Chapter 6
Watershed Plan

The Cameron Run Watershed Plan is consistent with Fairfax County's Policy Plan (the county-wide element of the comprehensive plan). The Board of Supervisors' goal for environmental protection, as stated in the Policy Plan, reads

> "The amount and distribution of population density and land uses in Fairfax County should be consistent with environmental constraints inherent in the need to preserve natural resources to meet or exceed federal, state, and local standards for water quality, ambient air quality, and other environmental standards. Development in Fairfax County should be sensitive to the natural setting to prevent degradation of the county's natural environment."

The county policy document also notes that

> "The protection and restoration of the ecological quality of streams is important to the conservation of ecological resources in Fairfax County. Therefore, efforts to minimize adverse impacts of land use and development on the county's streams should be pursued."

This Cameron Run Watershed Plan is intended to complement and supplement the county's policies and comprehensive plans over the next 25 years and to support its commitment to the Clean Water Act and Virginia's commitment to the Chesapeake Bay Preservation Ordinance. The county and community members of the Cameron Run watershed are committed to protecting Cameron Run and its tributaries from future degradation by promoting management actions that work to restore streams and other areas throughout the watershed to an environmentally healthy ecosystem. This commitment emphasizes the importance of protecting the county's valuable natural resources, including surface waters, and supports the sustainability and improvement of the environment, which directly affects the quality of life of the county's residents.

Specifically, the Cameron Run Watershed Plan was written to manage changes in the watershed so it can be enjoyed by future generations. The plan also will help the county meet federal, state, and local regulatory water quality requirements. This chapter summarizes the Watershed Plan, providing the vision, goals and objectives, policy recommendations, project actions, implementation, and benefits.

6.1 VISION

The Project Team and Advisory Committee jointly developed the following vision to guide development and implementation of the plan:

> *A fishable, swimmable, and biologically diverse Cameron Run watershed that supports a safe and enjoyable environment for people and property*

6.2 GOALS AND OBJECTIVES

Drawing on knowledge of the ultimate causes and proximate stresses affecting the watershed, the Project Team and Advisory Committee developed the following goals and objectives that are consistent with the vision defined for Cameron Run:

Goal A: Reduce the effects of stormwater runoff from impervious areas to help restore and protect streams within the Cameron Run watershed

Objective A1: Increase the effectiveness of existing BMPs by improving maintenance or "retrofitting" them to further reduce the effects of impervious areas (altered flows and poor water quality).

Objective A2: Install new BMP and LID facilities in areas that do not have existing stormwater management controls.

Objective A3: Require (1) reduction of the rate and volume of runoff following the development of new commercial and residential sites to the minimum possible levels and (2) reduction of post-development runoff at redevelopment sites by targeted percentages from the pre-development rate and volume.

Objective A4: Increase the participation of residents in decreasing the amount of stormwater runoff from impervious surfaces in residential areas.

Objective A5: Reduce the effects of stormwater runoff from existing and proposed roadways by instituting new countywide watershed management requirements.

Goal B: Preserve, maintain, and improve watershed habitats to support appropriate native flora and fauna

Objective B1: Preserve, restore, and manage riparian buffers to benefit appropriate native flora and fauna (and reduce the effects of stormwater runoff).

Objective B2: Preserve, restore, and manage habitat in streams and on stream banks to benefit appropriate native flora and fauna (and water quality).

Objective B3: Preserve, restore, and manage wetlands to benefit appropriate native flora and fauna.

Goal C: Preserve, maintain, and improve water quality within streams to benefit humans and aquatic life

Objective C1: Reduce and mitigate the effects of bank erosion and sedimentation.

Objective C2: Reduce the amount of pollutants such as fecal coliform, phosphorous, and nitrogen in stormwater runoff.

Objective C3: Reduce the amount of trash and number of dumping sites in the watershed to help protect and improve the streams.

Goal D: Improve stream-based quality of life and environmentally friendly recreational opportunities for residents of and visitors to Cameron Run watershed

Objective D1: Create additional access and trails for stream-based recreational opportunities in the watershed.

Objective D2: Increase public awareness and appreciation of streams in the watershed.

The substance of the plan is the policy recommendations and project actions developed by the Project Team, Advisory Committee, and public to accomplish these goals and objectives. Implementation of new or revised policies will be undertaken by Fairfax County on a county-wide basis. Project actions include both government-sponsored and private structural or non-structural initiatives that would be implemented at specific locations. These policy recommendations and project actions are presented in separate sections below.

6.3 POLICY RECOMMENDATIONS FOR CAMERON RUN WATERSHED

Policy recommendations include proposals that would typically involve amendments of the county Code or other supporting documents such as the Public Facilities Manual. The current approach for processing policy recommendations from the Cameron Run Watershed Plan is to combine them with the recommendations that have been developed in the Little Hunting Creek, Popes Head Creek, Cub Run, and Difficult Run watershed plans for consideration by the appropriate county decision makers. It is expected that this separate process will consider policy recommendations in the context of legal and administrative constraints, and will result in more specific and more effective recommendations. This plan advocates that the county consider all policy recommendations from all the plans when deciding how to amend the County Code or other guidance.

Goal A: Reduce the effects of stormwater runoff from impervious areas to help restore and protect streams within the Cameron Run watershed.

Objective A1: Increase the effectiveness of existing BMPs by improving maintenance or "retrofitting" them to further reduce the effects of impervious areas (altered flows and poor water quality).

- *Policy Recommendation A1.1*: The county and the Virginia Department of Transportation (VDOT) should develop an inspection protocol; inspect BMPs, ditches, pipes, and outfalls within the watershed every five years;

and make repairs as necessary. Establish a hotline for citizens to report problems, and fund projects that address citizen-reported problems. Support legislation that provides incentives for VDOT to use LID techniques in its projects and replace grass with more native trees and vegetation along highways. Adopt the same policies for any county-owned roads.

- *Policy Recommendation A1.2:* Provide additional staff and resources to the county for review and inspection of privately owned and county-owned BMPs.

- *Policy Recommendation A1.3:* Increase the frequency of inspection for private BMPs with maintenance agreements from approximately once every three-to-five years to annually and provide education, including written materials, to owners to ensure proper maintenance.

- *Policy Recommendation A1.4:* Evaluate the county's current list of recommended BMPs (dated October 2, 2001) to determine their effectiveness based on current literature. Expand the list to include newer practices such as porous pavement, bioretention, and green rooftops. These practices are currently in use in the county and a number of LID practices have recently been incorporated into the Public Facilities Manual. The county will consider adoption of additional LID measures in the future. Adding them to the recommended list will make it easier for developers to include these in their site plans for review. Allow for the siting of integrated LID management practices on individual residential lots. Prepare materials to give to builders, remodelers, and developers to educate them about these LID practices and the county's preference for them. Adopt a policy preferring these practices where they are effective.

- *Policy Recommendation A1.5:* Retrofit and upgrade existing stormwater management facilities and BMPs, where feasible, to make them more effective in managing stormwater runoff. Construct new public BMPs including LID practices to detain the runoff from surrounding development that does not currently have stormwater management controls. Construct LID demonstration projects at publicly owned locations such as schools, parks, and other county properties.

- *Policy Recommendation A1.6:* Enact a new policy to more stringently require all land disturbance, remodeling, building, and redevelopment to retain on-site all runoff that would normally infiltrate (on natural landscapes), and prevent it from flowing onto adjacent properties, unless an exception is granted (e.g., property is next to a stream or natural area). Do not grant final residency permits until stormwater controls are properly installed and tested.

- *Policy Recommendation A1.7:* Fairfax County should not grant waivers of water quality controls for nonbonded lots exceeding 18% imperviousness. Nonbonded lots refer to existing lots (new construction, redevelopment, expansion, or renovation) that were created as part of an older development project for which the performance bond has been released.

- *Policy Recommendation A1.8:* Increase fines for noncompliance with BMP or LID requirements.

- *Policy Recommendation A1.9:* Coordinate county stormwater management activities with those of neighboring jurisdictions and review this coordination annually.

Objective A2: Install new BMP and LID facilities in areas that do not have existing stormwater management controls.

- *Policy Recommendation A2.1:* Encourage approval of LID facilities as acceptable stormwater management and adopt a policy preferring LID projects where they are effective.

Objective A3: Require development of new commercial and residential sites to reduce the post-development rate and volume of runoff to the minimum possible levels, and redevelopment sites to reduce the post-development runoff by targeted percentages from the pre-development rate and volume.

- *Policy Recommendation A3.1:* Amend the Fairfax County Erosion and Sedimentation Control Ordinance, Chesapeake Bay Preservation Ordinance, and other applicable ordinances to require that commercial and residential redevelopment of sites demonstrate a 10% net decrease in runoff if possible. Adopt graduated incentives for projects that exceed the 10% minimum, and do not allow residency permits until the site owners demonstrate that this has been achieved.

- *Policy Recommendation A3.2:* Amend zoning regulations or plans to encourage better design of new development (both public and private) to reduce or eliminate post-development runoff.

- *Policy Recommendation A3.3:* Consider providing incentives for developers, redevelopers, builders, and remodelers to reduce runoff, through zoning incentives or an expedited review process for developers who include conservation design techniques and LID components in their site plans.

- *Policy Recommendation A3.4:* Limit removal of mature trees and native vegetation in any new development, redevelopment, or renovation of

commercial and residential sites by making associated permits contingent on landscape requirements directed by the county.

- *Policy Recommendation A3.5:* Conduct frequent inspections during the building process to ensure compliance with permit conditions pertaining to landscaping requirements and adequate prevention of stormwater runoff. Rigorous fines and Stop Work Orders should be employed for noncompliance.

- *Policy Recommendation A3.6:* Allocate sufficient dedicated funding to adequately staff, educate, and otherwise support county inspection and enforcement related to preventing the removal of native mature trees and landscape or requiring restorative landscaping in accordance with permits.

Objective A4: Increase the participation of residents in decreasing the amount of stormwater runoff from impervious surfaces in residential areas.

- *Policy Recommendation A4.1:* Facilitate, through technical assistance, financial support, and other incentives, the construction and use of LID practices such as rain gardens, cisterns, and rain barrels throughout the watershed, initially targeting areas near the headwaters of streams to detain the runoff from developments that do not have stormwater management controls. The county should investigate mini grants, county tax abatements, or county property tax credits to facilitate implementation of LID practices.

- *Policy Recommendation A4.2:* Involve the public early in the planning of watershed projects and maintain transparency between the county and the public throughout the process. Improve coordination with and early notification of affected residents at both the study and implementation stages of proposed stormwater projects and notify affected civic associations.

Objective A5: Reduce the effects of stormwater runoff from existing and proposed roadways by instituting new countywide watershed management requirements.

- *Policy Recommendation A5.1:* In coordination with VDOT, require that road widening projects be designed to control the runoff from existing paved areas that do not have stormwater management controls and reduce the existing peak runoff rate by a minimum of 5%.

- *Policy Recommendation A5.2:* In coordination with VDOT, replace grasses on medians and sides of roadway with native trees and vegetation where possible.

Goal B: Preserve, maintain, and improve watershed habitats to support appropriate native flora and fauna.

Objective B1: P Preserve, restore, and manage riparian buffers to benefit appropriate native flora and fauna (and reduce the effects of stormwater runoff).

- *Policy Recommendation B1.1:* Plant buffers using native vegetation and trees adjacent to the stream in areas identified as good candidates for riparian buffer restoration. Monitor the condition of restored and existing riparian buffers for at least five years with annual stream walks to evaluate the condition and identify areas needing improvement.

- *Policy Recommendation B1.2:* Provide additional staff and dedicated funding to the county to ensure protection of riparian buffers and adequate review of waivers under the Chesapeake Bay RPA Ordinance. Ensure that county personnel are adequately trained with respect to the requirements of the RPA Ordinance and encourage strict enforcement of such requirements. Grant waivers very judiciously.

- *Policy Recommendation B1.3:* Require restoration of vegetation in the riparian buffer for development or redevelopment sites within the RPA that do not have existing buffer vegetation. Native vegetation mixes, suitable for local habitats, should be mandated in a BMP document identifying specific plants and trees that meet this definition.

- *Policy Recommendation B1.4:* Provide educational and technical assistance, including written materials, to owners of property with tidal shoreline and land adjacent to streams to help them manage existing buffers, including information about Virginia's wetlands' laws and the county's permitting process. Technical and educational assistance may include information about the benefits of riparian buffers, the value of native vegetation, identification and removal of invasive species, and healthy pruning.

- *Policy Recommendation B1.5:* Amend the county's tree cover policy to expand existing woodland habitat and prevent further deforestation. Conduct an inventory of significant native trees in the county. Strengthen the requirements of building permits and site plans to preserve native trees, encourage the planting of native trees, and protect trees with good construction practices. Require the planting of native trees and vegetation on all commercial properties where appropriate.

- *Policy Recommendation B1.6:* Determine the current level of mature tree canopy coverage existing in each subwatershed. Establish a reforestation goal, ensuring new native tree planting throughout each subwatershed to increase its canopy coverage by a minimum of 5% in five years. New reforestation targets should be adopted every five to seven years.

Objective B2: Preserve, restore, and manage habitat in streams and on stream banks to benefit appropriate native flora and fauna (and water quality).

- *Policy Recommendation B2.1:* Monitor and report on the condition of streams by performing a stream physical assessment every five years to track the improvement or degradation of streams from the baseline condition.

- *Policy Recommendation B2.2:* Facilitate the acquisition by and donation of conservation easements to community groups and land trust organizations for protection of streams and riparian buffers, as well as provision of public/private open space, for the environmental quality corridors described in the Fairfax County Comprehensive Plan and not adequately protected through the zoning process.

- *Policy Recommendation B2.3:* Adopt a county policy of implementing natural and water conserving landscaping approaches at all of its facilities in the watershed, implementing these beneficial watershed management approaches as models for future development.

- *Policy Recommendation B2.4:* Notify property owners of steps they could take to improve water quality in their streams (e.g., by providing information on reducing chemicals and fertilizers on lawns, using native plants, and performing natural landscaping).

Objective B3: Preserve, restore, and manage wetlands to benefit appropriate native flora and fauna.

- *Policy Recommendation B3.1:* Perform a wetlands functions-and-values survey to identify the location, size, owner, type, and quality of existing wetlands in the watershed to determine the baseline information.

- *Policy Recommendation B3.2:* Working with local communities, construct and restore wetlands at suitable locations in the watershed as identified by the wetlands functions-and-values survey.

- *Policy Recommendation B3.3:* Purchase private land, designate public land, or acquire easements for land conservation of critical wetland habitat areas as identified in the wetlands functions-and-values survey.

- *Policy Recommendation B3.4:* Create and distribute outreach materials that inform the public about the value and benefit of wetlands, the permits required for activities in wetlands, and the Wetlands Board's preference for LID techniques and "living shorelines."

- *Policy Recommendation B3.5:* Strengthen county policy and ordinances, in the event that impacts to wetlands are unavoidable, to require mitigation such as buying into a wetlands bank or creating compensatory wetlands. Wetland banks used for mitigation should be approved by state and federal regulatory agencies.

Goal C: Preserve, maintain, and improve water quality within streams to benefit humans and aquatic life.

Objective C1: Reduce and mitigate the effects of bank erosion and sedimentation.

- *Policy Recommendation C1.1:* Provide additional staff and resources to the county to inspect development projects and apply necessary penalties to ensure compliance with land disturbance prohibitions (and applicable erosion and sediment requirements) under the Chesapeake Bay Preservation Ordinance. Impose fines on persons or companies not complying with the requirements, and require restoration of the sites. Strengthen the current erosion and sediment control laws, policies, and regulations (e.g., Chapter 104 of the Fairfax County Code) to provide the penalties and restoration requirements described above."

- *Policy Recommendation C1.2:* Encourage application of bioengineering and natural stream channel design approaches to stabilize streambanks and improve stream habitat conditions.

- *Policy Recommendation C1.3:* Reduce the amount of county-applied de-icing materials such as sand and/or chemicals entering surface waters of the watershed, and require that excess de-icing materials be swept up in a timely manner to prevent them from reaching surface waters and causing sedimentation or impacting water quality. Limit the use of de-icing materials that impair water quality and recommend products and practices that will be specified in the county review and update of BMPs. Coordinate with VDOT to achieve the above goals on state roadways within the county.

Objective C2: Reduce the amount of pollutants such as fecal coliform, phosphorous, and nitrogen in stormwater runoff.

- *Policy Recommendation C2.1:* Identify sources of fecal coliform in the watershed (i.e., from humans, domesticated animals, or wildlife) and prepare an action plan to reduce the amount of fecal coliform.

- *Policy Recommendation C2.2:* Perform additional water quality monitoring that includes a macroinvertebrate and aquatic plant survey of Cameron Run

and its tributaries, and report the results to the public. Prepare an action plan based on the results.

- *Policy Recommendation C2.3:* Identify and investigate illicit discharges in the watershed from commercial and residential activities such as car repair and painting. Take enforcement actions to stop such illicit discharges.

- *Policy Recommendation C2.4:* Educate the public on ways to reduce the amount of pollutants in stormwater runoff. This can include, but is not limited to, storm drain stenciling, providing 'doggie mitts' in public parks, brochures, advertising, and working with community groups. Provide materials on natural landscaping, using native plants, and reducing use of chemicals and fertilizers.

- *Policy Recommendation C2.5:* Encourage all lawn management companies to participate in the Virginia Water Quality Improvement Program, and sign agreements requiring them to apply nutrients within established criteria to better control application rates and timing, thus creating a "green label" for lawn and landscaping companies. Provide a list of these companies to residential and commercial property owners and homeowners associations. Use only those companies on county-owned properties.

- *Policy Recommendation C2.6:* Strengthen enforcement of the "pooper scooper" regulation by instituting a $100 fine for violators.

Objective C3: Reduce the amount of trash and number of dumping sites in the watershed to help protect and improve the streams.

- *Policy Recommendation C3.1:* Work with community groups to clean up trash, woody debris that impedes stream flow, and dumpsites throughout the watershed.

- *Policy Recommendation C3.2:* Conduct a vigorous public information campaign, including installing signs throughout the watershed and coordinating with community groups, to deter littering and the dumping of trash.

- *Policy Recommendation C3.3:* Place containers at all public and other high-traffic facilities that have openings for recycling paper, glass, and aluminum with signs requesting sorting of trash and stating fines for littering.

- *Policy Recommendation C3.4:* Enforce the solid waste ordinance and the erosion and sedimentation control ordinance prohibitions against illegal dumping. Target locations experiencing frequent dumpings of trash and identify private, potentially illegal dumpsites located in the watershed. Impose fines on persons caught dumping illegally, take legal action against the property owners who create or knowingly allow illegal dumpsites, and

require restoration of the sites. Consider fencing or lighting on chronic dumping sites on both public and private land, where they would not cause adverse environmental impacts.

Goal D: Improve stream-based quality of life and environmentally friendly recreational opportunities for residents of and visitors to Cameron Run watershed.

Objective D1: Create additional access and trails for stream-based recreational opportunities in the watershed.

- *Policy Recommendation D1.1:* Identify stream corridors for purchase or acquisition of easements for public access and environmentally friendly recreation.

- *Policy Recommendation D1.2:* Develop a master plan for increased environmentally friendly recreational opportunities along the Cameron Run mainstem and major tributaries.

Objective D2: Increase public awareness and appreciation of streams in the watershed.

- *Policy Recommendation D2.1:* Post signage that publicizes the existence of RPAs and their importance for stream protection and environmentally sensitive recreation.

- *Policy Recommendation D2.2:* Install signage at public facilities to explain the reasons and benefits of rain gardens, green roofs, porous pavement, increased mature tree canopy coverage, and other LID features. Include this information in mailings to park users. Identify sources for interested citizens to obtain more information about these types of BMPs.

- *Policy Recommendation D2.3:* Evaluate, through a literature review or formal study, the effectiveness of public education programs for watershed stewardship. This could result in an addendum to this plan that identifies mechanisms for reaching watershed residents (e.g., through public and private schools, clubs, civic groups, service organizations, foreign-language communities). This addendum would also include the best methods for changing individual behaviors for better watershed stewardship. It would also include methods for monitoring the effectiveness of these methods, and adapting public education programs for success.

6.4 PROJECT ACTIONS

The proposed project actions for the Cameron Run Watershed Plan are based on analysis done by the Project Team with contributions from the Advisory Committee and the public. The

actions were selected to help meet the goals and objectives stated above. Specifically, these projects will address the following objectives:

Objective A1: Increase the effectiveness of existing BMPs by improving maintenance or "retrofitting" them to further reduce the effects of impervious areas (altered flows and poor water quality).

Objective A2: Install new BMP and LID facilities in areas that do not have existing stormwater management controls.

Objective A4: Increase the participation of residents in decreasing the amount of stormwater runoff from impervious surfaces in residential areas.

Objective B1: Preserve, restore, and manage riparian buffers to benefit appropriate native flora and fauna (and reduce the effects of stormwater runoff).

Objective B2: Preserve, restore, and manage habitat in streams and on stream banks to benefit appropriate native flora and fauna (and water quality).

Objective C1: Reduce and mitigate the effects of bank erosion and sedimentation.

Objective C2: Reduce the amount of pollutants such as fecal coliform, phosphorous, and nitrogen in stormwater runoff.

These actions may be structural or nonstructural projects of the following types:

- Projects initiated by the county via the Capital Improvement Program
- Projects initiated by developers via the Zoning Approval Process (proffers and development conditions) or waiver approval process
- Projects implemented by volunteer groups

The projects recommended in the plan fall into the following four categories:

- **Low impact development** – LID approaches are innovative practices designed to mimic natural flows by reducing the volume of stormwater runoff at the source, not just by managing flows as they leave a site. Distributed LID features are a series of smaller landscape features that function as retention/detention areas integrated with developed areas. These features are designed and constructed to detain and treat stormwater through natural processes such as infiltration, soil storage, and uptake by vegetation. Special attention should be paid to the composition of existing soils, as well as new soils or amended soils used. These solutions are increasingly being used to reduce the adverse environmental effects of stormwater and other urban stressors in developed areas (in addition to being incorporated into new development).

- **New storm water management ponds** – Placing new stormwater management (SWM) ponds, including small extended detention dry ponds, at locations that currently have no stormwater quantity or quality controls.
- **SWM retrofits** – Modifying existing SWM ponds to provide additional quantity or quality controls.
- **Stream restoration –** Modifying stream channels, banks, and instream habitat to improve degraded and unstable conditions.

As discussed in Chapter 5, the projects were separated into the following three groups to help prioritize the approximately 650 opportunities for watershed improvements identified during this study:

- **Tier 1** – Projects that represent the best opportunities for the county's efforts because they are located on public lands and were selected using SWMD's prioritization framework and in rough proportion to the amount of uncontrolled impervious surface within the subwatershed.
- **Tier 2** – Sites representing lower-priority projects on public land, or sites on private lands that present good opportunities and have received various levels of support from Advisory Committee members or the general public.
- **Tier 3** – The remainder of the approximately 650 sites identified during the initial map review and public involvement process.

The remainder of the plan focuses on the Tier 1 projects because they represent the best opportunities for the county to implement watershed improvements (Figure 6-1). The Tier 2 and Tier 3 sites present additional good opportunities, particularly if projects at these sites could be implemented through the development review process or other means; maps of these sites and tables containing descriptive information are included in Appendix A.2 and Appendix A.3.

In addition, the drainage complaints filed with the Fairfax County Maintenance and Stormwater Management Division were used to develop a supplemental list of projects that addressed drainage-related problems (see Section 6.4.7). Project fact sheets containing recommended actions for the 25 selected drainage complaint projects are included in Appendix A-4.

Table 6-1 shows a breakdown of all projects by project type and tier.

Table 6-1. The number of projects for each project type and tier

Project Type	Tier 1	Tier 2	Tier 3	Total
Non-structural projects and special studies	3	-	21	24
LID	77	54	306	437
New SWM pond	1	1	-	2
SWM pond retrofit	15	5	78	98
Stream restoration	4	32	2	38
Drainage Complaint Projects	25	-	-	25
Total	125	92	407	624

Implementing watershed improvement projects offers an opportunity to educate the surrounding community. To take advantage of this opportunity, the county should consider including an educational component (e.g., interpretive signs, brochures, public meetings, etc.) for each project that is implemented.

The sections that follow describe the various kinds of projects and include tables that list the specific project actions. More detailed information on projects is provided in Appendix A. Project fact sheets for the Tier 1 projects and the Drainage Complaint Projects are located in Appendix A-1 and Appendix A-4, respectively. Information on the Tier 2 and Tier 3 projects are provided in Appendix A-2 and Appendix A-3.

Implementation costs stated in the plan are order-of-magnitude estimates. Structural and non-structural projects will typically require additional design work, possible land rights acquisition, agreements, or other coordination during the implementation phase. It is assumed that the county will hire contractors to execute individual projects. The use of volunteer labor on appropriate projects will reduce costs. As the projects are evaluated further, more detailed cost estimates will be possible. In addition, site conditions may change over time as a result of maintenance, site improvements, natural processes, or other factors, and these changes may require modifying the proposed action at the time of implementation.

The projects for the plan are identified using the county's 6-digit numbering convention (XX9YZZ), where

XX9 = Watershed Code = CA9

Y = 1 for new SWM ponds or SWM retrofits
2 for stream restoration or stabilization projects
6 for flood control projects
7 for nonstructural projects and special studies throughout the watershed
8 and 9 for LID projects

ZZ = Digits representing locations in the watershed starting with 00 indicating the most downstream point in the watershed through 99 indicating the most upstream point.

6.4.1 Nonstructural Projects and Special Studies

Several nonstructural projects have been identified to address widespread issues and opportunities throughout the Cameron Run watershed (Table 6-2). Two of these projects provide educational and funding mechanisms to promote greater community support and participation in watershed improvements annually over the 25-year life of the plan.

