CITY OF FALLS CHURCH, VIRGINIA

Watershed Management Plan

City of Falls Church
Department of Public Works

Adopted February 27, 2012

Prepared with assistance from
AMEC Environment & Infrastructure, Inc.

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Department of Public Works
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EXECUTIVE SUMMARY

The City of Falls Church is divided into two local watersheds, Tripp's Run and Four Mile Run, both of which are important to the character and quality of life of the City and ultimately affect the health of the Potomac River and the Chesapeake Bay. This Watershed Management Plan is the result of a nearly two year long citizen-led process designed to create a roadmap for (1) reducing flooding to improve safety and protect property, (2) restoring and maintaining a healthy local aquatic ecosystem, and (3) cost-effectively complying with state and federal water quality and stormwater management regulations. The plan builds on previous watershed studies and supports the *City Council Vision and Long-Term Strategic Plan* objective to "Adopt and implement best practices in watershed management to improve community water quality."

Key Decision Making Factors

Three key factors provided focus for the development of this plan and for prioritizing strategies and recommendations. These factors include: (1) new state and federal mandates that will require significant additional investment in stormwater infrastructure; (2) deficient existing City infrastructure that causes flooding and creates a public safety hazard; and, (3) the desire of City residents to provide good stewardship of their natural resources.

New State and Federal Mandates

New Chesapeake Bay restoration requirements (known as the Chesapeake Bay TMDL, or Total Maximum Daily Load) will mandate the City to significantly reduce nitrogen, phosphorus, and sediment pollution from existing development starting in 2013 with a deadline of 2028. The City's Municipal Separate Storm Sewer System (MS4) permit, which is enforceable through substantial criminal, civil, and administrative penalties, is the primary mechanism that will be used by Virginia to ensure compliance with pollution reduction targets. As a result, the City must make substantial new investments in stormwater management infrastructure, including capital projects and ongoing system maintenance. An analysis of the capital construction cost to achieve the required reductions results in a total anticipated need of $25 million, or an average annual cost of $1.6 million per year in 2011 dollars. Taking into account inflation, this comes to more than $34 million. These figures do not include the added burden placed on the City to manage construction of these projects or to operate, inspect, and maintain these facilities in the future. The City will be required to demonstrate to state and federal regulators how it will pay for these improvements.

Infrastructure Concerns

The City's stormwater management program has long struggled with how to correct deficiencies in its drainage system to prevent localized flooding. This challenge is typical of older urbanized areas where early improvements did not always consider how increased volumes in one part of the system would affect undersized downstream pipes and structures. In addition, corrugated metal pipe (CMP), which has a short life-span of about 30 years, represents a large portion of the City's drainage infrastructure (approximately 28%) and is the cause of many collapsed pipes. This aging infrastructure means there is an increased need for inspection, maintenance, and rehabilitation.

At the same time, a growing number of public and private stormwater quality management facilities will stretch the City's ability to ensure their proper maintenance and oversight without additional resources.

The number of facilities to be monitored is expected to increase significantly as a result of newly promulgated Virginia Stormwater Management Regulations and the Chesapeake Bay restoration effort.

Stewardship of the City's Resources

The City's streams are an important part of the quality of life of Falls Church. These aquatic habitats have been significantly impacted by decades of development without the benefit of water quality controls. Based on a study of stream conditions conducted in 2009, most streams in the City are rated at the "fair" level for stream health. However, all but one is considered to have a "poor" rating for aquatic habitat conditions due to stream channelization and sedimentation.

WAC Recommendations

The strategies in the Watershed Management Plan were developed with the guidance of the City of Falls Church Watershed Advisory Committee (WAC). The WAC met seven times between October 2009 and December 2011 and included representatives from civic organizations, businesses, environmental organizations, academia, and other organizations. The WAC used a series of policy papers as the framework for making short, mid, and long-term recommendations in the following areas:

- *The City's Stormwater Program* – Recommendations for strengthening the City's stormwater program are found in Section 4 and include:

  - developing a long-term Chesapeake Bay Restoration Plan to ensure that compliance with the Chesapeake Bay TMDL is achieved in a cost-efficient manner;
  - providing adequate funding for system maintenance and rehabilitation;
  - developing a plan and schedule for comprehensively inspecting the storm drain system to ensure that problem areas are identified prior to failure;
  - developing a plan for maintaining publicly-owned stormwater facilities;
  - ensuring proper maintenance of privately-owned stormwater facilities;
  - ensuring that the City's GIS remains a robust tool for making informed long-term decisions;
  - securing additional resources for public education and outreach planning; and,
  - investigating how to leverage public funds to encourage private investments in upgrades to the City's stormwater management infrastructure.

- *Stream Restoration and Monitoring* – The WAC identified four significant stream restoration opportunities. These are found in Section 2. The timing and priority of these projects depends on the availability of outside resources, including federal, state, and private grants.

- *City Policies and Ordinances* – The WAC made recommendations to streamline and strengthen stormwater management in the City by:

  - consolidating the Erosion and Sediment Control Ordinance and the Chesapeake Bay Preservation Area Overlay District into a new Stormwater Management Ordinance;
  - increasing the flood prevention tools available to the City in the Floodplain Overlay District and transferring implementation authority to the Department of Public Works;
  - increasing the penalties for violations of the Erosion and Sediment Control Ordinance and illicit discharges and dumping as allowed by the Code of Virginia;
  - amending the Zoning Ordinance to encourage the reduction of impervious surface cover during development and redevelopment; and,

- adopting policies to better define the scope of City stormwater management services to manage expectations and to define the level of service to ensure adequate and consistent maintenance.

- *Stormwater Management Projects* – A key component of meeting Chesapeake Bay restoration requirements is the identification and funding of specific projects to reduce pollution from existing development. The WAC recommends the inclusion of 10 projects in the City's CIP based on their ability to cost-effectively address both local flooding and safety issues and the City's Chesapeake Bay restoration targets. Project Data Sheets are presented in Section 5.

Funding Considerations

Significant new resources will be required for the City to meet the Chesapeake Bay restoration requirements and to maintain and rehabilitate the City's aging infrastructure. Because of the short time frame for compliance with Chesapeake Bay restoration targets (2013 to 2028), it is important to make critical decisions regarding funding now in order to spread costs over time. The WAC considered several funding options, with the goal that the revenue source should be adequate and sustainable, and that the cost of City stormwater services should be distributed in a way that is fair and equitable. The WAC made the following recommendations:

- *Enterprise Fund Approach to Stormwater Management* – The City should shift to an enterprise fund approach to stormwater management. Many localities nationally and in Virginia have shifted from using general funds to a fee-for-service approach – similar to the way that the City now manages water and wastewater. This approach recognizes that funding for stormwater management is no longer discretionary and requires a long-term, stable source of revenue.

- *Use Impervious Cover as the Basis for a Stormwater Utility Fee* – Any fee for service should be based on the most equitable approach possible. The WAC recommends the use of a stormwater utility fee that recognizes that there is a direct correlation between the amount of impervious cover on a property and the burden a property places on the public stormwater management system.

- *Stormwater Utility Implementation Plan* – The WAC recommends that the City Council move forward with a stormwater utility fee based on impervious cover and that the next step should be the development of a Stormwater Utility Implementation Plan. The purpose of the plan will be to engage in additional public education and outreach, more specifically define the program levels of service that would be funded, develop a draft rate structure, examine credit policies, and investigate billing options. The goal will be to complete the plan by January 2013 in order to give the City Council the option of moving forward with a stormwater utility as a part of FY 2014 budget deliberations.

1. Introduction and Purpose

1.1 Watershed Management Plan Goals and Process

Over the past few decades, approaches to watershed management have shifted dramatically. While most early planning efforts in Falls Church focused on flood control, the City must now address a complex range of inter-related issues including water quality and habitat protection. Some of this change is driven by state and federal mandates. However, it is also a reflection of a greater level of awareness by City residents that streams and aquatic habitats are important community resources and that development and everyday activities in the City have an impact not only on these local resources but ultimately the health of the Potomac River and the Chesapeake Bay.

Meeting these challenges is particularly complicated in Falls Church. A majority of streams have been replaced by concrete channels or placed underground in storm drains. The City's stormwater conveyance system currently includes 140,000 linear feet of storm drain, 1,400 appurtenances, and 8,100 feet of stream channel. Most of the City was developed long before the advent of water quality and stream protection controls. As of 2011, stormwater management facilities treat about 13 acres of land in the City – or just slightly over 1% of the land area. As a result, change must come through redevelopment, retrofitting existing infrastructure and neighborhoods, and changing the behaviors that cause pollutants in the first place.

Tripp's Run as it exits the City. Water from the City enters the Chesapeake Bay approximately 130 miles downstream.

The purpose of this Watershed Management Plan is to establish a roadmap for restoring and maintaining a healthy, sustainable aquatic ecosystem in the City's watersheds and to provide adequate flood control and the safe management of stormwater runoff for the City's residents. The plan is also designed to position the City to effectively and cost-efficiently address stringent new state and federal stormwater management requirements and to help the City do its part for larger restoration efforts associated with the Chesapeake Bay.

The Watershed Management Plan was developed with the assistance and guidance of the City of Falls Church Watershed Advisory Committee (WAC), which included representatives from civic organizations, businesses, environmental organizations, academia, and many others (see Acknowledgements). The WAC used a series of five policy papers as the framework for developing the plan. These included:

- *Background and Current Program Assessment.* This policy paper included an assessment of past planning efforts and current program strengths, weaknesses, opportunities, and threats.

- *Watershed Evaluation, Assessment, and Monitoring Options.* This policy paper included an evaluation of the current health of City streams based on field investigations using the Rapid Stream Assessment Technique (RSAT).

- *Regulatory Drivers and Analysis of City Policies and Ordinances.* This policy paper included an evaluation of the City's existing policies and ordinances against new and upcoming state and federal regulatory actions, as well as City-identified goals and objectives.

- *Watershed Management Alternatives and Priorities.* City staff and AMEC Environment & Infrastructure, Inc. (AMEC) developed a list of potential watershed management alternatives to control flooding, improve water quality, improve aquatic habitats, and restore degraded streams. The WAC assisted in the development of prioritization and screening tools to select 10 priority projects for inclusion in the plan.

- *Funding Options and Recommendations.* This policy paper addressed the costs associated with recommended improvements and regulatory mandates and presented options for a stable, long-term funding mechanism.

The WAC used existing watershed related goals and objectives expressed by the City Council in the *2008 City Council Vision and Long-Term Strategic Plan* and the *2005 Comprehensive Plan* to help guide the planning process. The WAC also developed specific goals for the Watershed Management Plan, including overarching goals and supporting goals. Overarching goals are those that represent the WAC's vision for what the plan will achieve. Supporting goals represent the primary means for achieving the overarching goals. Table 1-1 presents the *City Council Vision and Long-Term Strategic Plan* goals and objectives related to watershed management. Table 1-2 presents the WAC's watershed planning goals.

Table 1-1. City Council Vision and Long-Term Strategic Plan Goals and Objectives Related to Watershed Management

City Council Goal	Objective
Regulatory Tools – Protect and improve natural resources through the enforcement of existing regulations and through the development of appropriate new regulatory tools.	Objective 1 – Adopt and implement best practices in watershed management to improve community water quality.
	Objective 2 – Incorporate "green" building practices into the City building permit process.
Community Education – Create and implement community education programs on best management practices that achieve environmental harmony.	Objective 1 – Develop, implement, and sustain community education and environmental programs to include energy management/reduction and production.
Infrastructure to Support Redevelopment – Build infrastructure that supports City-wide redevelopment that creates a vibrant, distinct, sustainable, great place.	Objective 1 – Meet current and future needs for sanitary sewer, water, and stormwater facilities.
Green City Facilities – Implement best management practices at City facilities to promote a healthy environment and be more efficient in our use of natural resources.	Objective 1 – Use the opportunities of new purchases and construction of new facilities or major renovations of existing facilities to implement green technology.
Land Use Tools – Create new land use tools that encourage creative, compatible, and sustainable development.	Objective 1 – Develop user-friendly, web-based uniform development code that contains innovative zoning tools and community design standards with integration for all development regulations including green building, affordable housing, historic preservation, and transportation.

Table 1-2. Watershed Advisory Committee Goals

Overarching Watershed Planning Goals			
Protect human safety and property from the hazards of flooding.			
Achieve a level of water quality in local streams needed to support the recreational needs of the community, a diverse range of fish and other aquatic life, and state and federal Chesapeake Bay restoration goals.			
Foster well-informed, conservation minded residents and businesses that are actively involved in promoting watershed stewardship and see urban runoff as an important natural resource.			
Supporting Goals			
Create effective watershed management tools that are coordinated and mutually supportive.	Develop reliable, accessible, and objective information needed to support effective decision making, measure progress, and understand how actions and policies affect watershed health.	Strengthen the City's ability to address watershed issues through collaboration and cooperation with neighboring localities, regional and state agencies, and volunteer organizations.	Identify or create a sustainable source of funding that meets the City's long-term needs in an equitable and effective manner.

1.2 Description of Watersheds and Summary of Major Issues

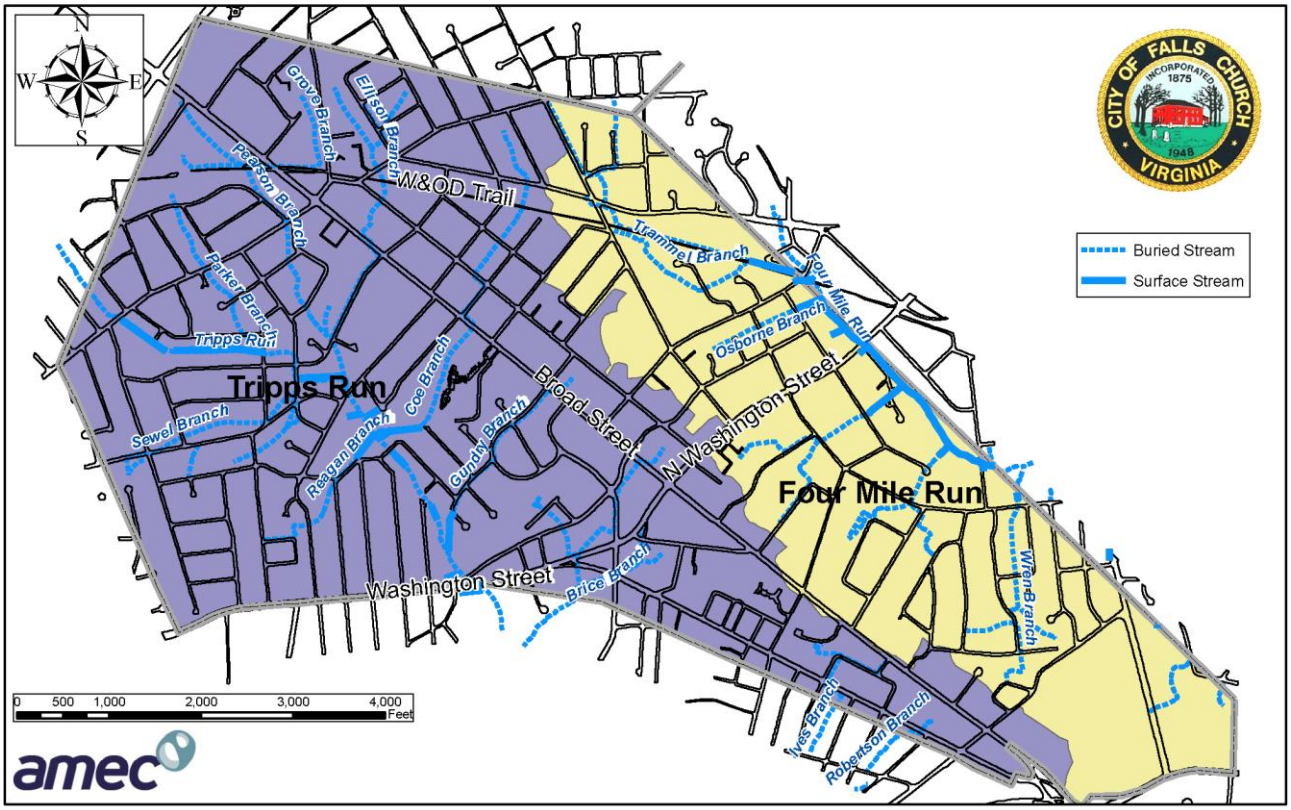
A watershed is the area of land that drains to a specific body of water. Elevated areas and ridge-lines serve as watershed boundaries. The size of a watershed is subjective, depending on the scale that is being considered. The City of Falls Church is divided into two local watersheds, Tripp's Run and Four Mile Run. These watersheds are part of the larger Chesapeake Bay watershed, which is over 64,000 square miles and crosses into six states (see insert). As a result, the health of Tripp's Run and Four Mile Run is essential not only to the City's quality of life but also the overall health of the Potomac River and the Chesapeake Bay.

The City of Falls Church occupies 2.2 square miles and has a population of 12,332 according to the 2010 U.S. Census. This is an increase of 1,955 residents, or 18.8%, since the 2000 census. The Tripp's Run watershed drains approximately 66% of the City (1.41 square miles) and originates one mile to the north in Fairfax County. Tripp's Run joins Holmes Run outside of the City to form Cameron Run. The remaining area of the City is drained by Four Mile Run (0.79 square miles). Four Mile Run and Tripp's Run drain to the Potomac River.

Both watersheds are classified as impaired, or not supporting federal and state swimmable and fishable

goals, by the Commonwealth of Virginia for bacteria (Four Mile Run for fecal coliform and Tripp's Run for e. coli). This status subjects these watersheds to regulation under the federal Clean Water Act, which requires the development of a Total Maximum Daily Load (TMDL) for all impaired waters. A TMDL is essentially a "pollution diet" and describes the maximum amount of a pollutant that a stream can receive and still meet water quality standards. A TMDL also identifies the sources of the pollutant of concern and the reductions needed to attain the standards. A TMDL and TMDL Implementation Plan have been developed for the non-tidal portion of Four Mile Run, while TMDL studies are now underway for Cameron Run (including Tripp's Run) and the tidal Four Mile Run.

Figure 1-1. City of Falls Church Streams and Watersheds



In addition to these two local TMDLs, the City is affected by TMDLs developed for the Potomac River and the Chesapeake Bay. The tidal Potomac is impaired for PCBs, while the Chesapeake Bay is impaired for nitrogen, phosphorus, and sediment. The TMDL Implementation Plan for the Chesapeake Bay, more commonly known as the Virginia Watershed Implementation Plan (WIP), will have a significant impact on the City's watershed management programs and the five-year Capital Improvements Program (CIP). Additional information is provided in Section 3.

While dumping and illicit discharges (including pet waste and anything other than stormwater) contribute to the degradation of water quality in Four Mile Run and Tripp's Run, uncontrolled impervious surfaces present the greatest challenge. The volume and velocity of stormwater entering local streams erode stream banks and scour stream bottoms – making it impossible for all but the hardiest aquatic species to survive. Additional information on the condition of the City's streams is provided in Section 2. Techniques used to reduce the impacts of stormwater runoff are discussed in Section 5.

In addition to water quality and habitat, the City has long struggled with how to correct deficiencies in its drainage system to prevent localized flooding. This is fairly typical for older urbanized areas where early improvements did not always consider how increased volumes in one part of the system would affect undersized downstream pipes and structures. The City's 1970 *Storm Drainage Study* notes "many of these systems are tied together, and as the weak link in a chain, the older inadequate culvert and unimproved ditches tend to negate the effectiveness of the larger parts of the system." While many of these problem areas have been corrected (often by placing natural streams or ditches underground), there remain problem areas.

The City's aging stormwater system also represents a potentially significant challenge that will require increased inspection, maintenance, and rehabilitation over the next several decades. While concrete structures can last up to 100 years if properly maintained, corrugated metal pipe (CMP) has a typical service life of about 30 years. Approximately 28% of the City's stormwater conveyance system consists of CMP. The City will require increased investment and monitoring to avoid costly "maintenance by emergency."

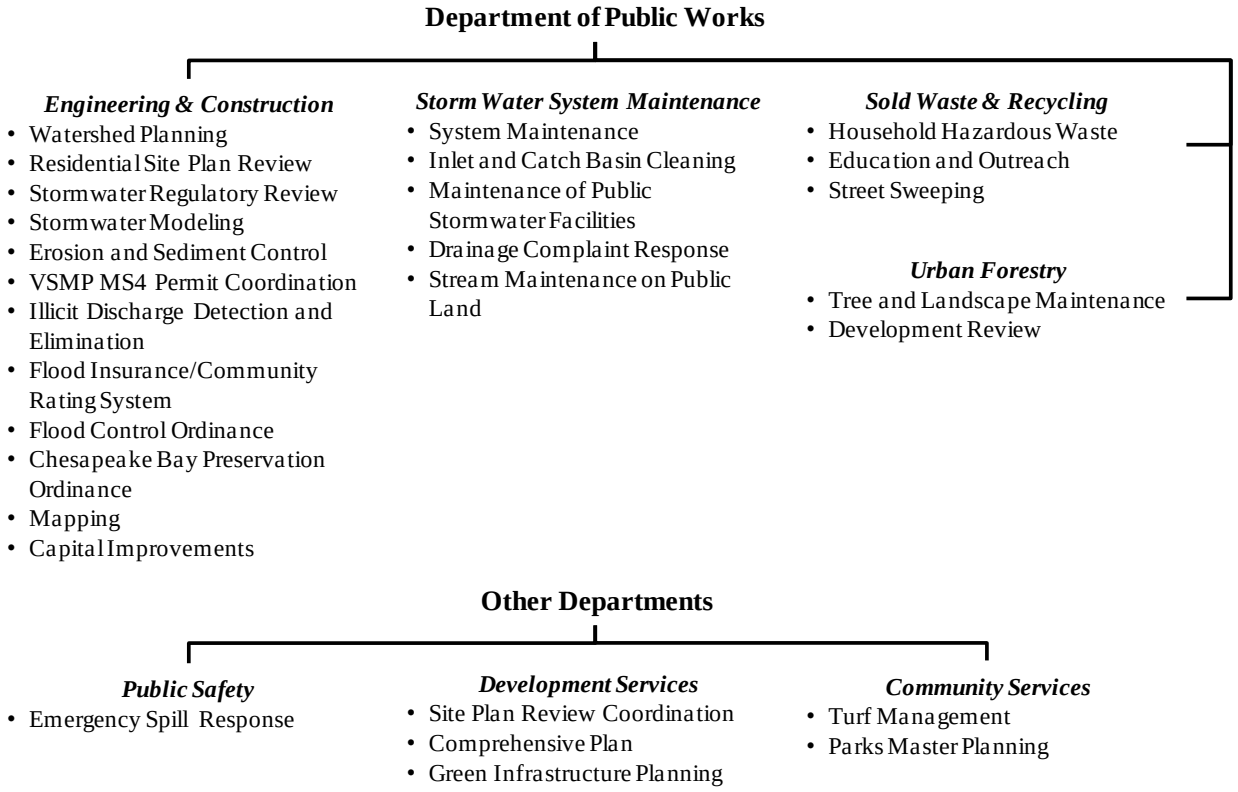
Stream bank erosion (left) and failing corrugated metal pipes (right) represent two significant challenges for the City.

1.3 Watershed Management Organizational Structure

The Department of Public Works (DPW) is the agency primarily responsible for coordinating and implementing watershed and stormwater management activities and programs in the City. DPW was created in 2011 through a City-wide reorganization and consolidated permit and regulatory compliance, operations and maintenance, and capital improvements – along with several other functions including urban forestry. In addition to DPW, the Department of Development Services, the Department of Community Services, and the Department of Public Safety have important roles in watershed management. These roles and responsibilities are further discussed in Section 4.

Figure 1-2 presents an organization chart that shows the major watershed related roles and responsibilities in the City of Falls Church.

Figure 1-2. Watershed Management Roles and Responsibilities



1.4 Previous Studies and Plans

The City has engaged in a wide range of studies and plans since at least the 1970s to deal with various aspects of storm drainage and watershed management. It is useful to understand these studies and plans as the City considers how to best meet the challenges ahead. While early studies focused almost exclusively on flood control and safety issues, more recent plans have reflected the shift toward the dual goals of flood control and water quality/habitat protection. The following is a brief overview of past studies and plans.

