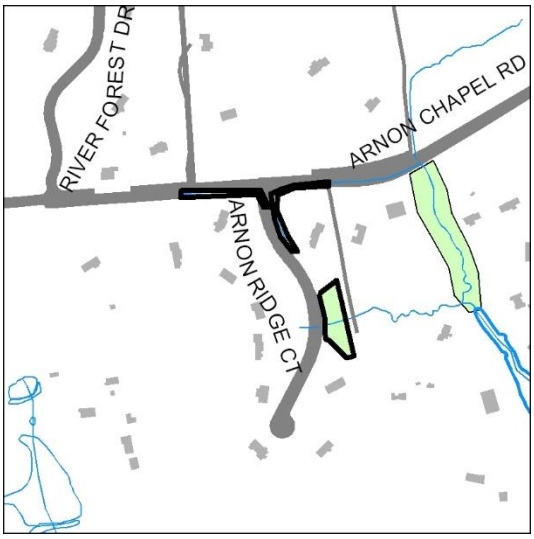
Project Benefits: The constructed wetlands will reduce stormwater peak flows for small storm events, reduce sediment and nutrient loadings, and provide for evaporation, evapotranspiration and wildlife habitat. An estimated 1,993 lbs/yr of total suspended solids, 24 lbs/yr of nitrogen, and 6 lbs/yr of phosphorus will be removed.

Project Design Considerations: Minimal environmental permitting requirements are anticipated. Additional permitting may be required for a project within a stream or wetland. Projects in RPAs may require exceptions or waivers. A storm drainage easement will be necessary. Accessibility is excellent from an ingress-egress easement along a private driveway. Tree impacts are anticipated. No significant construction issues are anticipated.

Costs:

Item	*Units*	*Quantity*	*Unit Cost*	*Total*
Organic Compost Soil Amendment	CY	50	$40.00	$2,000.00
Plantings	AC	0.2	$25,000.00	$5,000.00
Clear and Grub	AC	0.2	$8,500.00	$1,700.00
Grading and Excavation	CY	250	$35.00	$8,750.00
Access Road	SY	170	$25.00	$4,250.00
Access Road Gate	EA	1	$2,500.00	$2,500.00
Structural BMP and Incidentals (Low)	LS	1	$10,000.00	$10,000.00
New Storm Pipe (Low)	LF	25	$100.00	$2,500.00
Embankment	CY	100	$50.00	$5,000.00
			Initial Project Costs	**$41,700.00**
Plantings: 5% of project costs (unless incl. as line item)				$0.00
Ancillary Items: 5% of project cost				$2,085.00
Erosion and Sediment Control: 10% of project costs				$4,170.00
			Base Construction Costs	**$47,955.00**
			Mobilization (5%)	$2,397.75
			Subtotal 1	**$50,352.75**
			Contingency (25%)	$12,588.19
			Subtotal 2	**$62,940.94**
			Engineering Design, Surveys, Land Acquisition, Utility Relocation and Permits (45%)	$28,323.42
			Total Costs	**$91,264.36**
			Estimated Project Costs	***$100,000.00***

PN9114 Stormwater Pond Retrofit, BMP/LID



Address:	501 Arnon Ridge Court
Location:	Arnon Ridge Subdivision
Land Owner:	County/Private
PIN:	0083 11 0002, 0083 11 0009, 0083 11 0010
Control Type	Quality/Quanity
Drainage Area	12 acres
Receiving Waters	Mine Run Branch

Description: The Arnon Ridge area is in need of additional water quality treatment. Retrofit naturalized dry pond (0182DP) to enhanced extended detention dry pond by installing outlet structure. Replace concrete and grass swales with vegetated swales and check dams.

Project Area Map

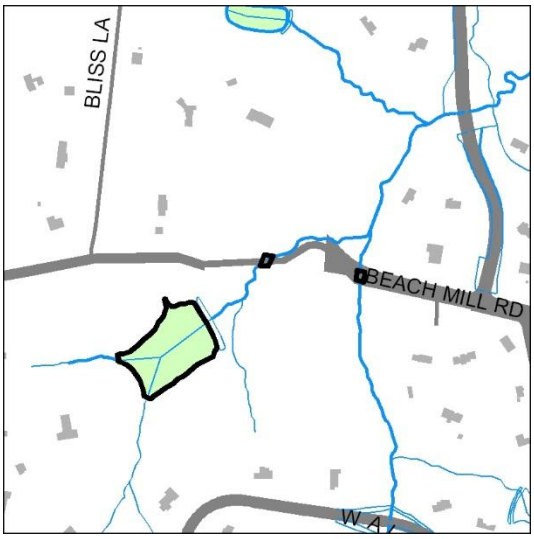
Project Benefits: This project will improve water quality by reducing sediment and nutrient loadings, reduce peak stormwater flows for storms up to the 10-year event, and provide for evapotranspiration and wildlife habitat. The new outlet structure will allow for a more controlled stormwater discharge to enhance the performance of the pond. Removal of the trickle ditch will also reduce stormwater velocities. An estimated 1,156 lbs/yr of total suspended solids, 14 lbs/yr of nitrogen, and 2 lbs/yr of phosphorus will be removed.

Project Design Considerations: Minimal environmental permitting requirements are anticipated. Additional permitting may be required for a project within a stream or wetland. This is a county facility, and is located within a storm drainage esement. Additional storm drainage easements will be necessary. Parts of the project are located along or within road rights-of-way. Accessibility is excellent from adjacent roads. There are no tree impacts or significant construction issues anticipated.

Costs:

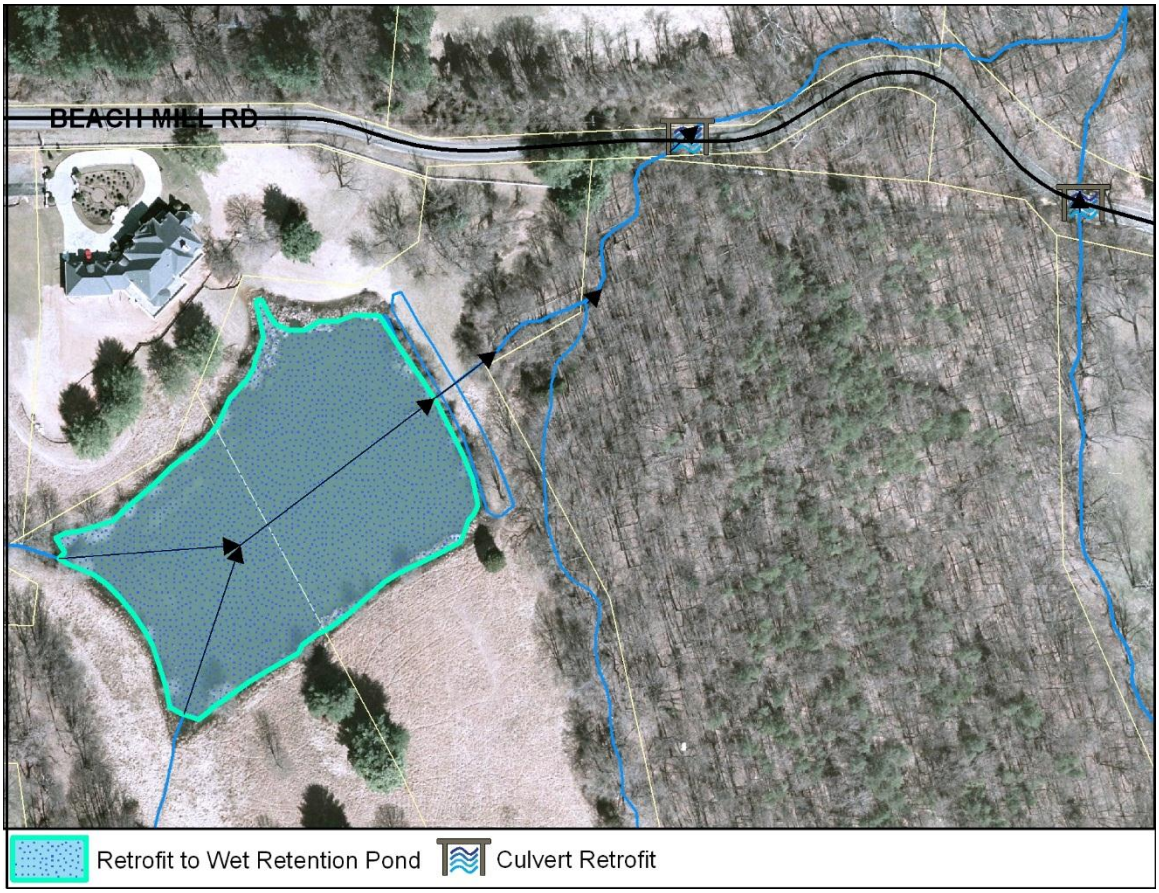
Item	*Units*	*Quantity*	*Unit Cost*	*Total*
Vegetated Swale	SY	1040	$50.00	$52,000.00
Organic Compost Soil Amendment	CY	130	$40.00	$5,200.00
Plantings	AC	0.1	$25,000.00	$2,500.00
Clear and Grub	AC	0.1	$8,500.00	$850.00
Grading and Excavation	CY	100	$35.00	$3,500.00
Embankment	CY	100	$50.00	$5,000.00
Outflow Pipe	LF	20	$125.00	$2,500.00
RipRap Stabilization	SY	15	$100.00	$1,500.00
Structural BMP Retrofit and Incidentals (Low)	LS	1	$10,000.00	$10,000.00
			Initial Project Costs	**$83,050.00**
Plantings: 5% of project costs (unless incl. as line item)				$0.00
Ancillary Items: 5% of project cost				$4,152.50
Erosion and Sediment Control: 10% of project costs				$8,305.00
			Base Construction Costs	**$95,507.50**
			Mobilization (5%)	$4,775.38
			Subtotal 1	**$100,282.88**
			Contingency (25%)	$25,070.72
			Subtotal 2	**$125,353.59**
			Engineering Design, Surveys, Land Acquisition, Utility Relocation and Permits (45%)	$56,409.12
			Total Costs	**$181,762.71**
			Estimated Project Costs	***$190,000.00***

PN9116 Stormwater Pond Retrofit, Culvert Retrofit



Address:	10223 Beach Mill Road
Location:	Near Beach Mill Road & Springvale Road
Land Owner:	County/Private
PIN:	0034 01 0034A, 0034 01 0034B, 0034 04 A, 0034 04 0062
Control Type	Quality/Quanity
Drainage Area	278.83 acres
Receiving Waters	Pond Branch

Description: Flooding is overtopping Beach Mill Road and causing erosion at two road culverts. Install outlet structure in wet pond (WP0202) to provide storage. Raise the road bed, install larger culverts, and stabilize streambanks above and below the culverts.



Project Area Map

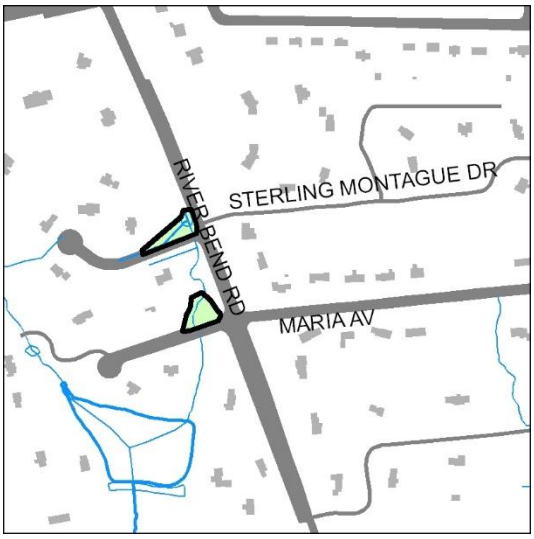
Project Benefits: The constructed wetlands will reduce stormwater peak flows for small storm events, reduce sediment and nutrient loadings, and provide for evaporation, evapotranspiration and wildlife habitat. The new outlet structure will allow for a more controlled stormwater discharge to enhance the performance of the pond. This project will also reduce flooding caused by undersized culverts, and will repair and stabilize streambank damage caused by flooding. An estimated 2,423 lbs/yr of total suspended solids, 29 lbs/yr of nitrogen, and 7 lbs/yr of phosphorus will be removed.

Project Design Considerations: Minimal environmental permitting requirements are anticipated. Additional permitting may be required for a project within a stream or wetland. Projects in RPAs may require exceptions or waivers. This is an existing private facility that is not located within a storm drainage easement. Storm drainage easements will be necessary. The two culverts are located within the road rights-of-way. Accessibility is excellent from Beach Mill Road. There are no tree impacts or significant construction issues anticipated.

Costs:

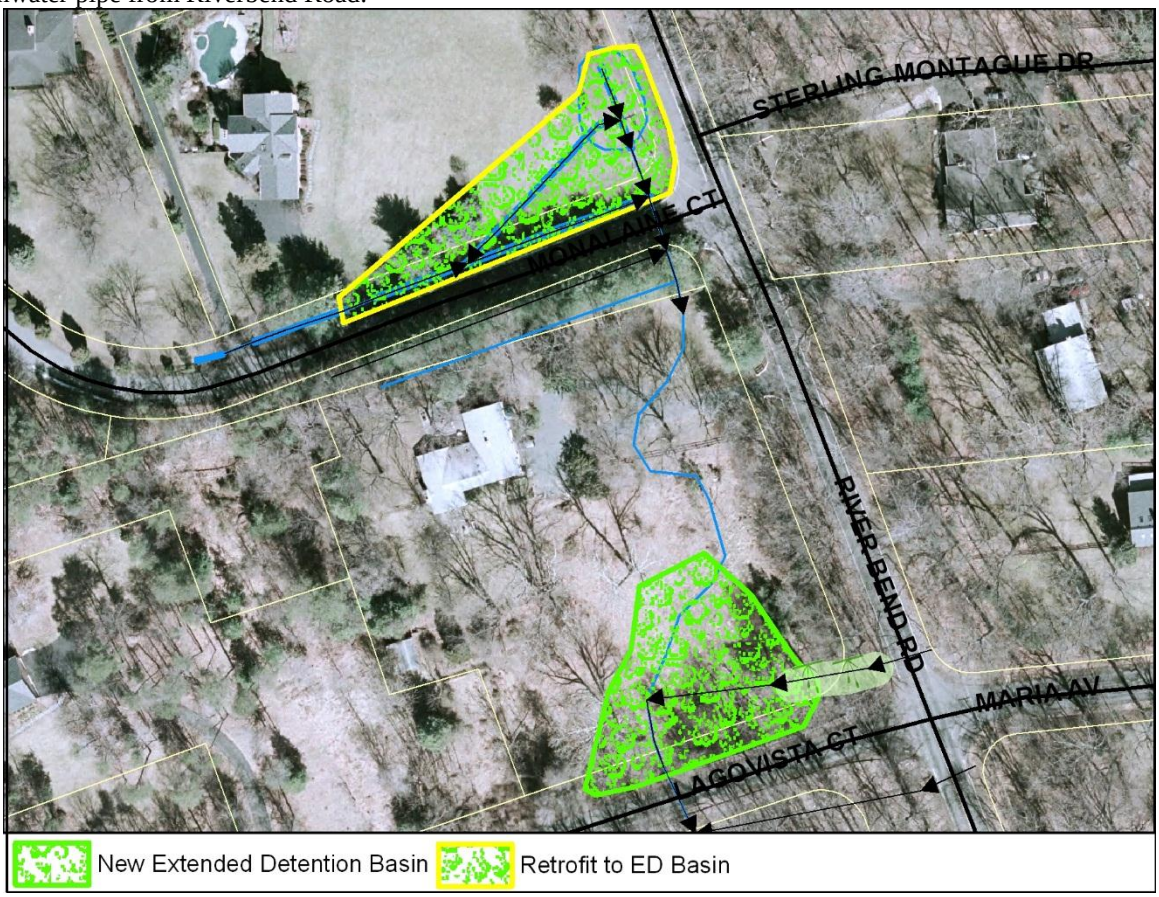
Item	*Units*	*Quantity*	*Unit Cost*	*Total*
Organic Compost Soil Amendment	CY	75	$40.00	$3,000.00
Plantings	AC	0.2	$25,000.00	$5,000.00
Clear and Grub	AC	0.2	$8,500.00	$1,700.00
Grading and Excavation	CY	2400	$35.00	$84,000.00
Earthen Berm	CY	150	$35.00	$5,250.00
Embankment	CY	150	$50.00	$7,500.00
Outflow Pipe	LF	100	$125.00	$12,500.00
RipRap Stabilization	SY	80	$100.00	$8,000.00
New Storm Pipe (Med)	LF	200	$200.00	$40,000.00
Structural BMP Retrofit and Incidentals (Med)	LS	1	$15,000.00	$15,000.00
			Initial Project Costs	**$181,950.00**
Plantings: 5% of project costs (unless incl. as line item)				$0.00
Ancillary Items: 5% of project cost				$9,097.50
Erosion and Sediment Control: 10% of project costs				$18,195.00
			Base Construction Costs	**$209,242.50**
			Mobilization (5%)	$10,462.13
			Subtotal 1	**$219,704.63**
			Contingency (25%)	$54,926.16
			Subtotal 2	**$274,630.78**
			Engineering Design, Surveys, Land Acquisition, Utility Relocation and Permits (45%)	$123,583.85
			Total Costs	**$398,214.63**
			Estimated Project Costs	***$400,000.00***