6.4.2 Low Impact Development

LID includes the use of innovative practices designed to mimic natural flows by reducing the volume of stormwater runoff at the source. Usually these practices are integrated to fit specific site needs. In this plan, LID projects may include any combination of the practices listed and

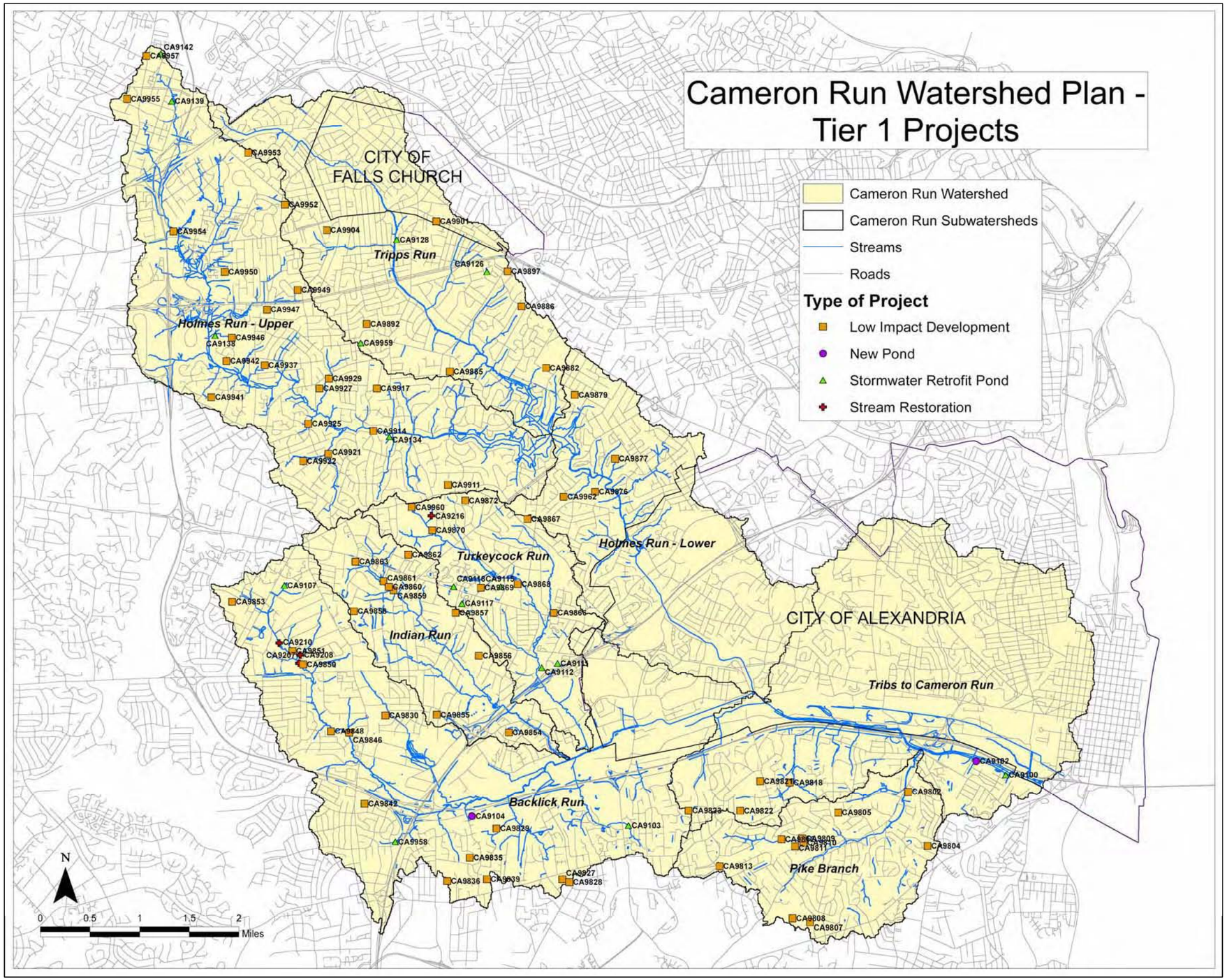


Figure 6-1. Location of Tier 1 candidate watershed restoration projects

Table 6-2. Nonstructural projects and special studies

Project ID	Project Name	Subwatershed	Proposed Action	Benefit	Estimated Cost
CA9700	Debris Jam Removal	Watershed-wide	Locate, evaluate, and remove debris jams observed to cause excessive erosion.	Improve stream stability, erosion, and instream habitat. Prevent property and structural loss. Reduce road flooding. Opportunity for public education.	$286,000
CA9701	Community Watershed Restoration Support	Watershed-wide	Provide education and technical assistance to encourage restoration practices on private property. Explain the need for restoration and describe effective techniques. Distribute "how to" information on creating rain gardens, backyard riparian buffers, and other LID projects. Provide technical assistance with individual LID projects.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion. Opportunity for public education.	$1,407,000 (over 25 years)
CA9702	Small Watershed Grant Program	Watershed-wide	Establish and administer an annual program that provides small grants to local organizations, residents, and businesses to facilitate education, capacity building, small retrofit and restoration projects, and monitoring activities. For example, grants could be used to off-set the costs to purchase and install rain barrels or other LID projects on private property via a coupon program or other sales mechanism, to cover staff time for a watershed organization, or to provide field equipment for a volunteer watershed monitoring program.	Improve stormwater quantity controls. Improve stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion.	$1,094,000 (over 25 years)

described in more detail below. LID projects have the best potential to control diffuse stormwater problems and restore natural hydrology throughout the watershed. They make up the majority of projects included in the plan.

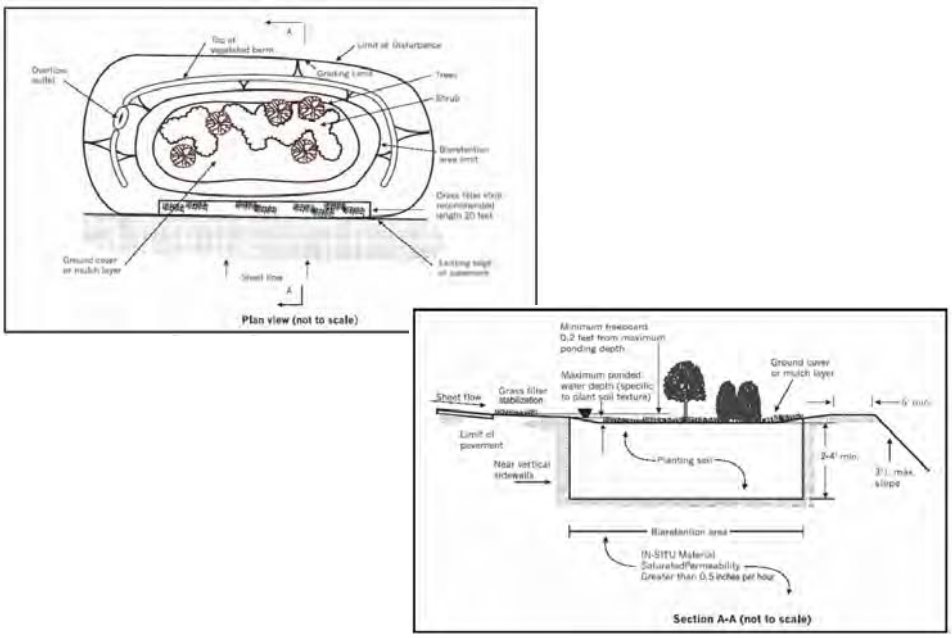
The following sections provide general descriptions of common LID techniques:

- bioretention areas (rain gardens)
- pipe outfall retrofits (off-line bioretention)
- infiltration trenches
- grassed swales
- tree box filters
- rain barrels/cisterns
- permeable pavers

6.4.2.1 Bioretention Area ("Rain Garden")

Description: A bioretention area is a shallow depression designed to detain and treat stormwater runoff from small, frequent storms by using a conditioned planting soil bed and planting materials (AMEC 2005). Pollutants are adsorbed by the soil and plant material, improving water quality. Water slowly infiltrates through the soil bed to recharge groundwater or is used by the plants via transpiration. In some cases, an underdrain system can be installed to carry treated water draining through the system to an existing stormdrain network.

Maintenance: Inspect the treatment area's components and repair or replace as necessary. This area is akin to a landscape feature in general maintenance needs, such as removal of accumulated sediment and debris, replacement of dead or stressed plants, and annual mulching (or as necessary). These facilities have an expected life span of 25 years.

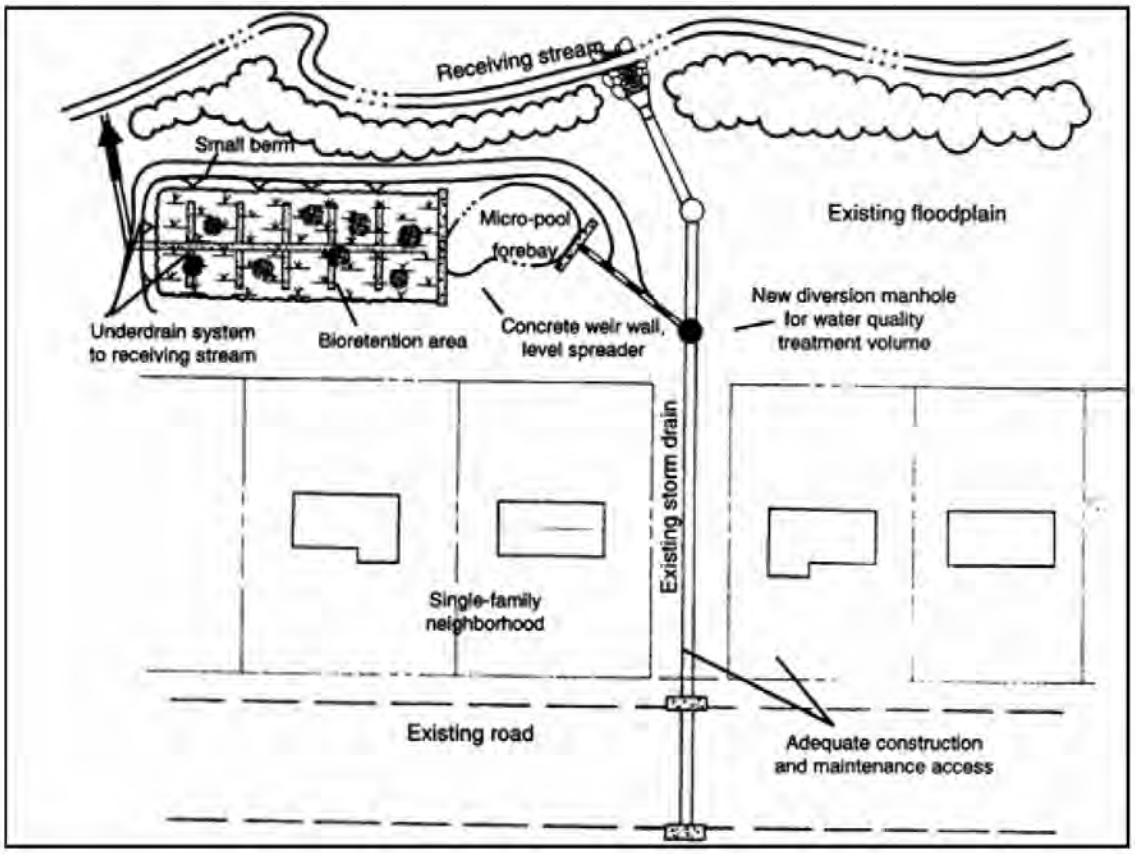


Bioretention Area (Source: Prince George's County 1999)

6.4.2.2 Pipe Outfall Retrofits (Off-line Bioretention)

Description: This retrofit option is installed immediately downstream of a stormwater drainage pipe outfall. Flow splitters can be used to convey water to a sand filter, bioretention area, off-line wetland, or wet pond for water quality treatment, while larger storms that exceed the treatment capacity are allowed to bypass the retrofit (AMEC 2005).

Maintenance: Inspect the treatment area's components and repair or replace as necessary. This area is akin to a landscape feature in general maintenance needs, such as removal of accumulated sediment and debris, replacement of dead or stressed plants, and annual mulching (or as necessary). An observation well can be used to make sure the underdrain is not clogged and is working properly. These facilities have an expected life span of 25 years.

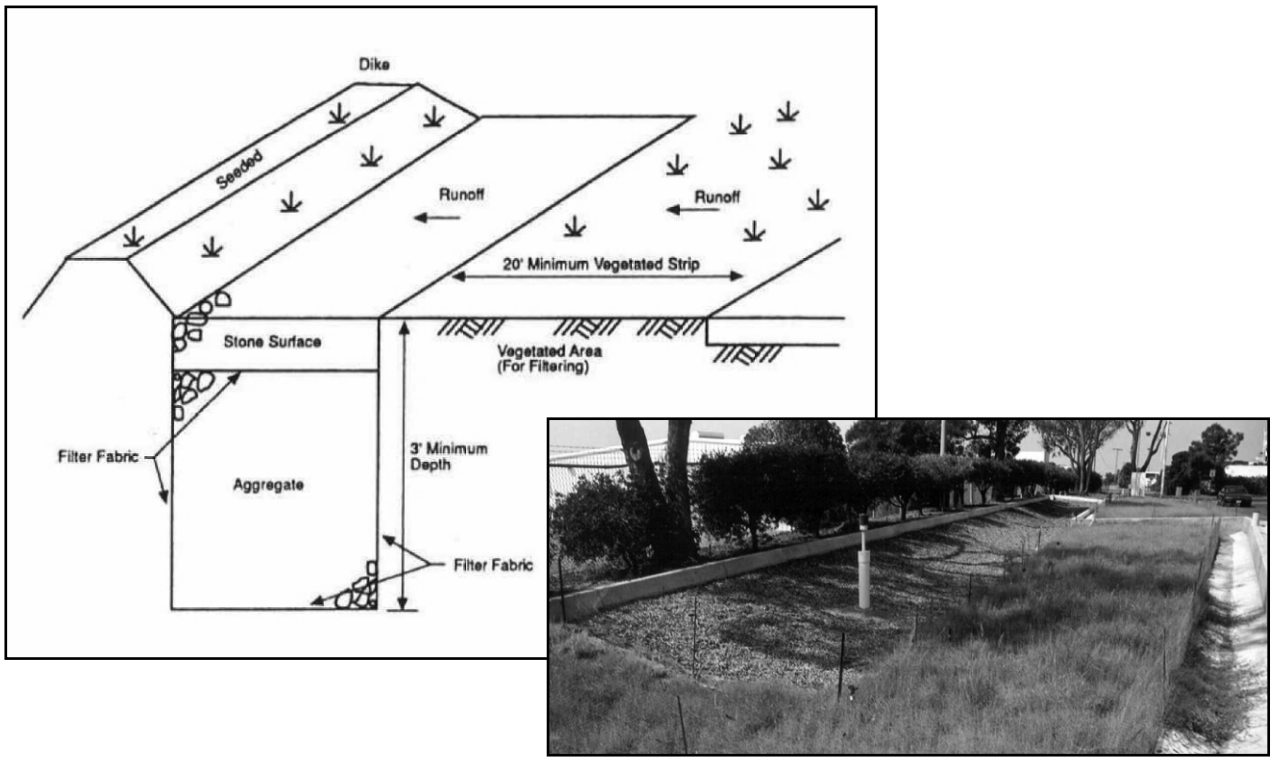


Pipe Outfall Retrofit (Source: Schueler et al. 2000)

6.4.2.3 Infiltration Trench

Description: An infiltration trench is an excavated trench that has been backfilled with stone to form a subsurface basin. Stormwater runoff is diverted into the trench and is stored until it can be infiltrated into the soil, usually over a period of several days. These structures are ideal for small urban drainage areas and have a longer life cycle when some form of pretreatment to remove sediment, such as a grass swale, is included in the design. Infiltration trenches can be installed in areas adjacent to parking lots, roads, and other impermeable surfaces to capture runoff (AMEC 2005).

Maintenance: Prevent sediments and debris from accumulating on the drained area, which could enter and clog the trench. Sediment and debris could be removed by routinely sweeping or by installing a grass filter strip or other pretreatment BMP. Maintenance of the pretreatment BMP is very important to prevent clogging. Filter strip maintenance consists of reseeding any eroded areas and periodically mowing to a height equal to or greater than the design flow height. These trenches have an expected life span of 10 years.

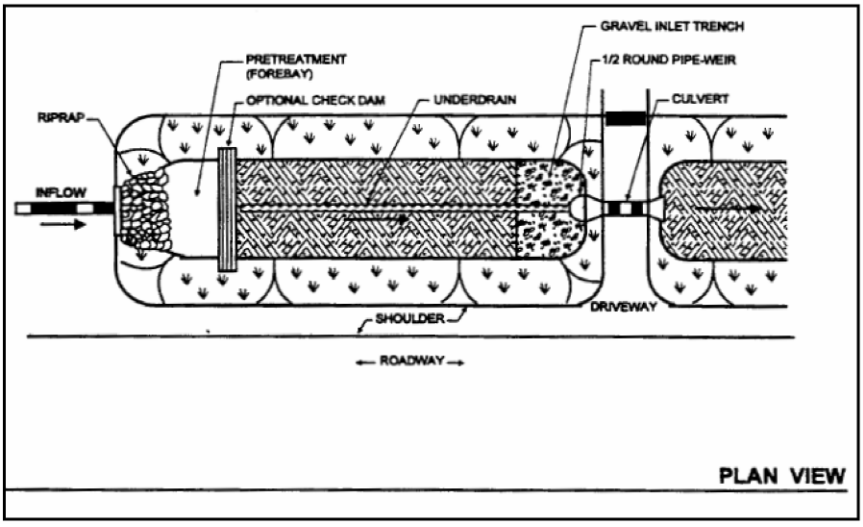


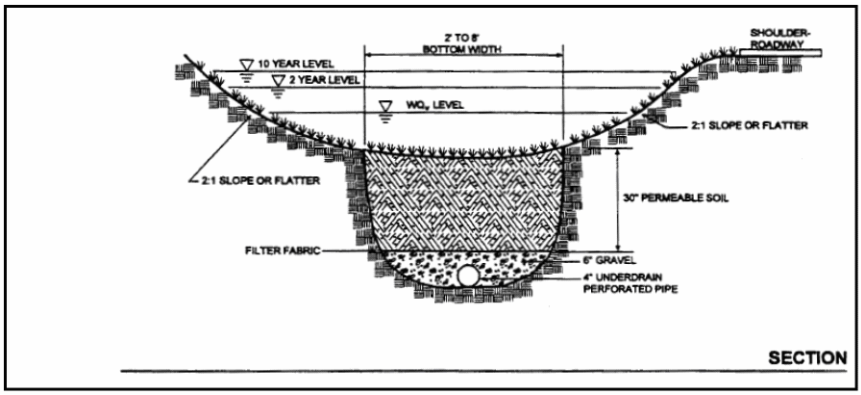
Infiltration Trench (Source: American Groundwater Trust and California Stormwater Quality Association in MAPC Undated)

6.4.2.4 Grassed Swale

Description: Grassed swales control both the quantity and quality of water. Stormwater travels more slowly in a grass swale than it does in a concrete ditch, reducing runoff volume and downstream erosion (AMEC 2005). Stormwater also infiltrates into the soil, further reducing volume and removing pollutants.

Maintenance: Maintain a dense, healthy grass cover through periodic mowing, keeping grass height at or above the design flow depth. In addition, weeding, watering, reseeding of bare areas, and clearing of debris and blockages may be necessary. Swales should be inspected periodically, especially after significant rain storms to correct sediment buildup and erosion. If sediment accumulates, sediments should be removed manually rather than with heavy machinery, which tends to reshape the swale and concentrate erosive flows. Fertilizers and pesticides should be avoided or used only when the grass cover is diseased or dying. Compaction of the swale, from parking cars and other uses, should also be avoided. Swales have an expected life span of 25 years.



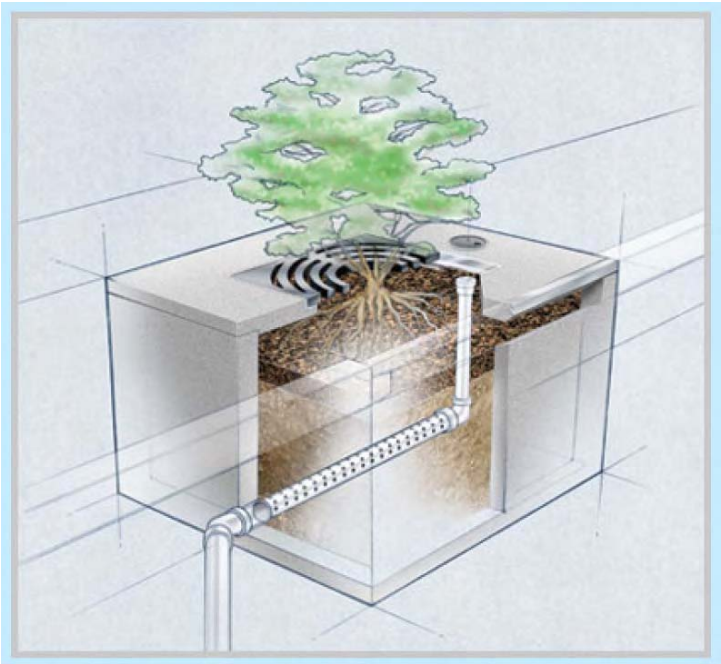


Grassed Swale (Source: Prince George's County 1999)

6.4.2.5 Tree Box Filter

Description: Tree box filters, such as the Filterra® Stormwater Bioretention Filtration System (or a comparable alternative), allow stormwater to flow through a specially designed filter mixture contained in a landscaped concrete container (AMEC 2005). These devices are typically used to retrofit traditional storm drain inlets with a bioretention function. The filter mixture inside the device immobilizes pollutants. Those pollutants are then decomposed, volatilized, and incorporated into the biomass of the unit. Stormwater runoff flows through the media and into an underdrain system at the bottom of the container, where the treated water is discharged to the stormdrain network.

Maintenance: Remove debris and sediment, replace dead or stressed plants, and mulch as necessary. Most manufactured LID devices come with an observation well that is used to make sure the underdrain is not clogged and is working properly. If the system becomes clogged, the filter mixture is replaced. Most manufacturers specify maintenance guidelines to maintain performance level. Manufactured LID devices have an expected life span of 25 years.

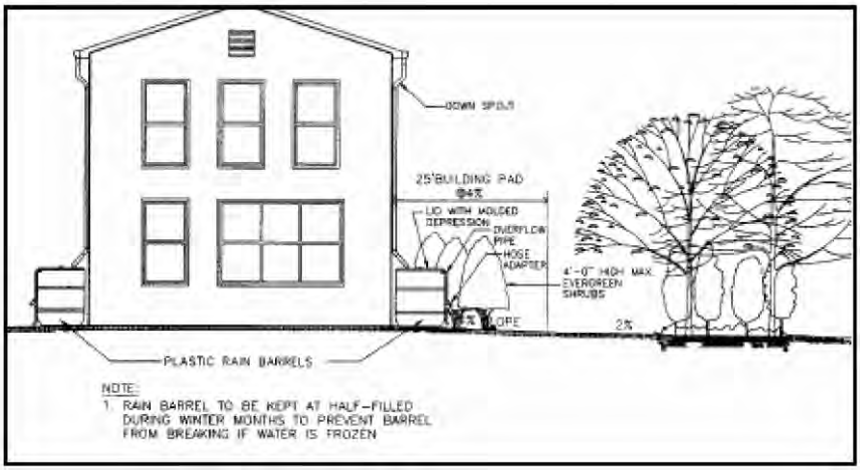


Schematic of a tree box filter in a storm drain inlet and recently installed filter at Providence RECenter (Sources: filterra.com; photo by P. Emerson, Versar, Inc.)

6.4.2.6 Rain Barrels/Cisterns

Description: Rain barrels are low-cost, effective, and easily maintainable retention devices that can be used in both residential and commercial/industrial sites. They are connected to downspouts to retain rooftop runoff. Rain barrels can be used to store runoff for later use in lawn and garden watering (AMEC 2005). Cisterns are larger rainwater storage containers placed either above or below ground. The water they capture is suitable for nonpotable uses.

Maintenance: Rain barrels and cisterns require very little maintenance. The container and attachments should be inspected for clogging several times a year and after significant storms. Minor parts, including spigots, screens, filters, downspouts, or leaders, may require replacement. Rain barrels and cisterns have an expected life span of 25 years.

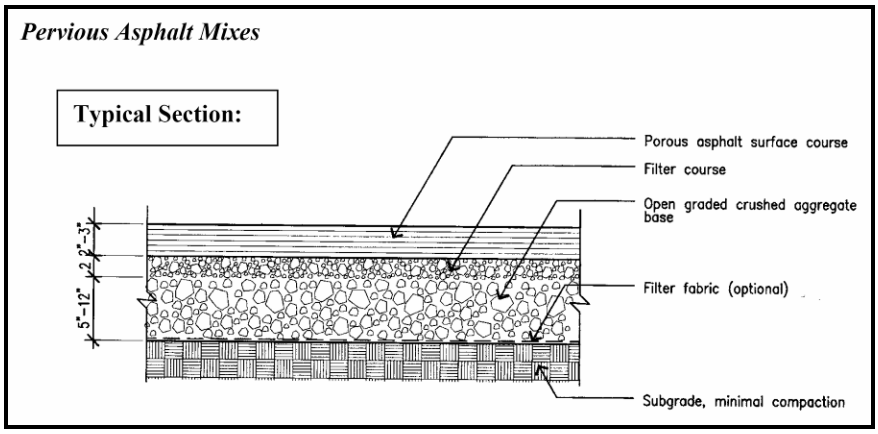


Rain barrel & above-ground cistern (Sources: Prince George's County 1999; www.aridsolutions.com; and www.plastmo.com)

6.4.2.7 Permeable Pavers

Description: Advances in paving technology have provided a variety of paving materials that allow water to move through the pavement section and into the subgrade and underlying soil. Three main types of permeable pavers are interlocking block systems, porous asphalt, and porous concrete. Each paving system is laid down on a specially constructed bed that allows downward and lateral transmission of water to provide a well-drained subgrade. Although such pavers have been used in high traffic and weight-load situations, they are ideal for lower-volume areas such as parking spaces, overflow parking lots, playing surfaces, and footpaths.