- *1970 Storm Drainage Study* – This extensive study of drainage and flooding problems created by early development of the City resulted in 22 recommended projects to convert open ditches into storm sewers or to replace undersized storm drain structures.

- *1986 Storm Drainage Study* – This study investigated the causes of flooding problems created by insufficient storm sewer capacity and increased runoff from new development. The study resulted in recommended improvements to mitigate flooding and prioritized these based on the potential severity of the flooding problems. The study used a computer-based analysis to help identify those areas likely to flood during a 10-year frequency storm. The study identified 28 priority improvements with a total cost of $5.4 million.

- *1996 Watershed Management Plan* – By 1996, the City was required to comply with both water quality and volume control requirements of the Virginia Stormwater Management Regulations and the Chesapeake Bay Preservation Area Designation and Management Regulations. This study was developed to "provide guidance to the City in developing and implementing measures to improve water quality, hydrological conditions, and the natural setting of streams, tributaries, and other stormwater conveyances within the City." The study resulted in a series of recommendations, including structural stormwater retrofits, streamside management strategies, and pollution prevention strategies.

- *2003 Stormwater Utility Study and Infrastructure Plan* – This report was developed to explore different funding options, including a potential stormwater utility. Driving the effort was the lack of capital funding to implement the 1996 *Watershed Management Plan* and concerns about the cost of new Virginia Stormwater Management Program (VSMP) Municipal Separate Storm Sewer System (MS4) permitting requirements.

- *VSMP MS4 Program Plan* – The City was issued a VSMP MS4 permit in 2003, and again in 2008, by the Virginia Department of Conservation and Recreation to discharge stormwater into waters of the Commonwealth. The MS4 Program Plan was developed to show how the City would meet permit requirements and implement six Minimum Control Measures (MCMs) in the areas of: Public Education and Outreach; Public Involvement and Participation; Illicit Discharge Detection and Elimination; Construction Site Stormwater Runoff Control; Post-Construction Stormwater Management for New and Redevelopment; and, Pollution Prevention/Good Housekeeping for Municipal Operations. This document remains the City's primary plan for reducing the discharge of pollutants into local water bodies.

Pictures from the 1970 report reflect the problems (failing pipe) and typical solutions (newly channelized Tripp's Run) of the time.

- *2005 Evaluation of Daylighting Opportunities* – While earlier studies focused on channelization and stream armoring, this study evaluated opportunities for restoring remaining natural channels and daylighting previously piped streams. The City identified 23 locations to be evaluated for potential daylighting, which were divided into 29 segments. Of those segments, four received a daylighting potential rating of "A," five received a rating of "B," two received a rating of "C," eight received a rating of "D," and nine received a rating of "F."

- *2007 Stormwater System Performance Assessment* – Building on several earlier efforts, the U.S. Army Corps of Engineers developed a detailed computer-based hydrologic and hydraulic model to assess areas experiencing chronic flooding and to develop recommendations for system improvements in three priority areas. The study resulted in alternatives, recommendations, and cost estimates for improvements to the Merryl House Apartments and Douglass Avenue, Highland Avenue and West Street, and Spring Street priority areas.

- *2007 Facility Assessment* – This assessment was a requirement of MCM#6 of the City's MS4 Program Plan and evaluated the risk of storm water contamination from the operation of City owned facilities. The report also provided a series of recommendations to mitigate those risks through structural or procedural changes in operations. While some of the recommendations are City-wide, there was a particular focus on the City's Property Yard.

Some of these plans are largely outdated. Others, such as the 1996 *Watershed Management Plan*, the *MS4 Program Plan*, the 2005 *Evaluation of Daylighting Opportunities*, the 2007 *Stormwater System Performance Evaluation*, and the 2007 *Facility Assessment* continue to be actively implemented and were used in the development of watershed management projects and policy recommendations presented in this Watershed Management Plan.

2. Summary of Watershed Conditions

This section provides a summary of watershed conditions for Tripp's Run and Four Mile Run, including water quality, the diversity and quantity of aquatic species, and the physical condition of stream banks and beds. Information was gathered from several organizations that conduct monitoring upstream and downstream from the City. These include the Virginia Department of Environmental Quality (DEQ), Arlington County, Fairfax County, and several citizen groups. In addition, AMEC conducted an assessment of the City's streams in July 2009 using the Rapid Stream Assessment Technique (RSAT). The purpose of this information is to establish a baseline from which to assess future progress as a result of the Watershed Management Plan.

2.1. Watershed Monitoring and Modeling Data

Most monitoring and modeling data for Tripp's Run and Four Mile Run comes from areas outside of the City. However, this information is still valuable since it provides insights into the City's water quality. Further, this data often serves as the basis for determining violations of Virginia's water quality standards. In an urban setting such as Falls Church, there exists an incredible array of pollutants that can be monitored and modeled. Table 2-1 provides a summary of the major pollutants and their sources.

Table 2-1. Common Sources of Urban Stream Pollutants[1]

Pollutant Source	Temperature	Suspended Solids	Nutrients	Bacteria	Dissolved Oxygen Demand	Metals	Petroleum Hydrocarbons	Synthetic Organic Compounds	Chlorine
Impervious Surfaces	✓	✓	✓	✓	✓	✓	✓	✓	
Soil/Streambank Erosion		✓	✓		✓	✓			
Fertilizers			✓		✓				
Leaking Sanitary Sewers		✓	✓	✓	✓				✓
Sanitary Sewer Cross Connections		✓	✓	✓	✓				✓
Animal/Pet Waste		✓	✓	✓	✓				
Vehicle Fluids		✓			✓	✓	✓		
Fuel Combustion			✓				✓		
Vehicle Wear		✓			✓	✓			
Industrial/Household Chemicals		✓	✓		✓	✓	✓	✓	✓
Paints and Preservatives						✓	✓	✓	
Pesticides						✓	✓	✓	
Pool Water/Car Washing									✓

[1] Modified from Urban Nonstructural BMP Handbook, Northern Virginia Regional Commission, 1996.

2.1.1 Chemical Water Quality

The Virginia DEQ maintains several monitoring sites within the Cameron Run and Four Mile Run watersheds. However, these sites are located several miles downstream from where the streams leave the City. Four Mile Run stations are located at George Washington Parkway, West Glebe Road, Columbia Pike, and Carlyn Springs Road. Cameron Run stations are located at George Washington Parkway, Telegraph Road, and Eisenhower Avenue (see Figure 2-1). Table 2-2 shows the pollutants monitored at the DEQ sites and the stations that have long-term trend data. DEQ monitors additional pollutants on an as needed basis to screen for potential problems that may require more intensive monitoring.

Figure 2-1. Virginia DEQ Water Quality Monitoring Stations

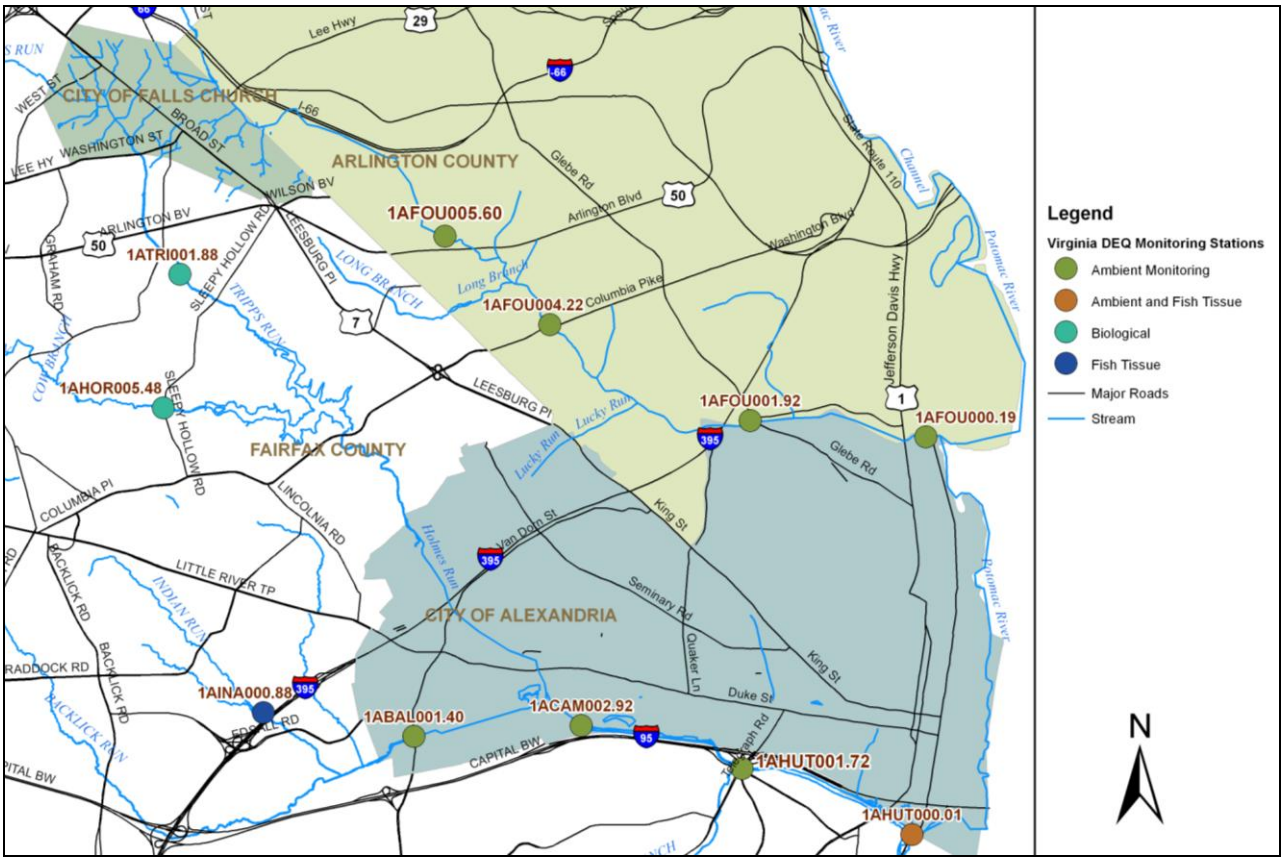


Table 2-2. Virginia DEQ Water Quality Monitoring Stations and Parameters Tested

Station	Location	Trend	Minimum Parameters Tested
Cameron Run/Tripp's Run			Temperature Dissolved Oxygen pH E. coli-MTEC-MF No./100 ML Phosphorus, Total (MG/L as P) Total Suspended Solids (MG/L) Nitrogen, Total (MG/L as N) Ammonia, Total (MG/L as N) Nitrite + Nitrate, Total (MG/L as N) Turbidity
1ACAM002.92	Eisenhower Avenue	✓	
1AHUT001.72	Telegraph Road		
1AHUT000.01	GW Parkway	✓	
Four Mile Run			
1AFOU005.60	Carlyn Springs Road		
1AFOU004.22	Columbia Pike	✓	
1AFOU001.92	West Glebe Road	✓	
1AFOU000.19	GW Parkway		Metals and Toxic Organic Compounds (Pesticides, PCBs), in Sediment Tested as Resources Allow

From a City and a regional perspective, four pollutants are of particular concern. These include bacteria, nutrients (phosphorus and nitrogen), suspended solids (sediment), and PCBs. This is because the City is located within watersheds that are considered impaired for these pollutants and are therefore subject to the TMDL regulations under the federal Clean Water Act.

Bacteria Monitoring and Modeling

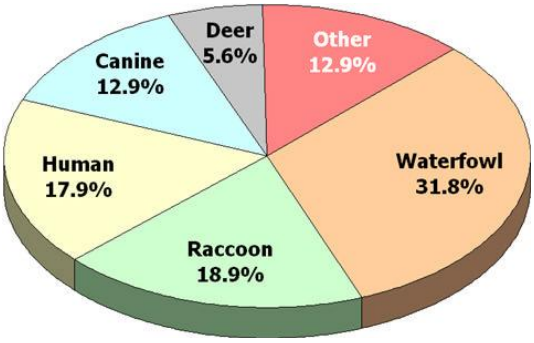
Both Tripp's Run (as part of Cameron Run) and Four Mile Run are classified as impaired by Virginia for bacteria. This means that both water bodies violate water quality standards for fishing and swimming (geometric mean greater than 126 bacteria/100 ml or any single sample greater than 235 bacteria/100 ml). A TMDL has been developed for non-tidal Four Mile Run, while TMDL studies are now underway for Cameron Run (including Tripp's Run) and the tidal Four Mile Run. Table 2-3 provides data from the Virginia 2010 TMDL Priority List of Impaired Waters that serves as justification for the impaired status.

Table 2-3. Bacteria Monitoring Violations for Cameron Run and Four Mile Run

Station	Location	Samples	# of Violations	% Violations
Cameron Run/Tripp's Run				
1ACAM002.92	Eisenhower Avenue	29	7	24.1%
1AHUT001.72	Telegraph Road	11	3	27.3%
1AHUT000.01	GW Parkway	39	17	43.6%
Four Mile Run				
1AFOU005.60	Carlyn Springs Road	6	5	83.3%
1AFOU004.22	Columbia Pike	14	3	21.4%
1AFOU001.92	West Glebe Road	28	12	42.9%
1AFOU000.19	GW Parkway	12	2	16.7%

In addition to DEQ monitoring, the Friends of Four Mile Run maintain two monitoring stations on Four Mile Run for e. coli at Bannekar Park at North Van Buren Street and at East Falls Church Park at North Roosevelt Street.[2] Both sites have been consistently (roughly monthly) monitored since October 2005. At Banneker Park, eight out of 25 samples (32%) violated Virginia water quality standards, while at East Falls Church Park, 18 out of 29 samples (62%) violated water quality standards. Some of the readings at East Falls Church Park were very high, including six exceeding 1,000 bacteria/100 ml.

Figure 2-2. Bacteria Sources in Four Mile Run



Sources of e. coli bacteria vary widely, and depend heavily on location. The Four Mile Run TMDL utilized bacteria source tracking (BST), a type of genetic fingerprinting, performed by Virginia Tech to understand the sources of bacteria in the watershed. The study found that a majority of bacteria comes from natural sources (or semi-natural sources, since wildlife is artificially concentrated as a result of human encroachment), with human-related sources making up approximately 31% of bacteria (human and dog). However, a more specific breakdown of information near where Four Mile Run exits the City shows that most of the bacteria come from wildlife (deer, waterfowl, raccoon, and beaver). This makes it difficult to achieve bacteria reductions in the City since the major sources are not human-caused.

Table 2-4 shows the bacteria reductions needed to bring Four Mile Run into compliance with Virginia water quality standards based on the TMDL model. The percentage reductions are indicative of the enormous effort it will take to de-list Four Mile Run from the impaired waters list.

Table 2-4. Four Mile Run TMDL Bacteria Reductions to Meet Water Quality Standards

	Waterfowl	Raccoon	Human	Dog	Other
Reduction from Base Conditions	95%	95%	98%	98%	95%

Nutrient Monitoring and Modeling

The pollutants of greatest concern for the Chesapeake Bay and the Potomac River are nutrients. Water bodies react to different types of nutrients in different ways. In general, phosphorus is the controlling nutrient in fresh water systems such as lakes and reservoirs while nitrogen is the controlling nutrient in brackish systems such as the Chesapeake Bay. High concentrations of these nutrients lead to excessive algae growth, which can cloud the water and block sunlight to submerged aquatic vegetation. As the algae die and decay, they consume large quantities of dissolved oxygen (DO) that are necessary for the survival of fish and other aquatic species.

The Chesapeake Bay is listed as impaired for both nitrogen and phosphorus. The U.S. EPA finalized the TMDL for the Chesapeake Bay in December 2010. As a result, the City will be required to implement nutrient reduction techniques through its VSMP MS4 permit as discussed in Section 3. While DEQ conducts monitoring of nutrients at many of its stations, the City's nitrogen and phosphorus reduction requirements will ultimately be assigned based on the Chesapeake Bay Model and the Virginia Watershed

[2] See http://gisweb.deq.virginia.gov/vwmc/viewer.htm for site locations and monitoring data.

Implementation Plan (WIP) that is currently under development. Table 2-5 shows the nitrogen, phosphorus, and sediment loads assigned to land uses in the City (which is part of Chesapeake Bay Model segment POTTF_VA) for impervious and pervious areas, the reduction targets established by the Virginia WIP, and the ultimate target loads that will be required for compliance with the Chesapeake Bay TMDL.

Suspended Solids/Sediment Monitoring and Modeling

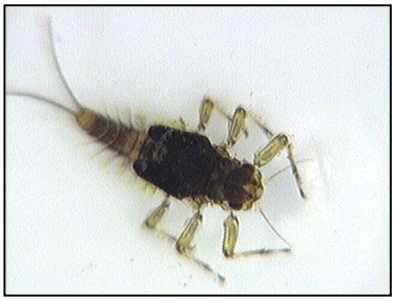
In addition to nutrients, the Chesapeake Bay is impaired for sediment as measured by Total Suspended Solids (TSS). All DEQ monitoring stations in Cameron Run and Four Mile Run test for TSS. To-date, neither water body is specifically considered impaired for this pollutant. However, specific sediment reduction targets have been developed by Virginia through the Chesapeake Bay TMDL process, which will in turn be imposed on the City of Falls Church. Table 2-5 shows existing and target loads assigned to the City through the Chesapeake Bay Model.

Table 2-5. Chesapeake Bay TMDL Pollutant Reduction Requirements

	Total Nitrogen		Total Phosphorus		Sediment	
	Imp. Area	Perv. Area	Imp. Area	Perv. Area	Imp. Area	Perv. Area
Base (2009) Load in Pounds/Acre/Year	9.85	7.23	1.36	0.36	1,171.48	169.46
% Reduction Required[3]	9%	6%	16%	7.25%	20%	8.75%
Target Load in Pounds/Acre/Year	8.96	6.80	1.14	0.33	937.18	154.63

PCB Monitoring and Modeling

Based on DEQ sediment and fish tissue sampling, the tidal Potomac is listed as impaired for PCBs. As a result, a TMDL for PCBs has been developed that includes the City of Falls Church. PCBs are monitored by DEQ at the tidal portion of Four Mile Run and the tidal portion of Hunting Creek (lower Cameron Run). PCBs are considered a legacy pollutant in that they are mostly associated with older industrial or utility-related land uses or are attached to bottom sediments that are re-suspended during large storm events. The TMDL assigns the City a wasteload allocation (WLA) of 0.293 PCBs in g/year. To achieve this target, the City would need to reduce PCBs by 95.2% from the existing baseline condition of 6.16 g/year.



Pollution Tolerant Aquatic Worm (Above) and Pollution Sensitive Mayfly

2.2.2 Biological Monitoring

In addition to the chemical quality of the water, the health of a stream can be directly measured by evaluating the physical integrity of the bank and beds and the diversity of species found in the water and stream bottom. Different species of aquatic macroinvertebrates (organisms that lack a backbone and can be seen with the naked eye) and other organisms exhibit varying degrees of tolerance for degraded

[3] Virginia Watershed Implementation Plan (WIP) Phase I.

stream conditions. For instance, leech, midge, aquatic worm, and black fly are all pollution tolerant. On the other hand, mayfly, caddisfly, water penny, stonefly, and dobsonfly are pollution intolerant. The health of a stream can be assessed based on the presence or absence of these species.

While Section 2.3 summarizes the biological and physical assessment of stream reaches conducted for the City in July 2009, it is useful to understand previous studies conducted by Fairfax County and Arlington County since they provide a regional context and a general means of comparison. Fairfax County conducted a County-wide *Stream Protection Strategy Baseline Study* in 2001 that assessed biotic integrity, habitat, and fish taxa richness. In 2007, Fairfax County also adopted a *Cameron Run Watershed Plan* with information on the physical condition of stream reaches in Cameron Run, including Tripp's Run. Finally, Arlington County conducted a Rapid Stream Assessment Technique (RSAT) in 2001 as part of the *Arlington County Watershed Management Plan*. A summary of the findings of these assessments is found in Table 2-6.

Table 2-6. Comparison of Fairfax County and Arlington County Stream Assessments

	Cameron Run Watershed Plan (2007)*		**Fairfax County Stream Protection Strategy (2001)**	**Arlington County Watershed Management Plan (2001)****
	Tripp's Run Entering the City	Tripp's Run Exiting the City	Tripp's Run at Sleepy Hollow	Upper Four Mile Run Main Stem
Overall Condition			**Very Poor**	**Fair**
Index of Biological Integrity			**Very Poor**	
Fish Taxa Richness			**Very Low**	
Habitat Conditions	**Poor**	**Poor**		
Instream Habitat Quality	**Poor**	**Poor**		**Fair**
Vegetated Buffer Zone Quality	**Poor**	**Poor**		
Riparian Habitat				**Poor-Fair**
Bank/Channel Stability	**Severe**	**Moderate**		**Good**
Channel Alteration	**Severe**	**Severe**		
Sediment Deposition	**Severe**	**Severe**		**Fair-Good**
Water Quality			**Fair**	**Fair**
Aesthetic Rating				**Poor-Fair**

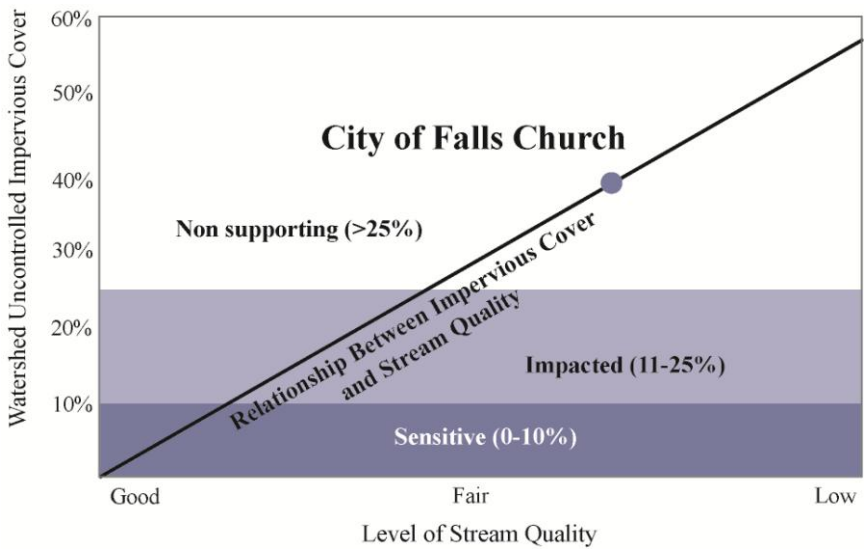
* Information from the Cameron Run Watershed Plan is based on a Stream Physical Assessment conducted by CH2M Hill, 2004.
** Composite of 51 stations.

In general, and while there are differences in methodologies used by Fairfax County and Arlington County, the upper main stem of Four Mile Run, which is the part of Four Mile Run flowing through the City, is assessed as in better overall condition than Tripp's Run.

2.2. Impacts of Impervious Surface Cover

Although dumping and illicit discharges contribute to stream degradation, uncontrolled impervious surfaces present the greatest challenge to habitats and the physical integrity of the City's streams. The volume and velocity of stormwater entering local streams erode stream banks and scour stream bottoms – making it impossible for all but the hardiest aquatic species to survive. According to research conducted by the Center for Watershed Protection, adverse effects on aquatic ecosystems occur at approximately 10-15% impervious area. Streams become seriously degraded, or "non-supporting" at about 25% imperviousness.