PN9117 New Stormwater Pond, Stormwater Pond Retrofit



Address:	414 River Bend Road
Location:	Monalaine Court & River Bend Road
Land Owner:	County/Private
PIN:	0084 01 0013E, 0084 10 0001
Control Type	Quality/Quanity
Drainage Area	33.96 acres
Receiving Waters	Mine Run Branch

Description: Expand existing dry pond (0303DP) to intercept drainage from McNalane Court; retrofit to naturalized extended detention dry pond. Construct new naturalized extended detention basin in existing depression; daylight stormwater pipe from Riverbend Road.



Project Area Map

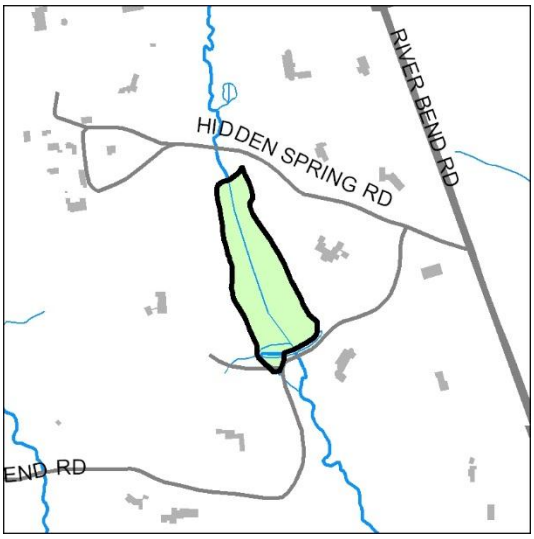
Project Benefits: This project will improve water quality by reducing sediment and nutrient loadings, reduce peak stormwater flows for storms up to the 10-year event, and provide for evapotranspiration and wildlife habitat. This project will also increase the storage capacity of the existing pond. The new outlet structure will allow for a more controlled stormwater discharge to enhance the performance of the pond. Removal of the trickle ditch will also reduce stormwater velocities. An estimated 978 lbs/yr of total suspended solids, 11 lbs/yr of nitrogen, and 2 lbs/yr of phosphorus will be removed.

Project Design Considerations: Minimal environmental permitting requirements are anticipated. Additional permitting may be required for a project within a stream or wetland. A storm drainage easement will be necessary for the privately-owned existing stormwater basin. Part of the proposed enhanced extended detention dry pond is located within a storm drainage easement which may need to be enlarged. Accessibility is excellent from River Bend Road. No tree impacts are anticipated. Existing storm sewer must be daylighted. The dry ponds must be deep enough to intercept piped storm sewers.

Costs:

Item	*Units*	*Quantity*	*Unit Cost*	*Total*
Organic Compost Soil Amendment	CY	85	$40.00	$3,400.00
Plantings	AC	0.3	$25,000.00	$7,500.00
Clear and Grub	AC	0.33	$8,500.00	$2,805.00
Grading and Excavation	CY	2050	$35.00	$71,750.00
Access Road	SY	300	$25.00	$7,500.00
Access Road Gate	EA	1	$2,500.00	$2,500.00
Embankment	CY	225	$50.00	$11,250.00
Outflow Pipe	LF	75	$125.00	$9,375.00
RipRap Stabilization	SY	30	$100.00	$3,000.00
Structural BMP and Incidentals (Med)	LS	1	$15,000.00	$15,000.00
New Storm Pipe (Med)	LF	60	$200.00	$12,000.00
Structural BMP Retrofit and Incidentals (Med)	LS	1	$15,000.00	$15,000.00
			Initial Project Costs	**$161,080.00**
Plantings: 5% of project costs (unless incl. as line item)				$0.00
Ancillary Items: 5% of project cost				$8,054.00
Erosion and Sediment Control: 10% of project costs				$16,108.00
			Base Construction Costs	**$185,242.00**
			Mobilization (5%)	$9,262.10
			Subtotal 1	**$194,504.10**
			Contingency (25%)	$48,626.03
			Subtotal 2	**$243,130.13**
			Engineering Design, Surveys, Land Acquisition, Utility Relocation and Permits (45%)	$109,408.56
			Total Costs	**$352,538.68**
			Estimated Project Costs	***$360,000.00***

PN9118 Stormwater Pond Retrofit, Culvert Retrofit



Address:	456 River Bend Road
Location:	Near River Bend Road & Hidden Springs Road
Land Owner:	Private
PIN:	0084 01 0020, 0084 01 0021, 0084 01 0025, 0084 01 0028, 0084 01 0034Z, 0084 01 0036, 0084 09 0012
Control Type	Quality/Quanity
Drainage Area	181.34 acres
Receiving Waters	Mine Run Branch

Description: Retrofit existing farm pond (FM0002) to wet retention pond; install outlet structure and lower water level for additional storage. Repair and stabilize erosion impacts to spillway and downstream channel and culvert at River Bend Road.

Project Area Map

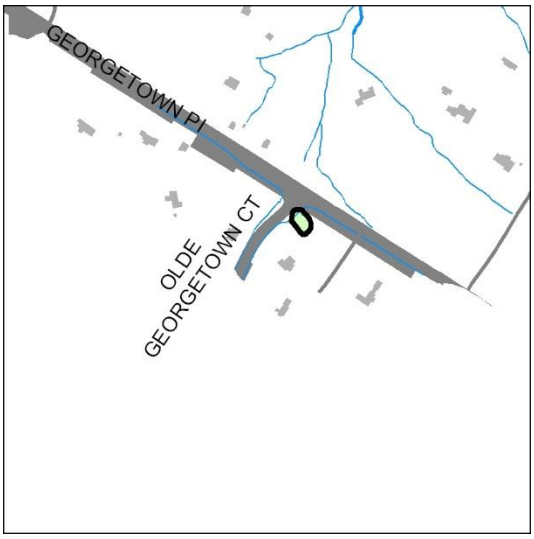
Project Benefits: This project will reduce sediment and nutrient loadings, improve water quality in downstream waterbodies, increase storage volume, reduce peak stormwater flows up to the 10-year event, and provide for evapotranspiration and wildlife habitat. This project will also repair damage to the spillway. The new outlet structure will allow for a more controlled stormwater discharge to enhance the performance of the pond. This project will also repair damage to River Bend Road and stabilize the channel. An estimated 1,612 lbs/yr of total suspended solids, 19 lbs/yr of nitrogen, and 5 lbs/yr of phosphorus will be removed.

Project Design Considerations: Minimal environmental permitting requirements are anticipated. Additional permitting may be required for a project within a stream or wetland. Projects in RPAs may require exceptions or waivers. The farm pond is privately owned by multiple owners. A storm drainage easement will be necessary. Accessibility is excellent via an ingress-egress easement from nearby roads. There are no tree impacts or significant construction issues anticipated.

Costs:

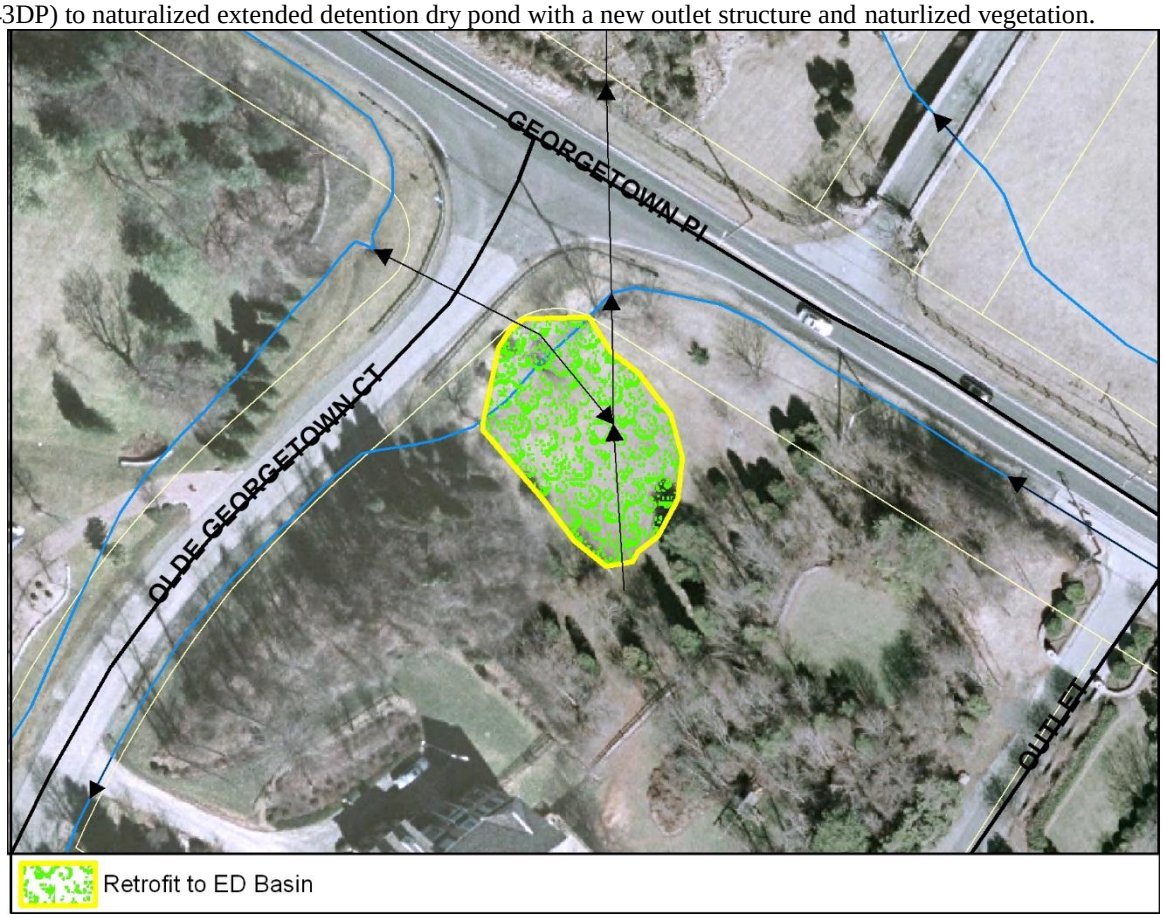
Item	*Units*	*Quantity*	*Unit Cost*	*Total*
Organic Compost Soil Amendment	CY	40	$40.00	$1,600.00
Plantings	AC	0.1	$25,000.00	$2,500.00
Clear and Grub	AC	0.1	$8,500.00	$850.00
Grading and Excavation	CY	250	$35.00	$8,750.00
Embankment	CY	150	$50.00	$7,500.00
Outflow Pipe	LF	50	$125.00	$6,250.00
RipRap Stabilization	SY	75	$100.00	$7,500.00
Structural BMP Retrofit and Incidentals (High)	LS	1	$20,000.00	$20,000.00
			Initial Project Costs	**$54,950.00**
Plantings: 5% of project costs (unless incl. as line item)				$0.00
Ancillary Items: 5% of project cost				$2,747.50
Erosion and Sediment Control: 10% of project costs				$5,495.00
			Base Construction Costs	**$63,192.50**
			Mobilization (5%)	$3,159.63
			Subtotal 1	**$66,352.13**
			Contingency (25%)	$16,588.03
			Subtotal 2	**$82,940.16**
			Engineering Design, Surveys, Land Acquisition, Utility Relocation and Permits (45%)	$37,323.07
			Total Costs	**$120,263.23**
			Estimated Project Costs	***$130,000.00***

PN9119 Stormwater Pond Retrofit



Address:	801 Olde Georgetown Court
Location:	Fallswood Subdivision
Land Owner:	Private
PIN:	0132 07 0009
Control Type	Quality/Quanity
Drainage Area	3.45 acres
Receiving Waters	Mine Run Branch

Description: Fallswood subdivision is in need of additional water quality treatment. Retrofit existing dry pond (1443DP) to naturalized extended detention dry pond with a new outlet structure and naturlized vegetation.



Project Area Map

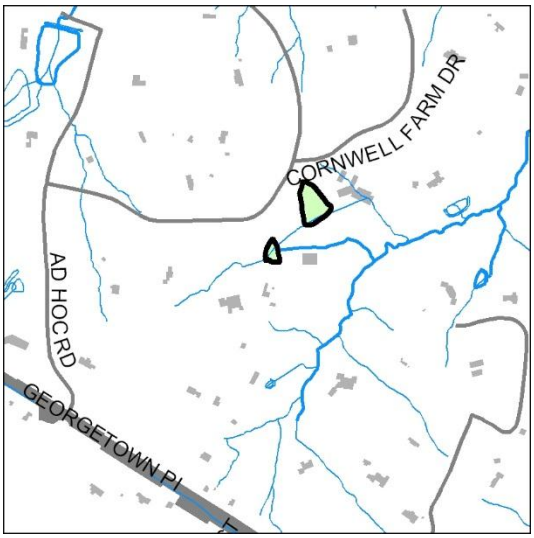
Project Benefits: This project will improve water quality by reducing sediment and nutrient loadings, reduce peak stormwater flows for storms up to the 10-year event, and provide for evapotranspiration and wildlife habitat. The new outlet structure will allow for a more controlled stormwater discharge to enhance the performance of the pond. An estimated 229 lbs/yr of total suspended solids, 3 lbs/yr of nitrogen, and 1 lb/yr of phosphorus will be removed.