Maintenance: Permeable paving systems require periodic vacuum sweeping to keep the pore spaces clear of debris and infiltrating properly. Porous asphalt can be ground and resurfaced as needed, similar to traditional asphalt pavement, to keep the surface free of blemishes.



Permeable pavers – asphalt, concrete, and block (Source: City of Portland 2003)

Specific LID projects in the Cameron Run watershed are shown in Table 6-3.

Table 6-3. Low impact development projects included in the plan

Project ID	Project Name	Sub-watershed	Proposed Action	Benefit	Estimated Cost
CA9802	Jefferson Manor Park Bioretention	Pike Branch	Construct bioretention area below parking lot and detention micro-berm along edge of baseball field.	Provide stormwater quantity controls. Provide stormwater quality controls.	$73,000
CA9804	Mount Eagle Elementary School LID	Pike Branch	Construct bioretention areas in traffic island, at parking lot margins, SW corner of trailers, and SW corner of property; direct roof drains to bioretention areas; install infiltration trench along W side of new parking lot.	Provide stormwater quantity controls. Provide stormwater quality controls. Opportunity for public education.	$210,000
CA9805	Wilton Administration Center LID	Pike Branch	Construct bioretention areas in traffic islands along front and side parking lot, at inlet on south side of school, and at storm drain outlet on west side; install infiltration trenches and porous pavement in parking lots and asphalt court. This facility may be renovated within the next five years, and these proposed retrofits, or similar stormwater improvements, should be incorporated into the renovation plans.	Provide stormwater quality controls. Improve stormwater quantity controls. Opportunity for public education.	$460,000
CA9807	Virginia Hills Administration Center (School) LID	Pike Branch	Construct linear bioretention areas along outside of bus loop and along rear parking lot; direct roof drains at front wing to bioretention areas; install infiltration trench in NW corner of bus parking area. This facility may be renovated within the next five years, and these proposed retrofits, or similar stormwater improvements, should be incorporated into the renovation plans.	Provide stormwater quantity controls. Provide stormwater quality controls. Opportunity for public education.	$352,000
CA9808	Lee District Park LID	Pike Branch	Retrofit SWM pond control structure to improve detention control and add micropool areas in pond bottom to improve water quality; construct bioretention areas along N parking lot, in south central swale, and in parking lot islands/road margins; install infiltration trench in tennis court parking lot and porous pavement in E parking lot; convert athletic fields to artificial turf; add tree cover throughout. Note that athletic fields are scheduled for conversion to artificial turf in 2008. Facility maintenance and renovation is an on-going process, and proposed retrofits, or similar stormwater improvements, should be incorporated into site improvement plans.	Improve stormwater quantity controls. Improve stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion. Improve community usage. Opportunity for public education.	$1,589,000
CA9809	Ridgeview Park LID - A	Pike Branch	Construct off-line bioretention in existing swale; plant meadow in lawn areas that extend into park/ROW; build detention micro-berm parallel to ROW in meadow areas; use integrated vegetation management practices to encourage shrub/low growing trees beneath power lines.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion.	$59,000

Table 6-3. (Continued)

Project ID	Project Name	Sub-watershed	Proposed Action	Benefit	Estimated Cost
CA9810	Ridgeview Park LID - B	Pike Branch	Install off-line bioretention areas to intercept flow before reaching stormwater outfall.	Provide stormwater quality controls. Improve stormwater quantity controls. Opportunity for public education.	$414,000
CA9811	Redwood Lane - LID	Pike Branch	Construct off-line bioretention area at stormwater pipe outfall below Mulberry Ct.; use integrated vegetation management practices to encourage shrub/low growing trees beneath power lines.	Provide stormwater quantity controls. Provide stormwater quality controls.	$211,000
CA9812	Ridge View Drive - LID	Pike Branch	Construct off-line bioretention area at stormwater pipe outfall.	Provide stormwater quantity controls. Provide stormwater quality controls. Opportunity for public education.	$249,000
CA9813	John Marshall Library LID	Pike Branch	Construct linear bioretention areas along edge of rear parking lot and in swale to NW; construct bioretention areas in islands along front of bldg. and in parking lot; install infiltration trench in rear parking lot.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion. Opportunity for public education.	$246,000
CA9818	Clermont School Site Park LID	Tributaries to Cameron Run	Construct bioretention area below houses on Gypsy Ct.	Provide stormwater quantity controls. Provide stormwater quality controls.	$49,000
CA9821	Clermont Elementary School LID	Tributaries to Cameron Run	Construct bioretention areas in bus loop traffic island and NW of building; construct linear bioretention area S of building and along west end of fields; replace inlet at NE corner of parking lot with a tree box filter.	Provide stormwater quantity controls. Provide stormwater quality controls. Opportunity for public education.	$308,000
CA9822	Twain Middle School LID	Tributaries to Cameron Run	Construct bioretention areas in bus loop traffic island and in grass island SW of bldg.; construct linear bioretention areas along E side of property; install infiltration trenches and tree box filters in SE parking lot.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve community usage. Opportunity for public education.	$660,000
CA9823	Bush Hill Elementary School LID	Tributaries to Cameron Run	Construct bioretention areas in traffic/sidewalk islands; install infiltration trenches in parking lots; construct off-line bioretention at end of concrete trench from eastern parking lot and detention micro-berm along northern tree line.	Provide stormwater quantity controls. Provide stormwater quality controls. Opportunity for public education.	$183,000
CA9827	Lee District Government Center LID	Backlick Run	Construct bioretention areas in traffic islands; install infiltration trench in lane SW of bldg.; install tree box filters and porous pavement.	Provide stormwater quantity controls. Provide stormwater quality controls.	$209,000
CA9828	Fire Station - Company No. 5 LID	Backlick Run	At Fire Station, divert roof drains to cistern for filling fire trucks; install porous pavement in W parking lot; construct bioretention area in SE corner; install tree box filter.	Provide stormwater quantity controls. Provide stormwater quality controls.	$71,000

Table 6-3. (Continued)

Project ID	Project Name	Sub-watershed	Proposed Action	Benefit	Estimated Cost
CA9829	Franconia Park LID	Backlick Run	Construct bioretention areas in islands of both parking lots; plant trees between soccer fields and other locations to provide shade; repair streambank erosion and downcutting. Note that athletic fields are scheduled for conversion to artificial turf. Facility maintenance and renovation is an on-going process, and proposed retrofits, or similar stormwater improvements, should be incorporated into site improvement plans.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion. Opportunity for public education.	$126,000
CA9830	Edsall Administration Center LID	Backlick Run	Install infiltration trenches in parking lots; construct bioretention areas in islands/borders; install tree box filters.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion. Improve community usage.	$139,000
CA9835	Springfield Elementary School LID	Backlick Run	Create bioretention areas in bus loop and landscape islands in front of bldg.; install infiltration trenches and tree box filters in parking lot; construct linear bioretention areas and filter strip adjacent to asphalt play yard; convert soccer/football field from grass to artificial turf with cistern and underdrain system.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion. Improve community usage. Opportunity for public education.	$1,356,000
CA9836	Lee High School LID	Backlick Run	Construct off-line bioretention area at outfall S of Deepford St.; construct infiltration trenches and bioretention areas in parking lots around school bldg.; linear bioretention areas along tennis courts and concrete swale E of trailers; build detention micro-berm around 2 inlets; reforest unused open space.	Provide stormwater quantity controls. Provide stormwater quality controls.	$3,421,000
CA9839	Key Middle School LID	Backlick Run	Construct bioretention areas, infiltration trenches, and tree box filters in parking lots; convert NE parking lot to porous pavement; provide depression storage N of bldg. in trailer area (not shown in aerial); convert two fields from grass to artificial turf with cistern and underdrain system.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion. Improve community usage. Opportunity for public education.	$2,745,000
CA9842	Lynbrook Elementary School LID	Backlick Run	Construct bioretention in bus loop island, in front of school building, and to E of bldg.; direct roof drainage to cistern to water fields; install infiltration trenches and tree box filters in parking lot.	Provide stormwater quantity controls. Provide stormwater quality controls. Opportunity for public education.	$254,000
CA9846	Leewood Park LID - A	Backlick Run	Restore grass swale; install bioretention area next to stormwater outfall pipe. Use woodland species.	Provide stormwater quality controls. Opportunity for public education.	$39,000
CA9848	Leewood Park LID - B	Backlick Run	Install riprap and infiltration trench at the end of stormwater outfall.	Provide stormwater quality controls. Opportunity for public education.	$13,000

Table 6-3. (Continued)

Project ID	Project Name	Sub-watershed	Proposed Action	Benefit	Estimated Cost
CA9850	Wilburdale Park LID - A	Backlick Run	Install bioretention areas next to court and along street; construct off-line bioretention area at outfall into concrete ditch; reforest unused areas in park.	Provide stormwater quality controls. Opportunity for public education. Improve community usage.	$156,000
CA9851	Wilburdale Park LID - B	Backlick Run	Develop/restore grass swales along road to deliver runoff to new bioretention area at end of roadway.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion.	$97,000
CA9853	Annandale High School LID	Backlick Run	Incorporate grass swale along roadway; construct linear bioretention areas and infiltration trenches along parking lots and courts; install tree box filters.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion. Improve community usage. Opportunity for public education.	$420,000
CA9854	Bren Mar Park Elementary School LID	Indian Run	Construct linear bioretention areas in grass areas along Beryl Rd. and along E edge of parking lot; install infiltration trench and tree box filter in rear of parking lot; plant shade trees between new basketball court and baseball field (not shown on aerial).	Provide stormwater quantity controls. Provide stormwater quality controls. Opportunity for public education.	$230,000
CA9855	Fire Station - Company No. 26 LID	Indian Run	At Fire Station, divert roof drains to cistern for filling fire trucks; construct bioretention areas in sodded ditch to north and along western edge of parking lot.	Provide stormwater quantity controls. Provide stormwater quality controls. Opportunity for public education.	$131,000
CA9856	Holmes Middle School LID	Indian Run	Construct linear bioretention areas in grass along Montrose St.; construct area bioretention areas in traffic islands in NW and E lots; install infiltration trenches in road ways and next to rear of bldg.; install tree box filters in front lot and filter strip along edge of rear parking lots; create multisport, artificial-turf playing fields.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve community usage. Opportunity for public education.	$1,593,000
CA9857	Weyanoke Elementary School LID	Indian Run	Construct bioretention area in Braddock Rd. traffic island and at edge of asphalt courts; install filter strip around asphalt courts; install linear bioretention area, tree box filters, and infiltration trenches in S parking lot	Provide stormwater quantity controls. Provide stormwater quality controls. Opportunity for public education.	$124,000
CA9858	Poe Middle School LID	Indian Run	Construct linear bioretention area in loop island; install infiltration trenches, tree box filters, and traffic island bioretention areas in parking lots.	Provide stormwater quantity controls. Provide stormwater quality controls. Opportunity for public education.	$248,000
CA9859	Indian Run Stream Valley Park LID - C	Indian Run	Install off-line bioretention area at end of stormwater outfall.	Provide stormwater quality controls. Improve stormwater quantity controls.	$516,000
CA9860	Indian Run Stream Valley Park LID - A	Indian Run	Install bioretention area at end of stormwater outfall.	Provide stormwater quality controls. Improve stormwater quantity controls.	$334,000

Table 6-3. (Continued)

Project ID	Project Name	Sub-watershed	Proposed Action	Benefit	Estimated Cost
CA9861	Indian Run Stream Valley Park LID - B	Indian Run	Install bioretention area at end of stormwater outfall.	Provide stormwater quality controls. Improve stormwater quantity controls.	$543,000
CA9862	Columbia Elementary School LID	Indian Run	Construct linear and area bioretention areas in traffic islands; install infiltration trenches in front parking lots and side road; replace inlets with tree box filters; restore existing grass swale in back of bldg.; add filter strips around two inlets.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion. Opportunity for public education.	$134,000
CA9863	George Mason Regional Library LID	Indian Run	Construct bioretention in traffic islands along Little River Turnpike, in parking lot, between bldg. and Hillbrook Dr., and at SW corner of bldg.; install infiltration trench along several parking rows; install tree box filter inserts.	Provide stormwater quantity controls. Provide stormwater quality controls. Opportunity for public education.	$403,000
CA9866	Turkeycock Run Stream Valley Park LID	Turkeycock Run	Install off-line bioretention area at end of stormwater outfall; repair concrete ditch and add riprap protection.	Provide stormwater quality controls. Improve stormwater quantity controls. Opportunity for public education.	$198,000
CA9867	Parklawn Elementary School LID	Turkeycock Run	Retrofit small dry pond to wet detention pond; construct bioretention areas in traffic islands; install infiltration trenches and one tree box filter in parking lots; install linear bioretention strips along large trailer (not shown) SW of bldg.; direct roof drains to cistern to water fields; reforest unused lawn areas.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve community usage. Opportunity for public education.	$168,000
CA9868	Green Spring Gardens LID	Turkeycock Run	Install linear bioretention area along parking spaces and infiltration trenches in traffic circle.	Provide stormwater quality controls. Improve stormwater quantity controls. Opportunity for public education.	$99,000
CA9869	Pinecrest Golf Course LID	Turkeycock Run	Implement stormwater retrofits based on the Park Authority's existing LID retrofit concept plan.	Provide stormwater quality controls. Improve stormwater quantity controls. Opportunity for public education.	$78,000
CA9870	Wolftree Lane LID	Turkeycock Run	Linear bioretention area to capture end of pipe stormwater.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion.	$286,000
CA9872	Mason Government Center LID	Turkeycock Run	Retrofit SWM pond control structure to improve detention control and add micropool areas in pond bottom to improve water quality; construct bioretention area along Columbia Pike to collect roadway runoff; install linear bioretention strips, bioretention areas, and tree box filters in parking lot.	Improve stormwater quantity controls. Improve stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion. Opportunity for public education.	$220,000

Table 6-3. (Continued)

Project ID	Project Name	Sub-watershed	Proposed Action	Benefit	Estimated Cost
CA9876	Glasgow Middle School LID	Holmes Run - Lower	Install off-line bioretention areas at stormwater pipe outfall on E side of entrance road. Note: school to be rebuilt by fall 2008.	Provide stormwater quantity controls. Provide stormwater quality controls. Opportunity for public education.	$703,000
CA9877	Baileys Community Center LID	Holmes Run - Lower	Construct linear and area bioretention areas in traffic islands along front and east sides, by tennis courts, west side of building, and end of Summers Lane; build detention micro-berm along north side of baseball field, NW corner of tennis court, and edge of southwestern lot; install tree box filter in inlet on Summers Ln.	Provide stormwater quantity controls. Provide stormwater quality controls. Opportunity for public education.	$351,000
CA9879	Baileys Elementary School LID	Holmes Run - Lower	Construct bioretention areas in traffic islands for bus loop and parking lots, near asphalt courts, and near portable classrooms; install infiltration trenches in parking areas and porous pavement in play yards; create artificial turf field with underdrains and cistern.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve community usage. Opportunity for public education.	$1,535,000
CA9882	JEB Stuart High School LID	Tripps Run	Construct linear bioretention area along Peace Valley Ln. median; construct a stepped bioretention areas along S edge of parking lot and SE corner of fields; construct bioretention areas in parking islands and around playing fields; plant wildflowers along SE side of baseball field; upgrade fields to multisport artificial turf with underdrains and cistern.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve community usage. Opportunity for public education.	$1,881,000
CA9885	Sleepy Hollow Elementary School LID	Tripps Run	Install infiltration trenches in parking lot and bioretention areas at yard drain inlets.	Provide stormwater quantity controls. Provide stormwater quality controls. Opportunity for public education.	$455,000
CA9886	Nicholson St - Ch. 2 Street LID	Tripps Run	Construct bioretention area in Chapter-2 street lot, divert road runoff into area.	Provide stormwater quantity controls. Provide stormwater quality controls. Opportunity for public education.	$100,000
CA9892	Westlawn Elementary School LID	Tripps Run	Install bioretention area, infiltration trenches, and tree box filters in parking lots; construct linear bioretention along asphalt courts; and construct grass swale around two sides of fields.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion. Opportunity for public education.	$117,000
CA9897	Fire Station - Company No. 28 LID	Tripps Run	At Fire Station, divert roof drains to cistern for filling fire trucks; construct bioretention areas in SW and SE corners of traffic islands in parking lot; construct linear bioretention areas on S side of truck entrance and S side of parking lot.	Provide stormwater quantity controls. Provide stormwater quality controls. Opportunity for public education.	$23,000
CA9901	Larry Graves Park LID	Tripps Run	Construct bioretention areas in grass along Hillwood Ave. and replace inlet with tree box filter.	Provide stormwater quantity controls. Provide stormwater quality controls. Opportunity for public education.	$41,000

Table 6-3. (Continued)

Project ID	Project Name	Sub-watershed	Proposed Action	Benefit	Estimated Cost
CA9904	Devonshire Administration Center (School) LID	Tripps Run	Construct bioretention areas in traffic circle and in grass areas next to N and S parking lots; construct linear bioretention areas at edges of S lot; construct infiltration trenches and filter strips in N and rear lots; build detention micro-berm along tree line.	Provide stormwater quantity controls. Provide stormwater quality controls. Opportunity for public education.	$288,000
CA9911	Belvedere Elementary School LID	Holmes Run - Upper	Construct bioretention areas in bus loop island, traffic island, along back edge in side lot, and in landscape islands around bldg.; build detention micro-berm along north side of property; install linear bioretention area and infiltration trench in side parking lot; and convert concrete ditches to grass swales.	Provide stormwater quantity controls. Provide stormwater quality controls. Opportunity for public education.	$325,000
CA9914	Columbia Pines LID	Holmes Run - Upper	Construct off-line bioretention areas to capture end-of-pipe stormwater prior to entering the stream.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve stream stability, erosion, and instream habitat. Improve floodplain and nutrient cycling functions.	$ 96,000
CA9917	Beech Tree Elementary School LID	Holmes Run - Upper	Construct bioretention areas along Beechtree Ln. and in landscape islands around bldg. and trailers; install infiltration trenches in bus loop and drive; install two tree box filters at stormdrain inlets; install filter strip along Beechtree Ln.; build detention micro-berm along SW side of bldg.; convert playing fields to artificial turf with cistern.	Provide stormwater quality controls. Improve stormwater quantity controls. Improve community usage. Opportunity for public education.	$1,409,000
CA9921	Broyhill Crest Park LID	Holmes Run - Upper	Develop detention micro-berm along tree line to slow runoff and induce infiltration; construct bioretention areas with small cistern for watering community garden.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion. Improve community usage. Opportunity for public education.	$132,000
CA9922	Lacey Admin Center LID	Holmes Run - Upper	Develop playing field using artificial turf with underdrain/cistern system for use as soccer and football field; add bioretention areas and infiltration strips in parking lot islands and margins.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve community usage. Opportunity for public education.	$1,317,000
CA9925	Holmes Run Stream Valley Park LID	Holmes Run - Upper	Construct off-line bioretention areas (stepped) to capture end-of-pipe storm-water prior to entering the stream.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion. Improve floodplain and nutrient cycling functions.	$87,000

Table 6-3. (Continued)

Project ID	Project Name	Sub-watershed	Proposed Action	Benefit	Estimated Cost
CA9927	Round Tree Park LID - C	Holmes Run - Upper	Convert parking lot traffic islands to bioretention areas and re-route field and court drainage to bioretention areas; construct detention micro-berm in open area along stream.	Provide stormwater quality controls. Improve stormwater quantity controls. Opportunity for public education.	$195,000
CA9929	Round Tree Park LID - A	Holmes Run - Upper	Install off-line bioretention area to capture end of pipe stormwater prior to entering the stream.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion. Improve floodplain and nutrient cycling functions.	$52,000
CA9937	Walnut Hill Admin Center LID - B	Holmes Run - Upper	Construct linear bioretention strips along road, parking lots, and south side of playing fields; install infiltration trenches in front and rear lots; divert 12 roof drains and courts to bioretention areas; convert fields to artificial turf with underdrains; plantings in unused open space.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve community usage. Opportunity for public education.	$2,953,000
CA9941	Woodburn Elementary School LID	Holmes Run - Upper	Install bioretention areas in landscaped islands along Gallows Rd., Hemlock Dr., and bus loop; install infiltration trenches in front parking lot; install linear bioretention area along bldg. in downspout areas and ditch to N; install porous pavement in asphalt play area; convert soccer/football field from grass to artificial turf.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion. Improve community usage. Opportunity for public education.	$1,342,000
CA9942	Luria Park LID	Holmes Run - Upper	Install off-line bioretention areas at stormwater pipe outfalls and area bioretention areas at end of streets at Fallowfield Dr., Oak Run Ct., E end of Trail Run Rd., Crest Haven Ct., and W end of Camp Alger Av.	Provide stormwater quality controls. Improve stormwater quantity controls. Opportunity for public education.	$355,000
CA9946	Falls Church High School LID	Holmes Run - Upper	Construct bioretention areas in traffic islands along front of school, in landscape beds, and along side of E parking lot; install infiltration trench along E side of tennis courts, in NW parking lot, and in paved grandstand areas; create two multisport athletic fields with artificial turf; construct linear bioretention areas along S side of rear parking lot; build detention micro-berms around field margins and yard drain.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve community usage. Opportunity for public education.	$2,772,000
CA9947	Thomas Jefferson Library LID	Holmes Run - Upper	Construct bioretention areas in front of library for roof drainage, along row of head-on parking spaces, and at SW and SE corners of lot; install infiltration trench across entrance road.	Provide stormwater quantity controls. Provide stormwater quality controls. Opportunity for public education.	$179,000

Table 6-3. (Continued)

Project ID	Project Name	Sub-watershed	Proposed Action	Benefit	Estimated Cost
CA9949	Graham Road Elementary School LID	Holmes Run - Upper	Construct bioretention areas in traffic island for bus loop, between sidewalk and building in front, along Monticello Dr., and along north side of back lot; install porous pavement and infiltration trench in deteriorated asphalt play yard.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve community usage. Opportunity for public education.	$127,000
CA9950	Pine Spring Elementary School LID	Holmes Run - Upper	Construct detention micro-berm and bioretention areas along NW property line; construct bioretention areas in bus loop and parking lot islands, NW outfall, and trailers; construct linear bioretention along N parking lot, trailers, and in existing swale on S edge of property; construct off-line bioretention area at outfall S of rear parking lot.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve community usage. Opportunity for public education.	$576,000
CA9952	Timber Lane Elementary School LID	Holmes Run - Upper	Construct bioretention areas in lawn and traffic islands along West Street, in N parking lot, behind bldg., and next to fields; construct linear bioretention areas around building; install infiltration trench and tree box filter in N parking lot.	Provide stormwater quantity controls. Provide stormwater quality controls. Opportunity for public education.	$606,000
CA9953	Shrevewood Elementary School LID	Holmes Run - Upper	Construct bioretention areas in Shreve Rd. median islands, bus loop island, east side of parking lot, near playground, and at rear of bldg.; construct linear bioretention along NW corner of back field, next to asphalt courts, and in swale at NE corner along road.	Provide stormwater quantity controls. Provide stormwater quality controls. Opportunity for public education.	$359,000
CA9954	Jefferson District Park & Golf Course LID	Holmes Run - Upper	Install filter strips around SWM pond and 2 central water hazards; construct linear and area bioretention areas and infiltration trenches along parking lots and court surfaces; depress footpath to avoid directing flow from ponds to stream.	Improve stormwater quantity controls. Improve stormwater quality controls. Improve community usage. Opportunity for public education.	$236,000
CA9955	Dunn Loring Center (School) LID	Holmes Run - Upper	Disconnect downspouts and redirect to bioretention areas in landscape beds; construct linear bioretention areas around NW corner of bldg., above berm N of bldg., and at W end of fields; install infiltration trench in N parking lot; construct bioretention areas in traffic islands SW of bldg. and trailers.	Provide stormwater quantity controls. Provide stormwater quality controls. Opportunity for public education.	$722,000
CA9957	Fire Station - Company No. 13 LID	Holmes Run - Upper	Construct bioretention areas on W side of parking lot prior to inlets; provide rain barrels for downspouts from overhangs at front and rear entrances; install infiltration trenches along N side and in front of bldg.; install linear bioretention area in median along Gallows Rd.	Provide stormwater quantity controls. Provide stormwater quality controls.	$132,000

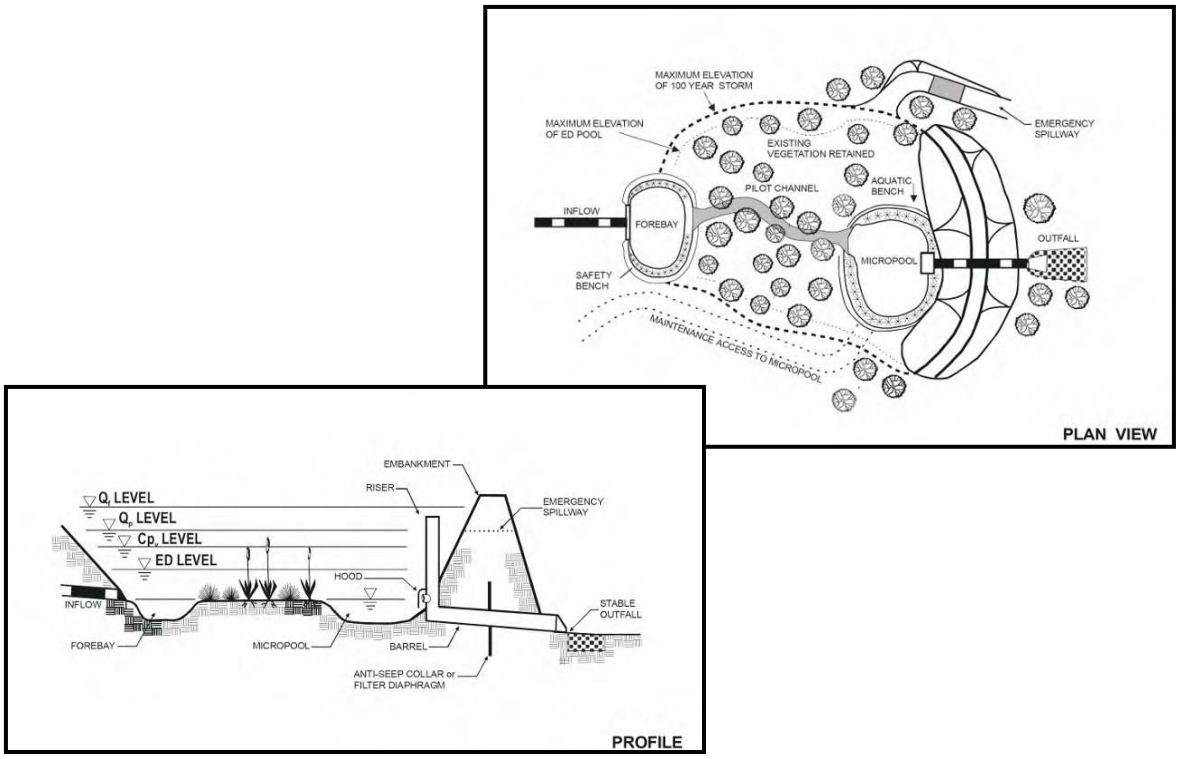
Table 6-3. (Continued)

Project ID	Project Name	Sub-watershed	Proposed Action	Benefit	Estimated Cost
CA9958	Lynbrook Subdivision LID - A	Backlick Run	Add 2 off-line bioretention areas below road to capture flow from two outfalls; repair concrete apron below road culvert.	Improve stormwater quantity controls. Improve stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion.	$89,000
CA9959	Anna Lee Heights LID	Tripps Run	Construct bioretention area within existing swale.	Improve stormwater quantity controls. Improve stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion.	$77,000
CA9960	Mason District Park LID	Turkeycock Run	Implement stormwater retrofits based on the Park Authority's existing LID retrofit concept plan.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion. Opportunity for public education.	$120,000
CA9962	Holmes Run Park LID	Holmes Run - Lower	Install linear and circular bioretention areas along road and detention micro-berms around two stormwater area drains in park.	Provide stormwater quantity controls. Provide stormwater quality controls. Opportunity for public education.	$158,000

6.4.3 New SWM Ponds

Description: SWM ponds are the traditional method of controlling stormwater flows. Create new SWM ponds to provide detention and water quality controls in areas where no ponds exist. Although sufficient space for this option may be difficult to obtain in built-out settings, the resulting benefits to flow volume and velocity control, and water quality improvement can be significant. Benefits may vary depending on the specific design features of the individual ponds.