Figure 2-3. Relationship Between Impervious Cover and Stream Quality



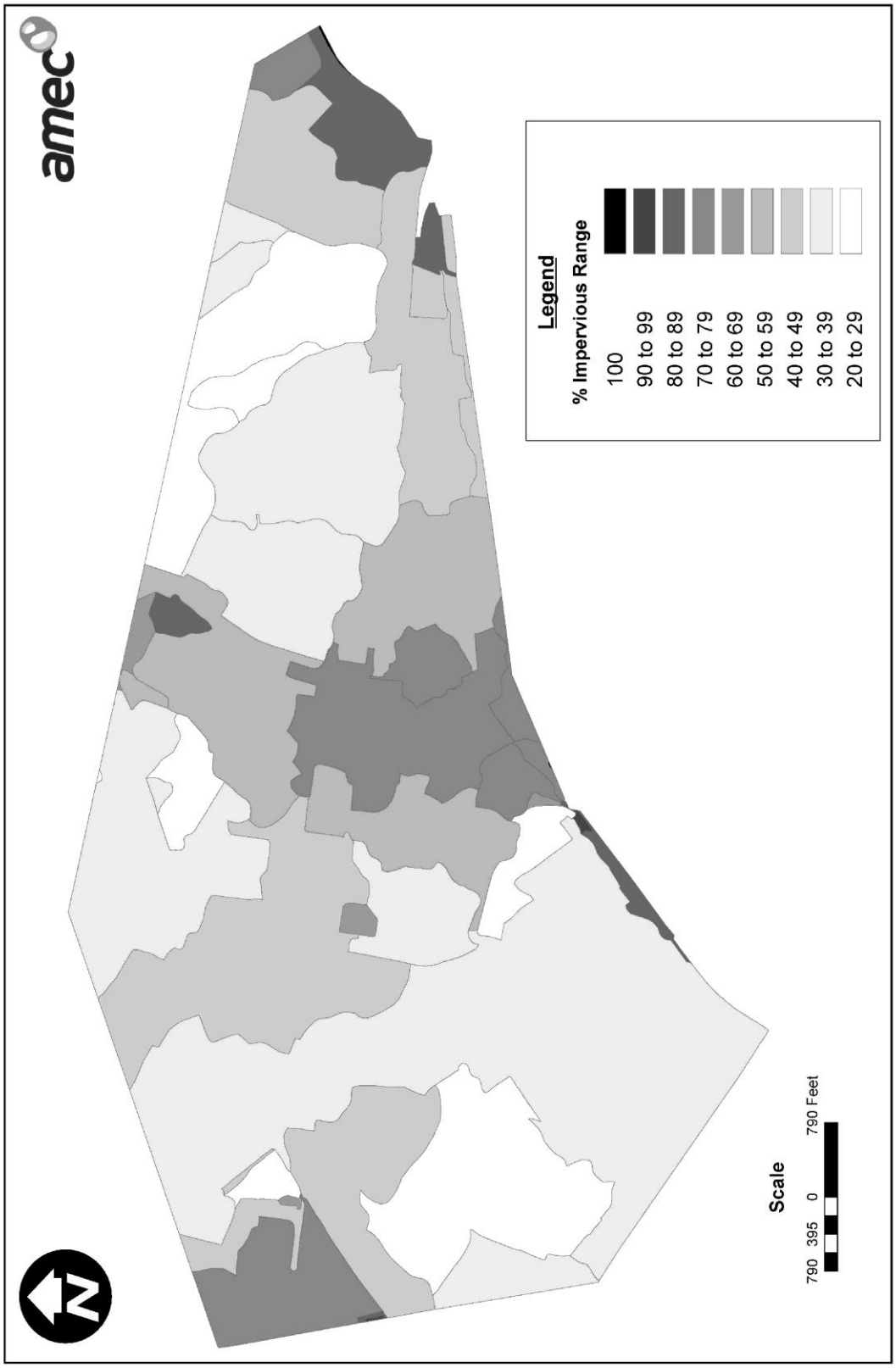
The impacts of impervious surface cover can be partially mitigated through appropriate stormwater management controls that help to replicate natural conditions (discussed in Section 5). However, since Falls Church was largely built before water quality requirements, solving the problem involves retrofitting either through redevelopment or voluntary measures.

Based on an assessment of current conditions by AMEC using City GIS, Falls Church has an average impervious cover of 41.3%. This places the City well into the non-supporting category for stream quality. However, these conditions vary widely by sub-watershed (see Figure 2-4). It is not unusual for sub-watersheds within the City's commercial corridors and nodes to have impervious cover greater than 70%. However, several areas with predominantly residential and recreational land uses have impervious cover of less than 30%. Stream reaches wholly contained within highly impervious sub-watersheds will typically not be good candidates for restoration but should be managed to control water quantity and quality for the benefit of downstream reaches. Areas of the City with lower impervious cover may be good candidates for restoration if the volume and velocity of contributing stormwater can be controlled.

AMEC was tasked with predicting future imperviousness based on the potential to develop vacant parcels or redevelop underutilized parcels.[4] In a developing watershed, this information is useful as a way of accounting for the ultimate impacts on the stream system based on future land uses and developing appropriate macro-level management strategies. However, in an area like Falls Church, the information is useful primarily as a tool for identifying where increased runoff could potentially exacerbate existing problems and where opportunities may exist for retrofits. This "build-out" scenario shows that the City could potentially have an impervious cover of up to 46%. This is a modest gain that reflects the fact that there are few vacant parcels available and most communities are built to their ultimate density.

[4] Underutilized is defined as a parcel where the existing land use is of lower density than underlying zoning or future land use as defined in the City' Comprehensive Plan.

Figure 2-4. Existing Impervious Surface Cover Conditions By Subwatershed



2.3. City of Falls Church Stream Assessment

During a two week period in July 2009, AMEC conducted an assessment of a representative sample of the City's stream reaches using the Rapid Stream Assessment Technique (RSAT). The purpose of the assessment was to better understand the condition of the City's streams, identify areas for possible restoration, and to provide a benchmark point for measuring future progress in restoring the City's watersheds. The RSAT methodology was developed by the Metropolitan Washington Council of Governments (MWCOG) to quickly identify existing channel erosion problem areas and systematically evaluate general stream quality conditions on a watershed-wide scale. The RSAT identifies six evaluation categories to represent overall health of the stream system. The evaluation factors are:

- Channel Stability
- Channel Scouring/Sediment Deposition
- Physical Instream Habitat
- Water Quality
- Riparian Habitat Conditions
- Biological Indicators (Macroinvertebrates)

The stream reaches investigated for study were selected based on a balance of factors. Decision criteria included ease of access for current and future study efforts, intermittent or perennial stream status, and the possibility of biological resources in the study reach. A total of 14 reaches were studied, with a total of 16 transects being taken by field investigators. The reaches studied are indicated in Figure 2-6.

The following is a summary of the RSAT evaluation and the major findings. Figure 2-7 shows a map of stream reach locations and associated RSAT scores. RSAT scoring criteria is found in Table 2-7. Table 2-8 provides an overview of each reach and a summary of the investigation results and any recommendations. Finally, Appendix B contains the full field investigation sheet for each stream reach.

Figure 2-5. RSAT Photos

Top – RSAT Team Member in Four Mile Run
Bottom – Juvenile Salamander Found in Trammel Branch

Figure 2-6. RSAT Investigation Stream Reaches

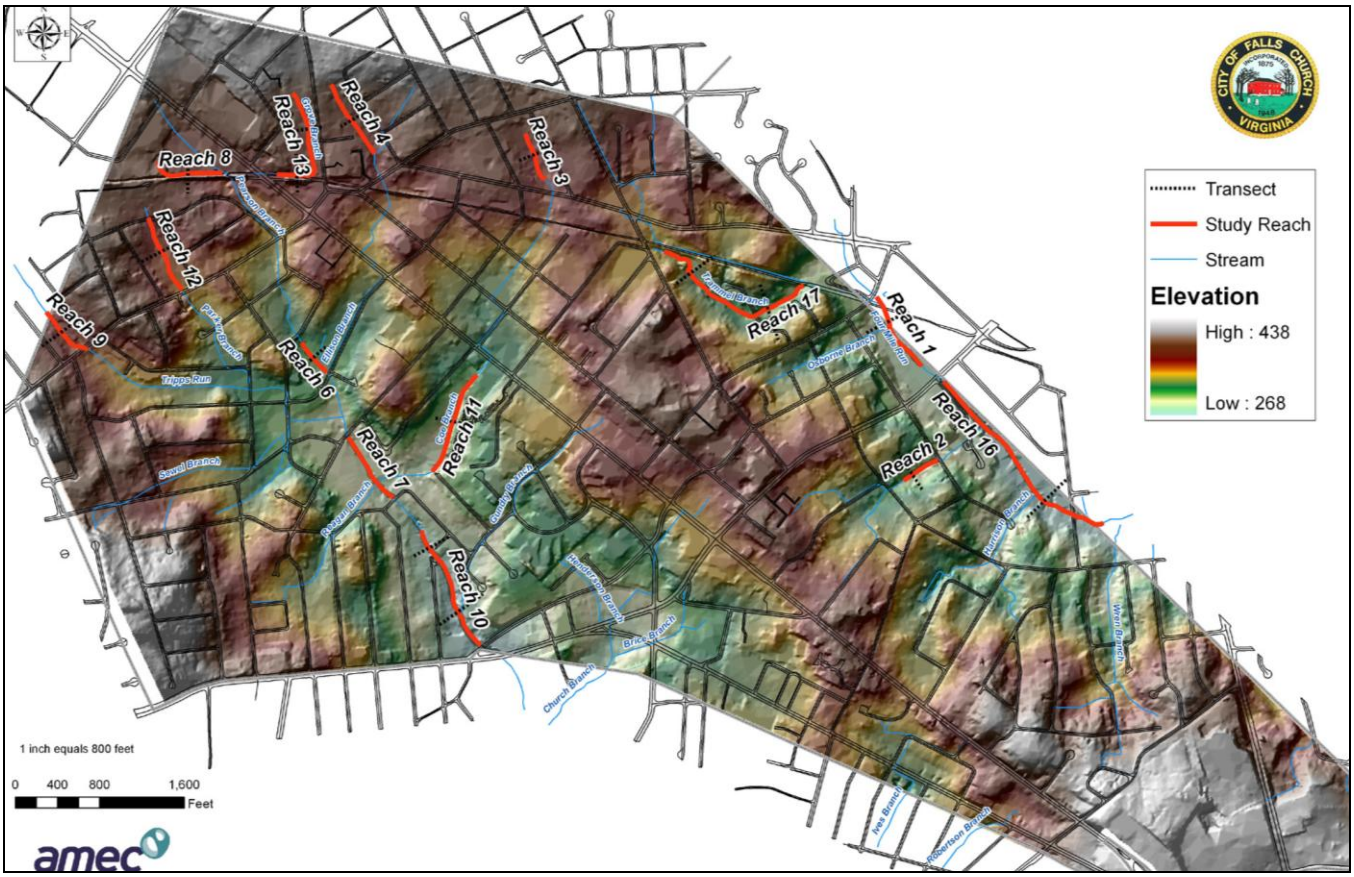


Table 2-7. RSAT Scoring System

RSAT Evaluation Category	General Rating Categories and Associated Point Range			
	Excellent	Good	Fair	Poor
Channel Stability	9-11	6-8	3-5	0-2
Channel Scouring/Sediment Deposition	7-8	5-6	3-4	0-2
Physical Instream Habitat	7-8	5-6	3-4	0-2
Water Quality	7-8	5-6	3-4	0-2
Riparian Habitat Conditions	6-7	4-5	2-3	0-2
Biological Indicators	7-8	5-6	3-4	0-2
Total Points:	42-50 Excellent			
	30-41 Good			
	16-29 Fair			
	<16 Poor			

Figure 2-7. RSAT Scores for Stream Reaches

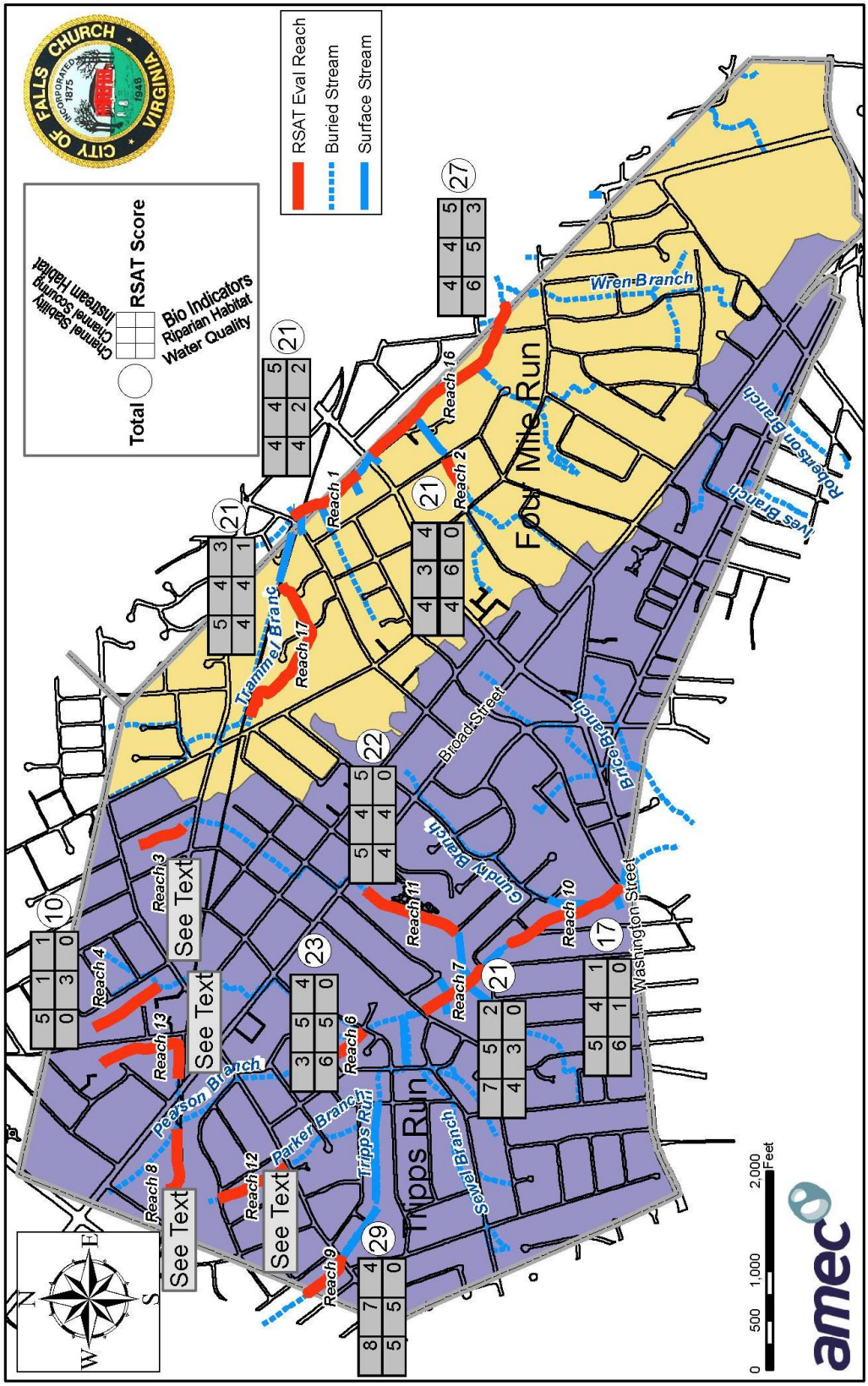


Table 2-8. Summary of RSAT Evaluation

Reach # (See Figure 2-7) and Picture	Total Score	Channel Stability	Channel Scouring	Instream Habitat	Water Quality	Riparian Habitat	Biological Indicators
Reach #1 (Four Mile Run)	21 – Fair	F	F	G	F	P	P
	This reach has been heavily channelized and impervious surfaces encroach very close to the stream, which creates very poor habitat conditions. The stream bed remains somewhat natural and the stream could benefit from reforestation of the riparian zone.						
Reach #16 (Four Mile Run)	27 – Fair	F	F	G	G	G	F
	Beds and banks are in fairly good condition, and the stream is well shaded and buffered. There is still considerable damage from excessive runoff. A 48" outfall containing Harrison Branch is causing significant erosion of the right bank of Four Mile Run.						
Reach #3 (Coe Branch)	No viable surface stream.						
11 (Coe Branch)	22 – Fair	F	F	G	F	F	P
	Coe Branch in this area has high potential for stream restoration and for use by residents as a passive recreation area. This reach received a low RSAT score largely due to heavy damage from excess sedimentation and the resulting habitat loss. The encroachment of the left bank developments (Jefferson at the Byron and the Falls Park) also limits the habitat value of the stream.						

Reach # (See Figure 2-7) and Picture	Total Score	Channel Stability	Channel Scouring	Instream Habitat	Water Quality	Riparian Habitat	Biological Indicators
Reach #4 (Ellison Branch)	10 – Poor	F	P	P	P	F	P
	This reach is ephemeral and was dry at the time of the field investigation. Opportunities for restoration are limited.						
Reach #6 (Pearson Branch)	23 – Fair	F	G	F	G	G	P
	This stream reach has been identified by the City for a future stream restoration effort. The upper portion of the reach has a bed of concrete and imbricated rip-rap, with masonry walls on both banks. Approximately 150 feet below the Irving Street culvert, the concrete bed gives way to a natural bottom with dirt banks interspersed with masonry reinforcement in two locations. The planned restoration would feature cutting back the left bank to provide improved access to the stream, removal of the existing concrete and masonry surfaces, and installation of in-stream structures such as J-hooks and cross vanes to improve aquatic habitat. There is one outfall on this reach that is not shown on City GIS data. It is an 8" pipe on the left bank, apparently draining the Scouting Council property. This pipe and outfall are in poor condition.						
Reach #7 (Tripps Run)	21 – Fair	G	G	P	F	F	P
	This reach was channelized in the 1960s to stop stream erosion. The stream channel is a uniform, low gradient trapezoidal concrete ditch throughout its length. Despite receiving an RSAT score of Fair, this reach must be considered to be in an undesirable condition. The concrete lining has eliminated meaningful freshwater habitat, and the only living things visible in the reach are algae mats scattered across the channel bottom. The broad, flat, and uniformly shallow channel allows solar radiation to heat the water to high temperatures during summer months, which can be expected to negatively affect the stream biota for some distance. In addition, the low roughness of the channel bottom and banks causes high velocities during storm flows, preventing desirable sediment deposition and creation of habitat for stream biota. Finally, the homogeneity of the physical habitat guarantees a low diversity of biological resources in the reach. This reach would benefit greatly from a carefully considered stream restoration.						

Reach # (See Figure 2-7) and Picture	Total Score	Channel Stability	Channel Scouring	Instream Habitat	Water Quality	Riparian Habitat	Biological Indicators
Reach #9 (Tripps Run)	29 – Fair	G	E	F	G	G	P
	This reach constitutes the upper headwaters of Tripp's Run proper. Most of the watershed flowing to the point of analysis lies in Fairfax County. This stream has been modified to eliminate meandering and stream erosion in the private property lining both banks, but retains a somewhat natural stream bottom, with a moderate level of habitat for macroinvertebrates and periphyton. With the private property closely bordering all sides, opportunities for restoring a more natural stream bed and banks are limited.						
Reach #10 (Tripps Run)	17 – Fair	F	F	P	G	P	P
	Two transects were taken in Reach 10 due to its considerable length of open stream, one of the longest such reaches in the City. This reach was channelized in the 1960s in an effort to stop stream erosion. The issues and potential solutions are similar to those identified for Reach 7. With careful design consideration, this reach could benefit from a comprehensive stream restoration.						
Reach #12 (Parker Branch)	No viable surface stream.						
Reach #13 (Grove Branch)	No viable surface stream.						
Reach #8 (Grove Branch)	No viable surface stream.						
Reach #17 (Trammel Branch)	21 – Fair	F	F	F	F	G	P
	The upper transect of this reach is ephemeral in nature. The lower transect exhibits evidence of perennial flow and is well shaded with substantial vegetated buffers. Stability issues could be addressed to make this a more viable stream.						

Reach # (See Figure 2-7) and Picture	Total Score	Channel Stability	Channel Scouring	Instream Habitat	Water Quality	Riparian Habitat	Biological Indicators
Reach #2 (Crossman Branch)	21 – Fair	F	F	F	F	G	P
	Although this reach receives a Fair rating, the stream has been entirely channelized and altered. While this appears to have made the channel quite stable, the habitat value for the stream is very low. The stream lies entirely on private property, in the backyards of homeowners, making it a complex target for future stream restoration programs.						

2.4. Recommendations and Monitoring Options

The City's streams and aquatic habitats have been significantly impacted by decades of development without the benefit of water quality or quantity controls. While all but one of the stream reaches investigated by AMEC rated at the "fair" level (one was rated as poor), most have very unsuitable habitat conditions due to stream armoring and channelization. This is reflected in the fact that all but one reach had a rating of "poor" for biological indicators.

2.4.1 Restoration Opportunities

Individual sites identified by AMEC that may warrant further investigation for restoration are discussed below. This list does not address potential opportunities for stream daylighting, which involves removing underground storm drain pipes and restoring the surface stream. For daylighting recommendations, refer to the 2005 City of Falls Church report entitled *Evaluation of Daylighting Opportunities.*

- *Tripp's Run near Thomas Jefferson Elementary School (Reaches 7 and 10)* – These portions of the mainstem of Tripp's Run are currently contained within extensive concrete trapezoidal ditches. Tripp's Run in this area has a moderate riparian buffer zone. As a result, it may be able to sustain a modest biota if the channel were returned to a more natural condition. These reaches also are some distance from nearby structures, which makes a restoration effort much simpler than reaches where structures and private yards closely encroach on the stream. The portion of Tripp's Run as it leaves the City at Washington Street deserves special mention. The stream is overlain by a currently vacant commercial building. Removal of this structure and restoration of the surrounding area to a more natural condition could significantly enhance the ability of Tripp's Run to support aquatic life.

- *Pearson Branch near Spring Street (Reach 6)* – Pearson Branch suffers from failing banks and a heavily modified channel environment, although the stream has a narrow but healthy riparian buffer on the right bank, and a trail and park land on the left bank. This tributary of Tripp's Run has already been identified as a candidate for stream restoration and the City has a design and

construction documents in hand. Cooperation with most adjacent landowners has also been secured and the restoration effort awaits funding to proceed.

- *Coe Branch near Lee Street (Reach 11)* – Coe Branch retains natural features that would encourage the development of an improved biota with a stream restoration effort. This reach has some challenges due to the variety of riparian landowners. The right bank is contained within City-owned parkland, the Howard Herman Stream Valley Park, for a few hundred feet downstream of Broad Street. The left bank is bounded by common property associated with the Jefferson at the Byron development. The stream then enters common property associated with the Rees Place development. The stream then re-enters the sub-surface stormwater system at the end of Rollins Street. Securing the cooperation of the various landowners would present a challenge to stream restoration efforts, but the relatively natural appearance of the existing riparian environment and the stream bed and banks suggest this may be a worthwhile effort.

- *Four Mile Run (Reaches 1 and 16)* – The reaches of Four Mile Run within the City contain some of the best and worst stream conditions in Falls Church. Reach 1, near Arlington County Fire Station #6 between Little Falls Street and North Washington Street/Lee Highway, is in a highly altered condition with little habitat or opportunity for the establishment of a freshwater ecosystem. It is noted that this area of Four Mile Run benefited from a daylighting project in 2000 as part of the construction of the new Fire Station. Just a few hundred yards downstream, Reach 16 is one of the most natural looking reaches in the City. A simple reforestation plan for the riparian buffer on the east bank of Four Mile Run in the vicinity of the Fire Station could provide benefits to both Reach 1 and Reach 16 by reducing thermal impacts and allowing a wider range of aquatic biota to re-establish themselves. In Reach 16, a modest program to create in-stream structures, such as cross-vanes and J-hooks, might reduce the potential for bank erosion and improve the heterogeneity of habitat within the stream bed.

2.4.2 Monitoring Options

One of the most challenging aspects of a watershed plan is to develop the monitoring and assessment tools necessary to track progress in meeting established objectives. During the policy paper process, AMEC presented a range of monitoring options for tracking long-term chemical water quality, biological, and physical stream condition trends. However, the WAC recommended delaying consideration of any new programs given the uncertainty surrounding the monitoring that may be required as part of the City's next VSMP MS4 permit to meet Chesapeake Bay TMDL requirements. Appendix C contains monitoring options that may be considered by the City at a later date.

3. Regulatory Drivers and Analysis of Policies and Ordinances

This section describes state and federal regulatory drivers related to watershed management, including stormwater and floodplain management, and how they affect, or are likely to affect, the City of Falls Church. As with most regulatory mandates, non-compliance is enforceable through substantial criminal, civil, and administrative penalties. In the case of the City's MS4 permit, which will be used to enforce Chesapeake Bay TMDL requirements, fines can be up to $32,500 per violation per day.