Project Design Considerations: Minimal environmental permitting requirements are anticipated. Additional permitting may be required for a project within a stream or wetland. This is an existing stormwater facility that is not within a storm drainage easement. A storm drainage easement will be necessary. Accessibility is excellent from Olde Georgetown Court. There are no tree impacts or significant construction issues anticipated.

Costs:

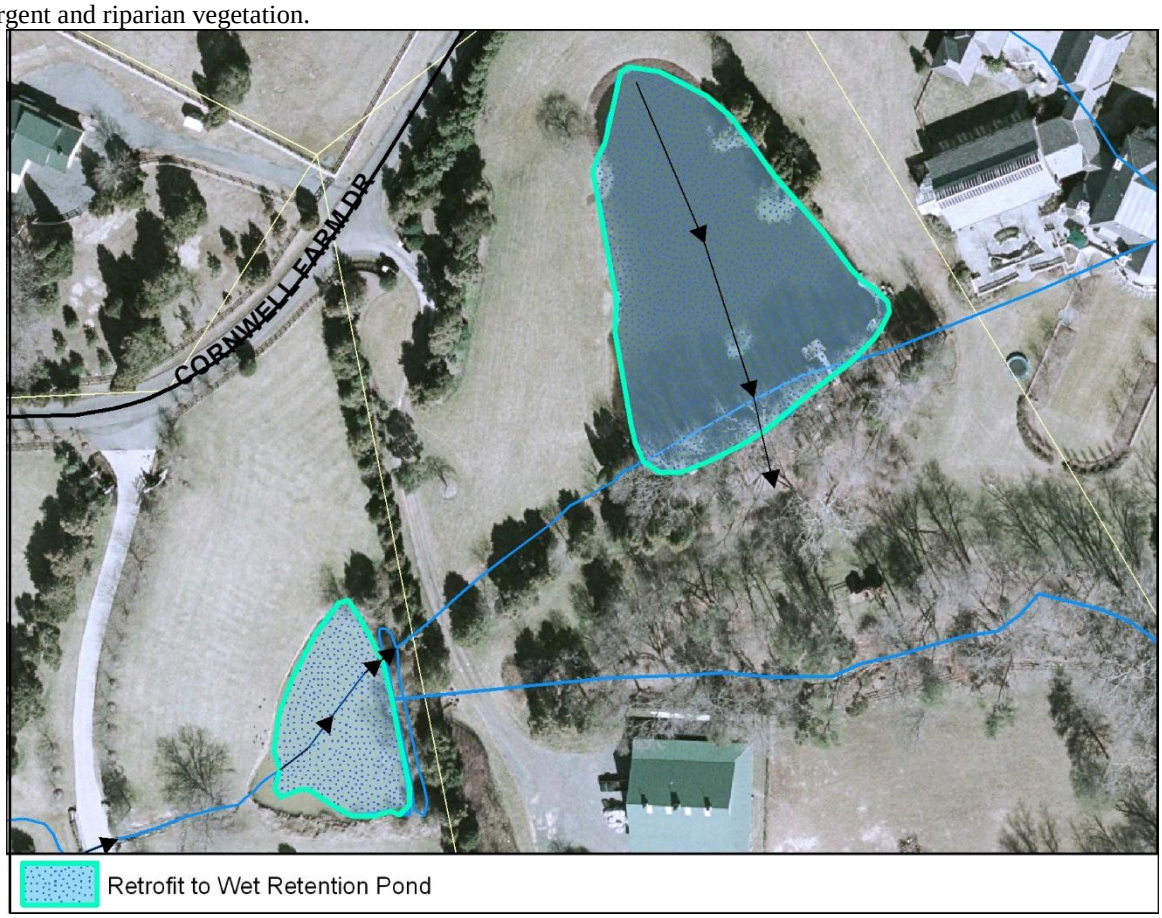
Item	*Units*	*Quantity*	*Unit Cost*	*Total*
Organic Compost Soil Amendment	CY	40	$40.00	$1,600.00
Plantings	AC	0.15	$25,000.00	$3,750.00
Clear and Grub	AC	0.1	$8,500.00	$850.00
Grading and Excavation	CY	360	$35.00	$12,600.00
Embankment	CY	100	$50.00	$5,000.00
Outflow Pipe	LF	55	$125.00	$6,875.00
RipRap Stabilization	SY	15	$100.00	$1,500.00
Structural BMP Retrofit and Incidentals (Low)	LS	1	$10,000.00	$10,000.00
			Initial Project Costs	**$42,175.00**
Plantings: 5% of project costs (unless incl. as line item)				$0.00
Ancillary Items: 5% of project cost				$2,108.75
Erosion and Sediment Control: 10% of project costs				$4,217.50
			Base Construction Costs	**$48,501.25**
			Mobilization (5%)	$2,425.06
			Subtotal 1	**$50,926.31**
			Contingency (25%)	$12,731.58
			Subtotal 2	**$63,657.89**
			Engineering Design, Surveys, Land Acquisition, Utility Relocation and Permits (45%)	$28,646.05
			Total Costs	**$92,303.94**
			Estimated Project Costs	***$100,000.00***

PN9120 Stormwater Pond Retrofit



Address:	9401Cornwell Farm Drive
Location:	Cornwell Farm Subdivision
Land Owner:	Private
PIN:	0132 06 0005A, 0132 06 0004A
Control Type	Quality/Quanity
Drainage Area	17.05 acres
Receiving Waters	Mine Run Branch

Description: This area of Cornwell Farm subdivision does not have existing stormwater treatment. Retrofit two existing ponds to wet retention ponds; install outlet structures and lower water levels for additional storage, plant emergent and riparian vegetation.



Project Area Map

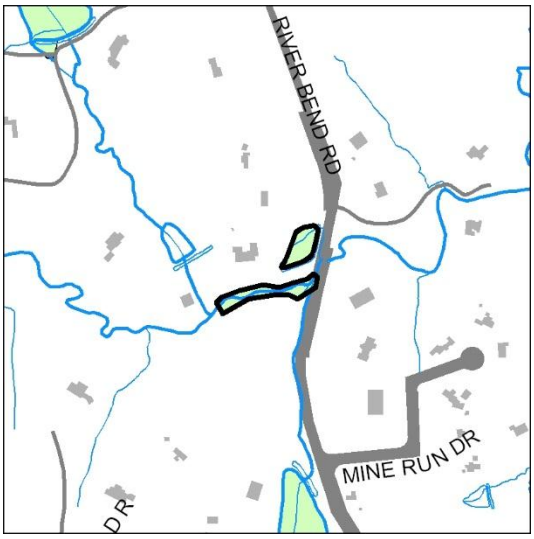
Project Benefits: This project will reduce sediment and nutrient loadings, improve water quality in downstream waterbodies, increase storage volume, reduce peak stormwater flows up to the 10-year event, and provide for evapotranspiration and wildlife habitat. The new outlet structures will allow for a more controlled stormwater discharge to enhance the performance of the ponds. An estimated 2,150 lbs/yr of total suspended solids, 26 lbs/yr of nitrogen, and 6 lbs/yr of phosphorus will be removed.

Project Design Considerations: Minimal environmental permitting requirements are anticipated. Additional permitting may be required for a project within a stream or wetland. Projects in RPAs may require exceptions or waivers. These ponds are privately owned and will require storm drainage easements. Accessibility is excellent from Cornwell Farm Drive. There are no tree impacts or significant construction issues anticipated.

Costs:

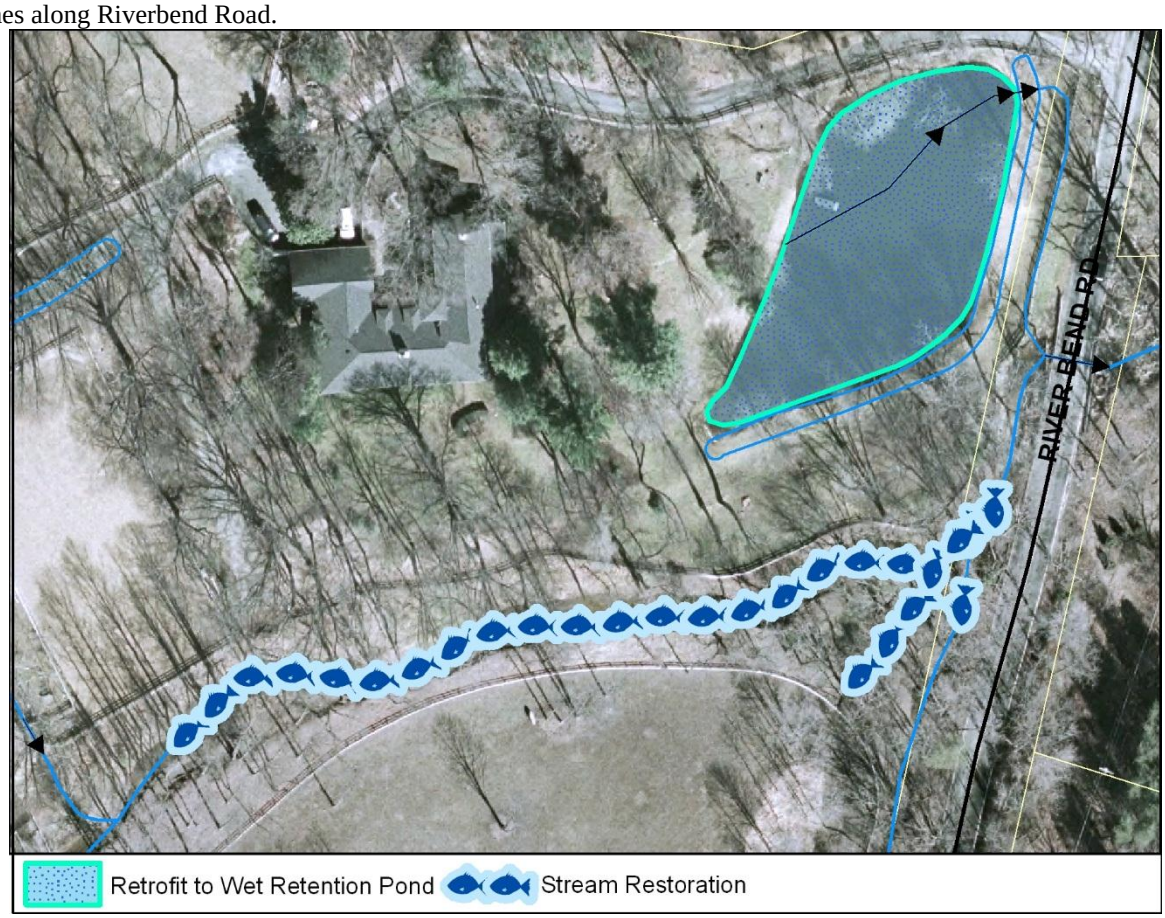
Item	*Units*	*Quantity*	*Unit Cost*	*Total*
Organic Compost Soil Amendment	CY	50	$40.00	$2,000.00
Plantings	AC	0.15	$25,000.00	$3,750.00
Clear and Grub	AC	0.1	$8,500.00	$850.00
Grading and Excavation	CY	350	$35.00	$12,250.00
Embankment	CY	175	$50.00	$8,750.00
Outflow Pipe	LF	130	$125.00	$16,250.00
RipRap Stabilization	SY	45	$100.00	$4,500.00
Structural BMP Retrofit and Incidentals (Low)	LS	2	$10,000.00	$20,000.00
			Initial Project Costs	**$68,350.00**
Plantings: 5% of project costs (unless incl. as line item)				$0.00
Ancillary Items: 5% of project cost				$3,417.50
Erosion and Sediment Control: 10% of project costs				$6,835.00
			Base Construction Costs	**$78,602.50**
			Mobilization (5%)	$3,930.13
			Subtotal 1	**$82,532.63**
			Contingency (25%)	$20,633.16
			Subtotal 2	**$103,165.78**
			Engineering Design, Surveys, Land Acquisition, Utility Relocation and Permits (45%)	$46,424.60
			Total Costs	**$149,590.38**
			Estimated Project Costs	***$150,000.00***

PN9122 Stormwater Pond Retrofit, Stream Restoration



Address:	528 River Bend Road
Location:	Jackson Hills Subdivision
Land Owner:	Private
PIN:	0132 04 B
Control Type	Quality/Quanity
Drainage Area	76.58 acres
Receiving Waters	Mine Run Branch

Description: Mine Run streambanks are incised and undercut. Re-grade and stabilize erosion impacts upstream of Riverbend Road. Retrofit nearby farm pond to wet retention pond to provide storage and water quality treatment for homes along Riverbend Road.



Project Area Map

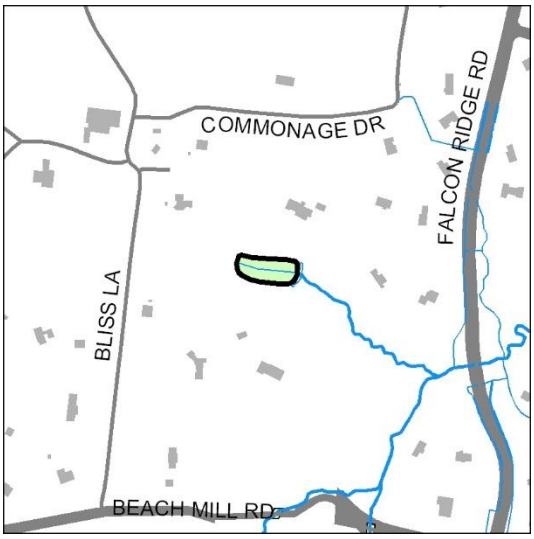
Project Benefits: This project will reduce sediment and nutrient loadings, improve water quality in downstream waterbodies, increase storage volume, reduce peak stormwater flows up to the 10-year event, and provide for evapotranspiration and wildlife habitat. The new outlet structure will allow for a more controlled stormwater discharge to enhance the performance of the pond. This project will also stabilize and restore the streambanks. An estimated 23,176 lbs/yr of total suspended solids, 21 lbs/yr of nitrogen, and 8 lbs/yr of phosphorus will be removed.

Project Design Considerations: Minimal environmental permitting requirements are anticipated. Additional permitting may be required for a project within a stream or wetland. Projects in RPAs may require exceptions or waivers. This is a privately owned pond, and will require a storm drainage easement. Accessibility is excellent from River Bend Road. There are no tree impacts or significant construction issues anticipated.