Maintenance: The maintenance requirements of traditional stormwater ponds are well known. A typical pond is inspected by county personnel trained in dam safety and pond maintenance, looking at the dam, pipes, and riser structure to ensure they are functioning properly. Pretreatment facilities need to be inspected for clogging by sediments and large debris. If sediment or debris is evident, the area needs to be cleaned.



New SWM pond (micropool extended detention pond shown) (Source: MDE 2000a)

The new stormwater management pond project included in the plan is shown in Table 6-4.

Table 6-4. New stormwater management pond projects included in the plan

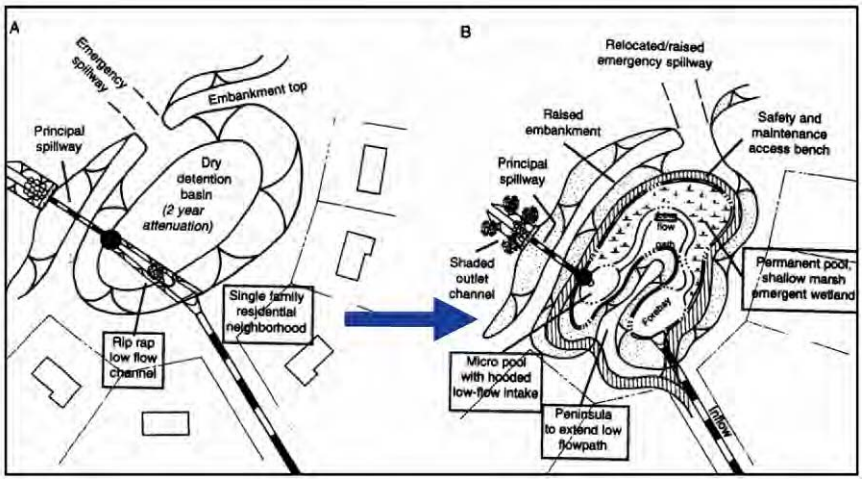
Project ID	Project Name	Sub-watershed	Proposed Action	Benefit	Estimated Cost
CA9102	Huntington Park SWM Pond	Tributaries to Cameron Run	Install SWM pond with micropool areas in pond bottom to provide water quality and extended detention controls. This project will be re-evaluated by the on-going flood damage reduction study for the Huntington community (Section 4.2.7.1) and recommendations from that study may supersede this project.	Improve stormwater quantity controls. Improve stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion.	$98,000

6.4.4 SWM Pond Retrofits

Description: Options for retrofitting existing SWM ponds (AMEC 2005) that may be suitable for implementation include the following:

1. Increasing detention storage by means of additional excavation and grading.
2. Providing water quality improvements at facilities that currently have only water quantity control. These facilities could be retrofitted to also provide water treatment by installing micropools, sediment forebays, or constructed stormwater wetlands or by increasing the surrounding riparian buffer.
3. Modifying or replacing the existing riser structure and outlet controls to further reduce the discharge rate from the stormwater management facility. A riser is a concrete structure with a metal grate on top, that controls the level of water in the stormwater pond.
4. Adding infiltration features such as sand filters or bioretention to promote greater peak flow reduction, increase groundwater recharge, and improve water quality treatment. A soil survey of the existing facility would be required to verify that this retrofit is suitable. Stormceptors or equivalent LID products could be installed in parking lots or other areas with a large percentage of impervious area. These devices are placed in the manhole and trap sediments and petroleum products before they flow into the pond.

Maintenance: The maintenance requirements of a retrofitted pond are not significantly greater than those for a traditional stormwater pond. A typical pond is inspected by county personnel trained in dam safety and pond maintenance who check the dam, pipes, and riser structure to ensure that they are functioning properly. Any pretreatment facilities need to be inspected for clogging by sediments and large debris items. If sediment or clogging is evident, the area needs to be cleaned. If manufactured LID devices are used, manufacturer's maintenance recommendations should be followed to ensure that devices function as designed.



Stormwater pond retrofit (A. pre-retrofit pond; B. retrofitted pond) (Source: Schueler et al. 2000)

The SWM pond retrofit projects included in the plan are shown in Table 6-5.

Table 6-5. Stormwater management pond retrofit projects included in the plan

Project ID	Project Name	Sub-watershed	Proposed Action	Benefit	Estimated Cost
CA9100	Farrington Park SWM Pond Retrofit	Tributaries to Cameron Run	Expand capacity of existing SWM wet pond and upgrade control structure. This project will be re-evaluated by the on-going flood damage reduction study for the Huntington community (Section 4.2.7.1) and recommendations from that study may supersede this project.	Improve stormwater quantity controls. Improve stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion.	$ 61,000
CA9103	Woodfield SWM Pond Retrofit	Backlick Run	Retrofit SWM pond control structure to improve detention control and add micropool areas in pond bottom to improve water quality.	Improve stormwater quantity controls. Improve stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion.	$276,000
CA9104	Thomas SWM Pond Retrofit	Backlick Run	Expand existing SWM pond control structure to provide additional storage capacity.	Provide stormwater quantity controls. Provide stormwater quality controls. Improve stormwater quality controls.	$148,000
CA9107	Jayhawk SWM Pond Retrofit	Backlick Run	Retrofit SWM pond control structure to improve detention control and add micropool areas in pond bottom to improve water quality.	Improve stormwater quantity controls. Improve stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion.	$236,000
CA9111	Beauregard SWM Pond Retrofit	Turkeycock Run	Retrofit SWM pond control structure to improve detention control and add micropool areas in pond bottom to improve water quality.	Improve stormwater quantity controls. Improve stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion.	$25,000
CA9112	Strawbridge Square SWM Pond Retrofit	Turkeycock Run	Retrofit SWM pond control structure to improve detention control and add micropool areas in pond bottom to improve water quality.	Improve stormwater quantity controls. Improve stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion.	$25,000
CA9115	Little River SWM Pond Retrofit	Turkeycock Run	Retrofit SWM pond control structure to improve detention control and add micropool areas in pond bottom to improve water quality.	Improve stormwater quantity controls. Improve stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion.	$33,000
CA9117	Braddock Place SWM Pond Retrofit	Turkeycock Run	Retrofit SWM pond control structure to improve detention control and add micropool areas in pond bottom to improve water quality.	Improve stormwater quantity controls. Improve stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion.	$49,000
CA9118	Pinecrest SWM Pond Retrofit	Turkeycock Run	Retrofit SWM pond control structure to improve detention control and add micropool areas in pond bottom to improve water quality.	Improve stormwater quantity controls. Improve stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion.	$69,000

Table 6-5. (Continued)

Project ID	Project Name	Sub-watershed	Proposed Action	Benefit	Estimated Cost
CA9126	Dominion SWM Pond Retrofit	Tripps Run	Retrofit SWM pond control structure to improve detention control and add micropool areas in pond bottom to improve water quality.	Improve stormwater quantity controls. Improve stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion.	$61,000
CA9128	Great Oak SWM Pond Retrofit	Tripps Run	Retrofit SWM pond control structure to improve detention control and add micropool areas in pond bottom to improve water quality.	Improve stormwater quantity controls. Improve stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion.	$89,000
CA9134	Columbia Pines SWM Pond Retrofit	Holmes Run - Upper	Retrofit SWM pond control structure to improve detention control and add micropool areas in pond bottom to improve water quality.	Improve stormwater quantity controls. Improve stormwater quality controls. Improve stream stability, erosion, and instream habitat. Improve floodplain and nutrient cycling functions.	$30,000
CA9138	Providence RECenter SWM Pond Retrofit	Holmes Run - Upper	Retrofit SWM pond control structure to improve detention control and add micropool areas in pond bottom to improve water quality; add bioretention areas in existing swale S of bldg.	Improve stormwater quantity controls. Improve stormwater quality controls. Opportunity for public education.	$102,000
CA9139	Kings Glen SWM Pond Retrofit	Holmes Run - Upper	Retrofit SWM pond with micro-pool micropool areas in pond bottom to provide water quality and extended detention controls; add detention micro-berm along contour and margin of mature woods in pond bottom	Improve stormwater quantity controls. Improve stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion.	$243,000
CA9142	Courts of Tyson SWM Pond Retrofit	Holmes Run - Upper	Retrofit SWM pond control structure to improve detention control and add micropool areas in pond bottom to improve water quality; install two bioretention areas at yard drains in Ch. 2 street (Kelleher Rd.).	Improve stormwater quantity controls. Improve stormwater quality controls. Improve stream stability and instream habitat. Reduce erosion.	$31,000

6.4.5 Stream Restoration/Bank Stabilization

Description: Streams damaged by erosive flows, excess sedimentation, and disruptive human activities are often not capable of re-establishing a stable form. Techniques to repair these damaged or degraded streams are now based on mimicking natural stream channels and the range of natural variability exhibited by nearby stable streams. Termed natural stream channel design, such repairs focus on establishing natural stream channel shape, size, and habitat features. Restoration can range from minor repairs to restore bank stability to complete reconstruction of the stream channel.

Maintenance: Maintenance of natural stream channel design projects includes periodic inspection and monitoring to ensure that conditions remain within the expected range of variability. Post-construction plantings need to be monitoring to ensure that they become well-established. In addition, periodic channel adjustments may be necessary after large flow events, especially while post-construction plantings become established.

A.

B.

Stream restoration (A. concrete lined urban channel; B. restored stream) (Photos by: A) M. Perot, Versar, Inc.; B) unknown)

The stream restoration/bank stabilization projects included in the plan are listed in Table 6-6.

Table 6-6. Stream Restoration/Bank Stabilization projects included in the plan

Project ID	Project Name	Sub-watershed	Proposed Action	Benefit	Estimated Cost
CA9207	Wilburdale Park Stream Restoration	Backlick Run	Notch two weirs and one concrete ford; redistribute large rocks in reach; control invasive vegetation; reforest buffer.	Improve stream stability and instream habitat. Reduce erosion. Improve floodplain and nutrient cycling functions. Opportunity for public education.	$320,000
CA9208	Wilburdale Park Bank Stabilization	Backlick Run	Remove check dam; enhance buffer through backyards; remove invasive bamboo and other species; implement backyard management program to reduce dumping of yard wastes/trash into streams.	Improve stream stability and instream habitat. Reduce erosion. Improve floodplain and nutrient cycling functions. Opportunity for public education. Improve community usage.	$169,000
CA9210	Brook Hill Stream Restoration	Backlick Run	Notch weirs in gabion lined channel; add rock vanes to straightened and overwidened middle section; cut log pour-overs/debris jams; add toe protection on steep berms in lower third; enhance buffer in localized areas; construct bioretention area at end of two roads; implement backyard management program to reduce dumping of yard wastes/ trash into streams.	Provide stormwater quantity controls. Improve floodplain and nutrient cycling functions. Opportunity for public education. Improve community usage. Greenway opportunity	$1,171,000
CA9216	Mason District Park Stream Restoration - A	Turkeycock Run	Implement Park Authority's stream restoration plans at this location.	Improve stream stability and instream habitat. Reduce erosion. Improve floodplain and nutrient cycling functions. Opportunity for public education. Improve community usage. Greenway opportunity	$996,000

6.4.6 Master Drainage Plan Projects

As discussed in Chapter 4, the county's Master Drainage Plan has identified 57 projects that have not yet been implemented in Cameron Run watershed. Upon review, 22 of the projects are recommended for "rollover" into the Cameron Run Watershed Management Plan (Table 6-7). Additional analysis of these opportunities and their priorities has placed these projects into the Tier 2 group of projects. Two residential flood relief projects are further evaluated in the following Drainage Complaint Projects section. The remaining 35 master drainage plan sites were not included in this plan because 1) more recent data from the SPA indicated that the severity of erosion was moderate or better; 2) county guidance noted that stream restoration potential was low, as indicated by "widening" or "incising" CEM stages; or 3) upstream candidate projects are anticipated to remove stressors from the project location.

Table 6-7. Master drainage plan projects (inactive) incorporated into the Cameron Run Watershed Management Plan

Segment	Tax Map	Type of Work	Old Project Name	Old Project Number	Comments
PIKE BRANCH	82-2, 83-1	STREAM RESTOR & STABIL		CA221	Incorporated with New Project CA9201
PIKE BRANCH	82-3	STREAMBANK STABIL		CA222	Incorporated with New Project CA9203
PIKE BRANCH	82-3	800' CHANN IMPROV	Franconia/Leewood	CA224	Not included in Plan
PIKE BRANCH	82-4	4000' STREAMBANK STABIL	Pike Branch Ph III	CA226	Not included in Plan
PIKE BRANCH	82-4	CHANNEL IMPROVEMENTS	Wilton Woods	CA227	Incorporated with New Project CA9203
CAMERON RUN	82-2	STREAM STABIL@ TELEGRAPH-BELTW		CA231	Incorporated with New Project CA9200
CAMERON RUN	82-2	600' INFRASTRUCTURE RPLMNT	Elmwood Drive	CA235	Not included in Plan
CAMERON RUN	82-2	STREAM STABILIZATION	Norton Villa	CA236	Not included in Plan
MILITARY	81-2	1800' STREAM STAB @ SOUTHERNRR		CA251	Incorporated with New Project CA9204
MILITARY	81-2	350' STREAM STAB SRR/S VAN DOR	Runnymede	CA252	Not included in Plan
MILITARY	81-4	1600' STORM SEWER	Old Rolling/Nedra	CA253	Not included in Plan
BACKLICK	81-1	STREAM STABIL & GABION @ RR		CA261	New Project CA9235
BACKLICK	80-2	STREAM @ SHIRLEY HWY		CA262	Not included in Plan
BACKLICK	80-2	STREAM STABIL D/S BACKLICK		CA263	Not included in Plan
WILBURDALE	71-3	1200' STORM SEWER	Leewood Subd	CA273	Not included in Plan
WILBURDALE	71-3	600' STORM SEWER, DITCH & BERM	Clemons Court	CA274	Incorporated with New Project CA9209
WILBURDALE	71-1	STUDY	Annandale Acres	CA276	Not included in Plan; area surveyed by SPA
INDIAN RUN	71-4	STREAMBANK STABIL		CA280	Not included in Plan
INDIAN RUN	72-3	800' STREAMBANK STABIL	Indian Run Ph III	CA281	Not included in Plan
INDIAN RUN	71-4	650' CHANNEL IMPROVEMENTS	Birch Lane	CA282	Not included in Plan
INDIAN RUN	71-4	400' STREAMBANK STABIL	Braddock Hills	CA283	Not included in Plan
INDIAN RUN	71-4	1000'STREAM REST @ SPRING VALL		CA284	Not included in Plan
INDIAN RUN	71-4	4000'STREAM ST U/S BRADDOCK RD	Willow Run Sub/Rndlp	CA285	Not included in Plan

Table 6-7. (Continued)

Segment	Tax Map	Type of Work	Old Project Name	Old Project Number	Comments
TURKEYCOCK	72-3	STREAM STAB @ EDSAL/SHIRLEY HW		CA291	Incorporated with New Project CA9211
TURKEYCOCK	72-3	1450'STREAM STAB @ CHOWEN AVE	Chowan Ave	CA292	Incorporated with New Project CA9212
TURKEYCOCK	72-3	60' STREAMBANK STABIL	Eighth St	CA293	Incorporated with New Project CA9212
TURKEYCOCK	72-1	STREAM STAB D/S BRADDOCK RD		CA295	Incorporated with New Project CA9213
TURKEYCOCK	72-1	STREAM STAB U/S BRADDOCK RD		CA296	Not included in Plan
TURKEYCOCK	72-1	650' STORM DRAIN IMP 250' RCBC	Holyoke-Piney Lane	CA298	Not included in Plan
PARKLAWN	72-2	800'STREAM ST @ ALEX CITY LINE		CA301	Not included in Plan
PARKLAWN	61-4	STREAM STABIL @ DRUMMOND DR		CA302	Incorporated with New Project CA9218
BARCROFT	60-4	STREAMBANK STABIL, ONE SIDE		CA312	Not included in Plan
BARCROFT	60-2	STREAM STABILIZATION	Crosswoods Dr.	CA314	Incorporated with New Project CA9228
BARCROFT	60-4	STREAM STABILIZATION	Juniper/Tripps	CA315	Incorporated with New Project CA9220
TRIPPS RUN	50-2	STREAMBANK STABIL		CA325	Incorporated with New Project CA9225
WEST FALLS CHUR	40-3	1000' STREAMBANK STABIL		CA331	Not included in Plan
HOLMES RUN	60-4	600' STREAM STABIL @ ROSE LANE	Holmes Run Ph II	CA342	Not included in Plan
HOLMES RUN	60-3	GABION @ BRADLEY CIRCLE		CA343	Not included in Plan
HOLMES RUN	60-3	200' STREAM BANK STABIL	Brookcrest Place	CA344	Not included in Plan
HOLMES RUN	60-1	STREAM STABIL @ ANNANDALE RD		CA345	Not included in Plan
HOLMES RUN	60-1	STREAM STABIL @ ARNOLD LANE		CA346	Not included in Plan
HOLMES RUN	60-1	90' STORM SEWER 370' SWALE	Locker Street	CA348	Not included in Plan
HOLMES RUN	60-4	200' STREAM BANK STABIL	Raleigh Road	CA349	Not included in Plan
HOLMES RUN	60-3	125' STREAM STABIL	Crest Drive	CA350	Not included in Plan
				CA353	Not included in Plan
MEMORIAL	39-4	150 L.F. STREAMBANK STABIL	Shadybrook	CA354	Incorporated with New Project CA9234
HOLMES RUN	60-3	100' STREAM STABIL / WALL	Raleigh Rd. Ph. II	CA361	Not included in Plan
INDIAN RUN	71-4	STREAM STABILIZATION	Fairland	CA381	Not included in Plan
INDIAN RUN	81-1	STREAM STABILIZATION	Bren Mar Ph II	CA382	Not included in Plan
TURKEYCOCK	72-1	ADD CULV @ BRADDOCK RD		CA491	New Project CA9236
TURKEYCOCK	72-1	ADD CULV @ OLD COLUMBIA PIKE		CA492	Not included in Plan
WEST FALLS CHUR	50-2	ADD CULV & STREAM STABIL		CA531	Incorporated with New Project CA9225
ALEXANDRIA	83-1	CONSTRUCT FLOODWALL ALONG CAME	Arlington Terrace	CA601	Additional evaluation underway by USACE study
BACKLICK	81-1	CONST EARTHEN BERM	Bren Mar Drive	CA661	Incorporated with New Project CA9205
INDIAN RUN	81-1	INSTALL RETAINING WALLS		CA681	Not included in Plan

Note: Master drainage plan projects not recommended for inclusion in this plan are shaded gray

6.4.7 Drainage Complaint Projects

Fairfax County's Maintenance and Stormwater Management Division (MSMD) maintains a database of storm drainage problems reported to the county. The county maintains the public storm drainage system contained within dedicated storm drainage easements, however, many of the drainage complaints received by the county are located outside these easements and cannot be addressed through existing maintenance programs. This watershed plan provides an alternate avenue for examining these citizen complaints and for developing recommendations to help alleviate problems in these areas.

Versar reviewed the county's drainage complaint database for flooding and erosion complaints, and found nearly 600 citizen complaints in Cameron Run watershed. Almost 75 percent of these complaints were related to house, yard, or road flooding issues, while the remaining complaints pertained to streambank and other erosion problems. Using the drainage complaints as an indicator of problem areas, Versar analyzed the location and nature of these complaints in combination with erosion and stream channel stability information from the SPA. As a result, Versar identified 57 locations that had a concentration of flooding complaints and 13 locations that had considerable erosion problems. Candidate projects were then developed for these identified problem areas (i.e., 70 candidate projects shown in Figure 6-2).

The county also maintains historical paper copy records on drainage complaints in the MSMD offices that date from the 1970s to the late 1990s, prior to creation of the electronic database. Versar reviewed these historical records for additional drainage complaint information on the 70 identified candidate projects.

Versar then applied a prioritization process similar to that described in Chapter 5.4 to help target restoration efforts to the biggest problem areas. Candidate drainage projects for flooding and erosion problems used different ranking criteria. Flooding project ranks were based on the size of the study area around the parcels with drainage complaints, the number of parcels with drainage complaints and the number of parcels with house flooding. Erosion project ranks were based on erosion site lengths, severity of erosion scores and CEM scores. Most criteria were converted to a 1 to 4 score with a 4 indicating the biggest problems. Erosion sites with a CEM score of 4 or 5 were assigned a score of 4; a score of 1 was assigned to the remaining sites. The 1 to 4 scores for each criterion were then summed within each flooding or erosion project.

The best opportunities to address drainage-related issues were chosen from the 70 candidate drainage complaint projects by selecting those that scored 8 or higher out of 12 on the selection criteria. This resulted in a list of 25 selected drainage complaint projects, including 21 flooding projects and four erosion projects (Figure 6-3 and Table 6-8). Project fact sheets for each of the selected project sites describe the recommended action to help alleviate drainage problems in these areas (Appendix A-4).