Next, this section describes the City's existing policies and ordinances and identifies options for enhancing these measures to meet City goals and objectives as well as changes that are likely to be required to meet forthcoming mandates and regulations. Issue areas and options were identified through discussions with staff at Virginia DCR (including the Division of Chesapeake Bay Local Assistance, the Division of Dam Safety and Flood Management, and the Division of Soil and Water Conservation) and Virginia DEQ, as well as through interviews with key City staff conducted by AMEC.

3.1 Major State and Federal Regulatory Drivers

The state and federal regulatory environment continues to change rapidly and will significantly affect the City's watershed management activities and regulations over the next several years. During the 1970s and 1980s, state and federal regulations focused primarily on flood control and drainage issues. In the late 1980s and 1990s, the focus shifted to water quality and protecting the Chesapeake Bay from the impacts of new development. Today, with previous Chesapeake Bay restoration efforts falling short, there is increased pressure to retrofit existing communities and to directly treat high volumes and velocities of stormwater runoff as a pollutant.

The City is subject to the federal National Pollutant Discharge Elimination System (NPDES), which in Virginia is called the Virginia Stormwater Management Program (VSMP). The VSMP requires the City to have a permit to discharge stormwater to waters of the Commonwealth and to develop a Municipal Separate Storm Sewer System (MS4) Program Plan to reduce pollutants to the maximum extent practicable (MEP). The City was issued its initial permit by Virginia DCR in 2003, which was re-issued in 2008. Each permit covers a five year period.

Impervious Areas are Increasingly the Focus of State and Federal Regulation

In addition to providing the minimum standards and basic structure for the City's pollution prevention programs, the permit provides regulators with a mechanism to require the City to meet increasingly stringent Chesapeake Bay protection requirements and related TMDL requirements. Most significantly, the Chesapeake Bay nutrient and sediment TMDLs will affect the City in two ways from a policy and ordinance perspective. These are described briefly below:

- *MS4 Permit Requirements* – Once the City's current MS4 permit expires in 2013, the Chesapeake Bay nutrient and sediment TMDLs will be incorporated into the City's new permit. The City will then be required to develop and implement a plan for how it will achieve necessary reductions to

meet the TMDLs. In a largely built-out community such as Falls Church, meeting the nutrient reduction requirements will necessarily rely on a combination of retrofitting existing impervious areas through public-private partnerships, the redevelopment process, and by controlling runoff from municipal properties and public streets.

- *Chesapeake Bay Preservation Area Overlay District* – Virginia's new Stormwater Management Regulations, which were adopted in October 2011, establish more stringent phosphorus load reduction requirements for new development and redevelopment based on what the U.S. EPA's Chesapeake Bay Model says is necessary to meet the Chesapeake Bay nutrient TMDL. The stormwater management regulations are implemented through the City's Chesapeake Bay Preservation Area Overlay District (CBPA-OD). As a result, major changes will need to be made to that ordinance no later than July 2014.

The U.S. EPA is also moving toward regulating stormwater "flow" directly as a pollutant, rather than using a surrogate such as sediment or total suspended solids. This approach is now being implemented in Fairfax County in the form of an Accotink Creek flow TMDL.[5] Because Virginia has not yet developed regulations declaring flow as a pollutant, the U.S. EPA has taken the lead on that project. It is not clear what the practical impact of this change will be on urban areas such as Falls Church, but it is likely to provide a more direct way for state and federal regulators to require reductions in impervious areas or the implementation of stormwater management retrofits.

Other issue areas have been relatively stable compared to stormwater management. No major changes have been made or proposed to state and federal requirements concerning floodplain management or erosion and sediment control. In both cases, the City is allowed to implement more stringent requirements (with certain limitations) than state or federal minimum standards. Some of these options are discussed in Section 3.2. Virginia's law governing the protection and filling of wetlands (§62.1-44.15:20 of the Code of Virginia) takes the opposite approach and states that "no locality may impose wetlands permit requirements duplicating state or federal wetlands permit requirements." This essentially relegates the City's role with wetlands to ensuring that state and federal permits are obtained. Non-tidal wetlands connected by surface flow and contiguous to water bodies with perennial flow are already protected as Resource Protection Areas (RPAs) under the CBPA-OD.

Finally, new authority was granted in 2008 to Northern Virginia local governments by the General Assembly (§15.2-961.1 of the Code of Virginia) to strengthen tree conservation requirements during development. According to U.S. Forest Service and the Center for Watershed Protection, "Trees and forests reduce stormwater runoff by capturing and storing rainfall in the canopy and releasing water into the atmosphere through evapotranspiration. In addition, tree roots and leaf litter create soil conditions that promote the infiltration of rainwater into the soil."[6] However, after reviewing the new state authorizing language, the City Arborist determined that the City's existing program, which was grandfathered under older rules and is also based on enabling language in the CBPA-OD, is already more rigorous than the enhanced authority.

3.2 Analysis of City Policies and Ordinances

The following is a review of ordinances and policies related to watershed management within the City. As appropriate, each section describes the "mandates" that will likely require changes to City policies and ordinances in the next few years as well as "voluntary" options available to Falls Church for enhancing

[5] Accotink Flow TMDL Legal Issues, Charles Martin, Virginia DEQ, August 19, 2009.
[6] Watershed Forestry Resource Guide, www.forestsforwatersheds.org, Center for Watershed Protection and U.S. Forest Service.

the protection of watershed resources. Section 3.3 provides a summary of changes recommended by the WAC for consideration by the City Council.

3.2.1 Floodplain Overlay District

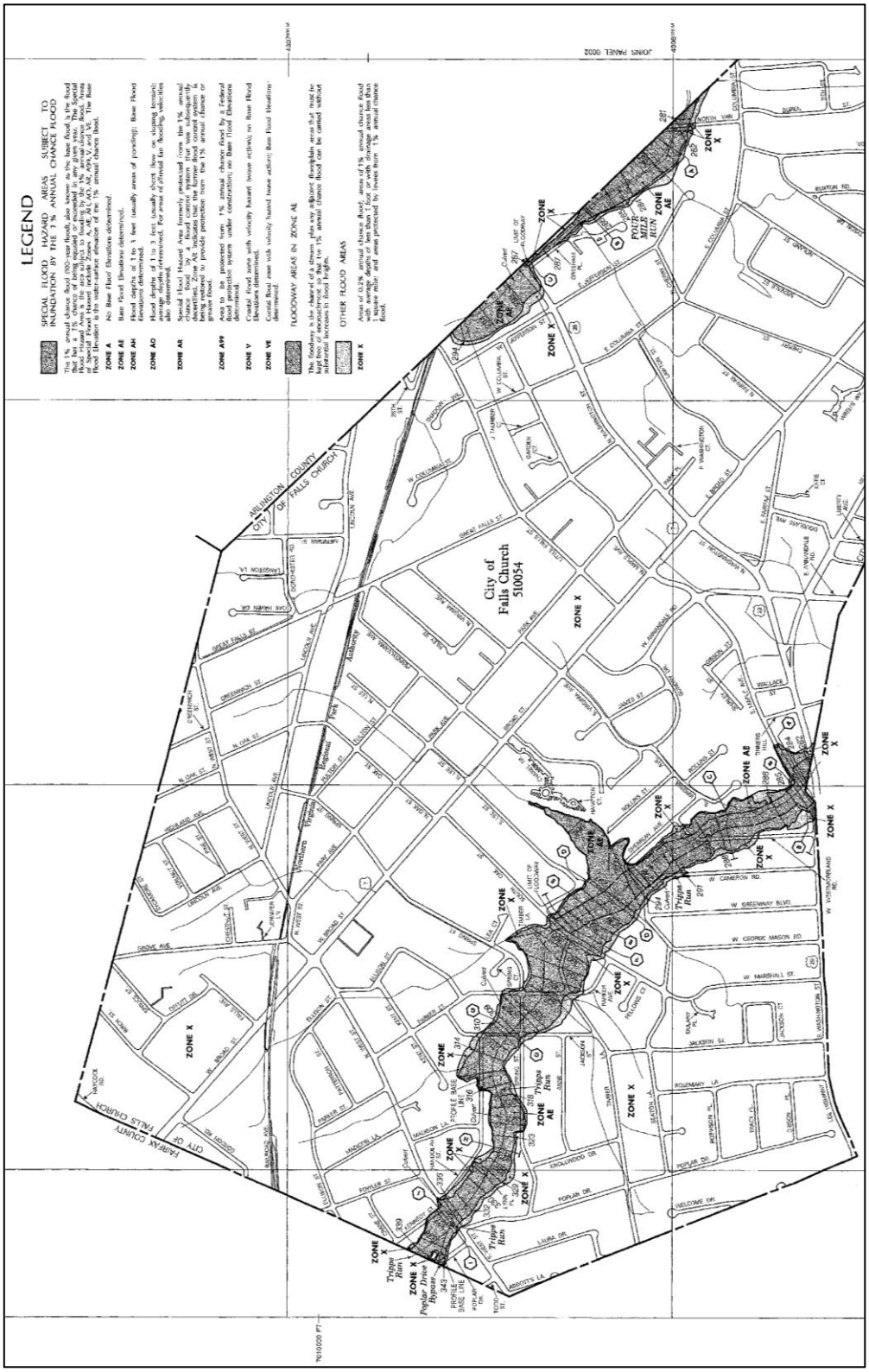
A floodplain is the relatively low area adjacent to a watercourse that is subject to inundation during storms or snow melt events. A floodplain consists of a floodway, which is the stream channel and adjacent areas that are subject to strong flows, and the flood fringe, which is the area outside of the floodway prone to inundation. Floods are defined and regulated based on their statistical probability of occurring in any given time frame. The standard most commonly used for regulatory purposes, including the City, is the 100 year flood. A 100 year flood has a 1% probability of occurring in any given year. Encroachment by development into the floodplain can put life and property at risk, and can also reduce the carrying capacity of the watercourse, therefore increasing flood hazards in both downstream and upstream areas.

The City regulates floodplains through the Floodplain Overlay District (Section 48-612 of the City Code), which is a part of the City's Zoning Ordinance. The provisions were adopted in 1982 to bring the City's program into compliance with FEMA's National Flood Insurance Program (NFIP). Mapped floodplains are located along Four Mile Run and Tripp's Run, including the lower portion of Coe Branch (Figure 3-1). Mapping originally occurred in 1981, and was updated in 2002. Increased impervious cover and stream channel modifications during that time, in addition to better mapping techniques, resulted in 65 additional parcels of land being added to the floodplain. Today, there are a total of 205 properties within the City's 100 year floodplain (187 in Tripp's Run and 18 in Four Mile Run).[7]

In addition to more traditional flooding, the City also has an issue with "area drains," or small stormwater drains that serve areas near stairwells or basements that drain to the sanitary sewer system. Cumulatively, these area drains can periodically overwhelm the sanitary sewer system. In response to flooding and area drain problems as a result of the remnants of Tropical Storm Lee (September 8, 2011), the Department of Public Works and the Department of Public Utilities have begun to work collaboratively to seek community input on the problem, including a town hall meeting, a letter and internet survey of all single family residential homeowners, and individual discussions with affected homeowners. City staff is using this information to inform future City projects including outreach, maintenance, and construction.

[7] City of Falls Church Division of Engineering, November 2008. Does not include parcels that are undeveloped, City-owned, or in Arlington County.

Figure 3-1. City of Falls Church Floodplain Overlay District



In addition to the Floodplain Overlay District, portions of the floodplain are protected as Chesapeake Bay Resource Protection Areas (RPAs), described in Section 3.2.4, and as parks and public open space.

Floodplain Mandates

There are no pending mandates that will require significant changes to the City's Floodplain Overlay District. The City's existing ordinance closely follows the model ordinance provided by Virginia at the time of adoption. However, an informal review by DCR[8] shows that there are areas that do not track with the current model ordinance checklist and should be considered for modification. The checklist is found in Appendix D.

Floodplain Options

One of the purposes of the Floodplain Overlay District is to provide businesses and residences access to the National Flood Insurance Program. While minimum regulatory standards are not expected to change significantly, FEMA strongly encourages higher levels of regulation and protection by giving policy holders insurance premium discounts if the community has voluntarily exceeded minimum NFIP standards. This is done through the NFIP's Community Rating System (CRS). The highest discount (45%) is given to Class 1 communities (4,500+ CRS points), while no discount is given for Class 10 communities. Falls Church (1,283 CRS points) is currently rated as a Class 8 community, which carries a 10% discount. However, representatives from CRS reviewed the City's program in late 2011 and the City is currently waiting for verification that it has enough points (1,500) to increase the rating to a Class 7, which carries a 15% discount.

Comparatively, Alexandria and Arlington are Class 8 communities, while Fairfax County is a Class 7 community. The Town of Vienna is a Class 9 community, while the City of Fairfax does not participate in CRS. At present, Class 7 is the highest designation in Virginia. By participating as a Class 8 community, policy holders save an average of $80 per year. Moving to a Class 7 community saves policy holders $117 per year. The average number of CRS points nationally is 2,023 (Class 6).[9]

Table 3-1 presents possible program enhancements that the City could consider to further increase CRS points based on discussions with DCR's Division of Dam Safety and Floodplain Management and an assessment by AMEC. While it is not likely that increased points are sufficient to bring the City to a Class 6 designation, they will help to better protect City residents from flooding.

In addition, the Floodplain Overlay District is now fully administered by the Department of Public Works rather than the Zoning Division. In order to align functional responsibilities with the authority provided in the City Code, DPW has initiated a proposal for the City Council's consideration to remove floodplain related responsibilities from the Zoning Code and to place them into a new, stand-alone section of the City Code. This will ensure consistency and help streamline the regulatory review process. During the update, changes to enhance the City's CRS and address any discrepancies between the City's ordinance and the DCR model ordinance may also be considered.

[8] Review by Allison Meehan, Virginia Department of Conservation and Recreation, January 10, 2010.
[9] Based on FEMA CRS Coordinators Manual, 2006 Edition.

Table 3-1. CRS Enhancement Considerations for Falls Church

Action	Description	Current City Effort	Potential Points	Discussion
Higher Regulatory Standards Suggested for Consideration by DCR				
Extra Freeboard	An ordinance may require new development or substantial improvements to be built with an additional margin of safety above the base flood level. This is called the "freeboard," and protects against unexpectedly high flooding, floating debris, and the impact of future development.	The City currently requires one foot of freeboard, which carries a maximum of 100 CRS points.[10]	Increasing the freeboard to two (2) or three (3) feet would increase the maximum allowable CRS points to 200 and 300 respectively.	• This policy change will bring the City closer to a Class 7 rating and save money on policies. • It could also increase the cost of new development or substantial improvements[11] to comply with the requirement.
Cumulative Substantial Improvement Rule	Non-conforming structures must comply with flood protection measures if a substantial improvement is made. Some property owners get around this requirement by making small improvements over several years. An ordinance may track these improvements cumulatively to close this loophole.	This item is not addressed in the City's current ordinance.	Incorporating this rule into the definition of "substantial improvement" would make the City eligible for a maximum of 110 CRS points.	• This policy change would bring structures into compliance faster than current rules. • Adopting this policy would require good tracking tools and potentially increase the cost to make improvements.
Lower Substantial Improvement Threshold	Non-conforming structures are required to meet ordinance requirements where a substantial improvement is made. Non-conforming structures can be forced into faster compliance if the threshold for qualifying as substantial is reduced.	The City currently uses the NFIP standard of 50% and does not receive any points.	Incorporating a more stringent threshold (for instance, 25%) would make the City eligible for a maximum of 90 CRS points.	• This policy change would bring structures into compliance faster than current rules. • However, it is not common in Virginia and could discourage smaller improvements meant to preserve the value of a structure.

[10] The actual points given to the City are less based on a "Community Growth Adjustment." This takes into account that the City is already developed, and therefore there are fewer opportunities for new requirements to reduce actual flood damage liability. For instance, while a one-foot freeboard provides up to 100 CRS points, the actual credit for the City is 68 points.
[11] Substantial improvement is defined as an improvement that exceeds 50% of the structure's value.

Action	Description	Current City Effort	Potential Points	Discussion
Repetitive Loss Definition	A substantially damaged structure is eligible for an Increased Cost of Compliance (ICC) claim to help off-set the cost to elevate, flood proof, or relocate the structure up to $30,000. A locality may adopt a repetitive loss definition that will also make a structure eligible for ICC claims if it has suffered two greater than 25% losses within a 10 year period.	The City does not currently have a definition of repetitive loss in the ordinance.	No CRS points are associated with this change. The benefit is that owners of repetitive loss properties would be eligible for ICC coverage.	• This change would force non-complying structure owners suffering two 25% or greater losses within 10 years into the substantially damaged category where compliance is mandatory. • However, they would then be eligible for up to $30,000 in ICC funds to assist with flood proofing efforts.
Protection of Critical Facilities	Credit can be received for prohibiting new critical facilities such as hospitals, nursing homes, police stations, and fire stations within the 500 year floodplain (0.2% chance in any given year).	This item is not addressed in the City's current ordinance.	Incorporating this provision would make the City eligible for a maximum of 100 CRS points. Points are also available for flood proofing existing critical facilities.	• Since the floodplain area is relatively limited in the City, prohibiting new critical use facilities may be something to consider.
Land Development Criteria	Incorporation of certain land use tools into local ordinances can result in CRS points. These include transfer of development rights (TDRs), cluster development, and encouraging the use of floodplains as open space in the comprehensive plan.	This item is not addressed in the City's current ordinance.	Provisions range from 100 points if new development is required to set aside all flood prone lands, to 50 points for TDRs and other density transfers meant to avoid floodplains, to 10 points for comprehensive plan language.	• The City has a C-R "Cluster Residence" zoning category, which has been used to protect floodplains. • However, the provisions are only available by-right to a specific zoning category and therefore may not be eligible for credit. • The City may wish to consult with NFIP on a more general cluster provision that is available for any property within a floodplain. Virginia State Code

Action	Description	Current City Effort	Potential Points	Discussion
				(§15.2-2316.1) allows the City to adopt a voluntary program for transferring density out of a floodplain and into an area better able to support density. • There is very little dense zoning within the floodplain.
Existing Items to Potentially Take Credit				
Drainage System Maintenance	Routine maintenance of channels and catch basins is eligible for CRS credit.	The City does not currently receive credit for system maintenance. However, the last CRS program review was 2004, prior to implementation of the City's system maintenance program.	The City is eligible for a maximum of 250 CRS points for this category.	• This item should be discussed with a NFIP representative during the next CRS review.
Floodplain Management Planning	Credits can be received for developing and implementing floodplain management or hazard mitigation plans.	The City does not currently receive credit for floodplain management planning. However, Falls Church may be eligible for points for participating in the 2006 regional Hazard Mitigation Plan,[12] which addresses flooding. City-specific actions from the plan are found in Appendix B.	The City is eligible for a maximum of 294 CRS points for developing a floodplain management plan.	• This item should be discussed with a NFIP representative during the next CRS review.
Potentially Applicable Fairfax County Outreach and Planning Programs[13]				
Outreach Projects	Credits can be received for providing education to property owners within the floodplain. This can be done through mailing letters or brochures, or by using	The City does not currently receive credit for outreach projects.	Fairfax County receives 100 CRS points for sending a newsletter to all property owners in the County's floodplains. This represents over 20,000 properties in the	• The City may wish to emulate the County's program if it is determined to be cost-effective.

[12] Northern Virginia Regional Hazard Mitigation Plan, Northern Virginia Regional Commission, July 2006.
[13] Email from Craig Carinci, Director, Fairfax County Stormwater Planning Division, April 13, 2010.

Action	Description	Current City Effort	Potential Points	Discussion
	organizations such as Boy Scouts.		County. In Falls Church, there are 205 properties.	
Floodplain Management Planning	As noted above, credits can be received for developing and implementing floodplain management or hazard mitigation plans.	The City does not currently receive credit for floodplain management planning.	Fairfax County receives 152 CRS points for floodplain management planning. The County takes credit for the regional Hazard Mitigation Plan developed by the Northern Virginia Regional Commission. To obtain these credits, the County publishes a "Floodplain Management Plan Progress Report" that describes the County's progress toward implementing County-specific actions contained in the plan.	• The City may wish to explore whether its participation in the regional plan qualifies for CRS points and what kind of reporting and tracking is necessary to receive these points.

3.2.2 Stormwater Detention and Four Mile Run Agreement

Stormwater detention provides a two-fold benefit. First, it serves as a floodplain management tool by mitigating flows that can cause downstream overbank flooding. Second, it reduces the peak flows that can cause stream bank erosion and deterioration of aquatic habitats. By the late 1960s and early 1970s, the lower portion of Four Mile Run could no longer handle the increased volume and velocity of stormwater created by upstream development. Flash flooding was a frequent occurrence, and in 1972 Hurricane Agnes caused millions of dollars of flood damage to communities along Four Mile Run. In 1974, Congress authorized the U.S. Army Corps of Engineers to construct a flood control channel for lower Four Mile Run. As a precondition, however, Congress required Arlington, Alexandria, Fairfax, and Falls Church to sign a Four Mile Run Watershed Management Agreement to protect the channel's ability to control flooding in the long run by ensuring that new development detains and releases stormwater where appropriate. The agreement, which is still in force, is administered through the Northern Virginia Regional Commission (NVRC). NVRC also maintains a model to determine where detention is most effective in protecting the flood control channel and how future land uses will affect flooding.

The City's detention requirements are contained in the Erosion and Sediment Control Ordinance, which is discussed in greater detail in Section 3.2.3. The following is an excerpt from the City Code:

> Section 14-93(d)(7)(b)(2) – Develop a site design that will not cause the predevelopment peak runoff rate from a 10-year storm and also the 2-year storm to increase. Such a design may be accomplished by enhancing the infiltration capability of the site or by providing on-site stormwater detention measures. These pre-development and post-development peak runoff rates must be verified by engineering calculations. Within the Four Mile Run Watershed, post-development peak runoff during a 100-year frequency storm shall not increase the peak runoff of the Four Mile Run Flood Control Channel as required by the City's contract with the United States Army Corps of Engineers. Within the remainder of the City, post-development peak runoff shall be designed so as not to increase the peak flow in any critical downstream channel or culvert during a ten-year and two-year storm.

Stormwater Detention Mandates

In addition to enhanced water quality requirements, the new Virginia Stormwater Management Regulations (discussed in Section 3.2.4) will require enhanced management of runoff for the control of volume and velocity. These changes, which will be mandatory for all localities, are stricter than what is currently required by the City.

3.2.3 Erosion and Sediment Control Ordinance

The City's Erosion and Sediment Control (E&SC) Ordinance (Section 14-88 of the City Code) is designed to prevent damage and degradation to streams and other water bodies by ensuring that adequate erosion and sediment control measures are enacted during site clearing and development activities. In Falls Church, any land owner proposing a land disturbing activity of 2,500 square feet or greater must first submit an erosion and sediment control plan to the City. Limited exceptions are granted for minor land disturbing activities such as home gardens, service connections, post holes, and emergency work. The importance of the E&SC ordinance is increased given the impairment of the Chesapeake Bay for sediment.

Two onsite inspectors from DPW are responsible for enforcing the program. No weaknesses were identified in the current program during interviews with City staff. The City's ordinance was last reviewed by Virginia DCR in January 2007. The review found the City's program to meet the minimum standards of effectiveness and DCR designated the program as "consistent" with Virginia law and regulations. The program is next up for review in 2012.

Silt Fence Installed to Prevent Erosion

Erosion and Sediment Control Mandates

According to DCR staff, there are no pending state or federal mandates that are likely to require changes to the City's Erosion and Sediment Control Ordinance. During the 2007 review, DCR staff noted that many of the provisions of the City's ordinance were out of date since state law had changed since the last major update of the City's ordinance in 1995. City Council adopted a major

recodification of the City Code on September 30, 2009 (T09-09), which included necessary updates to the Erosion and Sediment Control Ordinance. The one exception, dealing with civil penalties, is explained in greater detail below.