Costs:

Item	*Units*	*Quantity*	*Unit Cost*	*Total*
Organic Compost Soil Amendment	CY	40	$40.00	$1,600.00
Plantings	AC	0.1	$25,000.00	$2,500.00
Clear and Grub	AC	0.05	$8,500.00	$425.00
Grading and Excavation	CY	150	$35.00	$5,250.00
Embankment	CY	100	$50.00	$5,000.00
Outflow Pipe	LF	50	$125.00	$6,250.00
RipRap Stabilization	SY	30	$100.00	$3,000.00
Construct New Channel	LF	470	$200.00	$94,000.00
Additional Cost (first 500LF)	LF	470	$200.00	$94,000.00
Structural BMP Retrofit and Incidentals (Low)	LS	1	$10,000.00	$10,000.00
			Initial Project Costs	**$222,025.00**
Plantings: 5% of project costs (unless incl. as line item)				$0.00
Ancillary Items: 5% of project cost				$11,101.25
Erosion and Sediment Control: 10% of project costs				$22,202.50
			Base Construction Costs	**$255,328.75**
			Mobilization (5%)	$12,766.44
			Subtotal 1	**$268,095.19**
			Contingency (25%)	$67,023.80
			Subtotal 2	**$335,118.98**
			Engineering Design, Surveys, Land Acquisition, Utility Relocation and Permits (45%)	$150,803.54
			Total Costs	**$485,922.53**
			Estimated Project Costs	***$490,000.00***

PN9123 Stormwater Pond Retrofit



Address:	221 Bliss Lane
Location:	Near Bliss Lane & Commonage Drive
Land Owner:	Private
PIN:	0034 01 0008A
Control Type	Quality/Quanity
Drainage Area	28.9 acres
Receiving Waters	Pond Branch

Description: This area of Southdown Farm subdivision does not have existing stormwater treatment. Retrofit existing pond to a wet retention pond; install outlet structure and lower the water level for additional storage, and plant emergent and riparian vegetation.

Project Area Map

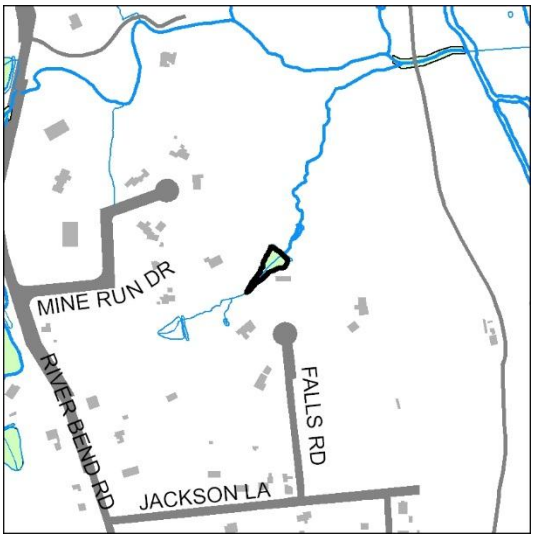
Project Benefits: This project will reduce sediment and nutrient loadings, improve water quality in downstream waterbodies, increase storage volume, reduce peak stormwater flows up to the 10-year event, and provide for evapotranspiration and wildlife habitat. The new outlet structure will allow for a more controlled stormwater discharge to enhance the performance of the pond. An estimated 1,742 lbs/yr of total suspended solids, 22 lbs/yr of nitrogen, and 5 lbs/yr of phosphorus will be removed.

Project Design Considerations: Minimal environmental permitting requirements are anticipated. Additional permitting may be required for a project within a stream or wetland. Projects in RPAs may require exceptions or waivers. This is a privately owned pond, and will require a storm drainage easement. Accessibility is good via an ingress-egress easement from Bliss Lane, the access easement may need to be extended directly to the pond for future maintenance. There are no tree impacts or significant construction issues anticipated.

Costs:

Item	*Units*	*Quantity*	*Unit Cost*	*Total*
Organic Compost Soil Amendment	CY	40	$40.00	$1,600.00
Plantings	AC	0.1	$25,000.00	$2,500.00
Clear and Grub	AC	0.05	$8,500.00	$425.00
Grading and Excavation	CY	100	$35.00	$3,500.00
Embankment	CY	100	$50.00	$5,000.00
Outflow Pipe	LF	85	$125.00	$10,625.00
RipRap Stabilization	SY	20	$100.00	$2,000.00
Structural BMP Retrofit and Incidentals (Med)	LS	1	$15,000.00	$15,000.00
			Initial Project Costs	**$40,650.00**
Plantings: 5% of project costs (unless incl. as line item)				$0.00
Ancillary Items: 5% of project cost				$2,032.50
Erosion and Sediment Control: 10% of project costs				$4,065.00
			Base Construction Costs	**$46,747.50**
			Mobilization (5%)	$2,337.38
			Subtotal 1	**$49,084.88**
			Contingency (25%)	$12,271.22
			Subtotal 2	**$61,356.09**
			Engineering Design, Surveys, Land Acquisition, Utility Relocation and Permits (45%)	$27,610.24
			Total Costs	**$88,966.34**
			Estimated Project Costs	***$90,000.00***

PN9124 Stormwater Pond Retrofit



Address:	531 Falls Road
Location:	Jackson Hills Subdivision
Land Owner:	Private
PIN:	0132 04 0009, 0132 04 0010B
Control Type	Quality/Quanity
Drainage Area	16.6 acres
Receiving Waters	Mine Run Branch

Description: This area of Jackson Hills does not have existing stormwater treatment. Retrofit existing pond to a wet retention pond; install outlet structure and lower the water level for additional storage, and plant emergent and riparian vegetation.

Project Area Map

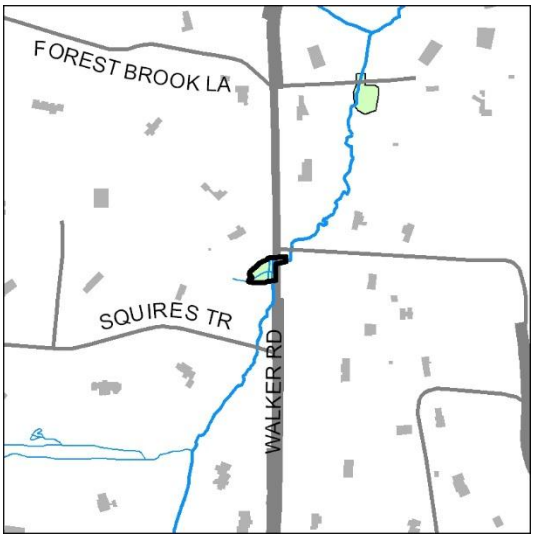
Project Benefits: This project will reduce sediment and nutrient loadings, improve water quality in downstream waterbodies, increase storage volume, reduce peak stormwater flows up to the 10-year event, and provide for evapotranspiration and wildlife habitat. The new outlet structure will allow for a more controlled stormwater discharge to enhance the performance of the pond. An estimated 1,063 lbs/yr of total suspended solids, 13 lbs/yr of nitrogen, and 3 lbs/yr of phosphorus will be removed.

Project Design Considerations: Minimal environmental permitting requirements are anticipated. Additional permitting may be required for a project within a stream or wetland. Projects in RPAs may require exceptions or waivers. This pond is privately owned by multiple owners. A storm drainage easement will be necessary. Accessibility is good from Falls Road through a clearing on private property, access easements will be needed for future maintenance. There are no tree impacts or significant construction issues anticipated.

Costs:

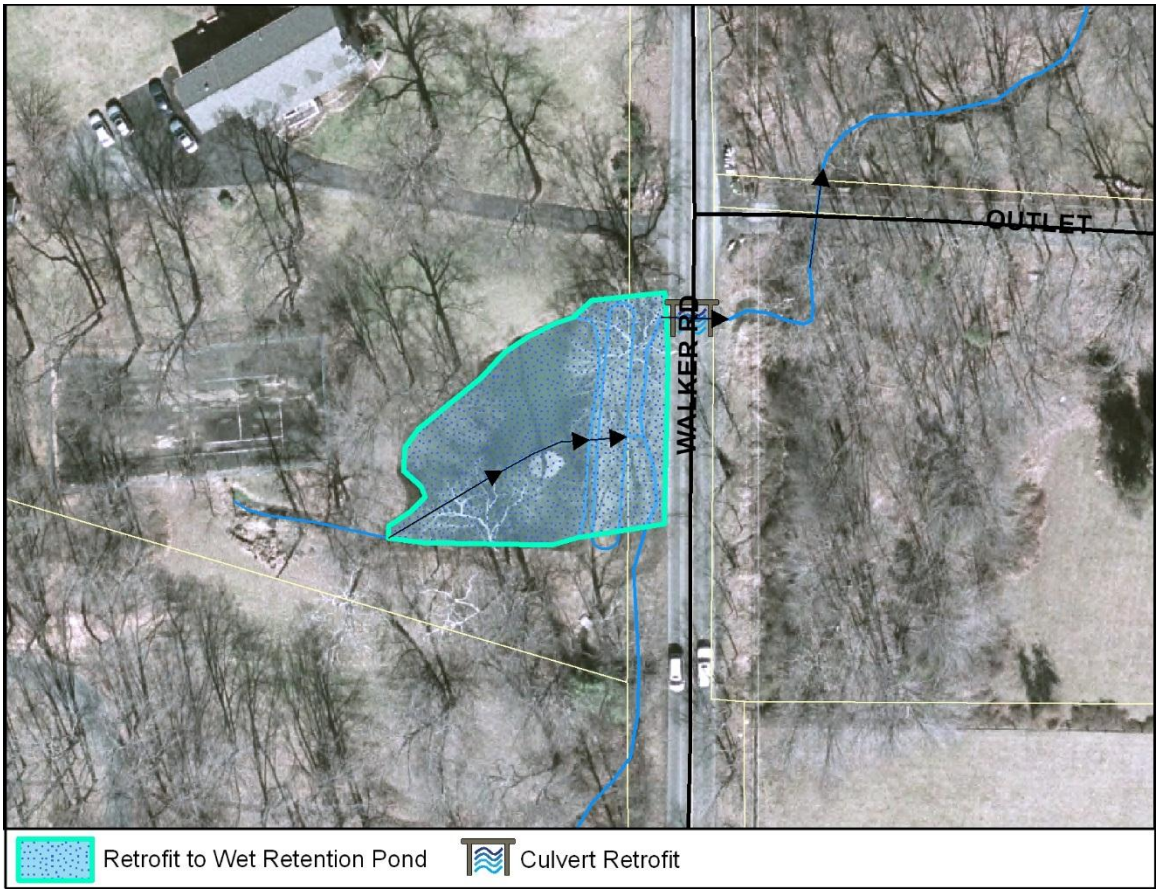
Item	*Units*	*Quantity*	*Unit Cost*	*Total*
Organic Compost Soil Amendment	CY	40	$40.00	$1,600.00
Plantings	AC	0.1	$25,000.00	$2,500.00
Clear and Grub	AC	0.1	$8,500.00	$850.00
Grading and Excavation	CY	100	$35.00	$3,500.00
Embankment	CY	100	$50.00	$5,000.00
Outflow Pipe	LF	55	$125.00	$6,875.00
RipRap Stabilization	SY	20	$100.00	$2,000.00
Structural BMP Retrofit and Incidentals (Low)	LS	1	$10,000.00	$10,000.00
			Initial Project Costs	**$32,325.00**
Plantings: 5% of project costs (unless incl. as line item)				$0.00
Ancillary Items: 5% of project cost				$1,616.25
Erosion and Sediment Control: 10% of project costs				$3,232.50
			Base Construction Costs	**$37,173.75**
			Mobilization (5%)	$1,858.69
			Subtotal 1	**$39,032.44**
			Contingency (25%)	$9,758.11
			Subtotal 2	**$48,790.55**
			Engineering Design, Surveys, Land Acquisition, Utility Relocation and Permits (45%)	$21,955.75
			Total Costs	**$70,746.29**
			Estimated Project Costs	***$80,000.00***

PN9126 Stormwater Pond Retrofit



Address:	502 Walker Road
Location:	Squire's Haven Section 2 Subdivision
Land Owner:	Private
PIN:	0074 03 0021B, 0074 04 A
Control Type	Quality/Quanity
Drainage Area	3.68 acres
Receiving Waters	Clarks Branch

Description: The culvert under Walker Road is collapsed or completely blocked with sediment. Replace road culvert and retrofit upstream pond to a wet retention pond to provide storage and water quality treatment for Squire's Haven subdivision.



Project Area Map

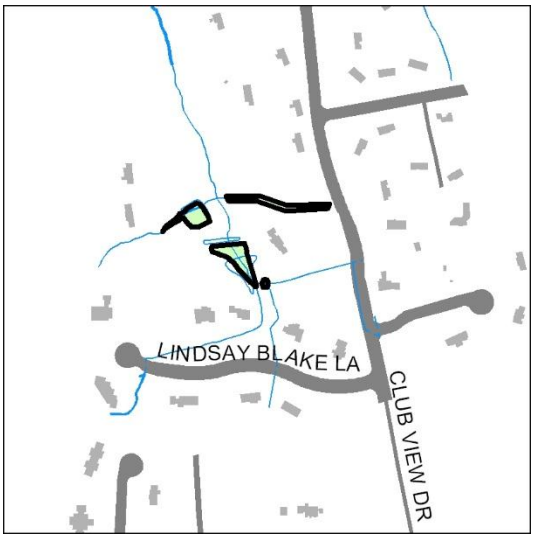
Project Benefits: This project will reduce sediment and nutrient loadings, improve water quality in downstream waterbodies, increase storage volume, reduce peak stormwater flows up to the 10-year event, and provide for evapotranspiration and wildlife habitat. The new outlet structure will allow for a more controlled stormwater discharge to enhance the performance of the pond. This project will also repair the damaged culvert. An estimated 8,375 lbs/yr of total suspended solids, 98 lbs/yr of nitrogen, and 24 lbs/yr of phosphorus will be removed.

Project Design Considerations: Minimal environmental permitting requirements are anticipated. Additional permitting may be required for a project within a stream or wetland. Projects in RPAs may require exceptions or waivers. This is a privately owned pond, and will require a storm drainage easement. Accessibility is excellent from Walker Road. There are no tree impacts or significant construction issues anticipated.