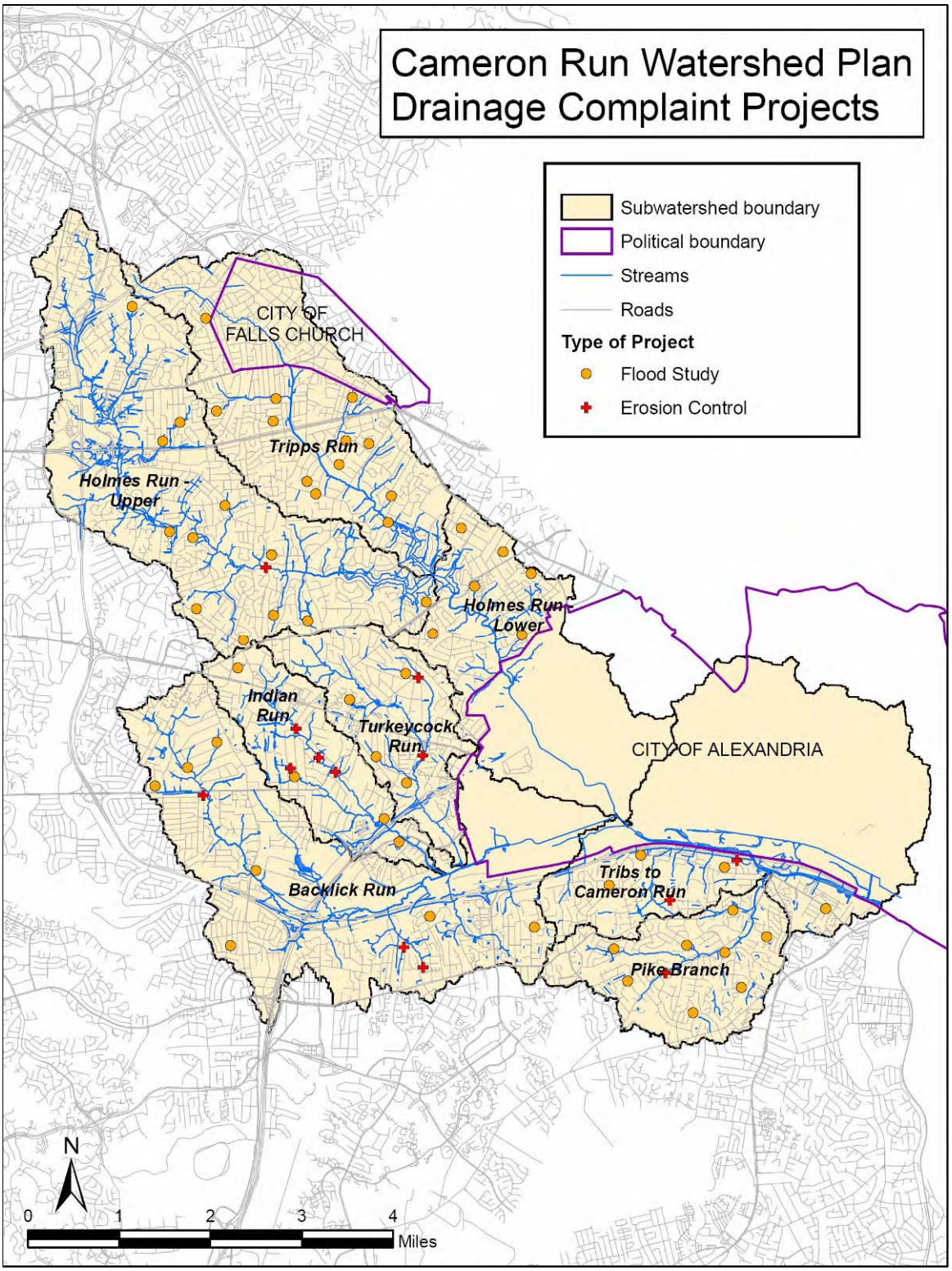


Figure 6-2. Location of candidate projects identified using the county's drainage complaint records

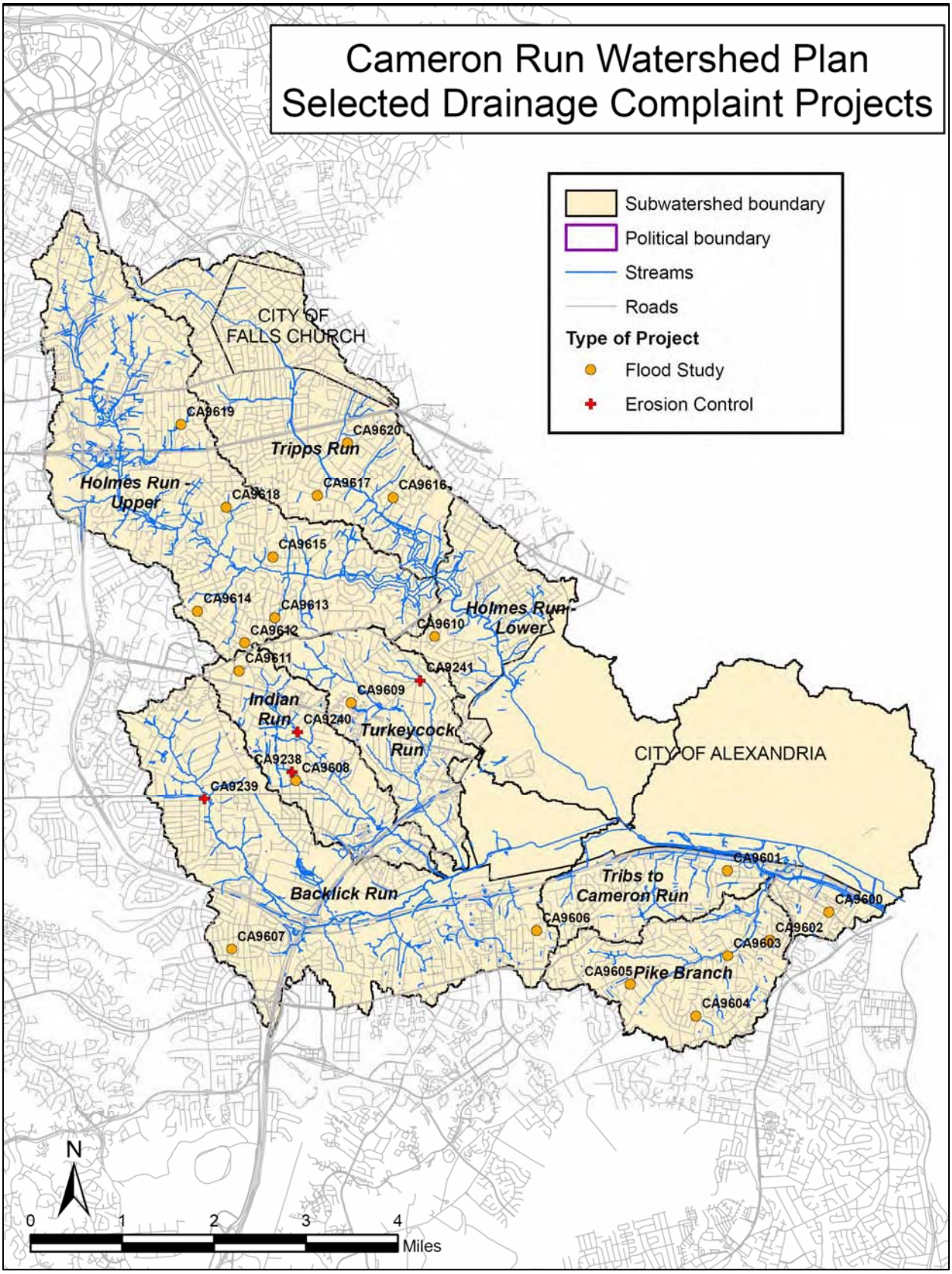


Figure 6-3. Selected project locations to address drainage related problems from the county's drainage complaint records

Table 6-8. Summary of selected projects to address drainage related problems from the county's drainage complaint records

Project ID	Project Name	Subwatershed	Proposed Action	Estimated Cost
CA9238	Indian Run Streambank Stabilization - B	Indian Run	Restore natural stream channel morphology, stabilize banks, and enhance riparian buffer.	$50,000
CA9239	Backlick Run Streambank Stabilization	Backlick Run	Restore natural stream channel morphology, stabilize banks, and enhance riparian buffer.	$69,000
CA9240	Indian Run Streambank Stabilization - A	Indian Run	Restore natural stream channel morphology, stabilize banks, and enhance riparian buffer.	$84,000
CA9241	Turkeycock Run Stream Stabilization	Turkeycock Run	Restore natural stream channel morphology, stabilize banks, and enhance riparian buffer.	$77,000
CA9600	Huntington Drainage Study	Tributaries to Cameron Run	Conduct a neighborhood drainage improvement study to investigate reported house and yard flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements. This drainage study is being completed as part of an on-going flood damage reduction study for the Huntington community (Section 4.2.7.1).	$38,000
CA9601	Burgundy Village Drainage Study	Tributaries to Cameron Run	Conduct a neighborhood drainage improvement study to investigate reported house, yard, and road flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements.	$38,000
CA9602	Jefferson Garden & Wilton Hall Drainage Study	Pike Branch	Conduct a neighborhood drainage improvement study to investigate reported house and yard flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements. Improvements to the curb and gutter system have been initiated in this area since the analysis was performed, and evaluation of their effectiveness and the need for any additional improvements should be considered during the recommended drainage study.	$38,000
CA9603	Wilton Woods & Millwood Estates Drainage Study	Pike Branch	Conduct a neighborhood drainage improvement study to investigate reported house and yard flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements.	$57,000
CA9604	Virginia Hills Drainage Study	Pike Branch	Conduct a neighborhood drainage improvement study to investigate reported house and yard flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements.	$57,000
CA9605	Rose Hill Drainage Study	Pike Branch	Conduct a neighborhood drainage improvement study to investigate reported house and yard flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements. Additional complaints about this area have been received since the analysis was performed, and all complaints will be considered during the detailed drainage study recommended for this area.	$38,000
CA9606	Brookland Estates Drainage Study	Backlick Run	Conduct a neighborhood drainage improvement study to investigate reported house and yard flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements. Possible cross-connections between the storm drainage network and sanitary sewer system have also been reported for this area and should be investigated as part of the recommended drainage study.	$38,000
CA9607	Crestwood Drainage Study	Backlick Run	Conduct a neighborhood drainage improvement study to investigate reported house and yard flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements.	$38,000
CA9608	Braddock Hills Drainage Study	Indian Run	Conduct a neighborhood drainage improvement study to investigate reported house, yard, and road flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements.	$57,000
CA9609	Pinecrest Drainage Study	Turkeycock Run	Conduct a neighborhood drainage improvement study to investigate reported house, yard, and road flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements.	$38,000
CA9610	Parklawn Drainage Study	Holmes Run - Lower	Conduct a neighborhood drainage improvement study to investigate reported house and yard flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements.	$19,000
CA9611	Evergreen Heights Drainage Study	Indian Run	Conduct a neighborhood drainage improvement study to investigate reported house and yard flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements.	$38,000
CA9612	Webbwood Drainage Study	Holmes Run - Upper	Conduct a neighborhood drainage improvement study to investigate reported house and yard flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements.	$19,000

Table 6-8. (Continued)

Project ID	Project Name	Subwatershed	Proposed Action	Estimated Cost
CA9613	Sleepy Hollow Woods Drainage Study	Holmes Run - Upper	Conduct a neighborhood drainage improvement study to investigate reported house and yard flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements.	$38,000
CA9614	Kenwood Drainage Study	Holmes Run - Upper	Conduct a neighborhood drainage improvement study to investigate reported house and yard flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements.	$38,000
CA9615	Valley Brook Drainage Study	Holmes Run - Upper	Conduct a neighborhood drainage improvement study to investigate reported house and yard flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements.	$19,000
CA9616	Ravenwood Drainage Study	Tripps Run	Conduct a neighborhood drainage improvement study to investigate reported house and yard flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements.	$38,000
CA9617	Marlo Heights Drainage Study	Tripps Run	Conduct a neighborhood drainage improvement study to investigate reported house and yard flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements.	$38,000
CA9618	Anna Lee Heights Drainage Study	Holmes Run - Upper	Conduct a neighborhood drainage improvement study to investigate reported house and yard flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements.	$19,000
CA9619	Fenwick Park Drainage Study	Holmes Run - Upper	Conduct a neighborhood drainage improvement study to investigate reported house and yard flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements.	$38,000
CA9620	Sleepy Hollow Drainage Study	Tripps Run	Conduct a neighborhood drainage improvement study to investigate reported house and yard flooding problems in the area, and develop preliminary plans and cost estimates to provide improvements.	$38,000

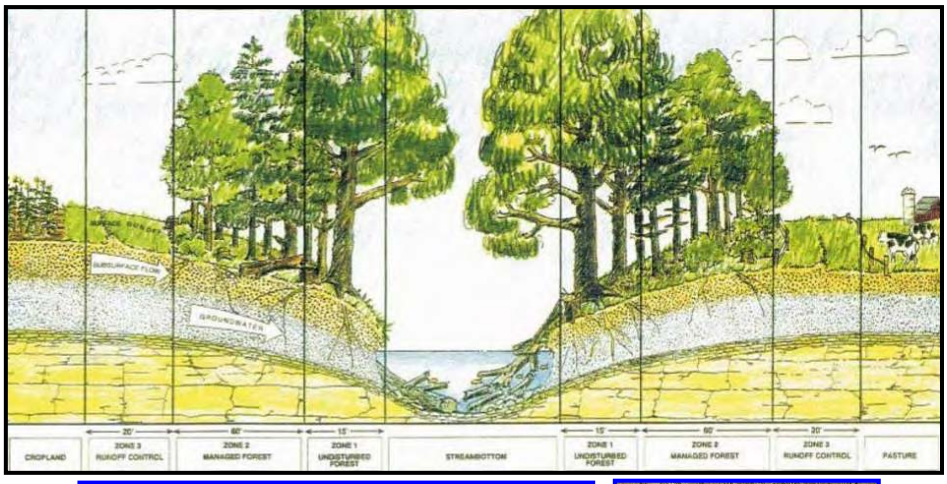
6.4.8 Other Opportunities

Planting riparian buffers is a high priority for the Cameron Run watershed, but this action will be addressed by the existing countywide riparian buffer planting program and is not included explicitly as a plan project. The concept and benefits of riparian buffer planting are described as below.

6.4.8.1 Riparian Buffer Enhancement

Description: Enhancing existing streamside vegetation by planting native varieties of trees, shrubs, and wildflowers restores many of the water quality, wildlife, and aesthetic benefits associated with riparian buffers. Vegetation filters sediments and other pollutants from storm-water runoff, moderates water temperatures in streams, improves aesthetics, and provides shelter and food to both terrestrial and stream organisms.

Maintenance: Maintenance of buffer enhancement projects includes periodic watering, removal of invasive species, and trash clean-up to ensure that plantings become well-established.



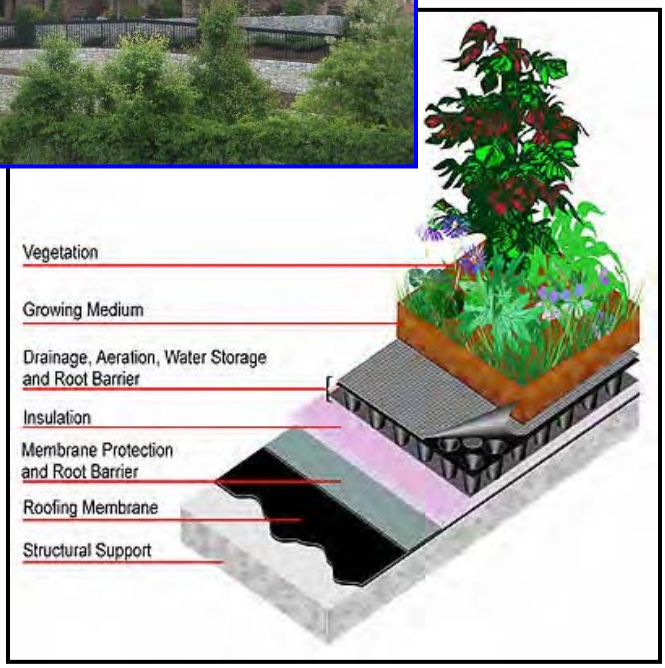
Buffer enhancement (Sources: Palone and Todd 1998; MDE 2000b; M. Southerland, Versar, Inc.)

6.4.8.2 Green Roof

Description: Green roof technology, which involves placing a layer of soil and vegetation on top of an impervious rooftop, can be applied to buildings to provide several benefits.

Economic Benefits –

- increases the life expectancy of rooftop and waterproofing (2-5 times) by providing protection against temperature extremes and ultraviolet light. The increased life span of the roof off-sets the somewhat higher up-front installation costs
- conserves energy by moderating building temperatures



Green roof construction

Ecological Benefits –

- reduces stormwater runoff (30% to 100% of annual rainfall can be stored, relieving stormdrains and feeder streams)
- reduces heat island effect (cooler air temperatures and higher humidity can be achieved through natural evaporation)
- improves air quality (up to 85% of dust particles can be filtered out of the air)
- provides new habitat for plants, insects, and birds

Amenities –

- reduces noise level by limiting reverberation and improving insulation
- improves the aesthetics of the landscape

Maintenance: Once a green roof is well-established, its maintenance requirements are usually minimal. Initial watering and occasional fertilization are required until the plants have fully established themselves, and periodically thereafter during drought conditions. Periodic trimming, weeding, inspection, and plant replacement is necessary.

Several county facilities present good opportunities for green roof technology (Figure 6-4, Table 6-9). Given the greater up-front expense of green roofs, it is recommended that the county consider this option on a case-by-case basis as each facility's roof approaches the end of its current life span. Scheduled roof replacement costs could substantially off-set the initial cost of a green roof, making this multipurpose roofing option more attractive.

Figure 6-4. Example of a county facility (Shrevewood Elementary School) that could present a good opportunity for a green roof

Table 6-9. County facilities that could be considered for a green roof during future renovation cycles

Project ID	Project Name	Subwatershed	Parcel ID No.
CA9805	Wilton Administration Center LID	Pike Branch	0824 01 0004A
CA9813	John Marshall Library LID	Pike Branch	0823 12 B
CA9822	Twain Middle School LID	Tributaries to Cameron Run	0823 01 0020
CA9823	Bush Hill Elementary School LID	Tributaries to Cameron Run	0823 01 0001
CA9830	Edsall Administration Center LID	Backlick Run	0714 01 0042
CA9835	Springfield Elementary School LID	Backlick Run	0813 01 0005B
CA9836	Lee High School LID	Backlick Run	0804 01 0037
CA9839	Key Middle School LID	Backlick Run	0813 01 0022B
CA9853	Annandale High School LID	Backlick Run	0711 01 0068
CA9854	Bren Mar Park Elementary School LID	Indian Run	0811 01 0006
CA9856	Holmes Middle School LID	Indian Run	0723 01 0014
CA9857	Weyanoke Elementary School LID	Indian Run	0721 01 0013
CA9858	Poe Middle School LID	Indian Run	0711 01 0131
CA9862	Columbia Elementary School LID	Indian Run	0712 05 0084A
CA9872	Mason Government Center LID	Turkeycock Run	0613 01 0003
CA9876	Glasgow Middle School LID	Holmes Run - Lower	0614 01 0151A
CA9879	Baileys Elementary School LID	Holmes Run - Lower	0612 01 0002
CA9882	JEB Stuart High School LID	Tripps Run	0611 01 0013
CA9892	Westlawn Elementary School LID	Tripps Run	0504 01 0002
CA9911	Belvedere Elementary School LID	Holmes Run - Upper	0604 01 0037
CA9917	Beech Tree Elementary School LID	Holmes Run - Upper	0602 38 A
CA9941	Woodburn Elementary School LID	Holmes Run - Upper	0592 01 0044
CA9946	Falls Church High School LID	Holmes Run - Upper	0503 01 0001A
CA9950	Pine Spring Elementary School LID	Holmes Run - Upper	0494 01 0060
CA9952	Timber Lane Elementary School LID	Holmes Run - Upper	0501 01 0044
CA9953	Shrevewood Elementary School LID	Holmes Run - Upper	0501 01 0002
CA9954	Jefferson District Park & Golf Course LID	Holmes Run - Upper	0492 01 0088

6.4.9 Watershed Projects By Subwatershed

The Cameron Run Watershed Plan Tier 1 candidate projects are shown in the following series of maps (Figs. 6-5 through 6-12) so that their location within each subwatershed can be readily determined. Detailed fact sheets for each Tier 1 candidate project are provided in Appendix A-1.

6.5 BENEFITS OF THE PLAN

As described in Chapter 5, estimating the benefits of the policy and project actions is critical to developing a plan that meets the county's and community's goals. The types of projects and their locations were selected to maximize benefits for stream protection and restoration. In the tables and fact sheets provided, we include estimates of benefits and costs.

6.5.1 Benefits of the Policy Recommendations

The policy recommendations will provide a range of benefits to the Cameron Run watershed. Policies that are implemented countywide in conjunction with other watershed management plans will be most efficient and should result in improved environmental conditions throughout Fairfax County and the surrounding region. Because these policy recommendations are non-structural, it is difficult to quantify the benefits to the watershed. Generally, the policy recommendations will help to improve the enforcement of existing regulations and laws and provide additional protection for areas that are environmentally valuable, but not necessarily located within an RPA. Institution of programmatic solutions is one of the best ways to deal with adverse cumulative effects from distributed sources such as stormwater.

6.5.2 Benefits of the Project Actions

Cameron Run is the most heavily urbanized watershed in the county, with impervious surface in each subwatershed exceeding the 10% to 15% threshold considered the minimum for good stream conditions. Most of the development in the watershed occurred before stormwater controls were required; therefore, reducing the effects of excessive runoff of stormwater is the most important benefit that can be achieved through project actions. Each stormwater-control project included in the plan has been scored based on the area of impervious surface controlled and the effectiveness of the recommended practice to help prioritize projects. Both water quantity improvement (i.e., reduction in average peak flows) and water quality improvement (i.e., reduction in pollutant loading) are included. More precise estimates of project benefits have been modeled (Appendix B). These model-based estimates can be used to evaluate the Plan's contributions to meeting water quality standards (e.g., TMDL implementation) and Chesapeake Bay Tributary goals.

Future conditions with proposed BMP projects were modeled to compare the condition of the watershed as development continues and when projects identified above are completed. The proposed actions in the Cameron Run Watershed Management Plan will reduce pollutant loadings throughout the county portion of the watershed. The model of future conditions with proposed projects shows a 4.9% decrease in total suspended solids, a 3.8% decrease in total phosphorus, and a 3.6% decrease in total nitrogen pollutant loads for the entire Cameron Run watershed. It is important to note that the model shows only small decreases in pollutant loading