Erosion and Sediment Control Options

The City's E&SC program is compliant with state regulations and was generally updated in 2009 to match current state law. However, the part of the City Code (Section 14-99(i)) dealing with civil penalties was not updated to meet enhanced enforcement tools allowed under the Code of Virginia (§10.1-562). While civil penalties are technically an option in the City Code, enforcement of the E&SC program is accomplished through non-monetary penalties such as a "stop work order." The City issues roughly four or five of these a year, which has generally been effective. However, some localities use civil penalties as an added enforcement mechanism.

While the general civil penalties language from the Code of Virginia is contained in the City's ordinance, the language is out-of-date and the ordinance lacks the necessary penalty schedule. The following is what the existing City ordinance section dealing with enforcement and penalties would look like if it were updated to what is allowed under the Code of Virginia.

> Section 14-99(i) – The civil penalty for any one violation shall be not less than $100 ~~except that the civil penalty for commencement of land disturbing activities without an approved plan as provided in Section 14-91 shall be~~ nor more than $1,000. Each day during which the violation is found to have existed shall constitute a separate offense. In no event shall a series of specified violations arising from the same operative set of facts result in civil penalties which exceed a total of $~~3,000~~ 10,000 except that a series of violations arising from the commencement of land-disturbing activities without an approved plan for any site shall not result in civil penalties which exceed a total of $10,000. Adoption of such an ordinance providing that violations are subject to a civil penalty shall be in lieu of criminal sanctions and shall preclude the prosecution of such violations as a misdemeanor under subsection (a).

Updating the E&SC ordinance would allow a higher cap on cumulative civil penalties for the same offense ($10,000 versus $3,000) and give the City greater flexibility in how much to charge for civil penalties (anywhere between $100 and $1,000 versus $100 except in the case of commencing land disturbing activities without an approved plan).

Local governments are allowed to have more stringent E&SC controls than those allowed under state law except in the areas of plan approval and permit assistance (§10.1-570 of the Code of Virginia). Other than enhanced penalties such as those described previously, DCR staff did not identify areas where this flexibility has been used by other localities in Virginia.

3.2.4 Chesapeake Bay Preservation Overlay District

The City's Chesapeake Bay Preservation Area Overlay District (CBPA-OD) will take on added importance because it is the mechanism used by Falls Church to implement both the Virginia Chesapeake Bay Preservation Area Designation and Management Regulations and the Virginia Stormwater Management Regulations.

The Virginia Chesapeake Bay Preservation Act, enacted by the General Assembly in 1988, requires the City to regulate land uses in a way that protects aquatic habitats and water quality in the Chesapeake Bay. The Bay Act has been implemented in three phases: Phase I consists of developing the program and adopting necessary ordinances; Phase II consists of adopting appropriate language in the local comprehensive plan; and, Phase III consists of ensuring that local policies and ordinances all work

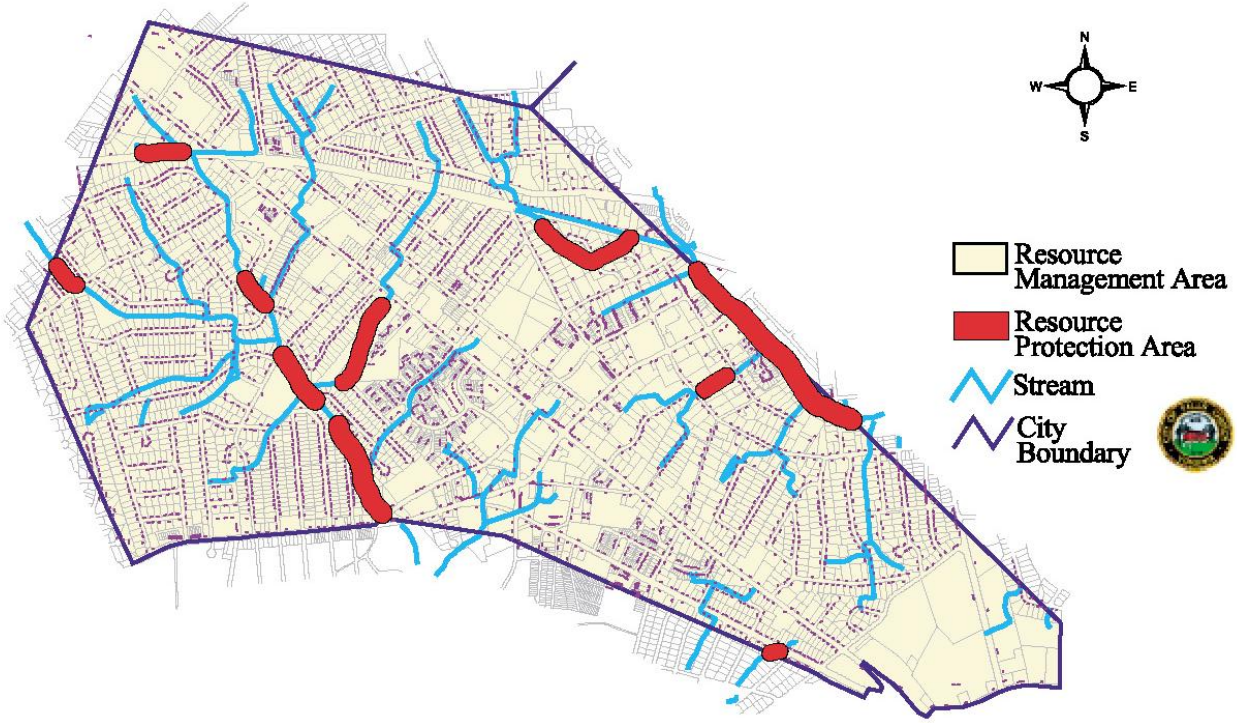
together properly to meet the goals of the Bay Act. In Falls Church, Phase I was implemented through the CBPA-OD (Section 46-824 of the City Code), which is part of the Zoning Ordinance. The CBPA-OD was last reviewed and found consistent by the Chesapeake Bay Local Assistance Board (CBLAB) in December 2007. Phase II was implemented through Chapter 5 of the City's Comprehensive Plan "Natural Resources and the Environment." The City's Comprehensive Plan was reviewed and found consistent in April 1999. The Phase III review criteria were finalized by CBLAB in 2009 and are currently being implemented.

The CBPA-OD divides the City into a Resource Protection Area (RPA) and a Resource Management Area (RMA). The RPA consists of sensitive lands, including streams (natural and channelized) and non-tidal wetlands connected by surface flow and contiguous to perennial streams. The RPA also includes a 100-foot vegetated buffer located adjacent to these features (see Figure 3-2). Development is prohibited or extremely limited in the RPA, with rules governing improvements to non-conforming structures and the development of parcels where impacts to the RPA are unavoidable.

The RMA includes land types that if improperly developed have the potential to cause water quality degradation or diminish the value of the RPA. The City's original ordinance limited the RMA to just certain areas of the City. However, Falls Church expanded the RMA in 2004 to cover the entire City. This is consistent with all other surrounding localities, including Arlington, Alexandria, Fairfax County, and the City of Fairfax, and recognizes the fact that all development impacts local water quality. Within the RMA, development is required to (1) limit land disturbance to the area necessary to provide for the proposed use or development, (2) preserve existing indigenous vegetation and trees to the maximum extent practicable, and (3) minimize impervious cover associated with the proposed use or development. These are known as the "general performance standards."

In addition, all development and redevelopment must comply with the water quality requirements of the Virginia Stormwater Management Regulations. In general, these regulations require no increase in stormwater pollution from new development based on existing average watershed conditions and a 10% reduction in stormwater pollution from redevelopment. Phosphorus is the "keystone" pollutant used to measure these reductions. Reductions are achieved by reducing impervious surface cover, maximizing vegetated areas where stormwater can soak into the ground, and through the use of structural best management practices (BMPs) such as ponds, green roofs, rain gardens (bioretention facilities), and a wide variety of other mechanisms.

Figure 3-2. City of Falls Church Chesapeake Bay Preservation Area Overlay District Map



Chesapeake Bay/Stormwater Regulations Mandates

In 2004, the General Assembly passed legislation expanding the scope and purpose of the Virginia Stormwater Management Regulations. The new regulations were finalized in October 2011. Localities have until July 2014 to make all required changes to ordinances and policies. Table 3-2 compares the existing and new requirements in areas where significant changes have been made.

Table 3-2. Major Elements of the New Virginia Stormwater Management Regulations

Category	Existing Requirement	New Requirement
New Development	The amount of phosphorus pollution from a new development cannot exceed that of the "jurisdictional average." The average, which is based on impervious cover at the time of ordinance adoption, is 35% in Falls Church. This means that no water quality controls are required for a development that has less than 35% impervious cover.	The amount of phosphorus from a new development cannot exceed 0.41 pounds per acre per year (or the equivalent of between 8% and 16% impervious cover).
Redevelopment	Redevelopment must achieve a 10% reduction in phosphorus compared to the existing site conditions at the time of redevelopment (except that the requirement cannot be more stringent than for new development).	Redevelopment will need to meet a 20% reduction standard. However, projects disturbing less than one acre must only meet the existing 10% reduction standard.

Category	Existing Requirement	New Requirement
Construction Permits	VDCR is responsible for issuing and enforcing state VSMP stormwater construction permits given to developers.	The City will now be required to assist in the administration and enforcement of stormwater construction permits.
Off-Site Compliance	If it is determined that existing stormwater management requirements cannot be met cost-effectively on-site, the City currently has no consistent option for implementing BMPs off-site where greater reductions can be achieved for the same cost. This can either result in a request for a waiver or the inefficient use of limited resources.	The City may allow for off-site compliance in accordance with a watershed management plan. However, the City must allow for off-site compliance if five acres or less area will be disturbed, the phosphorus control requirement is less than 10 pounds, or at least 75% of compliance has been accomplished with on-site facilities.

Chesapeake Bay/Stormwater Regulations Options

Both the Chesapeake Bay Preservation Act and the Stormwater Management Act allow localities to adopt more stringent requirements above the minimum standards. The following represent the two most common enhancements.

- *Enhanced Water Quality Standards* – Currently, water quality requirements do not apply in the City until a new development exceeds 35% impervious cover. Under the existing Chesapeake Bay Act, a locality may either use the local impervious cover average (which was adopted for Falls Church), or the Chesapeake Bay watershed average. Since the Chesapeake Bay watershed average is much lower (16%) than the City-wide average, using the Bay average would result in higher water quality protection and more development being required to implement stormwater BMPs. This issue will be addressed in the new Virginia Stormwater Management Regulations, since the new phosphorus reduction standard results in an equivalent of less than 16%. However, since the new regulations do not require the City to make changes until July 2014, the City could adopt the enhanced requirement earlier to ensure that new development does not further contribute to pollutant loads that will need to be made up later.

- *Expanded Resource Protection Areas* – While the regulations spell out the minimum land types that must be included in the RPA, the "other lands" provision of the regulations allow localities to include any "other such lands considered… to be necessary to protect the quality of state waters." The City currently includes all perennial and intermittent streams as RPAs. Based on AMEC's Stream Evaluation Report, there are few if any options for including additional streams that aren't already covered as RPAs. However, the City could expand the RPA by designating other features as RPAs, such as floodplains, steep slopes, and highly erodible soils.

4.2.5 Virginia Stormwater Management Program MS4 Permit

As previously noted, the City holds a permit issued by DCR to discharge stormwater into waters of the Commonwealth. Under the permit, the City must develop and implement an MS4 Program Plan to implement six minimum control measures. These include:

- MCM #1 – Public Education and Outreach
- MCM #2 – Public Involvement and Participation
- MCM #3 – Illicit Discharge Detection and Elimination

- MCM #4 – Construction Site Stormwater Runoff Control
- MCM #5 – Post-Construction Stormwater Management for New and Redevelopment
- MCM #6 – Pollution Prevention/Good Housekeeping for Municipal Operations

The City submits an annual report to DCR to demonstrate progress in meeting these minimum control measures. Some of these measures capitalize on existing programs. For instance, MCM#4 consists largely of implementing the City's Erosion and Sediment Control Ordinance, while MCM#5 is satisfied through implementation of the City's CBPA-OD. However, several measures have required new programs to be developed and implemented. MCM#3 requires the City to conduct monitoring of all storm drain outfalls each year to look for signs of illicit discharges and dumping, while MCM#6 requires the City to increase efforts to reduce pollution from municipal operations.

MS4 Permit Mandates

Once the MS4 permit comes up for renewal in 2013, it is very likely that more stringent requirements will be incorporated that will require the City to plan for how to reduce nutrients and sediments in accordance with the Chesapeake Bay TMDL. These will be reflected in the City's MS4 Program Plan.

MS4 Permit Options

While all aspects of the City's MS4 permit are in compliance with state regulations, concern was raised by City staff that Falls Church's tool to enforce penalties for illicit discharges and dumping may not be as strong as it could be since it relies on the authority in Chapter 34 "Solid Waste" of the City Code. Under Section 34-8, the maximum fine for an initial violation is $100 and the maximum fine for subsequent violations is $150 with a cumulative cap of $3,000. However, §10.1-603.14 of the Code of Virginia grants MS4 localities the authority to establish fines between $2,500 and $32,500. Other Northern Virginia localities have adopted language based on this enabling authority that imposes stronger penalties for those who purposely caused an illicit discharge to the stormwater system.

3.2.6 Zoning Ordinance

Zoning and land use decisions have a significant impact on water quality by influencing the amount of impervious cover of a development and how the development relates to natural features. A major focus of the U.S. EPA and DCR is to encourage the use of Low Impact Development (LID). LID seeks to mimic site hydrology under natural conditions by reducing impervious cover where possible and promoting the infiltration of stormwater into the ground. LID also encourages walkability and access to public transportation – since vehicle emissions are a major source of nitrogen in stormwater runoff.

One issue identified is that the City does not have a formal policy regarding LID in the Zoning Ordinance or another City ordinance, and therefore developers are unclear as to expectations for implementing these concepts. The City is undergoing a major re-write of its Zoning Ordinance, and several changes are being considered to incorporate LID and green building concepts. These recommendations were submitted by the City Zoning Ordinance Advisory Committee (ZOAC) in December 2010.

To further examine opportunities to enhance the Zoning Ordinance, Department of Development Services staff and AMEC completed the Center for Watershed Protection's "Code and Ordinance Worksheet." This worksheet was designed to assist local governments with the review of standards, ordinances, and codes that shape how development occurs with respect to watershed management. Table 3-5 is a summary of the worksheet. The full worksheet is found in Appendix E.

Table 3-5. Summary of the Codes and Ordinances Worksheet

Classification	Max. Points	Falls Church	Discussion	Potential Improvement Areas
Street Design and Parking	40	25	The City does very well in the area of parking codes (shared parking arrangements, etc.) and providing incentives for structured parking. The City lost points for not setting aside a percent of parking for compact cars. This was done in the past but was rescinded since car size is unpredictable over time. The City also lost points for the Zoning Code being silent on allowing landscaped islands in cul-de-sacs. The City received points for allowing vegetated open channels rather than curb and gutter – although this practice is not actively encouraged. Many LID techniques rely on either minimizing the footprint of roads, or the ability to integrate LID techniques into road rights-of-way. Technically, the City has flexibility with residential streets as long as they meet minimum engineering best practices. Because Route 29 and Route 7 are National Highway System (NHS) roads, VDOT does hold a great deal of oversight. Even so, VDOT will allow for design flexibility using certain guidelines. However, the City relies on VDOT's more conservative standards, which has the potential to hamper integrating LID into the streetscape. The City may wish to consider examining where flexibility is desired and develop City-specific criteria where necessary.	Incorporate standards or requirements for cul-de-sacs to include landscaped vegetated islands to reduce impervious cover and promote infiltration. Determine what additional flexibility is desired with regard to street standards (e.g. narrower street widths, etc.) and work internally and with VDOT to develop City-specific criteria to allow that flexibility.
Open Space and Lot Size and Design	36	21	The City lost points for lacking flexible site criteria for developers that utilize open space or cluster design options such as reduced setbacks, road widths, and lot sizes. The City also lost points for its general lack of flexibility with regard to setbacks and frontage requirements. In two areas where the City lost points, the City has made a conscious policy decision not to move in that direction. The first is for open space to have a minimum percentage managed in a natural condition. The second is for internal pedestrian networks (trails through common areas) to be substituted for sidewalks. In both instances the dense urban nature of the City makes these impractical (open space is at a premium for recreation and the City puts a strong focus on sidewalks for walkability and connectivity)	The new Zoning Ordinance will deal with some of the issues regarding setbacks, lot sizes, etc.

Classification	Max. Points	Falls Church	Discussion	Potential Improvement Areas
Protection of Natural Features and Water Quality	24	19	The City did well in the areas of stormwater quality controls, tree conservation, clearing and grading requirements, and stream buffer systems. The City lost points for lack of land conservation incentives (transferable development rights, density bonuses, etc.).	Voluntary land conservation incentives are at least partially addressed in the draft Zoning Ordinance under the sustainability standards.
Total	100	65	According to the Center for Watershed Protection, a score of 60-69 indicates that "Development rules are inadequate to protect your local aquatic resources."	Changes in the Zoning Ordinance are likely to improve the City's overall rating.

3.2.7 Comprehensive Plan

The Comprehensive Plan, which was last updated by the City in 2005 and is currently under revision, is an important land use tool both in terms of setting expectations and also establishing guidance for rezoning applications and other land development activities that are required to go through the special use permit process. Chapter 5 of the Comprehensive Plan "Natural Resources and the Environment" was developed in keeping with the requirements of the Chesapeake Bay Preservation Area Designation and Management Regulations and has been approved by the Chesapeake Bay Local Assistance Board.

In addition to the Comprehensive Plan, the City has also developed guidelines and plans for specific areas of the City. One such plan, which can serve as a model for the integration of watershed management techniques into the City, is the North Washington Street Streetscape Design Guidelines. These guidelines were adopted by the City Council in January 2010. One of the primary goals of the plan is to incorporate sustainable stormwater management into the public streetscape. In contrast to recent upgrades to the West Broad Street streetscape, which incorporated trees and vegetation without any opportunity for stormwater to be used for natural irrigation, the North Washington Street plan diverts runoff into planters and bioretention filters where they provide irrigation, flood control/detention, and water quality benefits. The picture shows how stormwater can be treated in a cascading fashion through bioretention facilities between the sidewalk and the road.

Plan of North Washington Street Showing Stormwater Management Integrated into the Streetscape

3.2.8 Capital Improvement Program and Extent of Service Policy

The City's five-year Capital Improvements Program (CIP) is the policy document that sets forth and prioritizes stormwater infrastructure projects that will be implemented using public funds. The ability of the CIP to keep pace with stormwater needs, including retrofit projects associated with the Chesapeake Bay TMDL and replacement of failing corrugated metal pipe, has been identified as a significant issue that is further addressed in Section 5 and Section 6.

In addition to the CIP, City staff has identified a need to better articulate an "extent of service" policy. As stormwater management becomes more comprehensive and complicated, many localities struggle to define the "public" responsibility as opposed to a "private" responsibility. Key to a successful policy is to decide not only what constitutes public drainage, but under what circumstances will the City accept an easement on private property. Localities approach these issues differently depending on the types of problems being addressed. A newly developing locality with state-of-the-art drainage standards may have a very high threshold for when it will become involved in a drainage issue on private property where an easement was not previously granted. On the other hand, a locality that was developed prior to stringent controls may adopt a lower threshold for deciding when a drainage issue becomes a public concern (for instance, drainage that traverses several properties). An example of an extent of service policy addressing drainage issues from the City of Charlottesville, Virginia is provided below:

> "Public services will be limited to that portion of the system located on City-owned properties and rights-of-way, on private properties through which the drainage system is carrying public water from public rights-of-way or properties – provided that an easement is granted, and on those portions of the system for which the City has been granted an established drainage or maintenance easement. The only exception is where the City is required to act to protect the public's health or safety. Public water, for this policy, is defined as stormwater runoff directly draining from public roads, City-owned property, or public easements. Water from creeks and streams, flowing through private property, is not considered public water."

Related to extent of service is the question of "level of service." Level of service is an articulation of how much the City will do to maintain the public drainage system (inspect and clean every year, every two years, etc.). While the City has significantly increased its system maintenance program, there is no official City policy about the level of service that will be maintained over time. Many communities have also expanded the level of service discussion to include maintenance of stormwater quality facilities. Since stormwater management facilities are a relatively new phenomenon, almost all of these facilities have easements that allow for access by the City for inspections. However, maintenance is still the responsibility of the private owner. Over time, many localities have found that these BMPs (primarily in residential areas) have not been maintained properly. Some localities have chosen to take over basic maintenance of these facilities, while others have decided to increase enforcement of existing BMP maintenance agreements. Currently, the City of Falls Church is engaged in the latter approach.

The City should consider the development of a formal "extent of service" policy to manage expectations, ensure consistency, and manage costs. The City may also wish to consider whether there are benefits to the adoption of a more formalized "level of service" policy for stormwater management.

3.3 Policy and Ordinance Recommendations

Table 3-6 provides a summary of policy and ordinance changes recommended by the WAC for consideration by the City Council. Some of the recommendations are very specific, while others encourage additional research and discussion prior to actual implementation. Each recommendation is designated Short Term (less than five years), Mid Term (between five and 10 years), and Long Term (greater than 10 years). Priority rankings include Low (recommendations without major consequences for inaction), Medium, and High (recommendations linked to regulatory compliance). High rankings are designated by an exclamation point.

Table 3-6. Summary of Policy and Ordinance Recommendations

Recommendation	Description	Timing	Priority
Ordinances			
Create a Stand-Alone Floodplain Ordinance	Move the Floodplain Overlay District out of the Zoning Ordinance and give implementation authority to the Department of Public Works. The existing overlay district is technically administered by the Zoning Administrator. However, all review and enforcement activities occur within DPW. Making this change will strengthen overall coordination and improve review and enforcement efficiency.	Short Term	Medium
Floodplain Ordinance Enhancements	Include changes in the new Floodplain Ordinance to increase Community Rating System (CRS) points so that City residents are better protected from flooding. By earning CRS points, City residents also have the potential for reduced flood insurance rates. The City was upgraded in 2011 from a Class 8 status (10% discount) to a Class 7 status (15% discount). The WAC recommends several other changes that while not likely to upgrade the City to a Class 6, will better protect City residents from flooding.	Short Term	Medium
Chesapeake Bay Preservation Area Overlay District and Erosion and Sediment Control Ordinance Consolidation and Enhancements	Consolidate the E&SC Ordinance and Chesapeake Bay Preservation Area Overlay District to better coordinate the review and enforcement process. The City should concurrently make changes to comply with recent amendments to the Virginia Stormwater Management Regulations and to take advantage of enhanced civil penalty provisions of the Virginia Erosion and Sediment Control Law.	Short Term	!

Recommendation	Description	Timing	Priority
Enhanced Enforcement Against Illicit Discharges	Adopt enhanced penalties allowed for dumping and illicit discharges under the Code of Virginia. The City currently relies on the relatively weak authority under Chapter 34 "Solid Waste." Changes should be incorporated into the consolidated E&SC Ordinance/Chesapeake Bay Preservation Overlay District.	Short Term	⚠
Low Impact Development in the Zoning Ordinance	Consider amendments to the Zoning Ordinance to allow and encourage low impact development (LID) techniques. Specifically, the WAC recommends allowing vegetated islands in cul-de-sacs and other roadways and narrower street widths designed to reduce impervious surface cover and increase the infiltration of stormwater into the ground.	Mid Term	Medium
Plans			
Floodplain Education and Outreach Plan	Implement a floodplain property owner outreach program similar to Fairfax County to obtain CRS credits and better protect City residents from flooding.	Mid Term	Low
Falls Church Floodplain Management Plan	Develop a Falls Church Foodplain Management Plan as a way to report on the progress of implementing the City's portion of the Regional All Hazards Mitigation Plan, which will better protect residents from flooding and obtain CRS credits.	Mid Term	Low
Policies			
Adopt an Extent of Service Policy	The City should adopt a formal "extent of service" policy to ensure consistency in the City's approach to capital improvements and investments in stormwater management infrastructure. This policy will be particularly important as the City considers public-private partnerships to meet new Chesapeake Bay restoration requirements.	Mid Term	Medium
Adopt a Level of Service Policy	The City should adopt a formal "level of service" policy to ensure a consistent and adequate level of stormwater system maintenance. The WAC recommends that the City consider whether the level of service should include public maintenance of residential stormwater quality maintenance facilities to ensure long-term maintenance.	Mid Term	Medium

4. City Watershed Management Programs

This section describes and assesses the City's existing watershed management programs and provides recommendations for enhancements based on discussions by the WAC. These enhancements are recommended both to further meet City goals and objectives and to prepare for new regulatory mandates such as the Chesapeake Bay TMDL and the Virginia Stormwater Management Regulations. Programs are presented as "functional areas" typically associated with watershed management.