Costs:

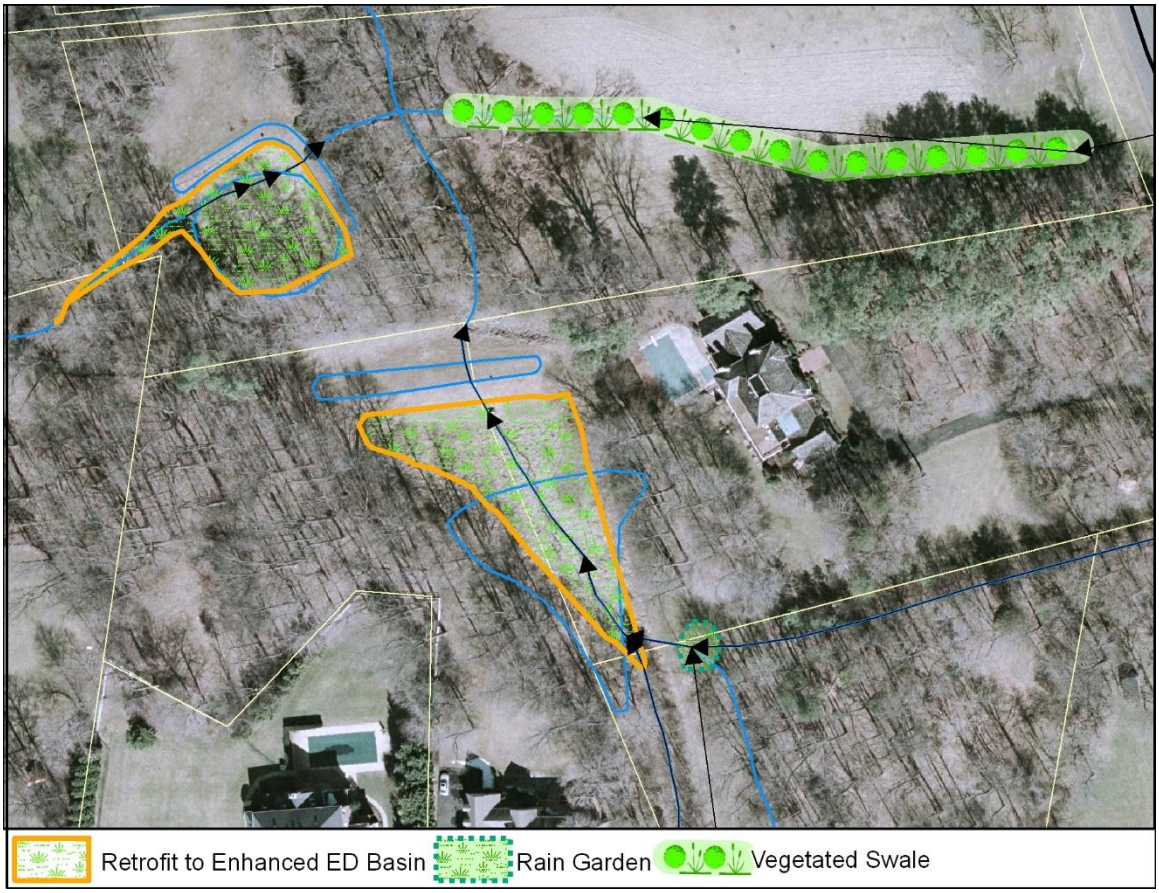
Item	*Units*	*Quantity*	*Unit Cost*	*Total*
Organic Compost Soil Amendment	CY	40	$40.00	$1,600.00
Plantings	AC	0.1	$25,000.00	$2,500.00
Clear and Grub	AC	0.1	$8,500.00	$850.00
Grading and Excavation	CY	2000	$35.00	$70,000.00
Embankment	CY	150	$50.00	$7,500.00
Outflow Pipe	LF	120	$125.00	$15,000.00
RipRap Stabilization	SY	40	$100.00	$4,000.00
Structural BMP Retrofit and Incidentals (Low)	LS	1	$10,000.00	$10,000.00
			Initial Project Costs	**$111,450.00**
Plantings: 5% of project costs (unless incl. as line item)				$0.00
Ancillary Items: 5% of project cost				$5,572.50
Erosion and Sediment Control: 10% of project costs				$11,145.00
			Base Construction Costs	**$128,167.50**
			Mobilization (5%)	$6,408.38
			Subtotal 1	**$134,575.88**
			Contingency (25%)	$33,643.97
			Subtotal 2	**$168,219.84**
			Engineering Design, Surveys, Land Acquisition, Utility Relocation and Permits (45%)	$75,698.93
			Total Costs	**$243,918.77**
			Estimated Project Costs	***$250,000.00***

PN9127 Stormwater Pond Retrofit, BMP/LID



Address:	354 Club View Drive
Location:	Eagon Hills & River Bend Estates Subdivision
Land Owner:	County/Private
PIN:	0081 05 A, 0081 05 0019, 0083 17 0003, 0081 11 0001, 0083 16 0003, 0083 16 0004
Control Type	Quality/Quanity
Drainage Area	61.68 acres
Receiving Waters	Clarks Branch

Description: Riverbend Esates and Dogwood Hills are in need of water quality treatment. Retrofit two dry ponds to enhanced extended detention dry ponds. Install rain garden around existing inlet. Daylight storm sewer and install vegetated swale with check dams.



Project Area Map

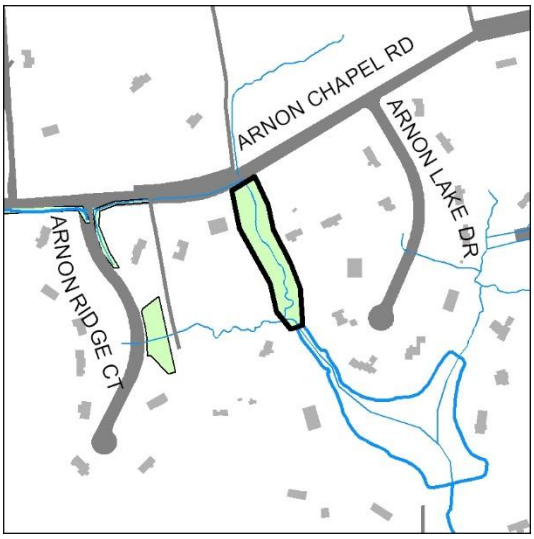
Project Benefits: This project will improve water quality by reducing sediment and nutrient loadings, reduce peak stormwater flows for storms up to the 10-year event, and provide for evapotranspiration and wildlife habitat. The new/improved outlet structures will allow for a more controlled stormwater discharge to enhance the performance of the ponds. The rain garden will also reduce stormwater runoff volumes by promoting infiltration. An estimated 2,832 lbs/yr of total suspended solids, 30 lbs/yr of nitrogen, and 6 lbs/yr of phosphorus will be removed.

Project Design Considerations: Minimal environmental permitting requirements are anticipated. Additional permitting may be required for a project within a stream or wetland. Existing pond 0086DP is located within a storm drainage easement; DP0892 is a privately-owned facility and will require a stormwater easement. Additional storm drainage easements will also be necessary for the rain garden and daylighting of the stream. Accessibility is good from Club View Drive or Lindsay Blake Lane. Access to 0892DP may be difficult due to tree cover. There are minimal tree impacts or significant construction issues anticipated.

Costs:

Item	*Units*	*Quantity*	*Unit Cost*	*Total*
Organic Compost Soil Amendment	CY	155	$40.00	$6,200.00
Plantings	AC	0.5	$25,000.00	$12,500.00
Clear and Grub	AC	0.5	$8,500.00	$4,250.00
Grading and Excavation	CY	2200	$35.00	$77,000.00
Embankment	CY	150	$50.00	$7,500.00
Outflow Pipe	LF	125	$125.00	$15,625.00
RipRap Stabilization	SY	40	$100.00	$4,000.00
Structural BMP Retrofit and Incidentals (Low)	LS	1	$10,000.00	$10,000.00
Structural BMP Retrofit and Incidentals (Med)	LS	1	$15,000.00	$15,000.00
			Initial Project Costs	**$152,075.00**
Plantings: 5% of project costs (unless incl. as line item)				$0.00
Ancillary Items: 5% of project cost				$7,603.75
Erosion and Sediment Control: 10% of project costs				$15,207.50
			Base Construction Costs	**$174,886.25**
			Mobilization (5%)	$8,744.31
			Subtotal 1	**$183,630.56**
			Contingency (25%)	$45,907.64
			Subtotal 2	**$229,538.20**
			Engineering Design, Surveys, Land Acquisition, Utility Relocation and Permits (45%)	$103,292.19
			Total Costs	**$332,830.39**
			Estimated Project Costs	***$340,000.00***

PN9200 Stream Restoration



Address:	9697 Arnon Chapel Road
Location:	Arnon Lake Subdivision
Land Owner:	Private
PIN:	0083 10 0010, 0083 10 0011, 0083 10 0015, 0083 10 0018
Control Type	Quality
Drainage Area	107.86 acres
Receiving Waters	Mine Run Branch

Description: Stream is lengthening and eroding meanders. Re-construct stream channel to start meander below Arnon Chapel Road and lengthen stream more evenly to reduce potential for erosion at downstream tight meanders and sediment deposition in the downstream pond.

Project Area Map

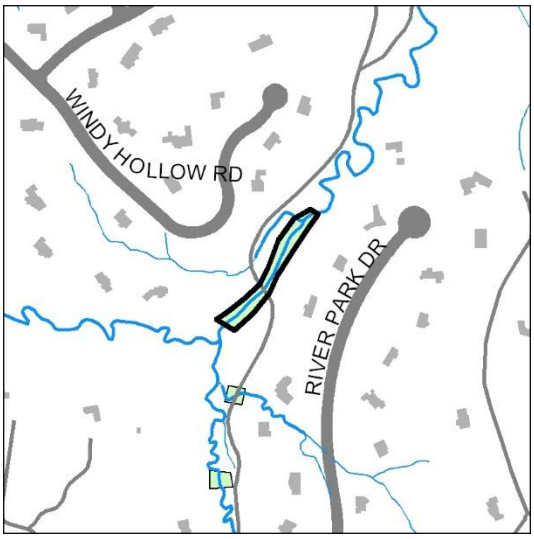
Project Benefits: This project will stabilize streambanks and improve water quality by reducing sediment and nutrient loadings. An estimated 5,960 lbs/yr of total suspended solids, 5 lbs/yr of nitrogen, and 2 lbs/yr of phosphorus will be removed.

Project Design Considerations: Minimal environmental permitting requirements are anticipated. Additional permitting may be required for a project within a stream or wetland. Projects in RPAs may require exceptions or waivers. Accessibility is excellent from Arnon Chapel Road. Tree impacts are expected. No significant construction issues anticipated.

Costs:

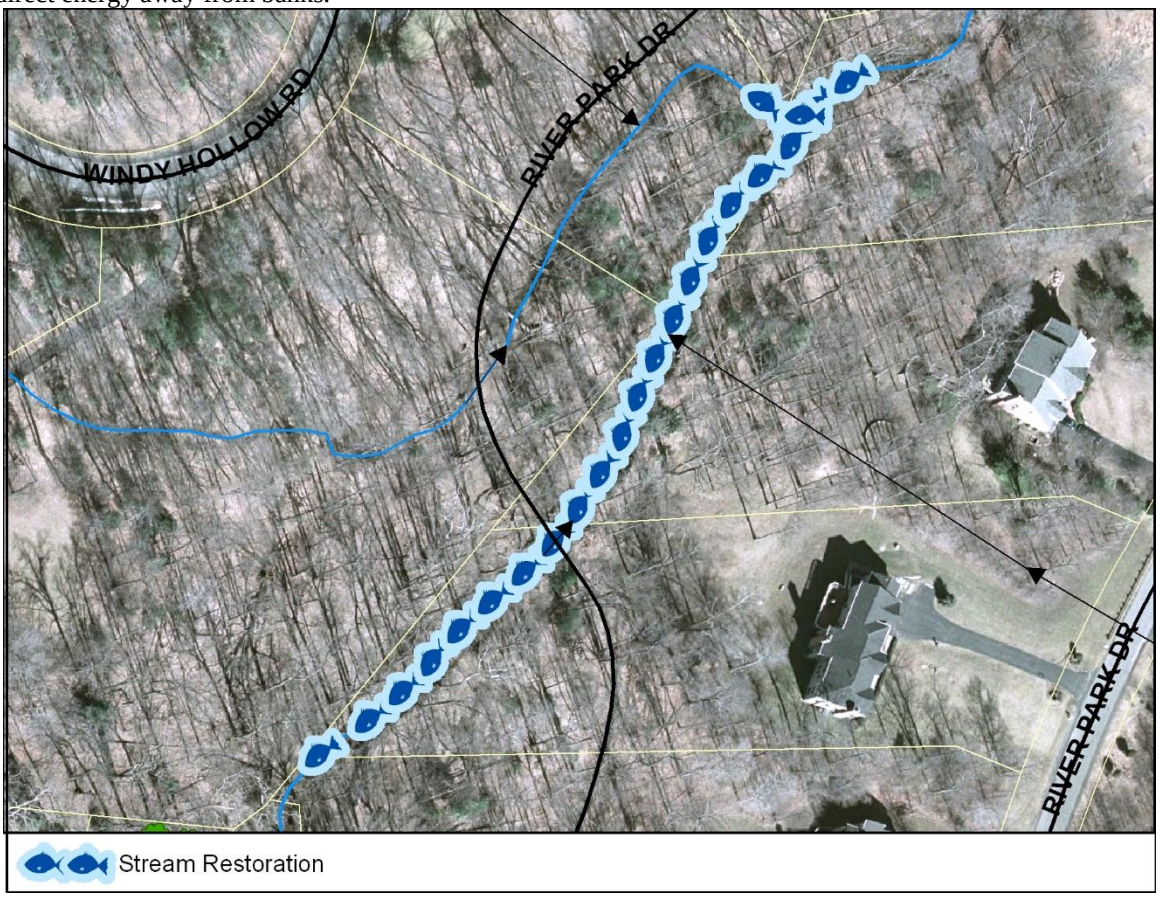
Item	*Units*	*Quantity*	*Unit Cost*	*Total*
RipRap Stabilization	SY	120	$100.00	$12,000.00
Construct New Channel	LF	350	$200.00	$70,000.00
Additional Cost (first 500LF)	LF	350	$200.00	$70,000.00
			Initial Project Costs	**$152,000.00**
Plantings: 5% of project costs (unless incl. as line item)				$7,600.00
Ancillary Items: 5% of project cost				$7,600.00
Erosion and Sediment Control: 10% of project costs				$15,200.00
			Base Construction Costs	**$182,400.00**
			Mobilization (5%)	$9,120.00
			Subtotal 1	**$191,520.00**
			Contingency (25%)	$47,880.00
			Subtotal 2	**$239,400.00**
			Engineering Design, Surveys, Land Acquisition, Utility Relocation and Permits (45%)	$107,730.00
			Total Costs	**$347,130.00**
			Estimated Project Costs	***$350,000.00***

PN9201 Stream Restoration



Address:	174 River Park Drive
Location:	Riverbend Knolls Subdivision
Land Owner:	County/Private
PIN:	0043 09 0006, 0043 09 0007, 0043 09 0008, 0043 09 0009, 0043 10 0003, 0043 10 0004, 0043 10 0005
Control Type	Quality
Drainage Area	644.7 acres
Receiving Waters	Pond Branch

Description: High energy stormflows and obstructions have caused severe erosion and washed out a pedestrian bridge near River Park Drive. Replace bridge; stabilize banks; install step pools and instream structures to dissipate energy and direct energy away from banks.