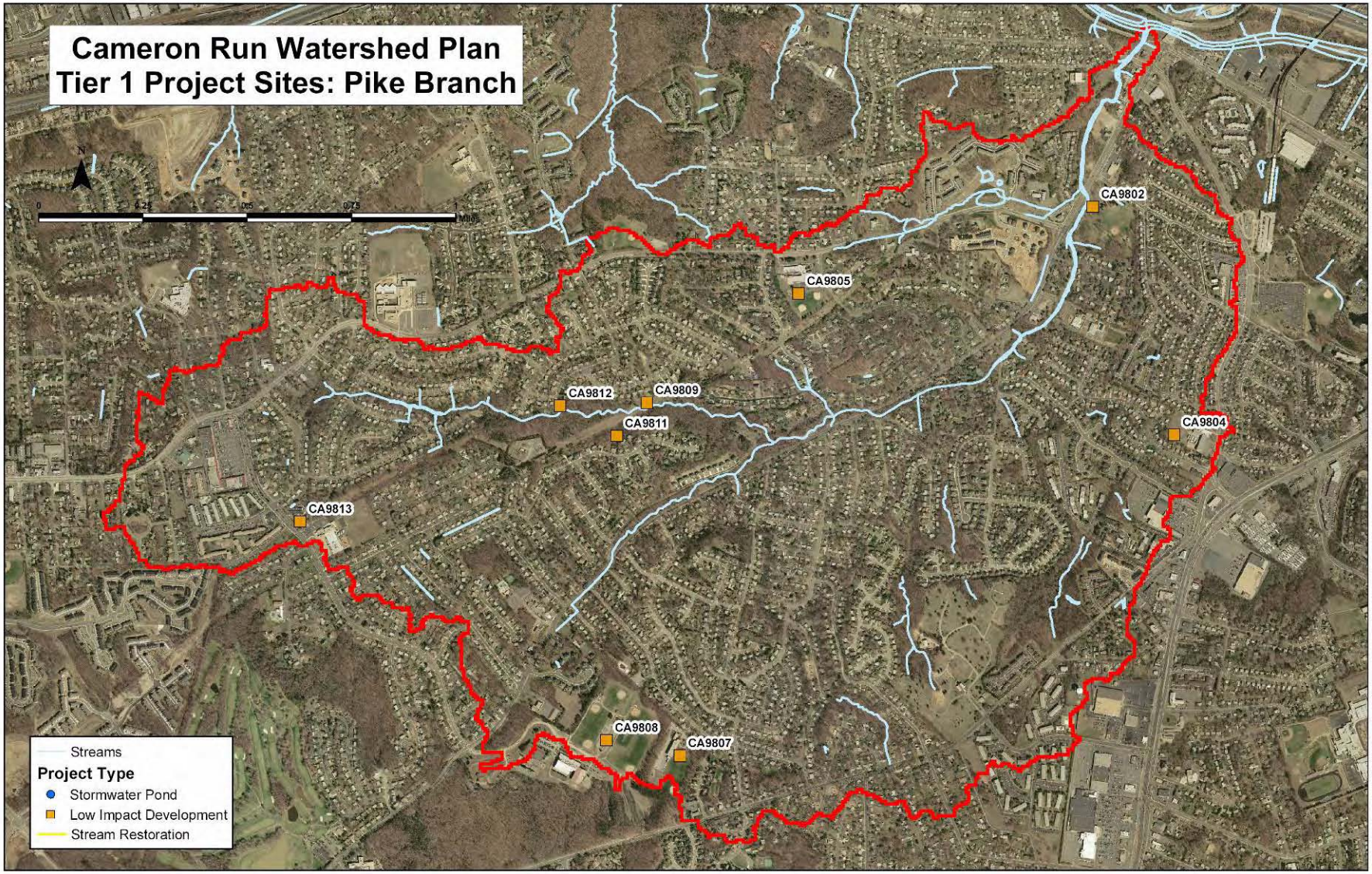


Figure 6-5. Pike Branch – Tier 1 candidate restoration sites

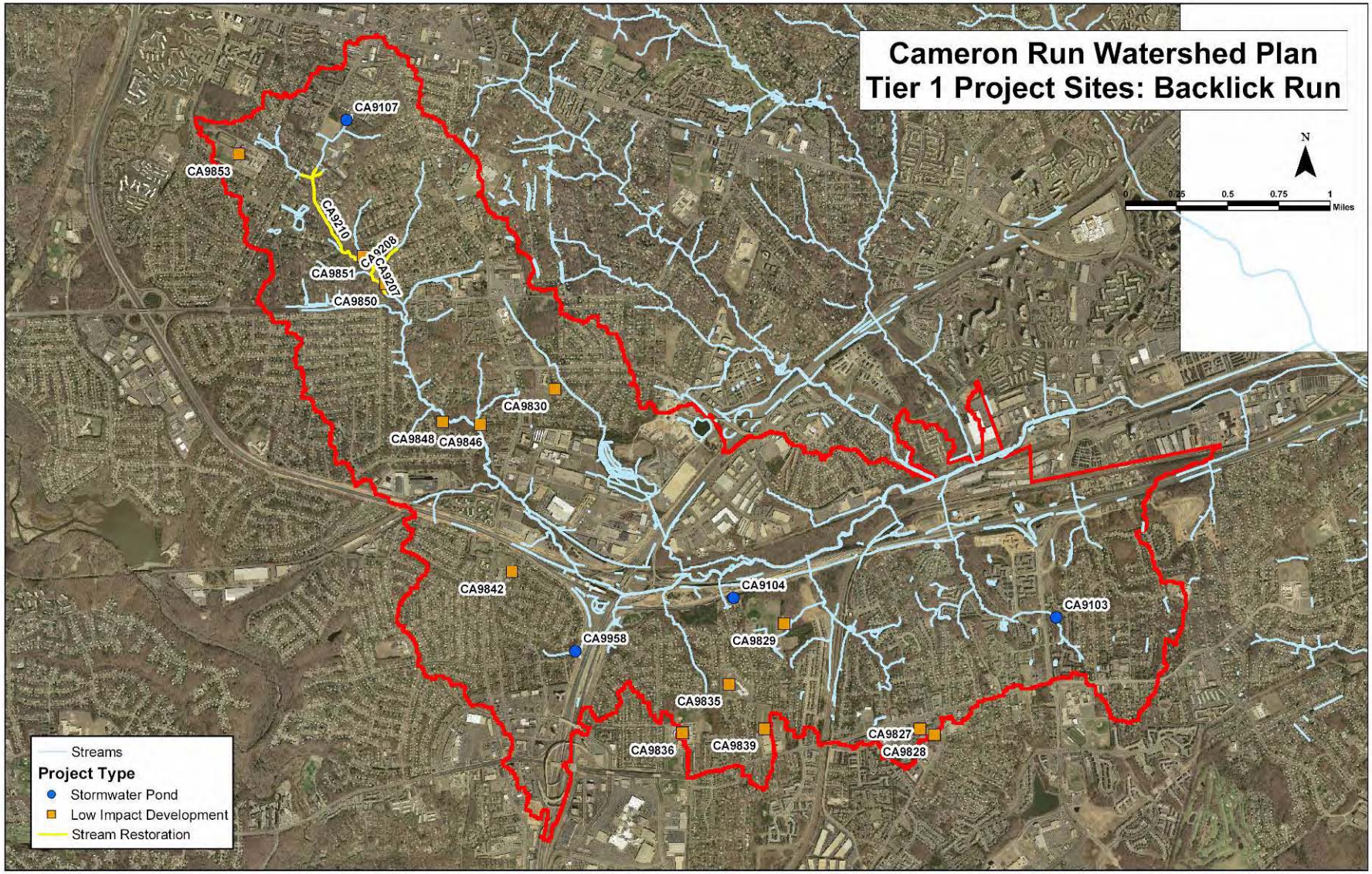


Figure 6-6. Backlick Run – Tier 1 candidate restoration sites

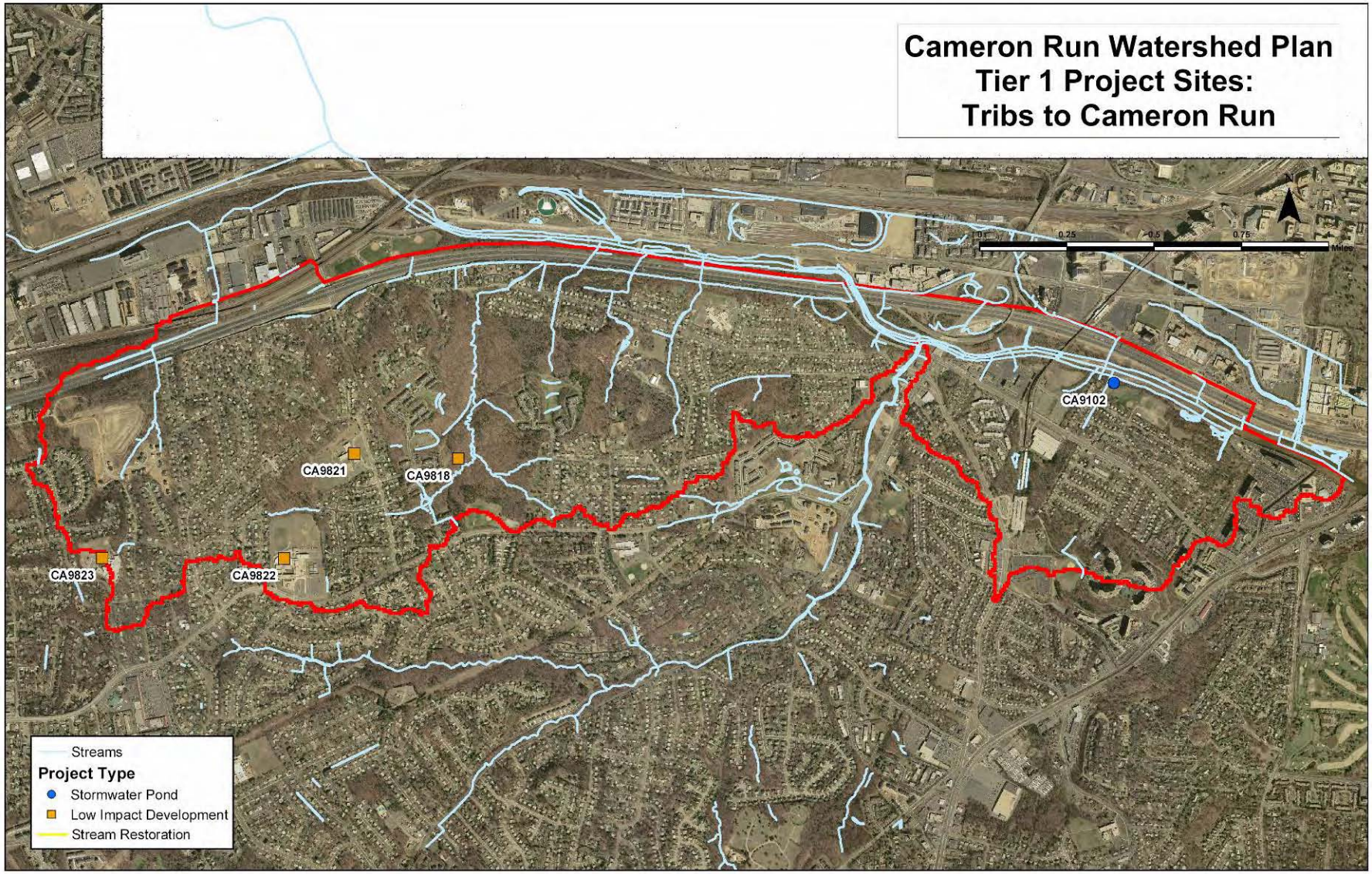


Figure 6-7. Tributaries to Cameron Run – Tier 1 candidate restoration sites

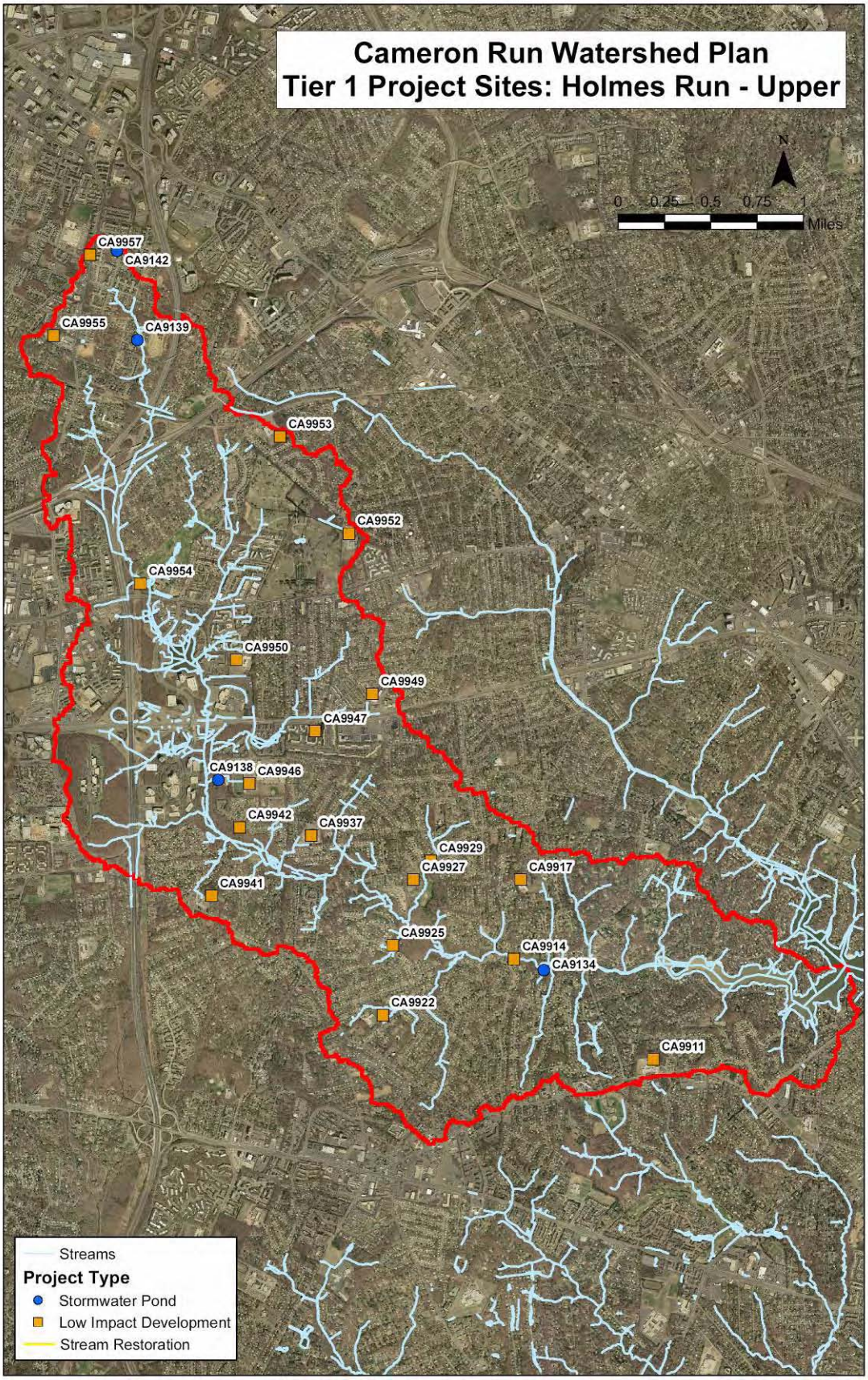


Figure 6-8. Holmes Run (Upper) – Tier 1 candidate restoration sites

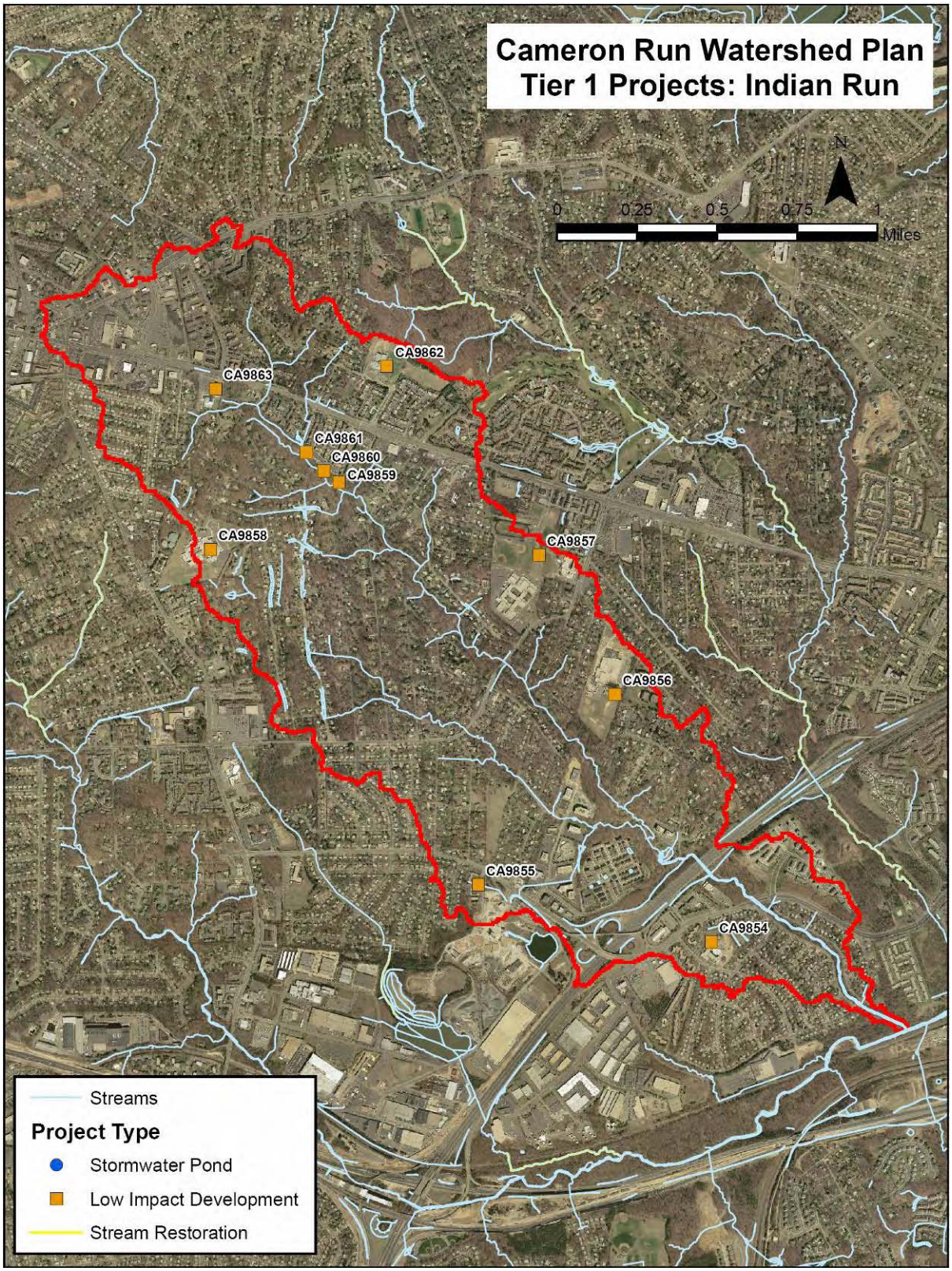


Figure 6-9. Indian Run – Tier 1 candidate restoration sites

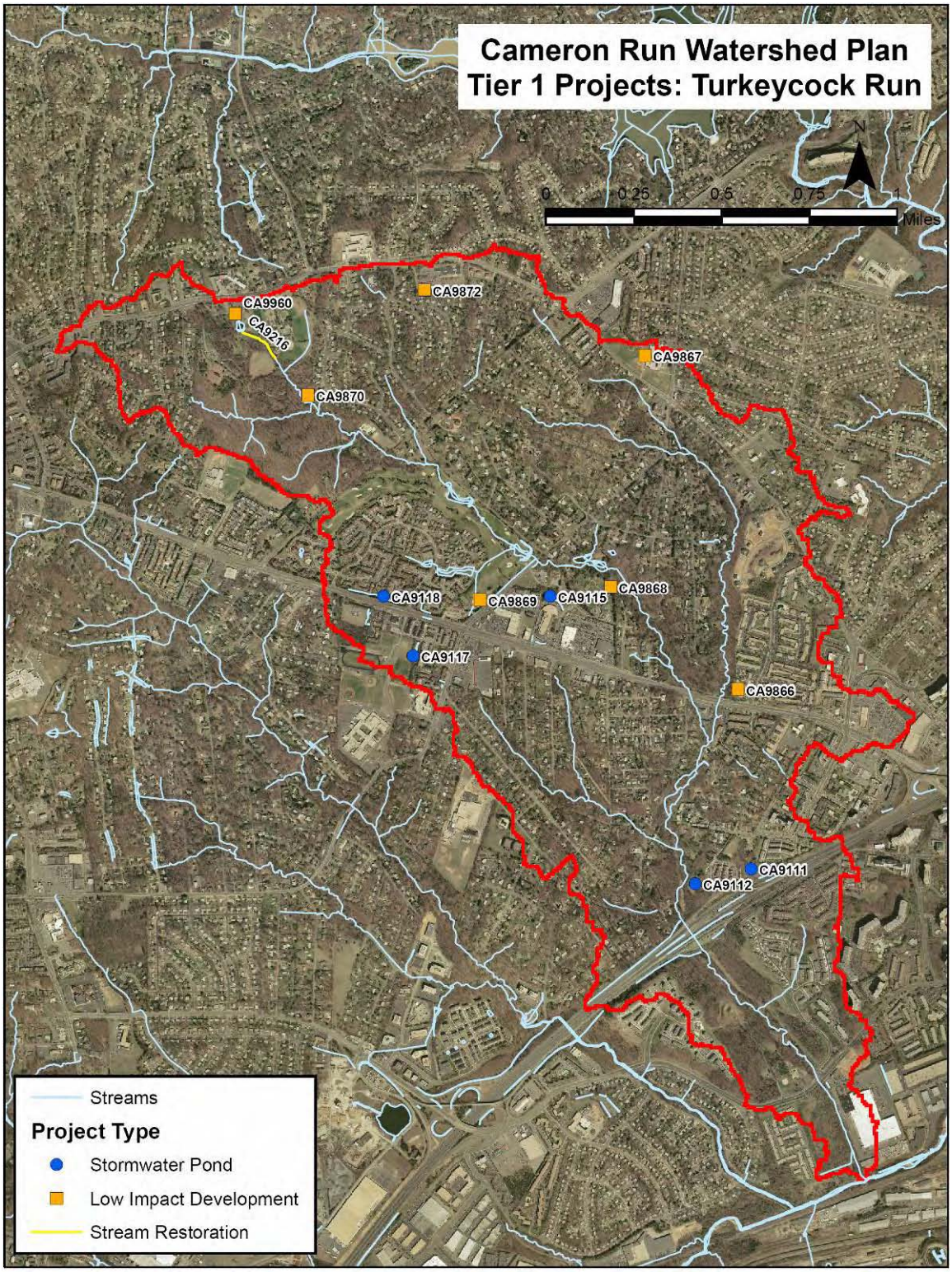


Figure 6-10. Turkeycock Run – Tier 1 candidate restoration sites

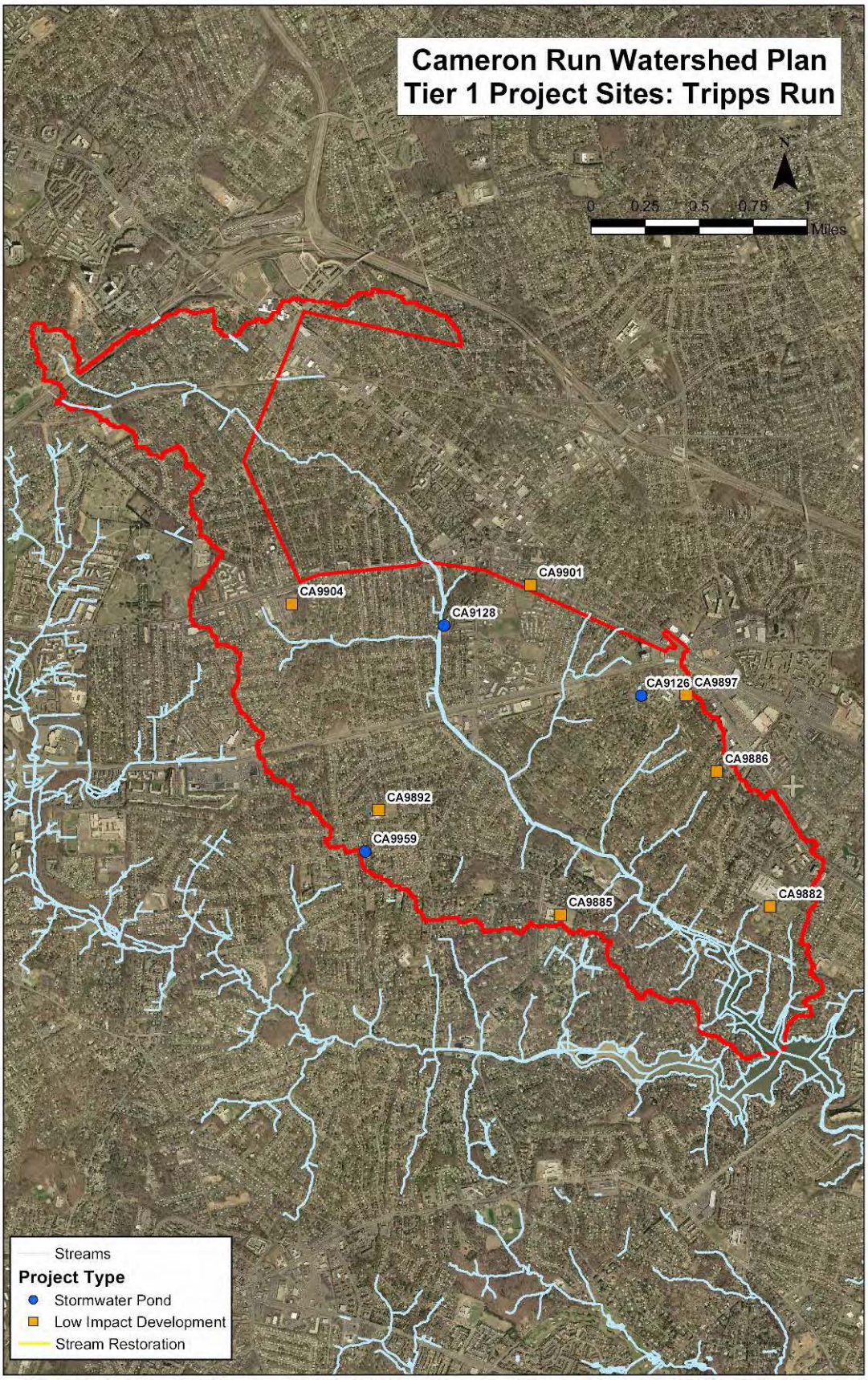


Figure 6-11. Tripps Run – Tier 1 candidate restoration sites

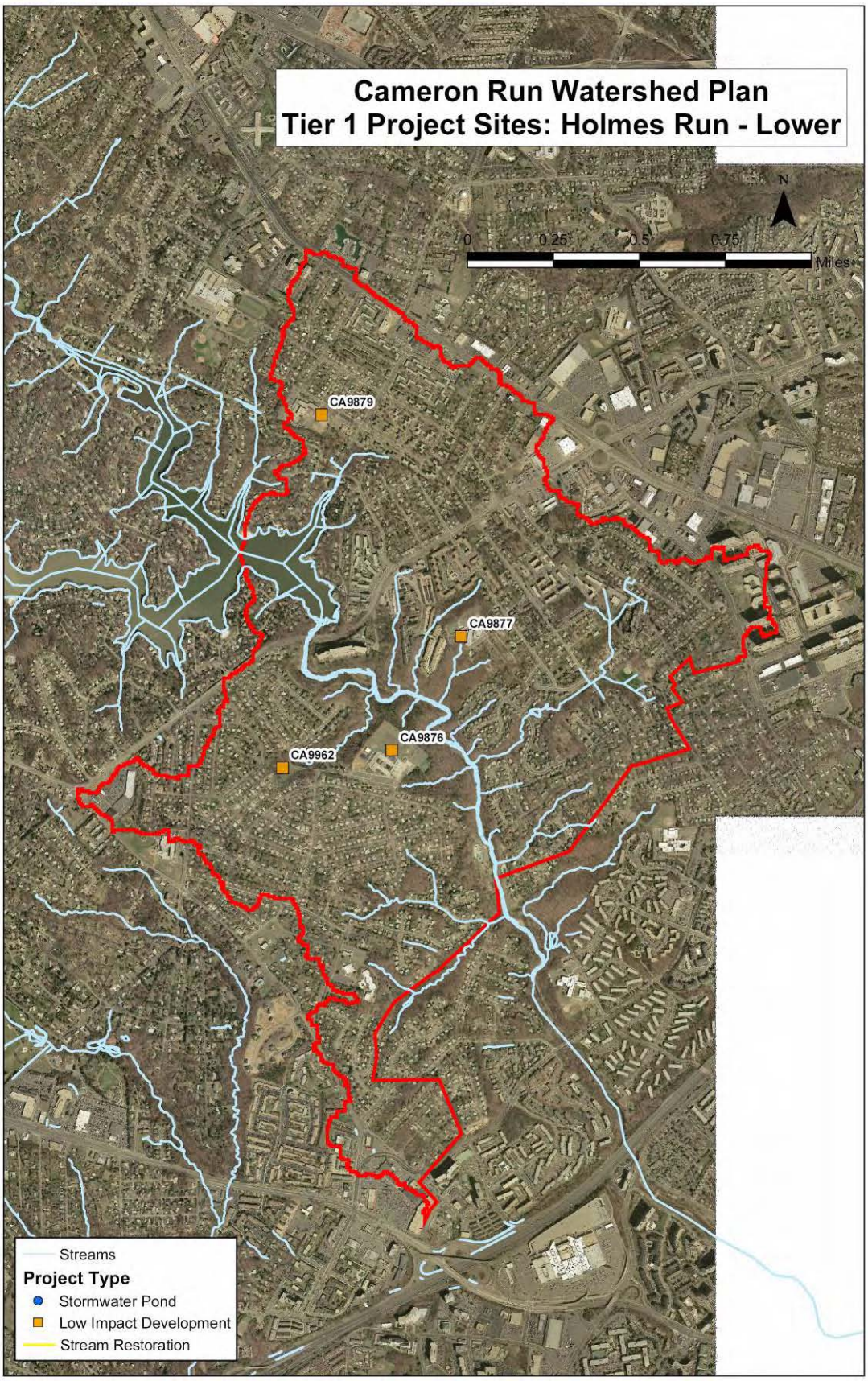


Figure 6-12. Holmes Run (Lower) – Tier 1 candidate restoration sites

because the Cameron Run watershed is highly developed; therefore, opportunities for BMPs are limited in many areas. Table 6-10 shows pollutant reductions by subwatershed if the proposed BMP projects are all implemented.