4.1 Summary of Watershed Management Programs

4.1.1 Planning, Development, and Internal Coordination

- The 2005 *Comprehensive Plan*, coordinated through Development Services, serves as the overall land use planning document for the City. This includes green infrastructure, redevelopment, stream corridors, Chesapeake Bay Preservation Overlay District Resource Protection Areas, etc. The plan contains a number of goals and strategies related to watershed planning.

- Most development in the City (estimated at 90%) is coordinated through the Special Use Permit (SUP) process, rather than by-right. Advantages include additional flexibility, but it also makes voluntary stormwater management commitments harder to enforce.

- Residential grading plan oversight is conducted by the Department of Public Works, Engineering and Construction Division, while commercial site plan overview is conducted by the Department of Development Services, Planning Division.

- A Chesapeake Bay Interdisciplinary Review Team (CBIRT) was formed in the early 1990s to foster coordination among different divisions on Chesapeake Bay Preservation Overlay District Ordinance implementation. The CBIRT currently consists of representatives from Public Works, the City Engineer, and the City Arborist and is coordinated through Public Works. The makeup of the team has changed due to restructuring of the organization and changes of duties. Although this has deviated from the original design, plans are still reviewed by representatives from different divisions prior to coming before CBIRT.

4.1.2 Mapping and Modeling

- Geographic Information Systems (GIS) and system water system modeling are coordinated through DPW. The City stormwater infrastructure map and model were both updated in 2007 during the Army Corps of Engineers' Stormwater System Performance Assessment. However, a 2011 effort to identify and map storm sewer easements appeared to show the need to investigate roughly 25% of the existing GIS layer since many structures were apparently missing or incorrectly located.

- While the GIS is relatively comprehensive, City staff has identified information gaps. Stormwater management facilities are not mapped and resident complaints and other water quality data are not linked to the GIS in order to identify and track hot-spots. The City's dedicated GIS position was eliminated in the FY2012 budget.

4.1.3 Regional Cooperation

- The City participates in the Northern Virginia Regional Commission's Four Mile Run flood control program and Clean Water Partners public education and outreach program. By approaching outreach from a regional perspective, the City is able to reach more people than if it engaged in these activities alone. Efforts to-date have focused on used oil, fertilizers, and pet waste. In 2009, the program aired radio ads on six stations that reached 355,446 individuals an average of 11 times each.

- The City participates in the Metropolitan Washington Council of Governments Chesapeake Bay Policy Committee and Water Resources Technical Committee as well as the Virginia Association of Municipal Stormwater Agencies (VAMSA). VAMSA's primary goals are to provide a venue for local governments to share knowledge on stormwater management; to establish and maintain good working relationships with federal, state and local officials; to encourage the establishment of sound policy relating to stormwater management; and, to assist in the development of laws, regulations, and policies based on good science and technology and sound management practices.

4.1.4 Public Education and Outreach

- DPW is responsible for coordinating public education and outreach in the City. Education and outreach activities are outlined in the City's MS4 Program Plan annual reports.

- DPW has worked regionally with the Northern Virginia Soil and Water Conservation District, Arlington County, the City of Alexandria, and others to promote the use of rain barrels – both as an education tool and a water conservation technique. The City tracks the number of rain barrels distributed to residents, but has no way to track their continued use in the future.

4.1.5 Public Flooding and Drainage Complaint Handling

- DPW, Storm Water System Maintenance handles flooding and drainage complaints through the Task Order System. Most complaints dealing with flooding in public rights-of-way (approximately 75%) are a result of catch basins that have been blocked or filled with debris. The remainder is a result of undersized infrastructure or other issues.

- The City receives from 30 to 40 complaints each year. The DPW's goal is to reduce the number of complaints to less than 10 per year.

4.1.6 Public Drainage System Maintenance

- Since 2005, DPW has implemented an aggressive system maintenance program. Before that, the system had never been comprehensively maintained. Using a contractor, the City spent four years inspecting the entire system, cleaning and flushing pipes and inlets, and repairing degraded infrastructure. Due to budget cuts, DPW now performs maintenance in-house using street maintenance crews.

- The City does not have a plan for inspecting the drainage system using cameras or other technology on a consistent basis. However, DPW is interested in performing this kind of assessment on a five-year rotating basis if it had the resources.

- DPW assists Recreation and Parks with maintenance of streams on public land. No assistance is provided for private property owners.

4.1.7 Management of Public Lands

- DPW arranges for contract mowing of all public lands. They have now established no-mow zones (typically 30 feet) from open channels and streams.

- Recreation and Parks maintains "informal" four or five page master plans for different parks that note problems and potential opportunities for stream restoration and daylighting.

- Fertilizers and pesticides are not applied to turf areas by Recreation and Parks (except by contractors at Madison Park and Thomas Jefferson Elementary). However, deteriorating turf areas may require the use of some fertilizers and pesticides in the future. If that is the case, Parks and Recreation intends to coordinate with Urban Forestry to develop nutrient management and integrated pest management plans.

- Dog waste bags are provided at all parks to encourage owners to pick up after pets.

4.1.8 Private Property Assistance

- The City receives a large number of calls from citizens requesting assistance with private drainage and flooding issues, including basement flooding. Staff from DPW will meet with residents on-site to offer generic suggestions, but will not provide design or other services due to time constraints and liability questions.

- DPW completed an effort in 2011 to comprehensively document stormwater drainage easements. Accurate easement information is critical to determining if a problem is public versus private, and to ensuring that the City has proper authority to enter private property to fix drainage issues. The result of the effort was that approximately 90% of the storm sewer network appears to have proper easements. While this is much higher than originally anticipated, the City is now looking at how to acquire easements in the remaining areas.

4.1.9 Illicit Discharges and Water Quality Problems

- There are usually only one or two major spills or illicit discharges in the City each year. Depending on the size and nature of the spill, these may be handled by the Fire Department and are then coordinated back with DPW. Common sources of illicit discharges or dumping include used motor oil and spills at gas stations. DPW reports that most water quality problems are concentrated along the West Broad Street and Jefferson Avenue area where there are a lot of automotive-related businesses.

- Prohibitions against illicit discharges and dumping are enforced through the Chapter 34 (Solid Waste) of the City Code.

- Engineering and Construction has started to regularly inspect storm drain outfalls for potential illicit discharges. This is a requirement of the City's VSMP permit. In 2009, of the 32 outfalls located and characterized, three were experiencing an obvious illicit discharge, while three were experiencing a probable illicit discharge. The remaining 26 were unlikely to have an illicit discharge.

- While cross-connections between the sanitary and storm sewer systems has not been a problem, area drains that allow stormwater to enter the sanitary sewer system have caused water quality problems by creating surges that pop manholes and discharge waste into local streams. The City is working on this problem.

- DPW has a vigorous Household Hazardous Waste (HHW) collection program to reduce the likelihood of dumping or illicit discharges. One event is held each year at the Property Yard. At all other times, residents are directed to use the West Ox Road Facility in Fairfax County.

4.1.10 Erosion and Sediment Control

- The City's Erosion and Sediment Control Ordinance has been reviewed by the Virginia Department of Conservation and Recreation and has been determined to be consistent with all state requirements.

- DPW administers the E&SC program. Two onsite inspectors are responsible for enforcing the provisions of the program.

4.1.11 Design Criteria and Low Impact Development

- The City's Chesapeake Bay Preservation Overlay District Ordinance details water quality requirements. The City does not have its own design criteria or public facilities manual for stormwater management facilities. Rather, the City relies on manuals such as the Fairfax County Public Facilities Manual, the Northern Virginia BMP Handbook, and the Virginia Stormwater Management Handbook.

- The City has been supportive of using Low Impact Development (LID) techniques and has worked with the Northern Virginia Regional Commission to develop a regional LID handbook. However, the City does not have specific guidance that would allow developers to understand what tools are appropriate for the City or the City's expectations regarding the use of LID.

- Development Services is currently in the process of updating the Zoning Ordinance, which may include the integration of LID into City standards.

4.1.12 Publicly Owned Stormwater Management Facilities

- The City owns only a small number of stormwater management facilities, including bioretention facilities at City Hall and the Community Center.

- While DPW has maintenance responsibility for these facilities, the maintenance is not consistent and a long-range plan for rehabilitation and eventual replacement has not been developed.

4.1.13 Privately Owned Stormwater Management Facilities

- Maintenance of private stormwater management facilities is the responsibility of the owner, which is typically a business or homeowners association. There are a total of 74 BMPs in the City, most of which are small infiltration facilities and manufactured stormwater management facilities.

- The City recently implemented a requirement for owners and operators of these facilities to send an annual report demonstrating proper maintenance. In addition, the City completed its first year of private facility inspections in May 2011.

- While all new BMPs for the past several years have been required to sign and record a BMP maintenance agreement with the land records, some earlier ones likely do not have such an agreement, which will make enforcement difficult.

4.1.14 Good Housekeeping

- DPW coordinates and provides annual training to all field employees on good housekeeping and pollution prevention practices.

- Environmental Services is developing a Storm Water Pollution Prevention Plan (SWPPP) for the Property Yard and is developing protocols for inspecting City facilities to ensure that they are employing good housekeeping practices.

4.1.15 Capital Improvements

- DPW is responsible for management of all stormwater and watershed related capital improvements.

- There is a placeholder of $775,000 per year for stormwater and watershed related capital improvements in the City's budget. However, this amount is predicated on the identification of an alternative funding source other than the General Fund and no capital funds were allocated in FY2012.

4.2 Program Recommendations

Table 4.1 presents recommendations made by the WAC for enhancements to the City's watershed management program to better position the City to meet local goals and existing and future regulatory requirements. Each recommendation is designated Short Term (less than five years), Mid Term (between five and 10 years), and Long Term (greater than 10 years). Priority rankings include Low (recommendations without major consequences for inaction), Medium, and High (recommendations linked to regulatory compliance). High rankings are designated by an exclamation point.

Table 4.1 – Program Enhancement Recommendations

Recommendation	Description	Timing	Priority
Operation and Maintenance			
System Maintenance and Rehabilitation Funding	Provide a consistent source of funding needed to address priority problem areas within the stormwater conveyance system, including a program to systematically replace failing CMP.	Short Term	Medium
Stormwater System Maintenance Crew	Create a stormwater-specific maintenance crew consisting of two or three workers to keep up with maintenance needs. Due to budget cuts in FY2010, contract services were eliminated for inlet and catch-basin cleaning. This responsibility was given to the City's existing street crews, who have not been able to achieve the level of service originally anticipated.	Short Term	Medium
Publicly-Owned Stormwater Facility Maintenance Plan	Develop and fund a plan for the consistent routine maintenance of all publicly-owned stormwater management facilities. In addition, the City needs to develop a long-range funding plan for rehabilitation and replacement of these facilities.	Short Term	!
Privately-Owned Stormwater Facility Inspections	Examine whether additional staff is needed to ensure that private stormwater management facilities are adequately maintained. The City has begun a private stormwater facility inspection program as part of its MS4 permit. As the number of facilities increase, and the City deals with enforcement and follow-up issues, additional staff is likely to be required.	Mid Term	Medium
Comprehensive Storm Drain System Inspection Plan	Establish a systematic inspection schedule for the City's storm drain system. In 2011, the City conducted a comprehensive assessment of the storm drain infrastructure, resulting in valuable information on where to prioritize maintenance efforts to avoid costly "maintenance by emergency." While the WAC did not recommend a specific follow-up inspection schedule, they did recommend that such a schedule should be established.	Long Term	Medium

Recommendation	Description	Timing	Priority
Regulatory Compliance and Engineering			
Geographic Information System Funding	Provide the funding necessary to ensure consistent upkeep of the City's GIS, either through additional staff or through contract services. GIS is critical to managing the City's MS4 permit and tracking overall system infrastructure improvements. Budget cuts for FY2012 eliminated the City's GIS position.	Short Term	Medium
Stormwater and Stream Management			
Chesapeake Bay Restoration Compliance Plan	Develop a master plan for how the City intends to meet Chesapeake Bay pollutant reduction requirements, including specific retrofit projects. While this Watershed Management Plan recommends specific projects to meet the first phase (2013 to 2018), a detailed plan is needed for how the City will meet the full requirements before 2028.	Short Term	⚠
Public Education and Outreach Plan	Develop a Chesapeake Bay restoration public education plan. Such a plan is important so that residents understand why the City needs to spend more resources on stormwater management.	Short Term	Medium
Stormwater Retrofit Grant Program	Consider the development of a City grant program to encourage local stormwater quality retrofits. With pressure to retrofit existing development to meet Chesapeake Bay requirements, fostering public-private partnerships through a cost-share or grant program could be a critical component of the City's compliance strategy.	Mid Term	Medium

5. Watershed Management Strategies

5.1 Introduction

This section presents the process used to identify and prioritize projects to solve locally-identified problems, such as flooding and degradation of stream habitats, or to help achieve larger regional goals such as restoring the health of the Potomac River and the Chesapeake Bay. Specifically, the City will need to implement projects between 2013 and 2018 to meet 5% of the overall pollutant reduction assigned to Falls Church. While long-term planning and costs are discussed in Section 6, the WAC believed that it was important to assure that projects identified in the Watershed Management Plan at least be sufficient to meet the City's commitments over the life of the five-year CIP. At the end of this section are "Project Data Sheets" for the top 10 priority projects.

5.2. Watershed Management Techniques

Falls Church, unlike more recently developed areas of Northern Virginia, was largely developed without the benefit of a comprehensive approach to managing stormwater or stringent stormwater management requirements. Many areas of the City are served by undersized stormwater pipes and inlets, if they are served at all. Additionally, there are relatively few stormwater management facilities to mitigate flooding, improve water quality, or both. The result is twofold. First, several areas of the City experience localized flooding after relatively routine storm events. This localized flooding is the most frequent subject of complaints by City residents. Second, Falls Church has a greater impact per acre on water quality in the Chesapeake Bay than more recently or less intensely developed areas in the region.

Most flooding problems in the City can be solved through more effective management of the volume/quantity of stormwater. Solutions are site-specific, but can include:

- upgrading undersized pipes, culverts, and inlets;
- stormwater diversion;
- implementing techniques such as rooftop or underground detention to temporarily store and slowly release stormwater; and,
- flood proofing.

Example of a street with too few inlets to adequately handle stormwater volume.

One common problem identified in the City is that many streets do not have an adequate number of inlets for the volume of water being handled. In those cases, new inlets need to be added and the system enhanced to deal with the added volume.

While new drainage infrastructure is relatively easy to incorporate into the urban environment, implementing techniques to control the quantity and quality of stormwater presents a much greater challenge. Traditional stormwater management techniques such as "extended detention dry ponds," "wet ponds," and "constructed wetlands" operate by detaining or retaining stormwater in an impoundment so that pollutants can settle out before the water is slowly released into the receiving stream. Although these

techniques are relatively common in more suburban areas, particularly those developed in the 1980s and 1990s, they have historically been avoided in the City because they consume too much space.

Low Impact Development/Urban Stormwater Controls

More recently, a diverse toolbox of techniques better suited to the urban environment has emerged. These techniques tend to be smaller than traditional controls. Many are designed to mimic the natural hydrology by slowing stormwater runoff and/or by promoting infiltration into the soil. Some techniques, such as cisterns and rain barrels, collect stormwater for later use as irrigation water – thereby reducing stormwater volume, improving water quality, and saving money. Techniques such as street sweeping and public education are designed to prevent pollutants from entering stormwater in the first place. Finally, stream restoration and day-lighting can be employed to repair the damage caused to streams from inadequate stormwater controls.

Traditional stormwater management techniques, such as the "wet pond" above, are not well suited for the City's more urban environment.

The major limitation in the City with regard to LID is that they often rely on the ability of the underlying soil to quickly infiltrate stormwater into the ground. Because most soil in the City is highly compacted, careful consideration needs to be given to the type of technique selected for a particular site. In some cases, the soil can be amended or removed and replaced with more porous soil. In other cases, techniques such as green roofs and "tree box filters" should be considered over techniques that rely primarily on infiltration.

Table 5-1 provides an overview of LID tools and other urban stormwater management techniques that are applicable in the City of Falls Church.

Table 5-1. Low Impact Development and Other Applicable Stormwater Management Techniques

Practice	Description	Advantages	Disadvantages	Picture
Cisterns and Rain Barrels	Large containers used to catch rainwater for reuse. Rain barrels are used for residential and smaller commercial applications. Cisterns are used for larger applications. Health Department restrictions may apply. Typically, rainwater is used for irrigation.	1. Water conservation and reuse. 2. Reduce load on storm drain system. 3. Small area required. 4. Use for landscape irrigation. 5. Low maintenance.	1. Highly variable benefits that are difficult to track for regulatory compliance purposes. 2. Requires large scale use to make significant difference. 3. Treats only a small area.	
Tree Box Filters and Manufactured BMPs	Precast concrete box with engineered media at curb line. In many cases, trees or other small vegetation are incorporated to promote nutrient uptake.	1. Easy to incorporate and can be used to retrofit streets and parking areas. 2. Small area needed for installation. 3. Aesthetically pleasing. 4. Pollutant removal efficiencies are relatively well documented.	1. Small drainage area. 2. Requires consistent maintenance program, including replacement of vegetation. 3. Does not provide flood control.	
Permeable Pavers	Open-jointed block system that infiltrates water through openings.	1. Does not take up additional land space. 2. Reduces impervious area of site. 3. Good for places of worship and secondary parking areas that are not used frequently.	1. Can clog and requires consistent maintenance. 2. Inappropriate for high traffic areas. 3. Requires permeable soils or installation of an under-drain. 4. If technique uses vegetation, sun/shade may be an issue.	

Practice	Description	Advantages	Disadvantages	Picture
Permeable Asphalt	Standard hot-mix asphalt with reduced sand or fines that allows water to drain through it.	1. Same as Permeable Pavers.	1. Same as Permeable Pavers.	
Green Roofs	Vegetated roof system. Rainwater filters through special soil medium. Specially selected plants promote nutrient uptake and evapo-transpiration.	1. Secondary benefits include improved air quality and reduced heating/cooling bills. 2. Aesthetically pleasing. 3. Can be installed in any urban area. Does not take up land space.	1. More expensive than a traditional roof. 2. Possibility of leakage. 3. Best for new construction or replacement of entire roof system. 4. Vegetation requires maintenance while being established.	
Grassed Swales	Earthen swale that is broad and shallow with vegetation. Check dams are usually installed to pond water and promote infiltration into the soil.	1. Easy to incorporate into site design. 2. Used for water quality by infiltration. 3. Can be used instead of curb and gutter in residential areas.	1. Water quality benefit requires permeable soils. 2. Not for use in steep terrain. 3. Relatively low pollutant removal. 4. Takes up more space than other techniques. 5. Requires periodic mowing.	
Sand Filter	Above or underground vault filled with sand and other materials. Water slowly infiltrates through the sand, where pollutants are trapped.	1. May be used in highly urban areas. 2. May be located under parking areas. 3. May be used to treat up to 20 acres of drainage area.	1. Subject to more intense maintenance than other facilities.	

Practice	Description	Advantages	Disadvantages	Picture
Bioretention/Rain Gardens	Planted area with engineered media beneath that infiltrates into the surrounding soil.	1. Aesthetically pleasing. 2. Minimal maintenance. 3. May be used as a landscaping feature. 4. May be used in a variety of situations.	1. Treats only a small drainage area. 2. Not to be used near marine clays. 3. Minimum size of approx 150 sq ft. 4. Important to install correct plants.	
Infiltration Trench	Stone filled trench that captures water and slowly infiltrates into soil.	1. Achieves high pollutant removal. 2. Can be located in tight spaces or along the edge of parking lots. 3. Can be used in place of gutter system along roads.	1. Must have permeable soils. 2. Subject to clogging and maintenance intensive. 3. Less aesthetically appealing than other techniques.	
Stream and Headwaters Restoration	Various techniques used to restore degraded streams or headwaters damaged by excessive volume and velocity of stormwater.	1. Can restore the biological integrity of stream segments. 2. Can be aesthetically pleasing.	1. Space limitations can make impractical. 2. Often requires extensive grading and the removal of trees. 3. May experience failure if volume/velocity issues are not addressed.	

In addition to the above structural techniques are several non-structural techniques that can be used to prevent pollutants from entering stormwater in the first place. Examples include:

- public education and outreach,
- street sweeping,
- storm drain clean out, and
- fertilizer management.

Under the terms of the City's MS4 stormwater permit, the City already engages in a rigorous public education program, conducts street sweeping on public roads, and cleans out storm drain inlets and catch-basins. In FY2011, street sweeping prevented 250 tons of sediment and debris from entering the storm sewer system. Likewise, storm drain inlet and catch-basin cleaning removed 200 tons of sediment and debris. Encouraging private property owners to engage in street sweeping and inlet cleaning is a potential BMP for the City's consideration.

A strategy contained in the Virginia WIP is to require the development of nutrient management plans for all public property where fertilizers are stored or applied. While fertilizer application is generally limited in the City to places such as Thomas Jefferson Elementary and Madison Park, these facilities and any future facilities where fertilizers are applied will likely need to develop nutrient management plans.

Additional ordinances, policies, and protocols that can be used to minimize impervious surface cover and promote infiltration of stormwater into the soil (such as reduced parking space standards, policies to promote shared parking, street with standards, etc.) are found in Section 3.

5.3. Problem/Opportunity Identification and Initial Prioritization

AMEC and City staff employed a three-tiered approach to identify problem areas and/or opportunities for improvements to water quality and aquatic habitats. These included (1) staff interviews (July 20-21, 2009), (2) an analysis of City complaint records, and (3) reviewing recommendations from previous watershed management and stormwater-related studies. Previous studies include:

- 2009 Stream Assessment Report
- 2007 Stormwater System Performance Assessment
- 2007 City Facility Assessment
- 2005 Evaluation of Daylighting Opportunities Report
- 2003 Stormwater Utility and Infrastructure Plan
- 1996 Watershed Management Plan

Based on this approach, AMEC and City staff compiled a draft list of problem areas/opportunities and used a desktop map exercise to eliminate initiatives that were clearly impractical. This resulted in 45 problem areas/opportunities for further prioritization.