Project Area Map

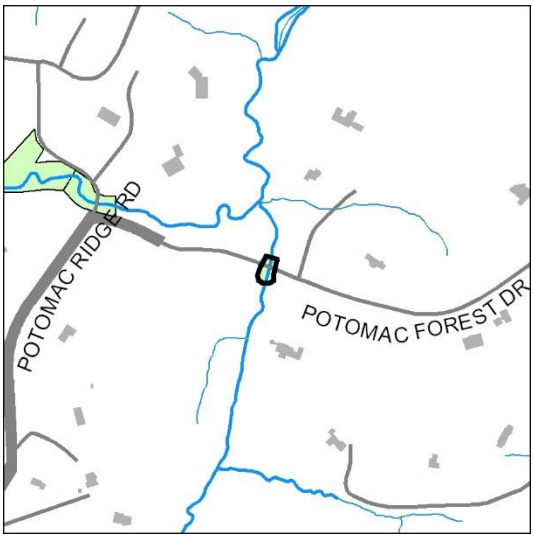
Project Benefits: Step pools will protect streambanks, reduce sediment and nutrient loadings, reduce stormwater peak flows, and provide for aquatic wildlife habitats. This project will also repair and stabilize streambanks. The washed out bridge will be replaced. An estimated 91,800 lbs/yr of total suspended solids, 73 lbs/yr of nitrogen, and 28 lbs/yr of phosphorus will be removed.

Project Design Considerations: Minimal environmental permitting requirements are anticipated. Additional permitting may be required for a project within a stream or wetland. Projects in RPAs may require exceptions or waivers. The majority of this project is located on a conservation easement with an ingress-egress easement crossing the site at the location of a washed out bridge. Bridge may be rebuilt for pedestrian/horse use only. Additional easements may be required in order to include the entire project area. Accessibility is excellent from River Park Drive. Existing trees are being actively impacted by receeding streambanks, minimal additional tree impacts and no significant construction issues anticipated.

Costs:

Item	*Units*	*Quantity*	*Unit Cost*	*Total*
RipRap Stabilization	SY	50	$100.00	$5,000.00
Construct New Channel	LF	100	$200.00	$20,000.00
Additional Cost (first 500LF)	LF	100	$200.00	$20,000.00
Change Channel Type - Step Pools	LF	550	$40.00	$22,000.00
			Initial Project Costs	**$67,000.00**
Plantings: 5% of project costs (unless incl. as line item)				$3,350.00
Ancillary Items: 5% of project cost				$3,350.00
Erosion and Sediment Control: 10% of project costs				$6,700.00
			Base Construction Costs	**$80,400.00**
			Mobilization (5%)	$4,020.00
			Subtotal 1	**$84,420.00**
			Contingency (25%)	$21,105.00
			Subtotal 2	**$105,525.00**
			Engineering Design, Surveys, Land Acquisition, Utility Relocation and Permits (45%)	$47,486.25
			Total Costs	**$153,011.25**
			Estimated Project Costs	***$160,000.00***

PN9400 Culvert Retrofit



Address:	9111 Potomac Forest Drive
Location:	Potomac Forest Subdivision
Land Owner:	County/Private
PIN:	0082 04 0011A
Control Type	Quality/Quanity
Drainage Area	318.7 acres
Receiving Waters	Clarks Branch

Description: Culvert at Potomac Forest Drive is clogging with debris and causing severe erosion downstream. Install micropool with control structure to reduce clogging upstream; install energy dissipation and stabilize stream banks downstream.

Project Area Map

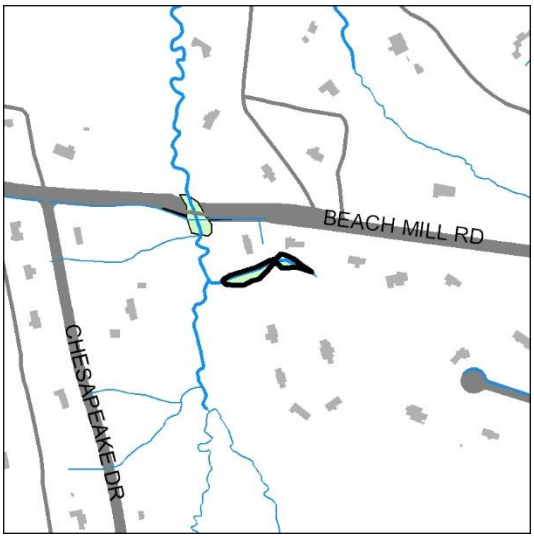
Project Benefits: This project will improve water quality by reducing sediment and nutrient loadings, reduce peak stormwater flows for storms up to the 10-year event, and provide for evapotranspiration and wildlife habitat. Streambanks downstream of culvert will be stabilized. Energy dissipation will reduce stormwater velocities. An estimated 5,487 lbs/yr of total suspended solids, 65 lbs/yr of nitrogen, and 16 lbs/yr of phosphorus will be removed.

Project Design Considerations: Minimal environmental permitting requirements are anticipated. Additional permitting may be required for a project within a stream or wetland. Projects in RPAs may require exceptions or waivers. This project is located within the ingress-egress easement of Potomac Forest Drive. A storm drainage easement will be necessary. Accessibility is excellent from Potomac Forest Drive. Tree impacts are expected. No significant construction issues are anticipated.

Costs:

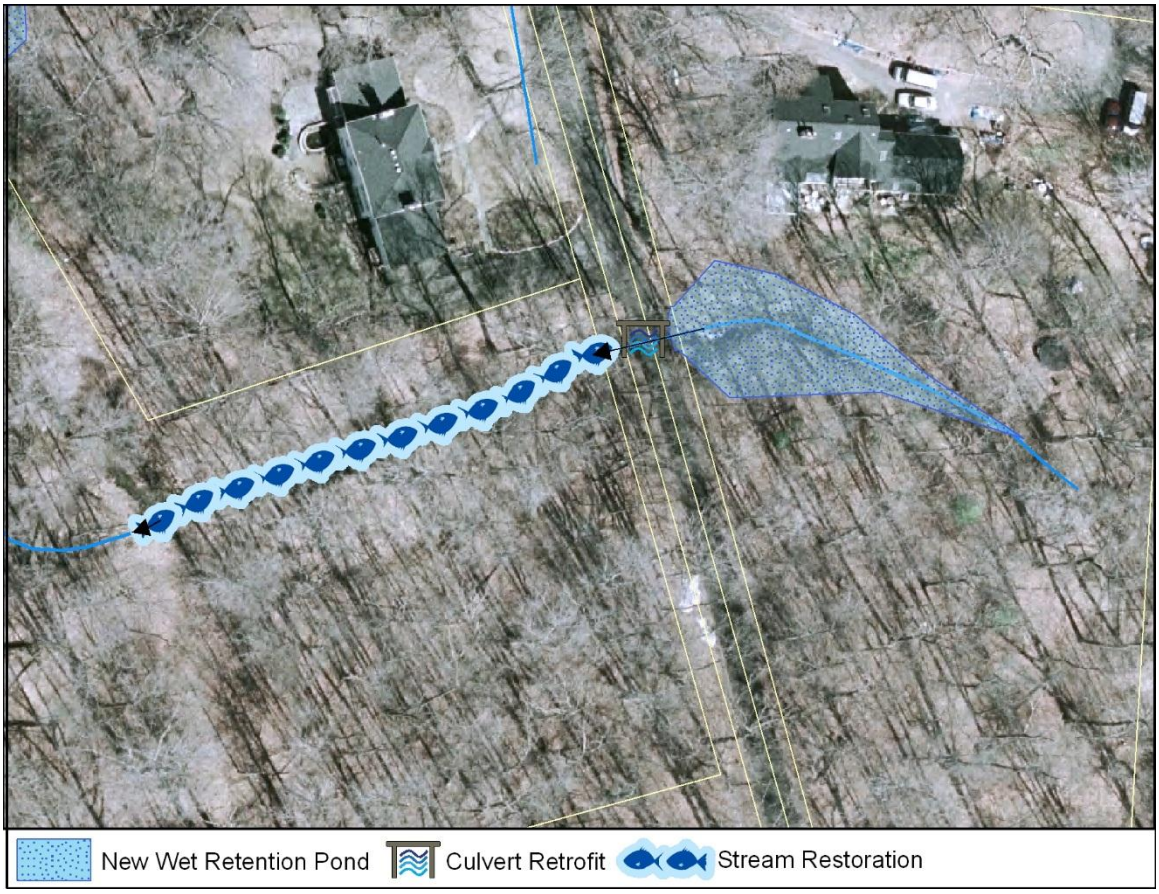
Item	*Units*	*Quantity*	*Unit Cost*	*Total*
Organic Compost Soil Amendment	CY	25	$40.00	$1,000.00
Plantings	AC	0.05	$25,000.00	$1,250.00
Clear and Grub	AC	0.05	$8,500.00	$425.00
Grading and Excavation	CY	550	$35.00	$19,250.00
Earthen Berm	CY	150	$35.00	$5,250.00
RipRap Stabilization	SY	50	$100.00	$5,000.00
Structural BMP and Incidentals (High)	LS	1	$20,000.00	$20,000.00
New Storm Pipe (High)	LF	0	$300.00	$0.00
			Initial Project Costs	**$52,175.00**
Plantings: 5% of project costs (unless incl. as line item)				$0.00
Ancillary Items: 5% of project cost				$2,608.75
Erosion and Sediment Control: 10% of project costs				$5,217.50
			Base Construction Costs	**$60,001.25**
			Mobilization (5%)	$3,000.06
			Subtotal 1	**$63,001.31**
			Contingency (25%)	$15,750.33
			Subtotal 2	**$78,751.64**
			Engineering Design, Surveys, Land Acquisition, Utility Relocation and Permits (45%)	$35,438.24
			Total Costs	**$114,189.88**
			Estimated Project Costs	***$120,000.00***

PN9408 Stream Restoration



Address:	9499 Beach Mill Road
Location:	Fitz Folly Farms Subdivision & Riverside Manor Subdivision
Land Owner:	Private
PIN:	0081 04 0050, 0081 04 0051, 0081 04 0052, 0081 10 0014
Control Type	Quality/Quanity
Drainage Area	25.46 acres
Receiving Waters	Clarks Branch

Description: Stream is eroded below a shared driveway culvert. Construct micropool above culvert; replace culvert and direct pipe toward new stream channel. Relocate stream channel below culvert away from steep bank; stabilize banks with boulder toe and live stakes.



Project Area Map

Project Benefits: This project will improve water quality by reducing sediment and nutrient loadings, reduce peak stormwater flows for storms up to the 10-year event, and provide for evapotranspiration and wildlife habitat. This project will also repair and stabilize streambanks. An estimated 7,088 lbs/yr of total suspended solids, 84 lbs/yr of nitrogen, and 20 lbs/yr of phosphorus will be removed.

Project Design Considerations: Minimal environmental permitting requirements are anticipated. Additional permitting may be required for a project within a stream or wetland. Projects in RPAs may require exceptions or waivers. Part of this project is located within an ingress egress easement. A storm drainage easement will be necessary. Accessibility is good from the ingress egress easement from Beach Mill Road, though it may be difficult due to tree cover. Tree impacts are expected. No significant construction issues are anticipated.

Costs:

Item	*Units*	*Quantity*	*Unit Cost*	*Total*
Vegetated Swale	SY	50	$50.00	$2,500.00
Organic Compost Soil Amendment	CY	90	$40.00	$3,600.00
Plantings	AC	0.35	$25,000.00	$8,750.00
Clear and Grub	AC	0.35	$8,500.00	$2,975.00
Grading and Excavation	CY	2300	$35.00	$80,500.00
Earthen Berm	CY	100	$35.00	$3,500.00
RipRap Stabilization	SY	250	$100.00	$25,000.00
Construct New Channel	LF	160	$200.00	$32,000.00
Additional Cost (first 500LF)	LF	160	$200.00	$32,000.00
Structural BMP and Incidentals (Med)	LS	1	$15,000.00	$15,000.00
New Storm Pipe (Med)	LF	135	$200.00	$27,000.00
			Initial Project Costs	**$232,825.00**
Plantings: 5% of project costs (unless incl. as line item)				$0.00
Ancillary Items: 5% of project cost				$11,641.25
Erosion and Sediment Control: 10% of project costs				$23,282.50
			Base Construction Costs	**$267,748.75**
			Mobilization (5%)	$13,387.44
			Subtotal 1	**$281,136.19**
			Contingency (25%)	$70,284.05
			Subtotal 2	**$351,420.23**
			Engineering Design, Surveys, Land Acquisition, Utility Relocation and Permits (45%)	$158,139.11
			Total Costs	**$509,559.34**
			Estimated Project Costs	***$510,000.00***

6.0 Benefits of Plan Implementation

There are numerous watershed restoration strategies that may have a significant impact on the overall health and quality of the Nichol Run and Pond Branch watersheds. In order to quantify the costs and benefits of implementing the watershed restoration strategies discussed in previous sections, additional analyses were required. This section discusses and summarizes the results of the pollutant load, hydrologic and hydraulic modeling used in the development of the watershed management plans to quantify any reductions in pollutant loading, total stormwater runoff volumes, peak rate of runoff and the extent of flooding. A summary of cost estimates and an analysis of the costs and benefits of the project plan are also discussed.

6.1 Stormwater Models

As discussed in Section 2, modeling is a way to mathematically predict and spatially represent what will occur during a given rainfall event. Hydrologic and hydraulic models are the two types of models that are used to achieve this. *Hydrologic models* take into account the particular rainfall event of interest, the physical nature of the land area where the rainfall occurs, and how quickly the resulting stormwater runoff drains a given land area. Hydrologic models can describe both the quantity of stormwater runoff and resulting pollution, such as nutrients (nitrogen and phosphorus) and sediment that are transported by the runoff. *Hydraulic models* are used to evaluate the effect the stormwater runoff from a particular rainfall event has on both man-made and natural systems. These models can predict both the ability man-made culverts/channels have in conveying stormwater runoff and the spatial extent of potential flooding.

Hydrologic and hydraulic models were created for three distinct scenarios as listed below:

- Existing conditions
- Future conditions without projects
- Future conditions with projects

For *Existing Conditions,* the models simulated the condition of the watersheds at the time the models were created by incorporating information on land use, soils, existing stormwater management and best management practice facilities, previous stream and watershed assessments, and actual field reconnaissance and site visits. The *Future Conditions without Projects* scenario simulated future conditions based on countywide future land use and development, derived from the county's comprehensive plan and build-out predictions. As the name implies, the *Future Conditions without Projects* models do not contain any of the watershed restoration strategies or projects identified in this plan. The *Future Conditions with Projects* scenario simulates the implementation of the projects discussed in the previous sections. The *Future Conditions with Projects* scenario uses the *Future Conditions without Projects* models as a base on which proposed restoration strategies are added and evaluated. Comparison of modeling results from these three scenarios yielded pollutant loading and stormwater runoff reductions discussed below. Detailed information on the setup and calibration of the STEPL pollution models, SWMM hydrologic models and HEC-RAS hydraulic models can be found in Technical Memo 3.6 in Appendix B.

6.2 Analysis of Stormwater Modeling Results

Results of the modeling efforts were compiled and analyzed to determine pollutant load and flow reductions. The reduction in values shown and discussed below indicates the overall benefits of implementing the restoration strategies described within the plan.