The selected stream restoration projects are expected to improve stream habitat and water quality. To quantify the benefits of the proposed stream restoration projects, the county's stream condition index (SCI) rating (modified from USACE and VDEQ 2003) was applied to determine the increase in stream habitat and reduction in erosion and sediment loss (Table 6-11). Briefly, the SCI is determined by looking at five variables within the stream and rating them from 1.0 (worst) to 5.0 (best). Each stream restoration project will gain a certain number of habitat units per the SCI index. In addition, the stream restoration projects in the plan will improve a certain number of stream miles from one condition class to another (e.g., very poor habitat to fair habitat), with assumed increases in the abundance and diversity of stream life. The county's application of the SCI index was based on stream condition data gathered during the 2002 SPA. Although the stream in Mason District Park (Project ID CA9216) was not surveyed during the SPA and sufficient data were not available to calculate the SCI for this project, similar improvements of stream condition as a result of the restoration project are anticipated.

6.6 IMPLEMENTATION OF THE PLAN

The policy recommendations and project actions will be implemented over the 25-year life of the Cameron Run Watershed Plan. This plan should serve as guidance for all county agencies and officials to protect and maintain the health of the Cameron Run watershed. The plan should be considered as an active, or "living," document that is revisited every five years. Most of the selected projects are on property owned by Fairfax County. This facilitates the coordination needed for implementation. Selected projects that would require access to privately owned property will be coordinated with landowners to obtain their approval early in the design phase.

6.6.1 Policy Recommendations

Fairfax County will review the policy recommendations described in Section 6.3 to evaluate countywide implications and to compare them with similar recommendations provided in other watershed management plans for the county. If ordinance amendments are needed, they will be developed to include other county initiatives and address the common ground that can be established between the various policy recommendations.

The first step in developing an implementation schedule was to prioritize the recommendations and evaluate how well they meet the goals of the plan. A weighted set of five criteria was used to prioritize each recommendation. The following criteria were used: Board Adopted Stormwater Control Project Prioritization Categories (40%); Direct Regulatory Contribution (10%); Effectiveness/Location (25%); and Ease of Implementation (15%). The recommendations in the plan were scored on a scale of 1 (worst) to 5 (best) for each of the criteria. The recommendations were ranked according to their total score, from highest to lowest. Table 6-12 shows the resulting priority of policy recommendations.

Table 6-10. Pollutant loading by subwatershed in Cameron Run

Subwatershed	Total Suspended Solids				Total Phosphorus				Total Nitrogen			
	Future (lb/ac/yr)	Future with Proposed BMPs (lb/ac/yr)	Reduction (lb/ac/yr)	% Decrease	Future (lb/ac/yr)	Future with Proposed BMPs (lb/ac/yr)	Reduction (lb/ac/yr)	% Decrease	Future (lb/ac/yr)	Future with Proposed BMPs (lb/ac/yr)	Reduction (lb/ac/yr)	% Decrease
Backlick Run	265	253	13	4.7	1.25	1.21	0.04	3.2	11.1	10.8	0.3	2.7
Holmes Run Lower	215	209	6	2.6	1.16	1.13	0.03	2.3	9.8	9.6	0.2	2.3
Holmes Run Upper	247	231	16	6.3	1.23	1.16	0.07	5.3	10.6	10.0	0.6	5.3
Indian Run	234	220	15	6.2	1.23	1.17	0.06	5.1	10.5	10.0	0.5	5.2
Pike Branch	240	235	5	2.0	1.32	1.29	0.02	1.8	11.2	11.0	0.2	1.8
Tributaries to CR	254	247	7	2.6	1.33	1.31	0.02	1.4	11.4	11.2	0.1	1.3
Tripps Run	233	223	10	4.3	1.29	1.25	0.04	2.8	10.8	10.5	0.3	2.7
Turkeycock Run	203	186	17	8.3	1.13	1.06	0.07	6.5	9.6	9.0	0.6	6.3
Cameron Run Weighted Average	243	231	12	4.9	1.24	1.20	0.05	3.8	10.7	10.3	0.4	3.6

Table 6-11. Stream Condition Index scores

Project ID	Project Name	Existing SCI	Proposed SCI	Increase in SCI
CA9210	Brook Hill Stream Restoration	2.98	3.35	11%
CA9208	Wilburdale Park Bank Stabilization	2.65	3.20	17%
CA9207	Wilburdale Park Stream Restoration	2.95	3.35	12%
CA9216	Mason District Park Stream Restoration - A	*	*	*

* Insufficient data to calculate SCI

Table 6-12. Priority of policy recommendations

Recommen-dation ID	Project Name	Board Adopted Categories (40%)	Direct Regulatory Contribution (10%)	Public Support (10%)	Effectiveness/ Location Rating (25%)	Ease of Implementa-tion Rating (15%)	Total Score
A2.1	Encourage approval of LID facilities as acceptable SWM; adopt policy preferring LID projects	3	4	4	4	5	3.75
A1.5	Retrofit and upgrade SWM facilities and BMPs; construct new BMPs including LID practices	3	4	4	4	3	3.45
A3.3	Provide incentives to developers, builders, etc. to reduce runoff by using conservation design/LID	3	4	4	4	3	3.45
A4.1	Facilitate construction and use of LID practices, initially targeting areas near headwaters	3	4	4	4	3	3.45
A1.4	Evaluate current list of recommended BMPs; add some newer practices (LID)	3	4	4	3	4	3.35
A1.8	Increase fines for noncompliance with BMP or LID requirements	3	4	4	3	4	3.35
A3.1	Amend ordinances to require that redevelopment demonstrate 10% net decrease in runoff	3	4	4	4	2	3.3
A3.2	Amend zoning regulations to encourage better design of new development to reduce runoff	3	4	4	4	2	3.3
A1.6	Enact new policy to require on-site water retention in all land disturbance projects	3	4	4	3	3	3.2
A1.9	Coordinate SWM activities with neighboring jurisdictions, including annual reviews	3	4	4	3	3	3.2
A3.5	Conduct frequent inspections to ensure compliance with permit conditions concerning landscaping	3	4	4	3	3	3.2
D2.3	Evaluate, through a literature review or formal study, the effectiveness of public education programs for watershed stewardship.	2	4	4	4	4	3.2
A1.1	Inspect BMPs and perform assessments every 5 years (county and VDOT)	3	4	4	4	1	3.15

Table 6-12. (Continued)

Recommen-dation ID	Project Name	Board Adopted Categories (40%)	Direct Regulatory Contribution (10%)	Public Support (10%)	Effectiveness/ Location Rating (25%)	Ease of Implementation Rating (15%)	Total Score
B1.3	Require restoration of buffer for RPA development; mandate native vegetation mixes	2	2	4	4	5	3.15
A1.2	Provide additional staff/resources to county for BMP review and inspection	3	4	4	2	4	3.1
A1.3	Increase frequency of inspection of BMPs to annually; provide maintenance education	3	4	4	2	4	3.1
A1.7	Do not grant waivers of water quality controls for nonbonded lots with > 18% imperviousness	3	4	4	2	4	3.1
A4.2	Involve the public in early stages of planning of watershed projects; maintain communication	3	4	4	2	4	3.1
A5.1	Require road widening projects to control runoff from existing paved areas w/o SWM controls	3	4	4	3	2	3.05
C1.1	Provide additional staff/resources to inspect development projects for erosion/ sediment controls	2	3	3	4	4	3
B1.1	Plant buffers using native vegetation and trees; monitor buffers for 5 years	2	2	4	4	4	3
B1.2	Provide additional staff/resources for buffer protection in RPAs; ensure adequate training	2	2	4	4	4	3
B2.3	Implement natural and water conserving landscaping at county facilities	2	2	4	4	4	3
C1.3	Reduce the amount of de-icing chemicals and sand entering surface waters of watershed	2	3	3	3	4	2.75
C2.2	Perform additional water quality monitoring including macroinvertebrate/aquatic plant surveys	2	3	3	3	4	2.75
C2.3	Identify, investigate, and prosecute illicit discharges from commercial and residential activities	2	3	3	3	4	2.75
A3.4	Limit removal of mature trees and native vegetation in any development or renovation	2	2	4	3	4	2.75
B1.4	Provide educational assistance regarding buffers to property owners with tidal shorelines or streams	2	2	4	3	4	2.75

Table 6-12. (Continued)

Recommen-dation ID	Project Name	Board Adopted Categories (40%)	Direct Regulatory Contribution (10%)	Public Support (10%)	Effectiveness/ Location Rating (25%)	Ease of Implementation Rating (15%)	Total Score
B2.1	Monitor and report on stream condition by performing stream physical assessments	2	2	4	3	4	2.75
B2.2	Facilitate acquisition/donation of easements to community groups for buffer/stream protection	2	2	4	3	4	2.75
B3.1	Perform wetlands functions-and-values survey to identify characteristics of existing wetlands	2	2	4	3	4	2.75
C3.3	Place containers at public facilities for recycling and install signs requesting sorting, fines for littering	2	2	4	3	4	2.75
B3.3	Purchase, designate, acquire land for conservation of critical wetland habitat areas	2	2	4	4	2	2.7
C2.1	Identify sources of fecal coliform in watershed; prepare action plan to reduce it	2	3	3	3	3	2.6
C2.5	Encourage all lawn management companies to participate in VA Water Quality Improvement Program; create a “green label” program for lawn/landscaping companies	2	3	3	3	3	2.6
A5.2	Replace grasses on medians and sides of roadway with native trees and vegetation where possible	2	2	4	3	3	2.6
B1.5	Amend ordinance to expand woodlands; survey existing trees and builder requirements	2	2	4	3	3	2.6
B1.6	Determine current level of mature tree canopy; establish a reforestation goal	2	2	4	3	3	2.6
B3.2	Construct and restore wetlands at suitable locations as identified in wetland survey	2	2	4	3	3	2.6
A3.6	Allocate sufficient funding for county inspection and enforcement of landscaping regulations	2	2	4	2	4	2.5
B2.4	Notify property owners on steps for improving water quality in their streams	2	3	3	2	4	2.5
B3.4	Provide outreach materials for value/benefit of wetlands, permits required for wetland activities	2	2	4	2	4	2.5
B3.5	Discourage further development in native wetlands; require mitigation when impacts are unavoidable	2	2	4	2	4	2.5

Table 6-12. (Continued)

Recommen-dation ID	Project Name	Board Adopted Categories (40%)	Direct Regulatory Contribution (10%)	Public Support (10%)	Effectiveness/ Location Rating (25%)	Ease of Implementation Rating (15%)	Total Score
C1.2	Encourage application of bioengineering to stabilize streambanks and improve habitat	2	3	3	2	4	2.5
C2.4	Educate public on ways to reduce pollutants in stormwater runoff	2	3	3	2	4	2.5
C2.6	Strengthen enforcement of "pooper scooper" regulation; institute $100 fine for violators	2	3	3	2	4	2.5
C3.1	Partner to clean up trash, woody debris, dumpsites throughout watershed	2	2	4	2	4	2.5
C3.2	Conduct vigorous public info campaign to deter littering and trash dumping	2	2	4	2	4	2.5
C3.4	Enforce solid waste and ESC ordinances against illegal dumping; impose fines/require restoration	2	3	3	2	4	2.5
D2.1	Post signage publicizing existence and importance of RPAs for stream protection and recreation	2	2	2	2	4	2.3
D2.2	Install signage at public facilities explaining benefits of LID; identify sources for further information	2	2	2	2	4	2.3
D1.2	Develop master plan for environmentally friendly recreation opportunities in Cameron Run	1	1	2	3	4	2.05
D1.1	Identify stream corridors for purchase for public access and environmentally friendly recreation	1	1	2	2	4	1.8

6.6.2 Project Actions

As described in Section 5.4.3, the county's stormwater project prioritization guidance, in conjunction with a cost-benefit analysis, was used to select and rank the Tier 1 candidate projects. Projects are listed by subwatershed, with those having a better cost-benefit ratio listed first (Table 6-13). Drainage complaint projects are not included in this table because they were prioritized using a separate process (see Section 6.4.7).

Table 6-13. Priority of proposed projects

Project ID	Project Name	Board Adopted Categories (40%)	Direct Regulatory Contribution (10%)	Public Support (10%)	Effectiveness/ Location Rating (25%)	Ease of Implementation Rating (15%)	Total Score	Acres Treated	Site Footprint (Acres)	Estimated Cost	Cost (Normalized)/ Benefit Ratio
Watershed-wide											
CA9700	Instream Debris Jam Evaluation and Removal	4	2	3	3	2	3.15	28,400		$286,000	3
CA9702	Small Watershed Grant Program	4.5	5	5	4	3	4.25	28,400		$1,094,000	9
CA9701	Community Watershed Restoration Support	4.5	5	5	4	3	4.25	28,400		$1,407,000	12
Pike Branch											
CA9802	Jefferson Manor Park Bioretention	4.5	4	5	4	5	4.45	9.2		$ 73,000	1,783
CA9809	Ridgeview Park LID – A	4.5	4	3	4	4	4.1	2.9		$ 59,000	4,962
CA9804	Mount Eagle Elementary School LID	4.5	5	3	5	5	4.6	5.9		$210,000	7,738
CA9808	Lee District Park LID	4.5	5	3	5	5	4.6	43.4		$1,589,000	7,959
CA9810	Ridgeview Park LID - B	4.5	4	3	5	4	4.35	7.6		$414,000	12,523
CA9805	Wilton Administration Center LID	4.5	5	3	5	5	4.6	6.6		$460,000	15,152
CA9807	Virginia Hills Administration Center (School) LID	4.5	5	3	5	5	4.6	4.8		$352,000	15,942
CA9811	Redwood Lane - LID	4.5	4	3	4	4	4.1	2.9		$211,000	17,746
CA9812	Ridge View Drive - LID	4.5	4	3	5	5	4.5	3.1		$249,000	17,849
CA9813	John Marshall Library LID	4.5	5	3	5	5	4.6	1.8		$246,000	29,710
Backlick Run											
CA9848	Leewood Park LID - B	4.5	4	3	3	4	3.85	6.6		$ 13,000	512
CA9103	Woodfield SWM Pond Retrofit	4.5	4	3	4	4	4.1	102.1		$276,000	659
CA9104	Thomas SWM Pond Retrofit	4.5	5	3	4	5	4.35	39.3		$148,000	866
CA9846	Leewood Park LID - A	4.5	4	3	3	4	3.85	11.4		$ 39,000	889
CA9107	Jayhawk SWM Pond Retrofit	4.5	5	3	4	5	4.35	46.3		$236,000	1,172
CA9850	Wilburdale Park LID - A	4.5	4	5	5	5	4.7	25.6		$156,000	1,297
CA9958	Lynbrook Subdivision LID - A	4.5	4	3	4	5	4.25	14.7		$ 89,000	1,425
CA9829	Franconia Park LID	4.5	5	3	4	5	4.35	12.8		$126,000	2,263
CA9851	Wilburdale Park LID - B	4.5	4	3	4	5	4.25	6.0		$ 97,000	3,804
CA9853	Annandale High School LID	4.5	5	3	5	5	4.6	17.7		$420,000	5,158
CA9842	Lynbrook Elementary School LID	4.5	5	3	4	5	4.35	11.0		$254,000	5,308
CA9828	Fire Station - Company No. 5 LID	4.5	4	3	4	5	4.25	2.6		$ 71,000	6,425
CA9830	Edsall Administration Center LID	4.5	5	3	5	5	4.6	4.5		$139,000	6,715
CA9827	Lee District Government Center LID	4.5	5	3	5	5	4.6	3.1		$209,000	14,656
CA9208	Wilburdale Park Bank Stabilization	4	5	3	3	4	3.75	-	2.8	$169,000	16,359
CA9836	Lee High School LID	4.5	5	3	5	5	4.6	42.1		$3,421,000	17,665
CA9207	Wilburdale Park Stream Restoration	4	5	3	3	4	3.75	-	3.6	$320,000	23,556
CA9210	Brook Hill Stream Restoration	3	5	5	4	3	3.65	-	12.6	$1,171,000	25,530

Table 6-13. (Continued)

Project ID	Project Name	Board Adopted Categories (40%)	Direct Regulatory Contribution (10%)	Public Support (10%)	Effectiveness/ Location Rating (25%)	Ease of Implementation Rating (15%)	Total Score	Acres Treated	Site Footprint (Acres)	Estimated Cost	Cost (Normalized)/ Benefit Ratio
Backlick Run (Continued)											
CA9839	Key Middle School LID	4.5	5	3	5	5	4.6	21.3		$2,745,000	28,016
CA9835	Springfield Elementary School LID	4.5	5	3	5	5	4.6	10.2		$1,356,000	28,900
Tributaries to Cameron Run											
CA9100	Farrington Park SWM Pond Retrofit	4.5	5	3	4	5	4.35	13.8		$ 61,000	1,016
CA9102	Huntington Park SWM Pond	4.5	5	3	4	5	4.35	16.7		$ 98,000	1,349
CA9823	Bush Hill Elementary School LID	4.5	5	3	5	5	4.6	9.6		$183,000	4,144
CA9821	Clermont Elementary School LID	4.5	5	3	5	5	4.6	12.4		$308,000	5,400
CA9818	Clermont School Site Park LID	4.5	4	3	3	4	3.85	1.1		$ 49,000	11,570
CA9822	Twain Middle School LID	4.5	5	3	5	5	4.6	9.6		$660,000	14,946
Holmes Run - Upper											
CA9139	Kings Glen SWM Pond Retrofit	4.5	5	3	4	4	4.2	81.8		$243,000	707
CA9929	Round Tree Park LID - A	4.5	4	3	5	4	4.35	16.0		$ 52,000	747
CA9914	Columbia Pines LID	4.5	4	3	5	4	4.35	28.1		$ 96,000	785
CA9954	Jefferson District Park & Golf Course LID	4.5	5	5	4	5	4.55	59.7		$236,000	869
CA9134	Columbia Pines SWM Pond Retrofit	4.5	5	3	4	4	4.2	7.7		$ 30,000	928
CA9142	Courts of Tyson SWM Pond Retrofit	4.5	5	3	4	4	4.2	6.5		$ 31,000	1,136
CA9942	Luria Park LID	4.5	4	3	5	5	4.5	57.1		$355,000	1,382
CA9138	Providence RECenter SWM Pond Retrofit	4.5	5	5	4	5	4.55	4.5		$102,000	4,982
CA9949	Graham Road Elementary School LID	4.5	5	3	5	5	4.6	4.7		$127,000	5,874
CA9953	Shrevewood Elementary School LID	4.5	5	3	5	5	4.6	11.8		$359,000	6,614
CA9927	Round Tree Park LID - C	4.5	4	3	4	5	4.25	6.8		$195,000	6,747
CA9911	Belvedere Elementary School LID	4.5	5	3	5	5	4.6	9.9		$325,000	7,137
CA9950	Pine Spring Elementary School LID	4.5	5	3	5	5	4.6	11.1		$576,000	11,281
CA9921	Broyhill Crest Park LID	4.5	4	3	4	5	4.25	2.4		$132,000	12,941
CA9952	Timber Lane Elementary School LID	4.5	5	3	5	5	4.6	9.7		$606,000	13,581
CA9946	Falls Church High School LID	4.5	5	3	5	5	4.6	38.1		$2,772,000	15,817
CA9955	Dunn Loring Center (School) LID	4.5	5	3	5	5	4.6	9.1		$722,000	17,248
CA9947	Thomas Jefferson Library LID	4.5	5	3	5	5	4.6	2.2		$179,000	17,688
CA9957	Fire Station - Company No. 13 LID	4.5	4	3	5	5	4.5	1.5		$132,000	19,556
CA9925	Holmes Run Stream Valley Park LID	4.5	4	3	4	5	4.25	0.9		$ 87,000	22,745
CA9917	Beech Tree Elementary School LID	4.5	5	3	5	5	4.6	7.8		$1,409,000	39,270
CA9922	Lacey Admin Center LID	4.5	5	3	5	5	4.6	6.7		$1,317,000	42,732
CA9941	Woodburn Elementary School LID	4.5	5	3	5	5	4.6	6.1		$1,342,000	47,826

Table 6-13. (Continued)

Project ID	Project Name	Board Adopted Categories (40%)	Direct Regulatory Contribution (10%)	Public Support (10%)	Effectiveness/ Location Rating (25%)	Ease of Implementation Rating (15%)	Total Score	Acres Treated	Site Footprint (Acres)	Estimated Cost	Cost (Normalized)/ Benefit Ratio
Holmes Run – Upper (Continued)											
CA9937	Walnut Hill Admin Center LID - B	4.5	5	3	5	5	4.6	8.7		$2,953,000	73,788
Indian Run											
CA9857	Weyanoke Elementary School LID	4.5	5	3	5	5	4.6	5.9		$124,000	4,569
CA9862	Columbia Elementary School LID	4.5	5	3	5	5	4.6	5.5		$134,000	5,296
CA9858	Poe Middle School LID	4.5	5	3	5	5	4.6	9.6		$248,000	5,616
CA9860	Indian Run Stream Valley Park LID - A	4.5	4	3	4	5	4.25	9.9		$334,000	7,938
CA9854	Bren Mar Park Elementary School LID	4.5	5	3	4	5	4.35	5.5		$230,000	9,613
CA9855	Fire Station - Company No. 26 LID	4.5	4	3	5	5	4.5	1.8		$131,000	16,173
CA9863	George Mason Regional Library LID	4.5	5	3	5	5	4.6	5.1		$403,000	17,178
CA9856	Holmes Middle School LID	4.5	5	3	5	5	4.6	17.5		$1,593,000	19,789
CA9859	Indian Run Stream Valley Park LID - C	4.5	4	3	4	5	4.25	3.9		$516,000	31,131
CA9861	Indian Run Stream Valley Park LID - B	4.5	4	3	4	5	4.25	3.6		$543,000	35,490
Turkeycock Run											
CA9118	Pinecrest SWM Pond Retrofit	4.5	5	3	4	5	4.35	13.3		$ 69,000	1,193
CA9866	Turkeycock Run Stream Valley Park LID	4.5	4	3	4	4	4.1	34.4		$198,000	1,404
CA9117	Braddock Place SWM Pond Retrofit	4.5	5	3	4	5	4.35	7.4		$ 49,000	1,522
CA9111	Beauregard SWM Pond Retrofit	4.5	5	3	3	4	3.95	3.5		$ 25,000	1,808
CA9115	Little River SWM Pond Retrofit	4.5	5	3	4	5	4.35	3.9		$ 33,000	1,945
CA9112	Strawbridge Square SWM Pond Retrofit	4.5	5	3	3	5	4.1	2.0		$ 25,000	3,049
CA9867	Parklawn Elementary School LID	4.5	5	3	5	5	4.6	11.1		$168,000	3,290
CA9960	Mason District Park LID	4.5	4	3	5	5	4.5	5.1		$120,000	5,229
CA9872	Mason Government Center LID	4.5	5	3	5	5	4.6	6.6		$220,000	7,246
CA9870	Wolftree Lane LID	4.5	4	3	5	5	4.5	8.6		$286,000	7,390
CA9869	Pinecrest Golf Course LID	4.5	4	3	4	4	4.1	1.9		$ 78,000	10,013
CA9868	Green Spring Gardens LID	4.5	4	3	3	5	4	1.1		$ 99,000	22,500
CA9216	Mason District Park Stream Restoration - A	3	5	5	5	5	4.2	-	4.8	$996,000	49,378
Tripps Run											
CA9959	Anna Lee Heights LID	4.5	4	3	5	4	4.35	16.8		$ 77,000	1,054
CA9128	Great Oak SWM Pond Retrofit	4.5	5	3	4	5	4.35	18.9		$ 89,000	1,083
CA9126	Dominion SWM Pond Retrofit	4.5	5	5	4	4	4.4	8.3		$ 61,000	1,670
CA9892	Westlawn Elementary School LID	4.5	5	3	5	5	4.6	8.0		$117,000	3,179
CA9901	Larry Graves Park LID	4.5	5	3	4	5	4.35	1.2		$ 41,000	7,854
CA9886	Nicholson St - Ch. 2 Street LID	4.5	4	5	4	5	4.45	2.4		$100,000	9,363

Table 6-13. (Continued)

Project ID	Project Name	Board Adopted Categories (40%)	Direct Regulatory Contribution (10%)	Public Support (10%)	Effectiveness/ Location Rating (25%)	Ease of Implementation Rating (15%)	Total Score	Acres Treated	Site Footprint (Acres)	Estimated Cost	Cost (Normalized)/ Benefit Ratio
Tripps Run (Continued)											
CA9897	Fire Station - Company No. 28 LID	4.5	5	3	5	5	4.6	0.5		$ 23,000	10,000
CA9885	Sleepy Hollow Elementary School LID	4.5	5	3	5	5	4.6	9.2		$455,000	10,751
CA9904	Devonshire Administration Center (School) LID	4.5	5	3	5	5	4.6	5.3		$288,000	11,813
CA9882	JEB Stuart High School LID	4.5	5	5	5	5	4.8	23.6		$1,881,000	16,605
Holmes Run - Lower											
CA9962	Holmes Run Park LID	4.5	4	3	5	5	4.5	8.0		$158,000	4,389
CA9876	Glasgow Middle School LID	4.5	5	3	5	5	4.6	22.6		$703,000	6,762
CA9877	Baileys Community Center LID	4.5	5	3	5	5	4.6	6.9		$351,000	11,059
CA9879	Baileys Elementary School LID	4.5	5	3	5	5	4.6	9.6		$1,535,000	34,760