5.3.1 Initial Problem/Opportunity Prioritization

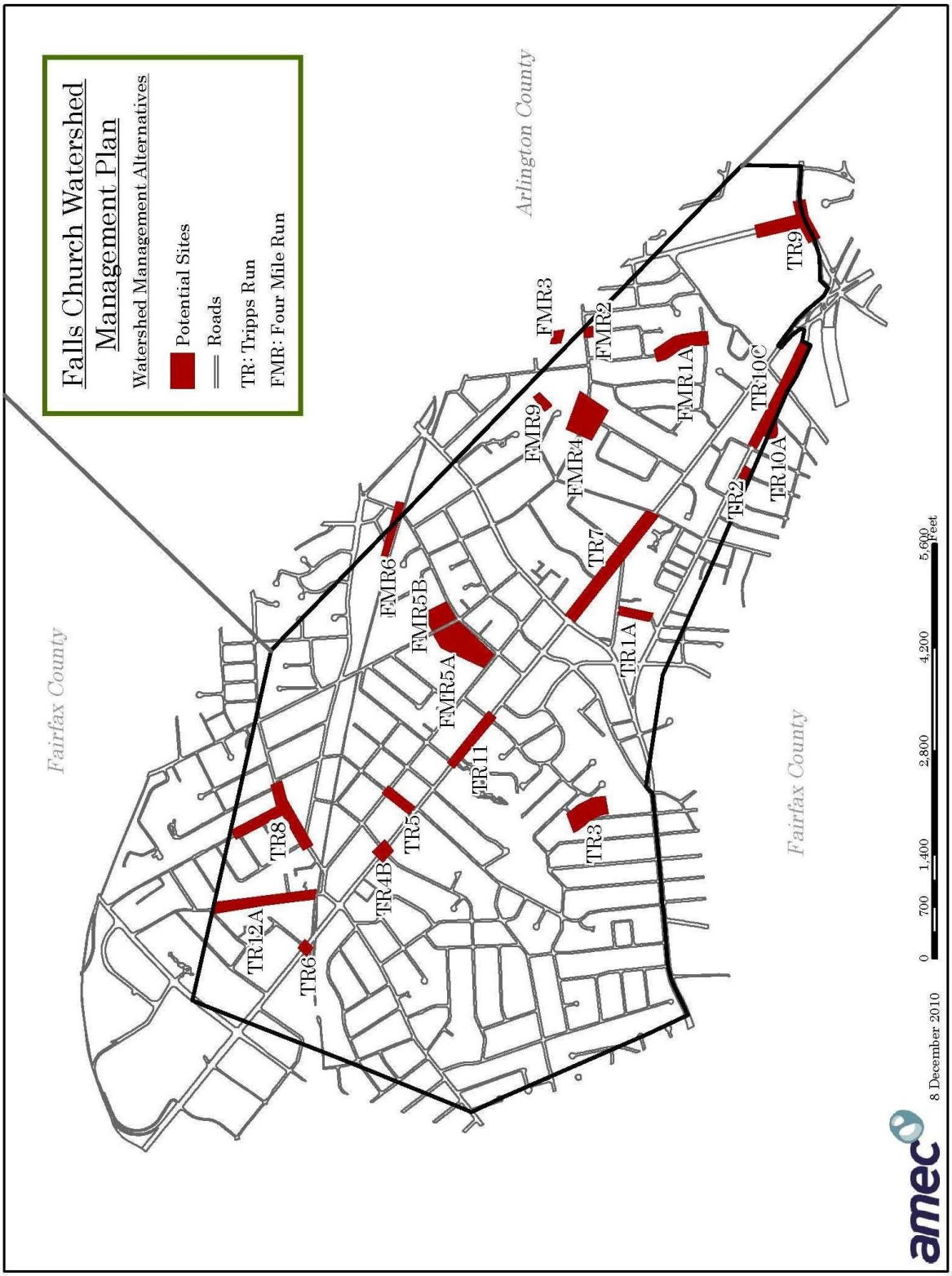
The next step was to develop prioritization criteria for use by the City and AMEC to narrow the list of problem areas/opportunities. These problem areas/opportunities would then be subject to additional analysis, including a field investigation. Table 5-2 presents the initial prioritization criteria. Priorities reflect those situations that present a threat to public safety (such as road flooding) or a threat to private property where the source of the problem is from a public right-of-way or public facility. Based on the Chesapeake Bay TMDL, where a flooding problem could potentially be solved in combination with an improvement to water quality, those projects are ranked higher. Flooding in parks, which represents a nuisance but not a threat to infrastructure or safety, and flooding on private property with no public source were ranked lower.

Table 5-2. Watershed Management Alternatives Initial Prioritization Criteria

Rank	Prioritization Criteria
1	Flooding on Road Right-of-Way/Public Safety Issue w/ Potential Water Quality Benefit
2	Flooding on Road Right-of-Way/Public Safety Issue
3	Home Flooding w/ Public Source w/ Potential Water Quality Benefit
4	Home Flooding w/ Public Source
5	Yard Flooding w/ Public Source w/ Potential Water Quality Benefit
6	Yard Flooding w/ Public Source
7	Stream Restoration/Daylighting w/ Water Quality Benefit
8	Water Quality Improvement Only
9	Stream Restoration/Daylighting Only
10	Flooding – Parks and Open Space
11	Flooding – Private Drainage Issues

Using the criteria in Table 5-2, the prioritization process resulted in 21 problem/opportunity areas for further field investigation and final prioritization. Figure 5-1 shows the potential project locations, while Table 5-3 provides a brief description, of each project, including potential benefits and conflicts. Appendix F includes the full list of prioritized problem/opportunity areas.

Figure 5-1. Problem/Opportunity Areas Identified for Field Investigation

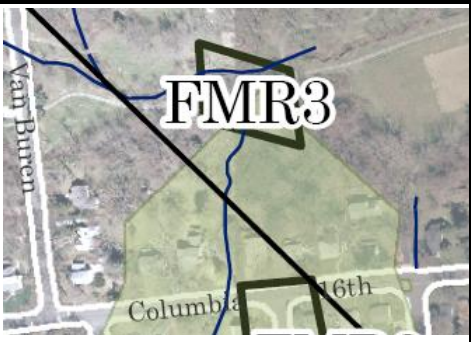


FMR-1A Van Buren Street Between Villa Ridge and Underwood	
Drainage Area: ≈4.5 Acres Percent Impervious: 25% Planning Level Cost: $120,000	
Problem/Opportunity: Water from City ROW. Flooding in yards of 209, 210, 211, and 212 Van Buren Street reported due to undersized pipes and poor layout. Wren Branch Daylighting at FMR-1B could help. Should be examined in tandem.	
Project and Benefits: Improvements to existing infrastructure should be based on a full drainage study of the area. The drainage study will help determine issues with the system and lead to possible retrofit solutions.	
Conflicts: Significant access, utility, and construction issues. Land acquisition involved.	

FMR-2 Columbia and Underwood Streets	
Drainage Area: ≈8.0 Acres Percent Impervious: 32% Planning Level Cost: $550,000	
Problem/Opportunity: Flooding in the intersection; one inlet reported in poor condition.	
Project and Benefits: The inlet along Columbia Street is in poor condition and needs to be replaced as per design capacity. Additional inlets need to be installed on Underwood Street to alleviate flooding. All inlets can be retrofitted with tree box filters to improve water quality from this relatively large drainage shed.	
Conflicts: Minor conflict with existing utilities.	

FMR-3 Four Mile Run Stream Culvert at Van Buren

Drainage Area: ≈46.8 Acres
Percent Impervious: 29%
Planning Level Cost: $210,000



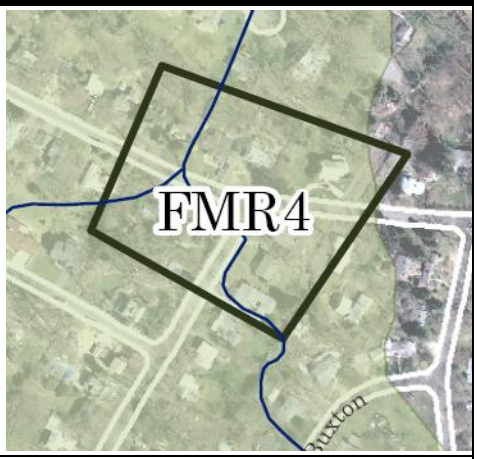
Problem/Opportunity: Undersized culvert causes backwater into East Falls Church Park.

Project and Benefits: The project would involve day-lighting of storm sewer and bank stabilization to alleviate the flooding issue around East Falls Church Park. The channel stabilization would include design of step pool system and stabilize banks using grade control for approximate 250 feet of headwater stream. The project would require coordination with Arlington County.

Conflicts: Significant construction access issues and potential impact on trees. Coordination required with Arlington County.

FMR-4 Columbia and Noland Streets

Drainage Area: ≈1.6 Acres
Percept Impervious: 69%
Planning Level Cost: $300,000



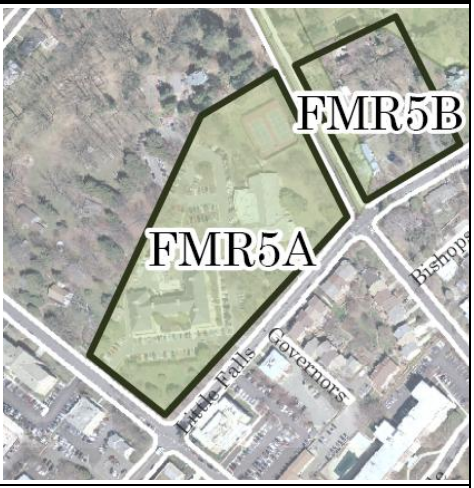
Problem/Opportunity: Drainage issues for individual homes (431, 432, and 434 Columbia Street). Potential capacity issue. Possible retrofit opportunity for water quality. Along Noland Street and Columbia Street, there is a lack of storm sewer inlets, and the water eventually collects and overtops the inlet in front of 431 Columbia Street. The water flows down the property line and onto the patio and in the basement.

Project: Additional storm sewer infrastructure consisting of inlets, storm sewers, and tree box filters are required along Noland Street and Columbia Street. The existing inlets are overwhelmed by the amount of sheet flow resulting from the paved surfaces. Tree box filters will provide water quality improvements.

Conflicts: Minor conflict with existing utilities. Lots of mature trees.

FMR-5A City Hall Campus

Drainage Area: ≈7.4 Acres
Percent Impervious: 35%
Planning Level Cost: $480,000



Problem/Opportunity: Potential to improve water quality from large area of uncontrolled impervious surface cover. The site already has some permeable pavement and a bioretention facility to promote infiltration and improve water quality.

Project and Benefits:

The project will help promote stormwater runoff infiltration and provide water quality benefits to a highly impervious area. The project may help reduce flooding issues along Great Falls Street (see right for inlet overwhelmed by drainage).

Specific project components include:

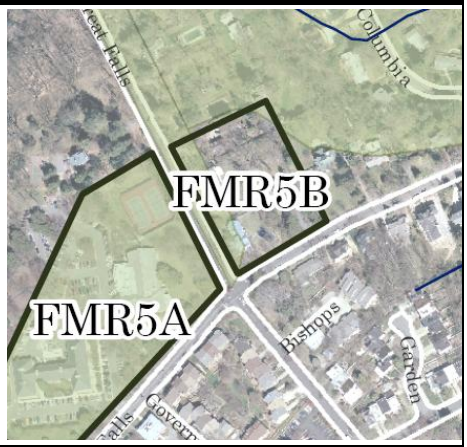
- Retrofit medians in the parking lot and the open area near the tennis court with bioretention facilities.
- Retrofit the buildings near the tennis courts with a cistern for rainwater harvesting to reduce the flow of runoff.
- Space may be available for tree box filters or additional bioretention along the perimeter of the employee lot.
- Integrate permeable pavers in several areas of the parking lot to promote infiltration.

Conflicts: Potential for minor impact to trees. Minor conflict with existing utilities.

Note: Improvements at the City Hall site may help the drainage problem on Great Falls Street and backyard drainage issues in the northeastern quadrant of the intersection of Great Falls Street and Little Falls Street (FMR-5B). As a result, it is recommended that FMR-5A and FMR-5B be considered in tandem so that the impact of any proposed improvements at FMR-5A on base conditions at FM- 5B can be better understood.

FMR-5B North Quadrant Little Falls Street and Great Falls Street

Drainage Area: ≈3.7 Acres
Percent Impervious: 39%
Planning Level Cost: $270,000



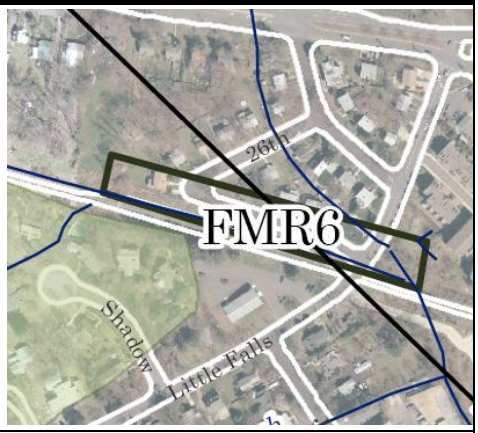
Problem/Opportunity: Significant water in backyards, with some from the street. 304 Great Falls Street and 307 Little Falls Street specifically noted by staff. Some of these problems could be reduced through the use of bioretention or on-site storage at FMR-5A.

Project and Benefits: Recommend adding more inlets along Great Falls Street. The existing inlet pipe can be retrofitted by increasing the diameter or using a horizontal elliptical pipe. New inlets can be added in combination with tree box filters. It is recommended that a drainage study be performed on the pipe system.

Conflicts: Impact to mature trees and significant conflict with existing utilities. Land acquisition and/or easements on private property required.

FMR-6 Trammel Branch Daylighing Between W&OD Trail and 26th Street

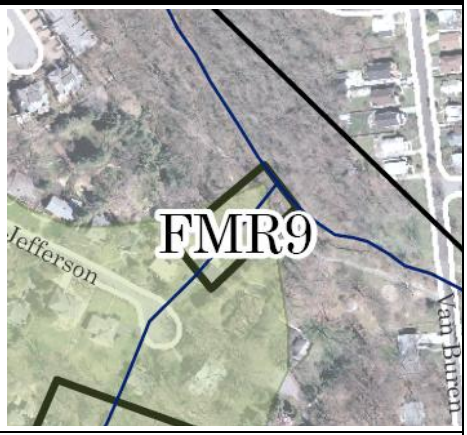
Drainage Area: ≈20.5 Acres
Percent Impervious: 25%
Planning Level Cost: $1,220,000



Problem/Opportunity: This site was given an "A" ranking for possible stream day-lighting in the 2005 Evaluation of Daylighting Opportunities Report. Individual home flooding is reported as an issue in this area

Project and Benefits: The project would provide grade control for the stream in the vicinity of homes. The culvert crossing at W&OD Trail would be removed and daylighted. The trail would be connected by a bridge over the stream. Since the stream would be linear, a step pool morphology with grade control boulders would be implemented. Since the project is along the City boundary, coordination with Arlington County will be required.

Conflicts: Significant access, utility, and construction issues. Coordination required with Arlington County and the Northern Virginia Regional Park Authority.

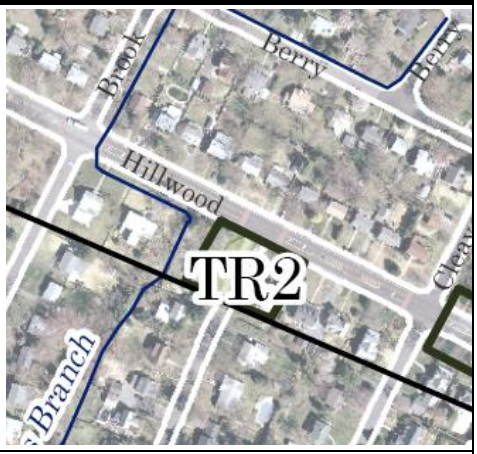
FMR-9 Harrison Branch Outfall and Four Mile Run	
Drainage Area: ≈73 Acres Percent Impervious: 32% Planning Level Cost: $180,000	
Problem/Opportunity: Blowout where 48" pipe containing Harrison Branch enters Four Mile Run. Potential for daylighting small portion and stabilizing outfall. Relatively easy project. Will reduce TSS from streambank erosion.	
Project and Benefits: The proposed project would day-light approximately 150 feet of pipe and create a step pool system with grade control. The project fixes the cantilevered culvert and excessive scour at the outlet.	
Conflicts: Impact to mature trees, floodplain, and Resource Protection Area. Potential need for land acquisition.	

TR-1A Douglass and Hillwood Avenues – Eastern Side of Shopping Center	
Drainage Area: ≈1.1 Acres Percent Impervious: 87% Planning Level Cost: $130,000	
Problem/Opportunity: Capacity issue, stormwater runoff jumps curb and floods office space. Potential for box filter to improve water quality.	
Project: Retrofit existing inlet and add new drainage inlets in combination with tree box filters along Douglass Avenue. New drainage inlets will help alleviate flooding issue around the office building. The addition of tree box filters will serve to improve water quality in this highly impervious area.	
Conflicts: Potential for minor impact to trees. Minor conflict with existing utilities.	

TR-2 Hillwood Avenue and Linden Lane

Drainage Area: ≈0.2 Acres
Percent Impervious: 55%
Planning Level Cost: $30,000

Problem/Opportunity: Flooding reported on street and in yards near this intersection. Potential opportunity for box filters to improve water quality.



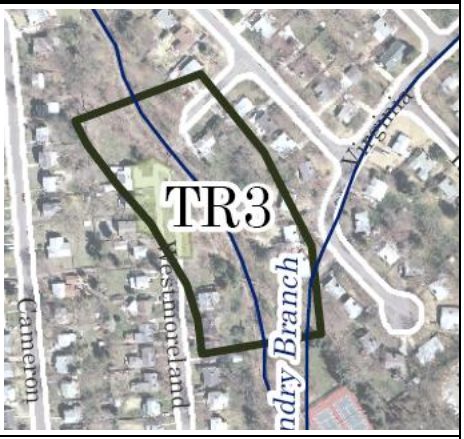
Project and Benefits: The addition of a drainage inlet along Linden Lane in combination with a tree box filter will help resolve the flooding issue and improve water quality.

Conflicts: Minor conflicts with existing utilities. Requires coordination with Fairfax County.

TR-3 Drainage at West Westmoreland Road and Tripp's Run Restoration

Drainage Area: ≈0.8 Acres
Percent Impervious: 38%
Planning Level Cost: $30,000

Problem/Opportunity: Water in street due to poor grading and no inlet. Contributes to drainage issues identified at 207 West Westmoreland Road. Tripp's Run in this area, which is a concrete trapezoidal channel, has high potential for stream restoration. Potential installation of bioretention at Cavalier Trail Park.



Project and Benefits: The project consists of diverting flow from the northwest side of West Westmoreland Street using a rock lined channel that would flow to a proposed rain garden/biofiltration facility. The entrance channel will alleviate the ponding that is occurring due to the build-up of leaves and debris at the end of West Westmoreland Street.

Conflicts: Some impact to mature trees. No utility conflicts. Involves land disturbance in floodplain and Resource Protection Area.

TR-4B West Broad and North Spring Streets

Drainage Area: ≈0.3 Acres
Percent Impervious: 83%
Planning Level Cost: $65,000

Problem/Opportunity: Standing water in the intersection.

Project and Benefits: Recommend raising the grade near handicap ramp at the intersection of West Broad Street and North Spring Street to divert flow downstream and prevent ponding water. Also need to add a drainage inlet along North Spring Street to divert the flow. A tree box filter can provide water quality benefits.

Conflicts: Likely significant utility conflicts. Minimal other conflicts.

TR-5 N. Oak Street Between Broad and Park

Drainage Area: ≈0.2 Acres
Percent Imperious: 89%
Planning Level Cost: $240,000

Problem/Opportunity: Flooding on N. Oak Street between Park Avenue and Broad Street possibly due to undersized pipes. Stormwater enters parking garage in the north-west quadrant of Oak and Broad. Potential for water quality improvement.

Project and Benefits: Add new drainage inlet in combination with tree box filters. Retrofit the sidewalk with permeable pavers. Replace compacted grass area in sidewalk with bioretention facility. The addition of a new drainage inlet will help reduce flooding and the potential for automobiles to hydroplane. It will also reduce the amount of runoff entering the parking garage (see right). The tree box filters, permeable pavers, and bioretention will improve water quality from this highly impervious area.

Conflicts: Potential for minor impact to trees. Minor conflict with existing utilities.

TR-6 West Broad and Falls Avenue

Drainage Area: ≈7.3 Acres
Percent Impervious: 38%
Planning Level Cost: $540,000

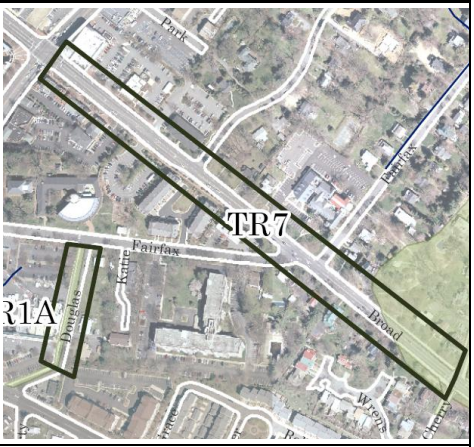
Problem/Opportunity: Standing water in the intersection.

Project and Benefits: The addition of a drainage inlet near the West Broad and Falls Avenue intersection will help resolve standing water issues. Inclusion of a tree box filter will provide water quality benefit.

Conflicts: Minor conflicts with existing utilities.

TR-7 East Broad Between Washington and Cherry Streets

Drainage Area: ≈4.0 Acres
Percent Impervious: 50%
Planning Level Cost: $400,000

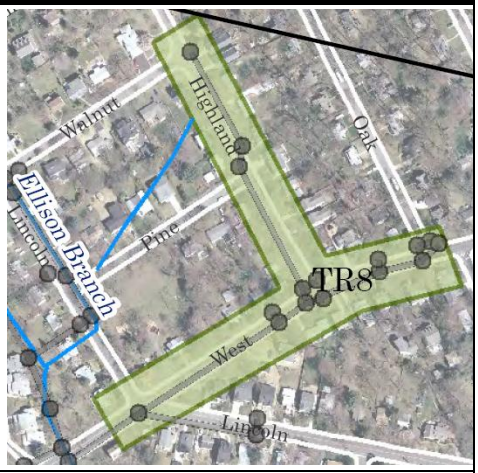


Problem/Opportunity: Standing water at low spot on Lawton Street. Entire area between Washington and Cherry is subject to excess sheet flow due to lack of inlets.

Project and Benefits: The East Broad Street intersection problem can be fixed by adding more drainage inlets along the road and the low spot location. The addition of drainage inlets will reduce flooding and spread and prevent vehicle hydroplaning (see picture to the right at the intersection at Lawton Street).

In order to provide water quality improvement, the proposed drainage inlets can be added in combination with tree box filters. The sidewalks along the streets can also be replaced with permeable pavers to provide stormwater infiltration.

Conflicts: Impact to trees. Significant access issues and conflict with existing utilities.

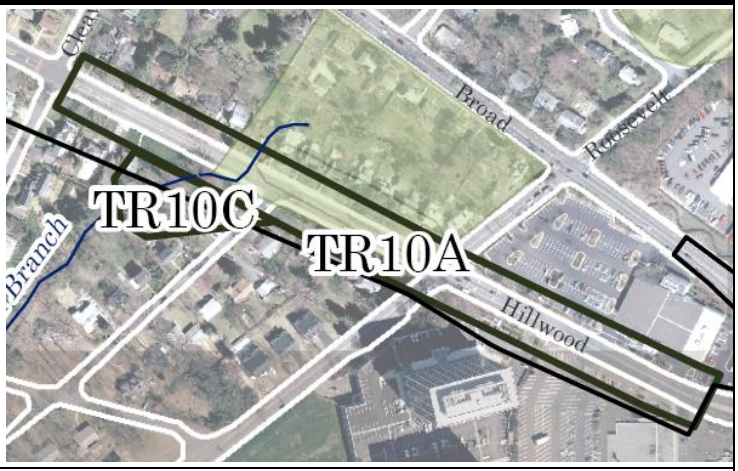
TR-8 Highland Avenue and West Street Drainage	
Drainage Area: ≈8.2 Acres Percent Impervious: 24% Planning Level Cost: $470,000	
Problem/Opportunity: Flooding issues were identified in the Stormwater System Performance Assessment conducted in 2007.	
Project: In order to alleviate the flooding at the intersection of Highland Avenue and West Street, this project proposes the addition of storm sewer inlets and pipes accompanied with tree box filters in order to provide added water quality benefit.	
Conflicts: Impact to mature trees. Minor conflicts with existing utilities.	

TR-9 Roosevelt and Wilson Boulevard	
Drainage Area: ≈0.7 Acres Percent Impervious: 91% Planning Level Cost: $110,000	
Problem/Opportunity: Capacity issue next to BJs commercial building. Inlet opening is partially collapsed. A quarter of the intersection goes under water during major storm events. Slope of pipe that causes clogging may also be a contributing factor. Highly impervious area.	
Project and Benefits: The focus of this project is to improve safety by reducing roadway flooding (see right for photo of intersection flooding). A secondary benefit is to improve water quality in a highly impervious area with large amounts of vehicular traffic and parking: Specific project components include: • Replace existing failed pipe at the intersection of Wilson Blvd and Roosevelt Blvd. • Replace existing sidewalk with permeable pavers. • Add curb cut inlets and cascade bioretention in existing median along Roosevelt Blvd. • Add storm sewer inlets and tree box filters along the eastern side of Roosevelt Blvd.	
Conflicts: Potential for minor impact to trees. Major conflict with existing utilities – some relocation may be required.	