6.2.1 Nichol Run

Tables 6.1 and 6.2 below summarize the results of the pollutant and hydrologic models in terms of pollutant loading and stormwater flow reductions for the Nichol Run Watershed. All values were normalized to the drainage area to allow for direct and accurate comparisons. Values were normalized by weighting them to account for the size of the drainage area and remove the effect of drainage area variability in comparisons between WMAs. Runoff volume and peak flow values were obtained from SWMM hydrologic models and were calculated cumulatively. In other words, flows were summed from upstream to downstream and were divided by the total contributing drainage area. Total suspended solids (TSS), total nitrogen (TN) and total phosphorus (TP) values were obtained from the results of the STEPL pollutant models. These values were calculated based on the individual land area contributions and may not increase from upstream to downstream. Non-area weighted pollutant loading values can be found in Technical Memo 3.6 in Appendix B.

Table 6.1
Nichol Run Pollutant Loading and Flow Reductions by WMA

WMA	Area (ac)	Scenario[3]	Runoff Volume (in)[1]		Peak Flow (cfs/ac)[1]		TN[2] (lb/ac/yr)	TP[2] (lb/ac/yr)	TSS[2] (lb/ac/yr)
			2 Year	10 Year	2 Year	10 Year			
Jefferson Branch WMA	1,184.94	Existing Condition	2.19	4.12	0.278	0.593	1.91	0.280	73.25
		Future Without Projects	2.20	4.13	0.281	0.598	1.99	0.290	73.60
		Future With 10-yr Projects	2.03	3.93	0.251	0.564	1.97	0.290	71.73
		Reduction (10-year Plan)	0.16 (7%)	0.19 (5%)	0.03 (11%)	0.03 (6%)	0.02 (1%)	0.00 (0%)	1.87 (3%)
		Future With 0-25 yr Projects	N/A	N/A	N/A	N/A	1.92	0.280	69.53
		Reduction (25-year Plan)	N/A	N/A	N/A	N/A	0.07 (4%)	0.01 (3%)	4.07 (6%)
Nichol-Lower WMA	820.52	Existing Condition	0.20	0.53	0.236	0.537	1.44	0.220	69.43
		Future Without Projects	0.21	0.54	0.240	0.543	1.84	0.280	70.58
		Future With 10-yr Projects	0.21	0.53	0.213	0.502	1.80	0.260	66.96
		Reduction (10-year Plan)	0.00 (2%)	0.01 (2%)	0.03 (11%)	0.04 (8%)	0.04 (2%)	0.02 (7%)	3.62 (5%)
		Future With 0-25 yr Projects	N/A	N/A	N/A	N/A	1.77	0.260	64.78
		Reduction (25-year Plan)	N/A	N/A	N/A	N/A	0.07 (4%)	0.02 (7%)	5.80 (8%)

[1] Flow is cumulative.
[2] Loads are representative of individual land area contributions.
[3] 25-year projects were not evaluated in the hydrologic model.
[4] No projects were proposed in this WMA.

Table 6.1
Nichol Run Pollutant Loading and Flow Reductions by WMA

WMA	Area (ac)	Scenario[3]	Runoff Volume (in)[1]		Peak Flow (cfs/ac)[1]		TN[2] (lb/ac/yr)	TP[2] (lb/ac/yr)	TSS[2] (lb/ac/yr)
			2 Year	10 Year	2 Year	10 Year			
Nichol-Potomac WMA[4]	697	Existing Condition	0.65	2.25	0.139	0.473	0.95	0.160	75.01
		Future Without Projects	0.68	2.30	0.182	0.537	1.19	0.190	73.82
		Future With 10-yr Projects	0.68	2.30	0.182	0.537	1.19	0.190	73.82
		Reduction (10-year Plan)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
		Future With 0-25 yr Projects	N/A	N/A	N/A	N/A	1.19	0.190	73.82
		Reduction (25-year Plan)	N/A	N/A	N/A	N/A	0.00 (0%)	0.00 (0%)	0.00 (0%)
Nichol-Upper WMA	2,548	Existing Condition	2.32	4.33	0.306	0.656	2.31	0.360	153.57
		Future Without Projects	2.33	4.34	0.315	0.672	2.41	0.370	153.31
		Future With 10-yr Projects	2.05	4.00	0.278	0.598	2.31	0.340	89.29
		Reduction (10-year Plan)	0.28 (12%)	0.34 (8%)	0.04 (12%)	0.07 (11%)	0.10 (4%)	0.03 (8%)	64.02 (42%)
		Future With 0-25 yr Projects	N/A	N/A	N/A	N/A	2.26	0.330	84.66
		Reduction (25-year Plan)	N/A	N/A	N/A	N/A	0.15 (6%)	0.04 (11%)	68.65 (45%)

[1] Flow is cumulative.
[2] Loads are representative of individual land area contributions.
[3] 25-year projects were not evaluated in the hydrologic model.
[4] No projects were proposed in this WMA.

Table 6.2
Nichol Run Overall Pollutant Loading and Flow Reductions

WMA	Area (ac)	Scenario[2]	Runoff Volume (in)[1]		Peak Flow (cfs/ac)[1]		TN (lb/ac/yr)	TP (lb/ac/yr)	TSS (lb/ac/yr)
			2 Year	10 Year	2 Year	10 Year			
Nichol Run Watershed	5,250	Existing Condition	1.08	2.18	0.129	0.303	1.90	0.290	111.87
		Future Without Projects	1.09	2.19	0.131	0.307	2.07	0.310	111.84
		Future With 10-yr Projects	0.99	2.07	0.117	0.285	2.01	0.300	79.80
		Reduction (10-year Plan)	0.10 (9%)	0.12 (5%)	0.01 (10%)	0.02 (7%)	0.06 (3%)	0.01 (3%)	32.04 (29%)
		Future With 0-25 yr Projects	N/A	N/A	N/A	N/A	1.96	0.290	76.72
		Reduction (25-year Plan)	N/A	N/A	N/A	N/A	0.11 (5%)	0.02 (6%)	35.12 (31%)

[1] Flow is cumulative.
[2] 25-year projects were not evaluated in the hydrologic model.

Based on modeling results, implementation of the restoration strategies and projects described in the 10-year plan will result in reductions in stormwater runoff flows and pollutant loads. The values shown in these tables have all been normalized to the drainage area and the reductions shown here indicate reductions per unit area.

The model results show the greatest reductions in Nichol-Upper WMA where stormwater management generally has the greatest effect and where projects have been prioritized. WMAs where no projects or restoration strategies are proposed such as Potomac WMA, which is mostly undeveloped and sparsely populated, are shown in Table 6.1 above without any reductions or increases in pollutant loadings or stormwater flow.

6.2.2 Pond Branch

Tables 6.3 and 6.4 below summarize the results of the pollutant and hydrologic models in terms of pollutant loading and stormwater flow reductions for the Pond Branch Watershed. All values were normalized to the drainage area to allow for direct and accurate comparisons. Values were normalized by weighting them to account for the size of the drainage area and remove the effect

of drainage area variability in comparisons between WMAs. Runoff volume and peak flow values were obtained from SWMM hydrologic models and were calculated cumulatively. In other words, flows were summed from upstream to downstream and were divided by the total contributing drainage area. Total suspended solids (TSS), total nitrogen (TN) and total phosphorus (TP) values were obtained from the results of the STEPL pollutant models. These values were calculated based on the individual land area contributions and may not increase from upstream to downstream. Non-area weighted pollutant loading values can be found in Technical Memo 3.6 in Appendix B.

Table 6.3
Pond Branch Pollutant Loading and Flow Reductions by WMA

WMA	Area (ac)	Scenario[3]	Runoff Volume (in)[1]		Peak Flow (cfs/ac)[1]		TN[2] (lb/ac/yr)	TP[2] (lb/ac/yr)	TSS[2] (lb/ac/yr)
			2 Year	10 Year	2 Year	10 Year			
Clark Run WMA	1,759	Existing Condition	1.99	3.87	0.295	0.669	2.20	0.340	90.30
		Future Without Projects	2.00	3.88	0.300	0.677	2.35	0.360	90.35
		Future With 10-yr Projects	1.35	3.09	0.159	0.412	2.19	0.330	76.98
		Reduction (10-year Plan)	0.65 (32%)	0.79 (20%)	0.14 (47%)	0.26 (39%)	0.16 (7%)	0.03 (8%)	13.37 (15%)
		Future With 0-25 yr Projects	N/A	N/A	N/A	N/A	2.01	0.280	60.78
		Reduction (25-year Plan)	N/A	N/A	N/A	N/A	0.34 (14%)	0.08 (22%)	29.57 (33%)
Pond Branch WMA	742	Existing Condition	2.00	3.88	0.361	0.815	2.70	0.430	226.29
		Future Without Projects	2.01	3.90	0.372	0.837	2.84	0.450	226.97
		Future With 10-yr Projects	1.17	2.86	0.220	0.482	2.69	0.400	98.59
		Reduction (10-year Plan)	0.84 (42%)	1.04 (27%)	0.15 (41%)	0.36 (42%)	0.15 (5%)	0.05 (11%)	128.38 (57%)
		Future With 0-25 yr Projects	N/A	N/A	N/A	N/A	2.69	0.400	98.59
		Reduction (25-year Plan)	N/A	N/A	N/A	N/A	0.15 (5%)	0.05 (11%)	128.38 (57%)
Mine Run WMA	1,633	Existing Condition	1.93	3.79	0.334	0.731	2.37	0.360	114.36
		Future Without Projects	1.94	3.80	0.347	0.740	2.50	0.380	114.99
		Future With 10-yr Projects	1.11	2.77	0.133	0.313	2.24	0.320	86.06
		Reduction (10-year Plan)	0.83 (43%)	1.03 (27%)	0.21 (62%)	0.43 (58%)	0.26 (10%)	0.06 (16%)	28.93 (25%)
		Future With 0-25 yr Projects	N/A	N/A	N/A	N/A	2.24	0.320	86.06
		Reduction (25-year Plan)	N/A	N/A	N/A	N/A	0.26 (10%)	0.06 (16%)	28.93 (25%)
Pond-Potomac WMA	1,270	Existing Condition	0.41	1.07	0.263	0.775	1.23	0.210	87.40
		Future Without Projects	0.41	1.07	0.271	0.785	1.30	0.220	86.82
		Future With 10-yr Projects	0.41	1.07	0.271	0.785	1.30	0.220	86.80
		Reduction (10-year Plan)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.02 (0%)
		Future With 0-25 yr Projects	N/A	N/A	N/A	N/A	1.26	0.210	82.44
		Reduction (25-year Plan)	N/A	N/A	N/A	N/A	0.04 (3%)	0.01 (5%)	4.38 (5%)

[1] Flow is cumulative.
[2] Loads are representative of individual land area contributions.
[3] 25-year projects were not evaluated in the hydrologic model.
[4] No projects were proposed in this WMA.

Table 6.4 Pond Branch Overall Pollutant Loading and Flow Reductions									
WMA	Area (ac)	Scenario[2]	Runoff Volume (in)[1]		Peak Flow (cfs/ac)[1]		TN (lb/ac/yr)	TP (lb/ac/yr)	TSS (lb/ac/yr)
			2 Year	10 Year	2 Year	10 Year			
Pond Branch Watershed	5,404	Existing Condition	1.72	3.52	0.276	0.647	2.09	0.330	115.55
		Future Without Projects	1.73	3.53	0.282	0.656	2.21	0.350	115.72
		Future With 10-yr Projects	1.16	2.83	0.155	0.417	2.07	0.310	85.00
		Reduction (10-year Plan)	0.57 (33%)	0.70 (20%)	0.13 (45%)	0.24 (36%)	0.14 (6%)	0.04 (11%)	30.72 (27%)
		Future With 0-25 yr Projects	N/A	N/A	N/A	N/A	2.00	0.290	78.70
		Reduction (25-year Plan)	N/A	N/A	N/A	N/A	0.21 (10%)	0.06 (17%)	37.02 (32%)

[1] Flow is cumulative.
[2] 25-year projects were not evaluated in the hydrologic model.

Based on modeling results, implementation of the restoration strategies and projects described in the 10-year plan will result in reductions in stormwater runoff flows and pollutant loads. The values shown in these tables have all been normalized to the drainage area and the reductions shown here indicate reductions per unit area.

The model results show the greatest reductions in Mine Run WMA. Mine Run WMA contained the largest number of projects in the watershed management plan of any WMA in Pond Branch watershed. WMAs where no projects or restoration strategies are implemented such as Pond-Potomac WMA, mostly undeveloped and sparsely populated, are shown in Table 6.3 above without any reductions or increases in pollutant loadings or stormwater flow

6.3 Project Costs and Benefits Analysis

An integral element to evaluating the benefits of restoration strategies and projects is associated costs. Cost estimates were calculated for all structural projects detailed in previous sections. Detailed cost estimates, as shown on the project fact sheets, were determined for structural projects in the 0-10 year implementation phase. The total costs of implementing projects in this phase were calculated to be approximately $2 million and $7 million for the Nichol Run and Pond Branch watersheds, respectively. Associated costs for structural projects in the 11-25 year implementation phase were roughly approximated based on the overall costs associated with similar projects in the 10 year implementation plan and are estimated at approximately $4 million. Cost estimates were not calculated for non-structural projects, because non-structural projects do not require traditional construction measures to be implemented and may be programmatic in nature.

In addition to the calculation of cost estimates for projects listed in the implementation plan, a cost benefit analysis was also performed. The project cost distribution for all projects listed in the 10-year implementation plan was evaluated. The evaluation of the project cost distribution allowed for a determination of outliers within the lists of projects. These outliers could be projects that were significantly more or less expensive than other projects in the lists. These projects were further scrutinized and evaluated to determine if they should remain in the 10-year list. Outliers determined to be kept in the list were evaluated separately from the other projects in the 10-year list. A cost to benefit ratio was calculated based on the subwatershed ranking composite score and the projects' associated costs. Using the cost to benefit ratio, all structural projects in the 10-year implementation plan were reordered based on this analysis. See Technical Memo 3.6 in Appendix B for more detailed information on project costs and benefits analysis.

6.4 Overall Costs and Benefits of Plan Implementation

The stormwater modeling and costs and benefits analysis described in this section demonstrates the value of the projects and restoration strategies discussed within the plan. The average cost for a project on the priority 10-year list is approximately $247,000, and the overall cost of implementing all the projects on the 10-year list is approximately $9 million. The costs to implement all projects would total approximately $13 million. Implementation of all projects and restoration strategies in the 10-year priority list will result in significant overall reductions in stormwater flows and pollutant loads, as shown in Table 6.5 and described in non-area-weighted units in Technical Memo 3.6 in Appendix B. Stormwater runoff volume from the 2-year and 10-year storm events would decrease by approximately 24 percent or 0.66 inches and 14 percent or 0.82 inches, respectively. The peak flow rates would also decrease by 34 percent, resulting in a reduction of 0.140 CFS per acre for the 2-year storm event, and 27 percent or 0.260 CFS per acre for the 10-year storm event. Total suspended solids would be reduced by 28 percent overall or 167 tons per year. Total nitrogen would be reduced by 5 percent or 1,113 pounds per year, and total phosphorus would be reduced by 9 percent or 290 pounds per year.