The 25-year implementation plan for structural and nonstructural projects is shown in Table 6-14. Projects have been placed into one of five implementation groups, based on relative priority. The five-year implementation groups are listed below:

Group A:	Fiscal Year 2007 – 2011
Group B:	Fiscal Year 2012 – 2016
Group C:	Fiscal Year 2017 – 2021
Group D:	Fiscal Year 2022 – 2026
Group E:	Fiscal Year 2027 – 2031

The dates for implementation are target dates, beginning with Board approval of the plan, and subject to County funding approval and ongoing updates to the plan. Implementation groupings for projects with specific locations are shown in Figures 6-13 through 6-17. Although not included in the following table or figures, implementation of the separate drainage complaint projects is targeted for the initial five-year period,

Some of the actions in the implementation plan were scheduled with the assistance of the Advisory Committee according to the following important factors in addition to the priority ratings:

- high visibility and opportunity for public education at a variety of kinds of facilities
- logical progression of actions, such as starting upstream flow-reduction actions before downstream restoration actions
- spreading of actions throughout the watershed during the plan period, not concentrating early actions in one area
- spreading costs out throughout the plan period

Table 6-14. Implementation of proposed projects

Project ID	Project Name	Implementation Timeframe	Estimated Cost
Watershed-wide			
CA9700	Instream Debris Jam Evaluation and Removal	A	$286,000
CA9702	Small Watershed Grant Program	A	$1,094,000
CA9701	Community Watershed Restoration Support	A	$1,407,000
Pike Branch			
CA9802	Jefferson Manor Park Bioretention	B	$73,000
CA9809	Ridgeview Park LID - A	B	$59,000
CA9804	Mount Eagle Elementary School LID	B	$210,000
CA9808	Lee District Park LID	A	$1,589,000
CA9810	Ridgeview Park LID - B	C	$414,000
CA9805	Wilton Administration Center LID	A	$460,000
CA9807	Virginia Hills Administration Center (School) LID	A	$352,000
CA9811	Redwood Lane - LID	D	$211,000
CA9812	Ridge View Drive - LID	D	$249,000
CA9813	John Marshall Library LID	A	$246,000

Table 6-14. (Continued)

Project ID	Project Name	Implementation Timeframe	Estimated Cost
Backlick Run			
CA9848	Leewood Park LID - B	A	$13,000
CA9103	Woodfield SWM Pond Retrofit	A	$276,000
CA9104	Thomas SWM Pond Retrofit	A	$148,000
CA9846	Leewood Park LID - A	A	$39,000
CA9107	Jayhawk SWM Pond Retrofit	A	$236,000
CA9850	Wilburdale Park LID - A	A	$156,000
CA9958	Lynbrook Subdivision LID - A	B	$89,000
CA9829	Franconia Park LID	B	$126,000
CA9851	Wilburdale Park LID - B	B	$97,000
CA9853	Annandale High School LID	B	$420,000
CA9842	Lynbrook Elementary School LID	B	$254,000
CA9828	Fire Station - Company No. 5 LID	B	$71,000
CA9830	Edsall Administration Center LID	A	$139,000
CA9827	Lee District Government Center LID	A	$209,000
CA9208	Wilburdale Park Bank Stabilization	C	$169,000
CA9836	Lee High School LID	D	$3,421,000
CA9207	Wilburdale Park Stream Restoration	D	$320,000
CA9210	Brook Hill Stream Restoration	D	$1,171,000
CA9839	Key Middle School LID	D	$2,745,000
CA9835	Springfield Elementary School LID	E	$1,356,000
Tributaries to Cameron Run			
CA9100	Farrington Park SWM Pond Retrofit	A	$61,000
CA9102	Huntington Park SWM Pond	A	$98,000
CA9823	Bush Hill Elementary School LID	B	$183,000
CA9821	Clermont Elementary School LID	B	$308,000
CA9818	Clermont School Site Park LID	C	$49,000
CA9822	Twain Middle School LID	C	$660,000
Holmes Run - Upper			
CA9139	Kings Glen SWM Pond Retrofit	B	$243,000
CA9929	Round Tree Park LID - A	A	$52,000
CA9914	Columbia Pines LID	A	$96,000
CA9954	Jefferson District Park & Golf Course LID	A	$236,000
CA9134	Columbia Pines SWM Pond Retrofit	A	$30,000
CA9142	Courts of Tyson SWM Pond Retrofit	C	$31,000
CA9942	Luria Park LID	B	$355,000
CA9138	Providence RECenter SWM Pond Retrofit	B	$102,000
CA9949	Graham Road Elementary School LID	C	$127,000
CA9953	Shrevewood Elementary School LID	B	$359,000
CA9927	Round Tree Park LID - C	B	$195,000
CA9911	Belvedere Elementary School LID	B	$325,000
CA9950	Pine Spring Elementary School LID	C	$576,000
CA9921	Broyhill Crest Park LID	E	$132,000
CA9952	Timber Lane Elementary School LID	C	$606,000
CA9946	Falls Church High School LID	C	$2,772,000
CA9955	Dunn Loring Center (School) LID	A	$722,000
CA9947	Thomas Jefferson Library LID	A	$179,000

Table 6-14. (Continued)

Project ID	Project Name	Implementation Timeframe	Estimated Cost
Holmes Run – Upper (Continued)			
CA9957	Fire Station - Company No. 13 LID	D	$132,000
CA9925	Holmes Run Stream Valley Park LID	D	$87,000
CA9917	Beech Tree Elementary School LID	E	$1,409,000
CA9922	Lacey Admin Center LID	A	$1,317,000
CA9941	Woodburn Elementary School LID	E	$1,342,000
CA9937	Walnut Hill Admin Center LID - B	B	$2,953,000
Indian Run			
CA9857	Weyanoke Elementary School LID	B	$124,000
CA9862	Columbia Elementary School LID	B	$134,000
CA9858	Poe Middle School LID	B	$248,000
CA9860	Indian Run Stream Valley Park LID - A	B	$334,000
CA9854	Bren Mar Park Elementary School LID	C	$230,000
CA9855	Fire Station - Company No. 26 LID	C	$131,000
CA9863	George Mason Regional Library LID	A	$403,000
CA9856	Holmes Middle School LID	D	$1,593,000
CA9859	Indian Run Stream Valley Park LID - C	E	$516,000
CA9861	Indian Run Stream Valley Park LID - B	E	$543,000
Turkeycock Run			
CA9118	Pinecrest SWM Pond Retrofit	B	$69,000
CA9866	Turkeycock Run Stream Valley Park LID	B	$198,000
CA9117	Braddock Place SWM Pond Retrofit	C	$49,000
CA9111	Beauregard SWM Pond Retrofit	B	$25,000
CA9115	Little River SWM Pond Retrofit	B	$33,000
CA9112	Strawbridge Square SWM Pond Retrofit	B	$25,000
CA9867	Parklawn Elementary School LID	B	$168,000
CA9960	Mason District Park LID	A	$120,000
CA9872	Mason Government Center LID	A	$220,000
CA9870	Wolftree Lane LID	B	$286,000
CA9869	Pinecrest Golf Course LID	C	$78,000
CA9868	Green Spring Gardens LID	D	$99,000
CA9216	Mason District Park Stream Restoration - A	A	$996,000
Tripps Run			
CA9959	Anna Lee Heights LID	C	$77,000
CA9128	Great Oak SWM Pond Retrofit	B	$89,000
CA9126	Dominion SWM Pond Retrofit	C	$61,000
CA9892	Westlawn Elementary School LID	B	$117,000
CA9901	Larry Graves Park LID	B	$41,000
CA9886	Nicholson St - Ch. 2 Street LID	C	$100,000
CA9897	Fire Station - Company No. 28 LID	C	$23,000
CA9885	Sleepy Hollow Elementary School LID	C	$455,000
CA9904	Devonshire Administration Center (School) LID	A	$288,000
CA9882	JEB Stuart High School LID	C	$1,881,000
Holmes Run - Lower			
CA9962	Holmes Run Park LID	B	$158,000
CA9876	Glasgow Middle School LID	B	$703,000
CA9877	Baileys Community Center LID	C	$351,000
CA9879	Baileys Elementary School LID	E	$1,535,000

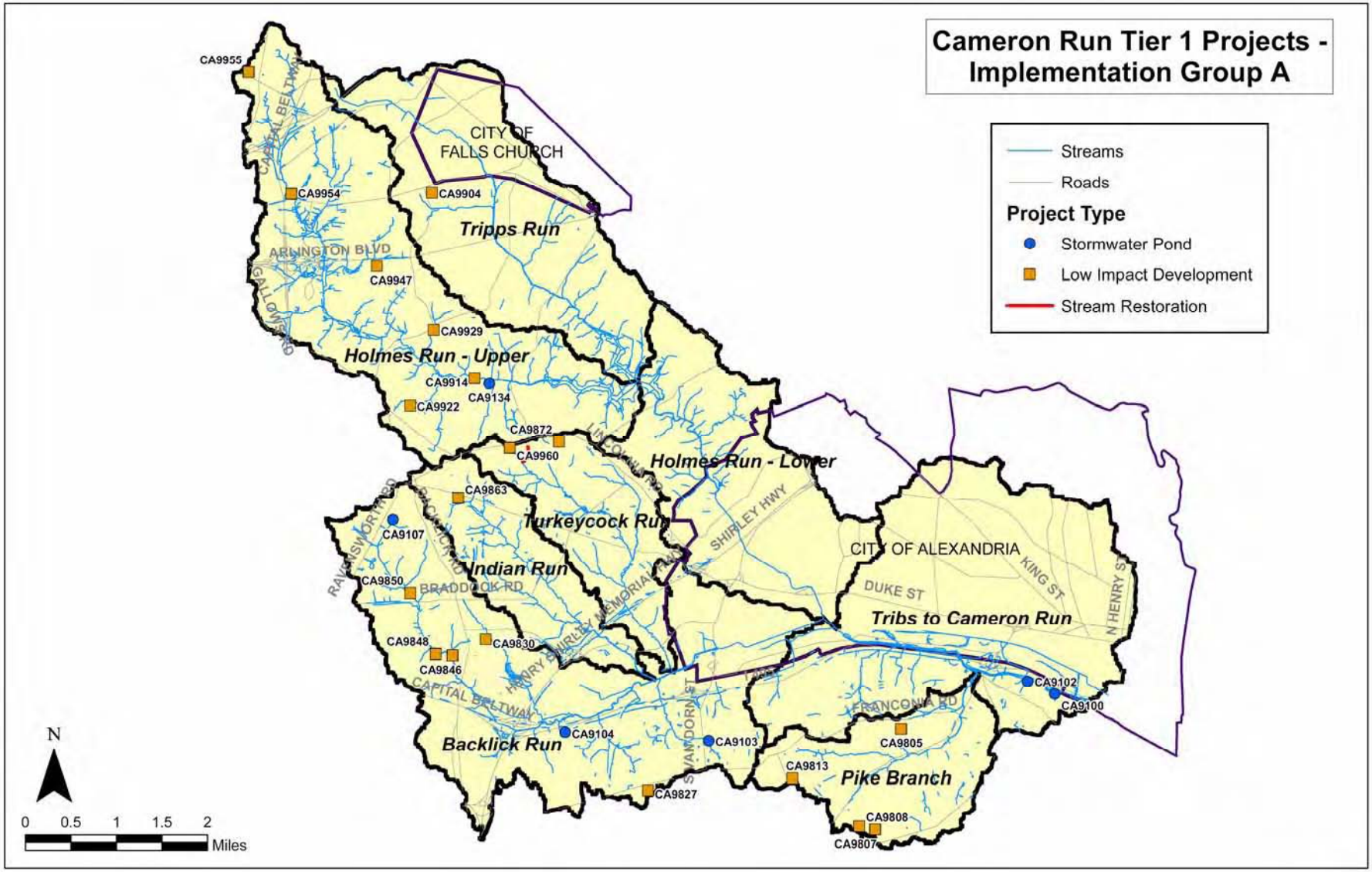


Figure 6-13. Implementation Group A (2007 – 2011)

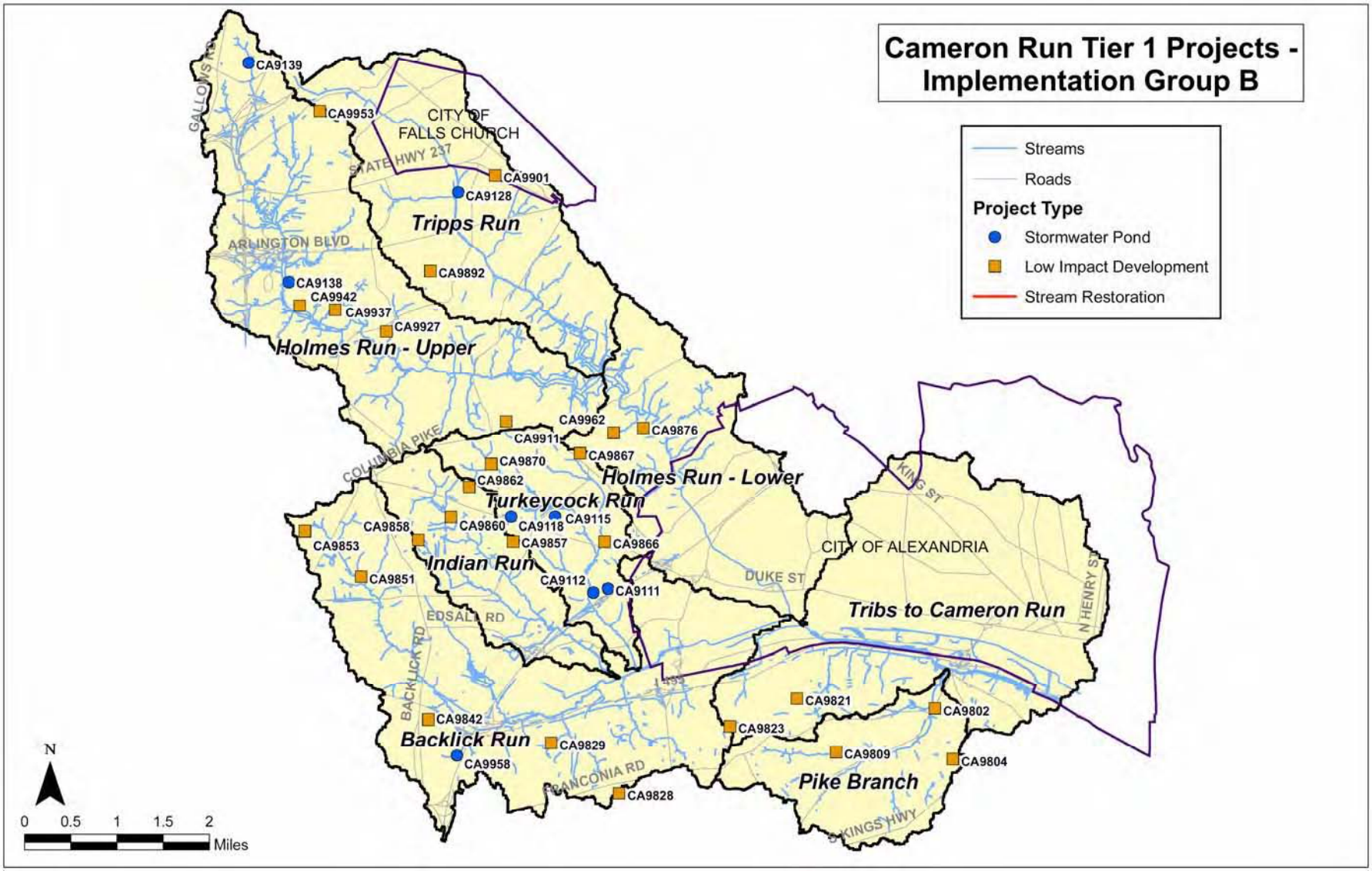


Figure 6-14. Implementation Group B (2012 – 2016)

Figure 6-15. Implementation Group C (2017 – 2021)

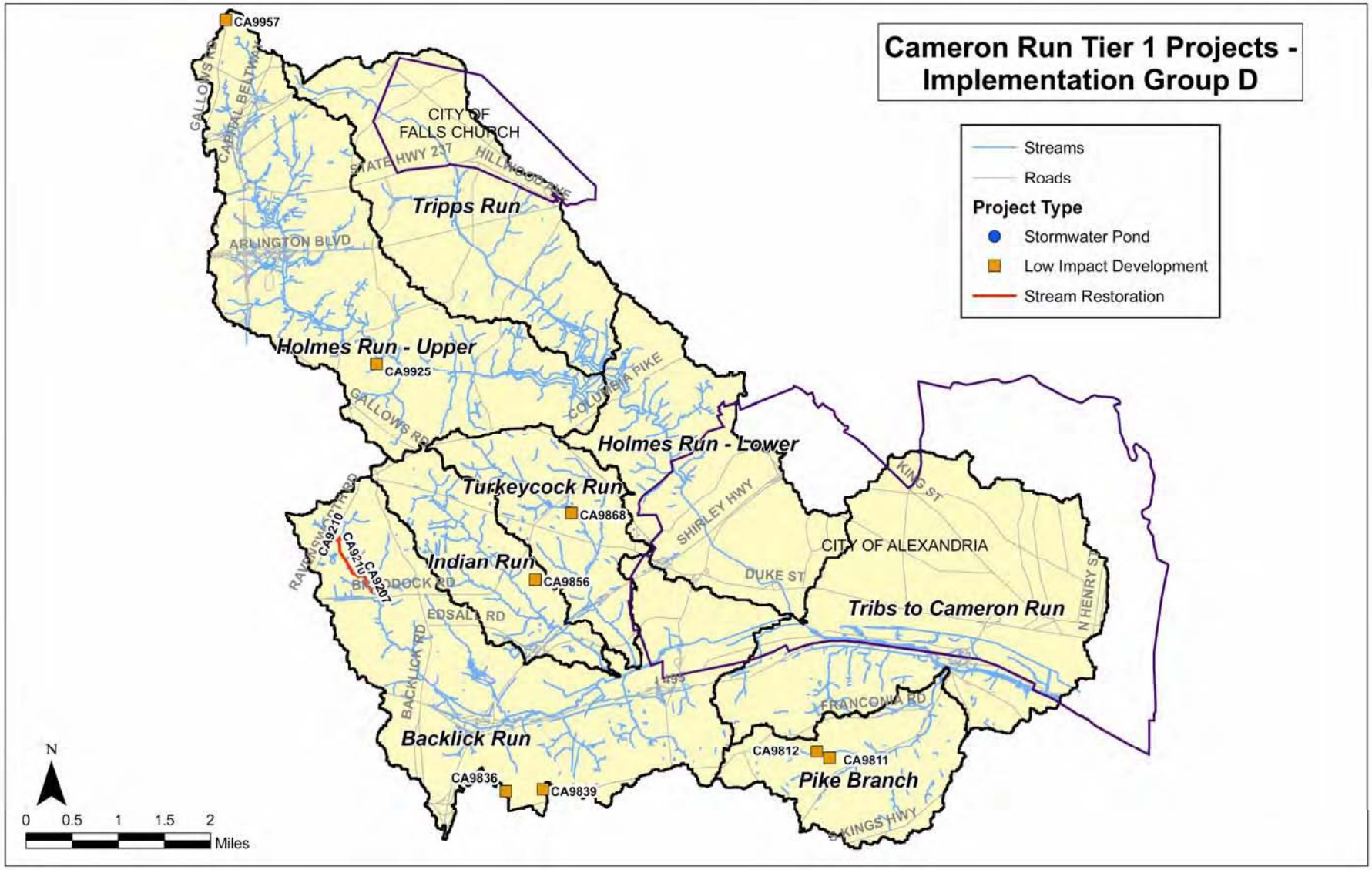


Figure 6-16. Implementation Group D (2022 – 2026)

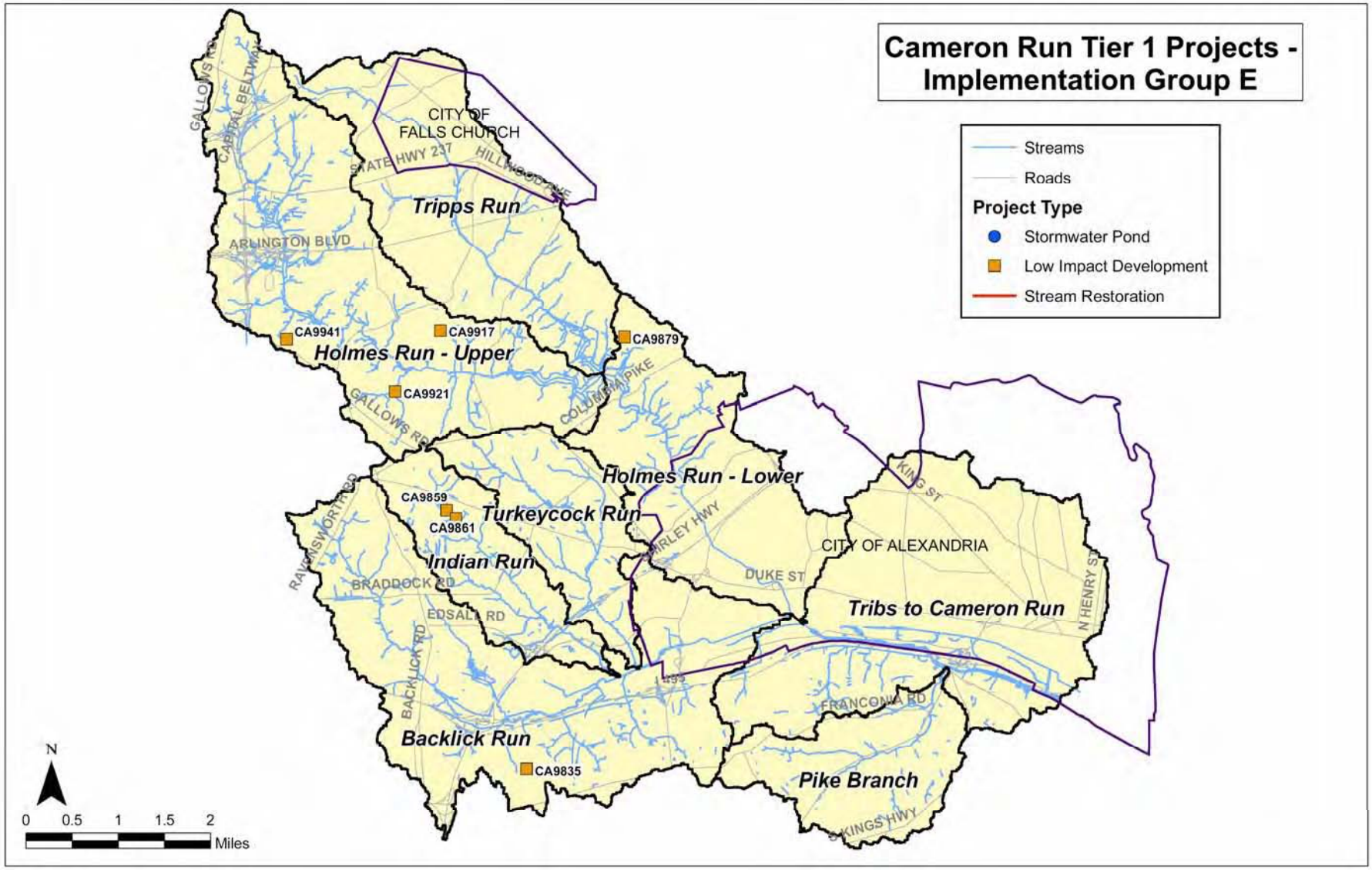


Figure 6-17. Implementation Group E (2027 – 2031)

The 25-year estimated funding requirements for all the structural and nonstructural recommended actions is $47.4 million. The breakdown of funding requirements for each five-year period of the plan is shown in Table 6-15. Estimated costs included in this plan represent actual costs that, in many cases, can be off-set or eliminated through the use of existing staff resources, in-kind services, cost-share programs, donated materials, volunteers, and other means.

Table 6-15. Funding requirements

Implementation Period	Estimated Funding Requirements
Group A: Fiscal Year 2007 – 2011	$11,468,000
Group B: Fiscal Year 2012 – 2016	$9,174,000
Group C: Fiscal Year 2017 – 2021	$8,840,000
Group D: Fiscal Year 2022 – 2026	$10,028,000
Group E: Fiscal Year 2027 – 2031	$6,833,000
Drainage Complaint Projects: Fiscal Year 2007 – 2011	$1,059,000
Total	$47,402,000

During the process of reviewing of the plan, members of the public frequently asked how the plan will be funded. Possible funding sources for the proposed actions in this plan include the general fund, a bond referendum, grants, cost sharing, and a stormwater environmental utility fee. Annual allocations of the general fund for controlling stormwater have ranged from $760,000 to $2.2 million over the past three years. The last stormwater bond referendum to be approved was in 1988 in the amount of $12 million subject to cash flow restrictions. As part of the county Board of Supervisors Environmental Agenda, an additional $17.9 million has been allocated in Fiscal Year 2006 for stormwater program implementation. The county has also signed a memorandum of agreement with the U.S. Army Corps of Engineers to share the cost of restoration projects in the watershed.

6.7 MONITORING PLAN

Monitoring the progress of implementation and the results of individual projects is critical to determining the success or failure of future structural and nonstructural projects and the overall success of the watershed management plan. Evaluation of project actions can also help to determine if the plan should be modified because of a low success rate or as watershed conditions change. As such, the plan should be reviewed annually to evaluate the progress of initiated projects, the overall implementation schedule, funding and staff availability, and future funding needs, using this information to revise the plan as needed.