Implementation of all projects within the plan, including projects in the 25-year implementation plan will result in additional reductions in stormwater flows and pollutant loads. Total suspended solids would be reduced by 32 percent overall or 192 tons per year. Total nitrogen would be reduced by 8 percent or 1,714 pounds per year and total phosphorus would be reduced by 12 percent or 433 pounds per year.

Table 6.5
Overall Pollutant Loading and Flow Reductions

Watershed	Area (ac)	Scenario[2]	Runoff Volume (in)[1]		Peak Flow (cfs/ac)[1]		TN (lb/ac/yr)	TP (lb/ac/yr)	TSS (lb/ac/yr)
			2 Year	10 Year	2 Year	10 Year			
Nichol Run and Pond Branch	10,653.73	Existing Condition	2.79	5.70	0.405	0.950	2.00	0.310	113.74
		Future Without Projects	2.81	5.72	0.413	0.962	2.14	0.330	113.81
		Future With 10-yr Projects	2.15	4.90	0.273	0.702	2.04	0.300	82.44
		Reduction (10-year Plan)	0.66 (24%)	0.82 (14%)	0.140 (34%)	0.260 (27%)	0.10 (5%)	0.030 (9%)	31.37 (28%)
		Future With 0-25 yr Projects	N/A	N/A	N/A	N/A	1.98	0.29	77.72
		Reduction (25-year Plan)	N/A	N/A	N/A	N/A	0.16 (8%)	0.040 (12%)	36.09 (32%)

[1] Flow is cumulative.
[2] 25-year projects were not evaluated in the hydrologic model.

7.0 Glossary and Acronyms

Acre – A measure of land equating to 43,560 square feet.

Aquatic Habitat – The wetlands, streams, lakes, ponds, estuaries and streamside (riparian) environments where aquatic organisms (e.g., fish, benthic macroinvertebrates) live and reproduce; includes the water, soils, vegetation and other physical substrate (rocks, sediment) upon and within which the organisms occur.

Benthic Macroinvertebrate – An aquatic animal lacking a backbone and generally visible to the unaided eye.

Best Management Practice (BMP) – A structural or nonstructural practice that is designed to minimize the impacts of changes in land use on surface and groundwater systems. Structural best management practices refer to basins or facilities engineered for the purpose of reducing the pollutant load in stormwater runoff, such as bioretention, constructed stormwater wetlands, etc. Nonstructural best management practices refer to land use or development practices that are determined to be effective in minimizing the impact on receiving stream systems such as the preservation of open space and stream buffers, disconnection of impervious surfaces, etc.

Bioengineering – Combines biological (live plants) and engineering (structural) methods to provide a streambank stabilization method that performs natural stream functions without habitat destruction.

Bioretention System (Rain Garden) – A stormwater BMP consisting of a shallow surface depression planted with native vegetation to capture, treat and infiltrate stormwater.

Channel Evolution Model (CEM) – The geomorphologic assessment of the incised stream channels developed by Schumm et. al.

Channel – A natural or manmade waterway.

Check Dam – A structure placed within a swale or other stormwater facility to slow the stormwater flow rate and create small, temporary ponding areas.

Confluence – The joining point where two or more stream create a combined, larger stream.

Constructed Stormwater Wetland – A stormwater management facility consisting of shallow pools constructed to replicate natural wetland ecosystems, designed to enhance the water quality of stormwater runoff.

Department of Public Works and Environmental Services (DPWES) – Fairfax County, VA, department in charge of public works, utilities, building permits, land use and development, stormwater, wastewater, recycling and other environmental services.

Design Storm – A selected rainfall hyetograph of specified amount, intensity, duration and frequency that is used as a basin for design.

Detention – The temporary impoundment or holding of stormwater runoff.

Ecosystem – All the component organisms of a community and their environment that together form an interacting system.

Environmental Protection Agency (EPA) – United States federal agency responsible for safeguarding and managing a region's natural resources and quality of life.

Erosion - is the natural process by which a stream channel adjusts to changes within its watershed. Increased development within a watershed can accelerate the erosion process, resulting in the loss of residential yards, threatened infrastructure, siltation of aquatic habitat and decreased water quality.

Extended Detention (ED) Basin – A stormwater management facility that temporarily stores stormwater runoff and discharges it at a slower rate through a hydraulic outlet structure.

Federal Emergency Management Agency (FEMA) – United States federal agency responsible for disaster mitigation, preparedness, response, recovery and education, including flood maps.

Floodplain - Area of land on each side of a stream channel that is inundated periodically by flood waters; important zone for dissipating the energy of peak storm flow discharges and for storing waters that otherwise might damage in-stream habitat and/or cause downstream flood damage; typically includes high-quality riparian habitat (if undisturbed); waters flowing in incised (down-cut) streams may not be able to access the adjacent floodplain area to dissipate the volume and energy of higher storm flow events.

Geographic Information System (GIS) – A method of overlaying spatial land and land use data of different kinds. The data are referenced to a set of geographical coordinates and encoded in a computer software system. GIS is used by many localities to map utilities and sewer lines and to delineate zoning areas.

Geomorphology – A science that deals with the land and submarine relief features of the earth's surface.

Grassed Swale – see *Vegetated Swale*

Headcut – The geomorphologic incision of the stream due to the hydraulic effect of a channel from head forces. One example is the accelerated cutting of a stream due to a manmade or natural constriction where water velocities are increased substantially. Another example is the outlet of a dam, where extreme velocities can occur due to the high static head forces created by the build-up of water from the dam structure.

Headwater – The source of a stream or watershed.

Hydrologic Engineering Centers River Analysis System (HEC-RAS) – A hydraulic model used to simulate the hydraulics of water flow through natural and/or manmade channels and rivers.

Hot Spot – A problem area that may contain significant stressors or pollutant sources that can affect watershed conditions within the immediate subwatershed and may be having an impact on downstream areas.

Hydraulics – The physical science and technology of the static and dynamic behavior of fluids.

Hydrograph – A plot showing the rate of discharge, depth, or velocity of flow versus time for a given point on a stream or drainage system.

Hydrology – The science of dealing with the distribution and movement of water.

Hyetograph – A graph of time distribution of rainfall over a watershed.

Index of Biotic Integrity (IBI) – A biological index, which includes macroinvertebrate population indices, fish taxa richness and percent impervious calculations, that is designed to provide a general water quality evaluation of a stream or watershed.

Indicator – A physical marker used to assess the condition of the environment, as an early-warning signal of changes in the environment and to diagnose causes of ecological problems.

Impervious Surface – A surface composed of any material that significantly impedes or prevents natural infiltration of water into the soil. Impervious surfaces include, but are not limited to, roofs, buildings, streets, parking areas, any concrete, asphalt, or compacted gravel surface.

Low-Impact Development (LID) – A comprehensive land planning and engineering design approach with the goal of maximizing the amount of natural features and vegetation at a site, in order to allow stormwater to be infiltrated on site and recharge the groundwater rather than being conveyed to detention facilities or storm sewers.

Metric - An analytical benchmark that responds in a predictable way to increasing human, climatic or other environmental stress, and can be used to help compare watersheds.

Modeling - Use of conceptual and/or computer models to simulate the response (e.g., pollutant loading to streams) of a natural system (e.g., watershed) to various management scenarios; useful in assessing which types of watershed protection techniques will yield the greatest benefit to water quality, habitat, or flooding conditions, and in determining which locations within the watershed are optimal for such practices or project sites.

Municipal Separate Storm Sewer System (MS4) Permit – Fairfax County stormwater permit that requires the creation of watershed management plans to facilitate compliance with the Clean Water Act.

Open Space – The area within the boundaries of a lot that is intended to provide light and air, and is designed for either scenic or recreational purposes. Open space shall, in general, be available for entry and use by residents or occupants of the development. Open space may include, but is

not limited to, lawns, decorative planting, walkways, recreation areas, playgrounds, undisturbed natural areas and wooded areas.

Peak Discharge – The maximum rate of flow at an associated point within a given rainfall event or channel condition.

Perennial Stream – A body of water that normally flows year-round in a defined channel or bed, and is capable, in the absence of pollution or other manmade stream disturbances, of supporting bottom-dwelling aquatic animals.

Pipes - carry water from various sources to a stream. Because of this, the discharge may contain pollutants such as oil from roadway runoff, sewage, nutrients from lawn fertilization, etc. The high volume and flow delivered to the stream, particularly during storm events, can result in erosion of the stream channel and banks.

Rain Barrel – A stormwater BMP consisting of a large container designed to capture and store rainwater from roofs. The rainwater can then be used to water gardens and lawns, and is prevented from becoming surface runoff.

Rain Garden – see *Bioretention System*

Redevelopment – The substantial alteration, rehabilitation, or rebuilding of a property for residential, commercial, industrial, or other purposes.

Regional Ponds – Large ponds that may serve as stormwater facilities for entire regions.

Resource Protection Area (RPA) – Vegetated riparian buffer areas, which include land within a major floodplain and land within 100 feet of a water body. These buffer areas are important in the reduction of sediments, nutrients, as well as the other adverse effects of human activities, which could potentially degrade these systems and those downstream.

Restoration - The re-establishment of wetlands or stream hydrology and wetlands vegetation into an area where wetland conditions (or stable streambank and stream channel conditions) have been lost.

Retention – The permanent storage of stormwater.

Retrofit – The modification of stormwater management systems through the construction and/or enhancement of wet ponds, wetland plantings, or other best management practices designed to improve water quality.

Return Period – The average length of time between events having the same volume and duration. If a storm has a one percent chance of occurring in any given year, then it has a return period of 100 years.

Riparian Buffer - An area adjacent to a stream, wetland, or shoreline where development activities (e.g., buildings, logging) are typically restricted or prohibited; may be managed as streamside

(riparian) zones where undisturbed vegetation and soils act as filters of pollutants in stormwater runoff; buffer zone widths vary depending on state and local rules, but are typically a minimum of 25 to 50 feet on each side of perennial streams.

Road Crossings - Structures that span the width of a stream, usually road or foot bridges. The structures constrict the flow within a stream which can result in detrimental effects including erosion, flooding and decreased water quality. In addition, structures may block fish and wildlife passage preventing migration to feeding/spawning areas.

Runoff – The portion of precipitation, snow melt, or irrigation water that runs off the land into surface waters.

Spreadsheet Tool for Estimating Pollutant Load (STEPL) – A modeling tool used to determine pollutant loads and load reductions for the watershed planning effort.

Stream Protection Strategy (SPS) – Fairfax County program that focused on developing and prioritizing stream protection and restoration strategies.

Stormflow – The portion of stream flow that is due to stormwater runoff.

Stormwater Management – Programs designed to maintain or return the quality and quantity of stormwater runoff to pre-development levels.

Stormwater (or Stormwater Runoff) – Excess precipitation that is not retained by vegetation, surface depressions, or infiltration, and therefore collects on the surface and drains into a surface water body.

Stormwater Management Facility – A device that controls stormwater runoff and changes the characteristics of that runoff including, but not limited to, the quantity and quality, the period of release or the velocity of flow.

Storm Water Management Model (SWMM) – A stormwater modeling technique developed by the US Environmental Protection Agency (EPA) as a design and planning tool for stormwater runoff.

Stormwater Planning Division (SWPD) – Division of the Fairfax County Department of Public Works and Environmental Services.

Stream Restoration – The reestablishment of the general structure, function and dynamic, but self-sustaining, behavior of the ecosystem.

Subwatershed – A subdivision of a watershed used for planning and management purposes, usually ranges in size from 100 to 300 acres.

Tree Cover – The area directly beneath the crown and within the drip line of a tree.

Total Maximum Daily Load (TMDL) – A tool for establishing the allowable loadings of a given pollutant in a surface water resource to meet predetermined water quality standards.

U.S. Army Corps of Engineers (USACE) – The federal agency responsible for investigating, developing and maintaining the nation's water-related environmental resources.

Vegetated or Grassed Swale – A broad and shallow channel vegetated with erosion resistant and flood-tolerant vegetation. The purpose of this BMP is to convey and slow down stormwater in order to enhance water quality through sedimentation and filtration.

Virginia Pollutant Discharge Elimination System (VPDES) – Virginia state permitting regulations that determine the location and amount of pollutant discharges to land and water resources.

Watercourse – A stream with incised channel (bed and banks) over which water are conveyed.

Watershed – A defined land area drained by a river, stream, or drainage way, or system of connecting rivers, streams, or drainage ways such that all surface water within the area flows through a single outlet.

Watershed Advisory Group (WAG) – Group of watershed stakeholders, including watershed community members and professional agency representatives, involved with preparing the watershed management plan.

Watershed Management Area (WMA) – A subdivision of a watershed used for planning and management purposes, usually four square miles in size.

Watershed Planning - The development of basin wide Watershed Restoration Plans; planning typically includes (1) an assessment of watershed conditions and functional impacts at progressively smaller scales of study, and (2) the development of land use management strategies and optimal watershed restoration, enhancement and protection/preservation projects designed to address the identified watershed needs & opportunities.

Wetland - Habitats where the influence of surface water or groundwater has resulted in the development of plant or animal communities adapted to aquatic or intermittently wet conditions. Wetlands include tidal flats, shallow sub-tidal areas, swamps, marshes, wet meadows, bogs and similar areas.

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Appendix A: Watershed Workbook

The watershed workbook is a reader-friendly document that is designed to provide the residents and stakeholders of the Sugarland Run and Horsepen Creek watersheds with information about their watersheds. The watershed workbook describes the watershed study methodology and summarizes the County-wide goals and objectives. The watershed workbook characterizes the existing state of the watersheds and describes the various methods and tools used in the evaluation of all the watershed management areas within the Sugarland Run and Horsepen Creek watersheds. The watershed workbook is a draft document that contains the information and modeling results available at the time and has not been updated or finalized.

Appendix B: Technical Documents

i. Subwatershed Strategies

Technical Memo 3.2 describes how initial strategies were developed for Sugarland Run and Horsepen Creek watersheds. The memo discusses the characterization of subwatershed improvement, stream restoration, and regional pond alternative strategies. The memo also describes how based on these strategies priority subwatersheds were identified and potential candidate restoration projects were selected.

ii. Prioritization

Technical Memo 3.4/3.5 describes how potential candidate projects were evaluated and the final list of projects incorporated in the watershed management plan was selected. The memo describes how candidate projects were investigated in the field to evaluate the scope, feasibility, and benefits of each candidate project. The memo also discusses the procedure by which candidate structural projects were evaluated and ranked.

iii. Modeling description

Technical Memo 3.6 describes the selection of projects to be further evaluated with hydrologic and hydraulic models. The memo discusses this assessment of potential impacts and discusses if objectives were met by implementing the modeled projects. The memo summarizes the setup, calibration and results of the hydrologic and hydraulic modeling performed. Results from the final STEPL pollution model were also summarized in this memo.

Appendix C: Public Involvement

Summaries of the initial community workshop, the draft plan forum and each of the five Watershed Advisory Group (WAG) meetings that were held through the watershed management plan development process are included in Appendix C.

i. January 22, 2009
ii. March 17, 2009
iii. May 28, 2009
iv. June 30, 2009
v. April 20, 2010
vi. September 9, 2010
vii. September 23, 2010