TR-10A Hillwood Avenue Between Cleave Drive and East Broad

Drainage Area: ≈0.6 Acres
Percent Impervious: 60%
Planning Level Cost: $171,000

Problem/Opportunity: Excess sheet flow during storms. Not enough inlets. Tree box inlets could improve water quality.



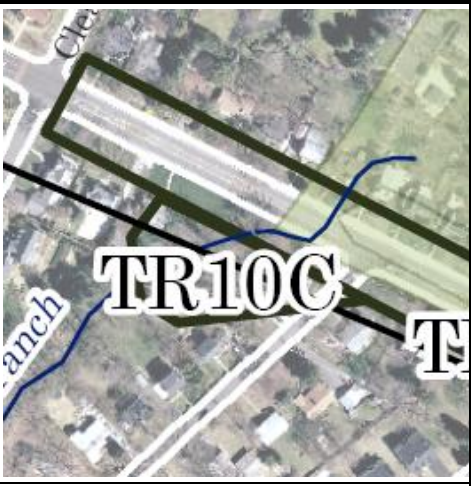
Project and Benefits: Add drainage inlets in combination with tree box filters along Hillwood Avenue. Retrofit sidewalks with permeable pavers. The addition of drainage inlet will help reduce flooding and hydroplaning. The permeable pavers will help improve water quality.

Conflicts: Minor impact to mature trees. Major conflict with existing utilities.

TR-10C Hillwood Avenue Outfall Stabilization

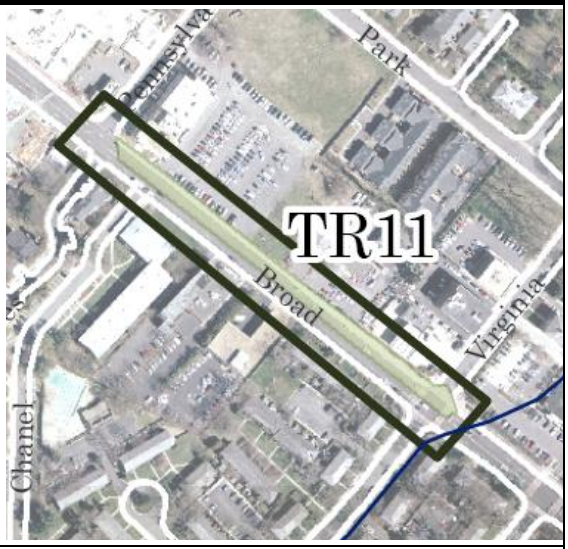
Drainage Area: ≈5.9 Acres
Percent Impervious: 31%
Planning Level Cost: $180,000

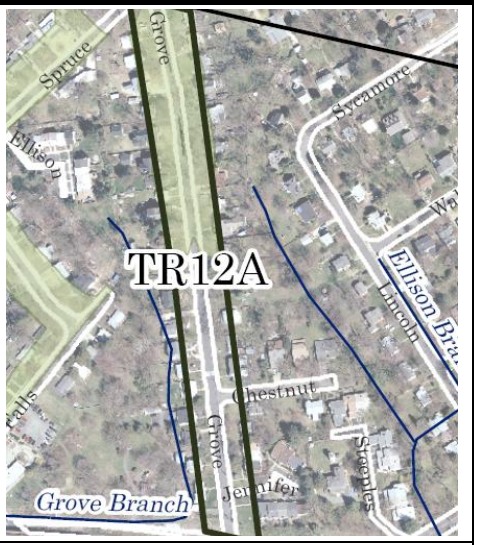
Problem/Opportunity: Outfall stabilization.



Project and Benefits: The project would involve fixing the stormwater outfall and headwater stream by using step pool system with boulders as grade control. The outfall would be stabilized by filling and cutting of a two-stage channel.

Conflicts: Significant access, utility, and construction issues. Coordination required with Fairfax County.

TR-11 West Broad Street Between Virginia and Pennslyvania	
Drainage Area: ≈2.0 Acres Percent Impervious: 91% Planning Level Cost: $380,000	
Problem/Opportunity: Excess sheet flow during storms on Broad Street due to lack of inlets. There are no inlets from Virginia Avenue to the intersection at Pennsylvania Avenue. Some of the inlets further upstream need to be larger.	
Project and Benefits: Reduce flooding and improve water quality by adding drainage inlets in combination with tree box filters. Replace sidewalk pavement with permeable pavers. Retrofit existing island with cascade bioretention (see picture to right of cascading bioretention incorporated into area between street and sidewalk).	
Conflicts: Potential for minor impact to trees. Major conflict with existing utilities.	

TR-12A Grove Avenue Between City Line and W&OD Trail	
Drainage Area: ≈17.7 Acres Percent Impervious: 22% Planning Level Cost: $660,000	
Problem/Opportunity: Several downspouts and sump pumps drain to Grove Avenue creating icy conditions in the winter. Neighbors complain about high groundwater table and poor yard drainage. Restoration or better drainage in Grove Branch and Ellison Branch might be potential solutions.	
Project and Benefits: This project consists of adding inlets along Grove Avenue in combination with tree box filters to collect water from sump pumps. The sump pump water draining to the ditch in the backyard of houses along the Grove Street can be implemented with two stage channel and step pools to provide grade control. This project was given extra weight due to the problem with icy road conditions.	
Conflicts: Impact to trees. Requires additional easements from private property owners for backyard ditch work.	

5.3.2 Field Evaluation Process

AMEC conducted two days of field visits (November 12 and 15, 2010) to gather site-specific information on the 21 problem/opportunity areas identified during the initial prioritization process. A standardized Candidate Watershed Management Project Investigation Form was used to ensure a consistent approach to each site. The form includes:

- Identified Issues
- Treatment Options
- Ownership Status
- Drainage Area and Land Use
- Site Characteristics
- Site Constraints
- Site Drawing
- Construction Considerations
- Recommendations

Visiting a potential project site. Pictured – Potential bioretention area at City Hall.

During the field investigation, particular attention was given to issues such as construction access and land acquisition, potential conflicts with utilities, impacts on mature trees, and other site-specific issues and complicating factors. All complete project investigation forms, including site sketches and pictures, are found in Appendix G.

5.4 Project Rankings

Projects were ranked based on three methodologies to assist the WAC in its process of selecting 10 projects for further development and recommendation for inclusion in the CIP. These included a composite ranking, a safety ranking, and a water quality ranking.

5.4.1 Composite Ranking

The composite ranking criteria used to score individual projects included the type of management practice(s) involved, site parameters and constraints, treatment potential (impervious area treated), and mitigating factors. These category scores were then added to arrive at a total score for each proposed project. A higher score correlates to a more effective and feasible project. Table 5-3 presents a summary of the composite ranking criteria.

5.4.2 Safety and Water Quality Ranking

Safety Ranking

Determining the severity of the safety concern addressed by any particular project is necessarily subjective. However, applying best professional judgment, City staff assessed each project and assigned it a safety ranking. The main factor considered was the potential for the project to solve a defined threat to human safety. For instance, several projects deal with flooding in the main travel lanes of major roads. These outranked projects that address nuisance flooding concentrated outside of the travel lanes. In addition, the potential for a problem to impact and cause damage to structures was also a primary consideration. City staff assigned each project a ranking from 1 to 5, with 1 being the highest severity.

Water Quality Ranking

While individual techniques will have some variation in their pollutant removal efficiencies, for comparative purposes the amount of impervious area treated is the most straight forward way of determining a project's potential to improve water quality. As part of this analysis, AMEC further refined estimates of the impervious area treated by proposed projects based on an analysis of site topography and aerial photographs.

A complicating factor is that stream restoration and outfall stabilization do not "treat" a particular area. Rather, they achieve a reduction in pollutants typically measured by pounds per linear foot restored. As a result, it is not appropriate to use impervious cover for comparing the pollutant removal ability of these types of projects (FMR-6, FMR-9, FMR-3, TR-12A, and TR-10C). To make an apples-to-apples comparison, AMEC determined an "average" number of pounds of phosphorus removed from an impervious acre of urban land using tree box filters. Phosphorus is considered by Virginia to be the "keystone" pollutant from which compliance is measured. An average urban acre generates approximately 7.6 pounds of phosphorus per year.[14] A tree box filter, which has a 60% removal efficiency, will therefore remove approximately 4.6 pounds of phosphorus per acre per year. The Chesapeake Bay Model currently gives stream restoration credit for removing 0.0035 pounds/linear foot/year. As a result, it takes approximately 1,300 linear feet of restoration to equal the reduction from one acre treated by a tree box filter. It should be noted that the Chesapeake Bay Program is in the process of reassessing the amount of credit that can be applied to stream restoration; however, those figures were not available before adoption of this plan.

[14] Calculated using the "Chesapeake Bay Method" in the *Northern Virginia BMP Handbook*. Assumes a phosphorus pollutant concentration of 1.08 mg/l.

Table 5-3. Composite Ranking Scoring Criteria

Management Practice(s)	Points[1]	Parameters/ Constraints	Points	Treatment Potential	Points	Mitigating Factors	Points
Infiltration Trench	19.5	Construction Access	Easy = 30 Mod. = 10 Difficult = 0	Percent Impervious	100% = 5 0% = 0	Large Drainage Area on Public Land	20
Porous Pavement	21	Land Acquisition/ Easement	No = 30 Yes = 0			ROW Safety Issue	15 to 25
Vegetated Swale	18.25	Potential Utility Conflicts	None= 30 Few = 15 Many = 0			Stormwater Impacts Structure	10
Tree Box Filter	18.5	Tree Removal	None = 30 Few = 15 Many = 0			Multi-Jurisdiction Cooperatio n Required	-10
Sand Filter	17					Extremely Difficult Site Access	-20
Green Roof	22.125						
Rainwater Harvesting	17.125						
Bioretention	21.125						
Pipes/Drainage	11.5						
Category Total	Cumulative up to four projects.	**Category Total**	Points are added for each sub category and averaged.	**Category Total**	Number of points.	**Category Total**	Cumulative number of points.

[1]REFERENCE DATA FOR MANAGEMENT PRACTICE PERFORMANCE

Virginia's Stormwater Impact Evaluation: Developing and Optimization Tool for Improved Site Development, Selection and Placement of Stormwater Runoff BMPS – Virginia Polytechnic Institute and State University, Blacksburg, VA, January 2009.

Galli, John. 1982. *Analysis of Urban BMP Performance and Longevity in Prince George's County, Maryland.*

Georgia Stormwater Management Manual Volume 2 Technical Handbook First Edition August 2001.

Fairfax County – LID BMP Fact Sheet – Tree Box Filters February 28, 2005.

Updated BMP Removal Efficiencies from the National Pollutant Removal Database and Acceptable BMP Table for Virginia.

East Baton Rouge Parish Stormwater BMPs – BMP Selection August 2007.

Handbook for Developing Watershed Plans to Restore and Protect Our Waters, Environmental Protection Agency, March 2008.

Cost Methodology

To establish a base for cost comparison, unit costs are based on information provided in the *County of Fairfax DPWES Land Development Services 2010 Comprehensive Unit Price Schedule* and the *Fairfax County Cost Templates for 2010 Watershed Management Plans*. Specific unit cost information is provided in Table 5-4.

Table 5-4. Project Component Unit Cost Summary

CATEGORY	UNIT	UNIT PRICE
Storm sewer inlet	EACH	$5,000
Tree box filter	EACH	$10,000
Pervious pavement	SY	$100
Bioretention	SY	$150
Rain barrels	GALLON	$1.50
15” Class IV RCP	LF	$49
18” Class IV RCP	LF	$60
24” Class IV RCP	LF	$87
30” Class IV RCP	LF	$107
Stream restoration	LF	$300
Clear and grub (stream rest)	ACRE	$10,000
Plantings (stream rest)	ACRE	$25,000

For each individual project, a base construction cost was computed. Percentages for the items shown in Table 5-5 were then added into the base construction cost and rounded to the nearest ten thousand dollars to determine the estimated planning level project cost. The cost estimates for each of the projects are pre-conceptual estimates for general budgeting purposes only. The planning level estimates are not engineering estimates. Stream restoration costs do not include 5% of base cost for plantings since planting cost is based on acreage.

Table 5-5. Summary of Project Cost Factors[15]

1	**Base Cost**	**Base Cost**
2	Mobilization	+ 5% of Base Cost
3	Plantings	+ 5% of Base Cost
4	Ancillary Items	+ 5% of Base Cost
5	Erosion and Sediment Control	+ 10% of Base Cost
6		**= Subtotal 1 (Sum 1-5)**
7	Contingency	+ 25% of Subtotal 1
8		**= Subtotal 2 (Sum of 6 & 7)**
9	Engineering Design, Surveys, Land Acquisition, Utility Relocations and Permits	+ 45% of Subtotal 2
10		**= Total (Sum of 8 & 9)**
11	**Total Cost**	**Estimated Planning Level Project Cost (Item 10 Rounded to Nearest $10,000)**

[15] Assumptions
1. Existing inlets capture 100% of the runoff and there is no bypass flow.
2. Estimate of storm sewer inlets placement based on 0.5 acres per inlet.
3. Tree box filters are determined based on drainage area and percent impervious: highly impervious areas (streets, C=0.90) placed every 0.5 acres; residential areas (yards and streets, C=0.50) placed every 1 acre.

Table 5-6 shows each project and its associated safety rank, impervious acres treated, total cost, cost per acre treated, and water quality ranking.

Table 5-6. Summary of Safety and Water Quality Rankings

Site ID#	Safety Rank	Impervious Acres Treated	Cost	Cost Per Acre Treated	Water Quality Rank
FMR-1A	**4**	1.1	$120,000	$106,195	2
FMR-2	**2**	2.6	$550,000	$214,008	10
FMR-3	**5**	0.2	$210,000	$1,094,400	18
FMR-4	**3**	1.1	$300,000	$272,727	12
FMR-5A and FMR-5B[16]	**2**	4.0	$750,000	$186,567	6
FMR-6	**5**	1.2	$1,220,000	$1,059,657	17
FMR-9	**2**	0.2	$180,000	$1,172,571	19
TR-1A	**3**	1.0	$130,000	$136,842	4
TR-2	**4**	0.1	$30,000	$272,727	13
TR-3	**4**	0.3	$30,000	$98,684	1
TR-4B	**1**	0.2	$65,000	$276,596	14
TR-5	**4**	2.2	$240,000	$110,092	3
TR-6	**1**	2.8	$540,000	$191,489	7
TR-7	**1**	2.0	$400,000	$200,000	8
TR-8	**3**	2.0	$470,000	$235,000	11
TR-9	**1**	0.8	$110,000	$141,753	5
TR-10A	**3**	0.4	$171,000	$488,571	16
TR-10C	**5**	0.2	$180,000	$1,172,571	20
TR-11	**2**	1.8	$380,000	$208,791	9
TR-12A	**3**	1.4	$660,000	$486,455	15

[16] FMR-5A and FMR-5B are combined for ranking purposes since they were considered by the WAC to represent different phases of a larger project.

5.4.2 Safety and Water Quality Ranking

Using the three scoring systems, the WAC discussed each project. Where water quality, safety, and composite ranks were all either high or mid-level, the WAC agreed to include these projects in the final top 10 priority projects. Likewise, those projects that scored low or mid-level across the board were removed from consideration. The WAC then voted on the remaining projects for ranking purposes. Table 5-7 shows the ranking results as recommended by the WAC.

Table 5-7. Final Project Ranking Summary*

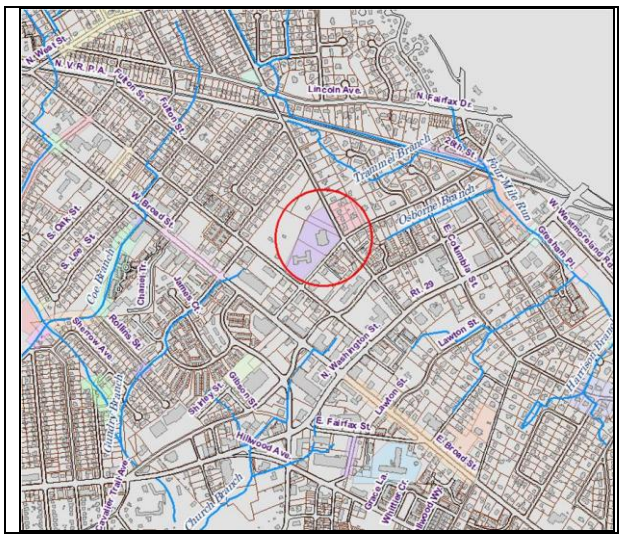
Site ID#	Description	Water Quality Rank	Safety Rank	Composite Rank	Const. Issues	Land Acquisition	Utility Conflicts	Tree Removal	WAC
FMR-5A	CITY HALL CAMPUS	6	Mid	126	Easy	No	Few	None/ Low	**Top Rank Concurred by WAC**
AND									
FMR-5B	NORTH QUADRANT LITTLE FALLS ST AND GREAT FALLS ST		Top	67	Moderate		Many	Few	**FMR-5A and 5B Planned Concurrently**
FMR-2	COLUMBIA AND UNDERWOOD STREETS	10	Mid	104	Easy	No	Few	None/ Low	**Top Rank Concurred by WAC**
TR-11	WEST BROAD ST BEWTEEN VIRGINIA AND PENNSYLVANIA	9	Top	96	Easy	No	Many	None/ Low	**Top Rank Concurred by WAC**
TR-1A	DOUGLASS AVE AND HILLWOOD AVE-EASTERN SIDE OF SHOPPING CENTER	4	Mid	92	Easy	No	Few	None/ Low	**Top Rank Concurred by WAC**
TR-7	EAST BROAD BETWEEN WASHINGTON AND CHERRY STREETS	8	Top	89	Easy	No	Many	Few	**Top Rank Concurred by WAC**
TR-6	WEST BROAD AND FALLS AVE	7	Mid	83	Easy	No	Few	None/ Low	**Top Rank Concurred by WAC**
TR-3	DRAINAGE AT WESTMORELAND ROAD AND TRIPPS RUN RESTORATION	1	Low	79	Easy	No	None/Low	None/ Low	**Top Rank by WAC Vote (9)**

Site ID#	Description	Water Quality Rank	Safety Rank	Composite Rank	Const. Issues	Land Acquisition	Utility Conflicts	Tree Removal	WAC
TR-4B	WEST BROAD ST AND NORTH SPRING ST	15	Top	79	Easy	No	None/Low	None/ Low	**Top Rank by WAC Vote (6)**
FMR-9	HARRISON BRANCH OUTFALL AND FOUR MILE RUN	20	Top	54	Easy	No	Few	Few	**Top Rank by WAC Vote (6)**
FMR-4	COLUMBIA AND NOLAND STREETS	13	Mid	91	Easy	No	Few	None/ Low	**Top Rank by WAC Vote (2)**
TR-10A	HILLWOOD AVE BETWEEN CLEAVE DR AND EAST BROAD ST	17	Mid	77	Easy	No	Many	None/ Low	**Top Rank by WAC Vote (2)**
TR-8	HIGHLAND AVE AND WEST ST INTERSECTION DRAINAGE	11	Low	76	Easy	No	None/Low	None/ Low	**Low Rank by WAC Vote (1)**
TR-5	OAK ST BETWEEN BROAD AND PARK	3	Low	92	Easy	No	Few	None/ Low	**Low Rank by WAC Vote (1)**
TR-12A	GROVE AVE BETWEEN CITY LINE AND W&OD TRAIL	16	Low	86	Easy	Yes	Few	Few	**Low Rank by WAC Vote (None)**
TR-9	ROOSEVELT BLVD AND WILSON BLVD	5	Top	120	Easy	No	Many	Few	**Low Rank by WAC Vote (None)**
TR-2	HILLWOOD AVE AND LINDEN LANE	14	Low	49	Easy	No	Few	None/ Low	**Removal from Consideration Concurred by WAC**
FMR-1A	VAN BUREN ST DRAINAGE BETWEEN VILLA RIDGE AND UNDERWOOD	2	Low	38	Moderate	Yes	Many	Few	**Removal from Consideration Concurred by WAC**
FMR-6	TRAMMEL BRANCH DAYLIGHTING BETWEEN W&OD TRAIL AND 26TH ST	18	Low	26	Moderate	Yes	Many	Few	**Removal from Consideration Concurred by WAC**

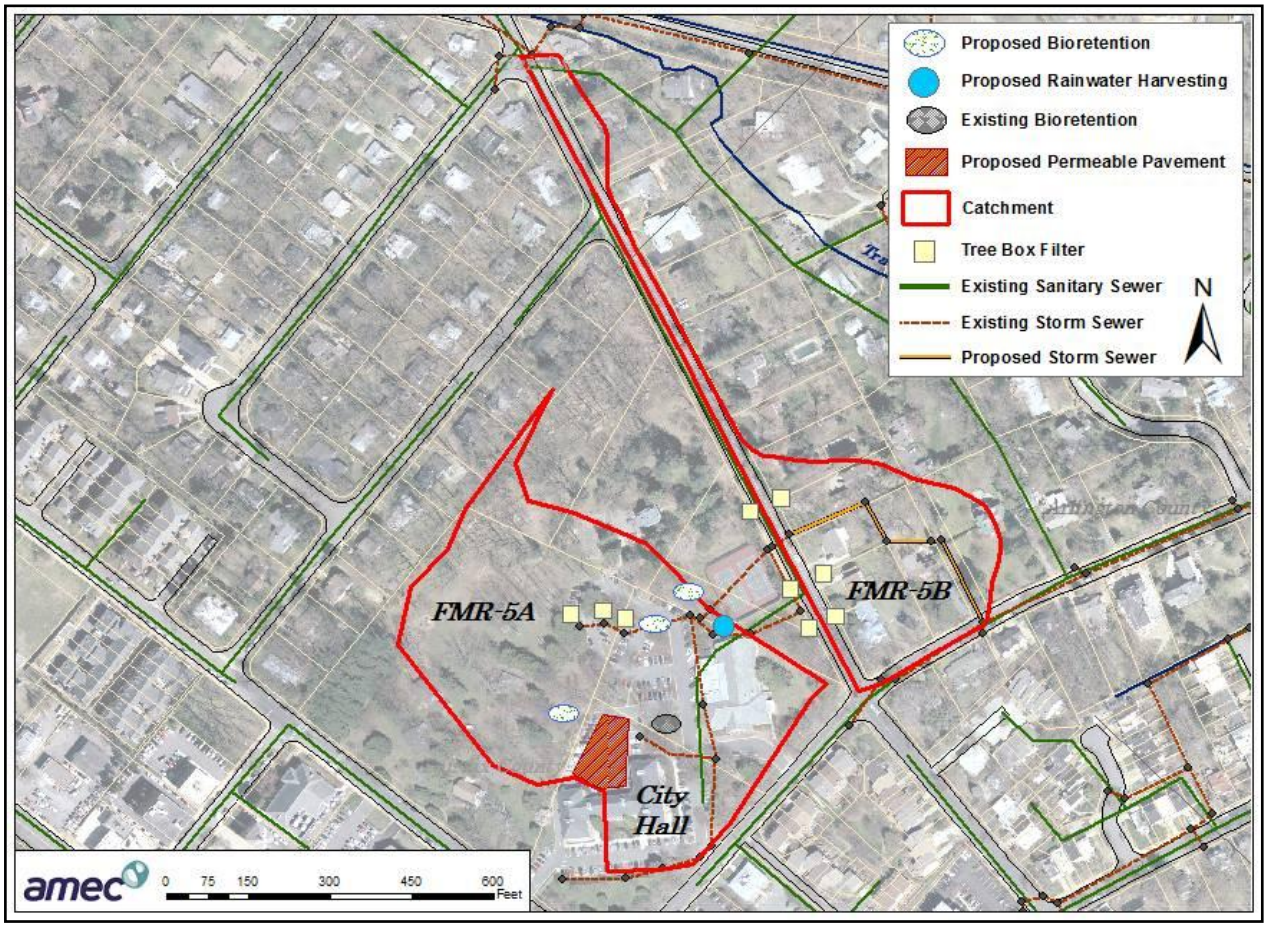
Site ID#	Description	Water Quality Rank	Safety Rank	Composite Rank	Const. Issues	Land Acquisition	Utility Conflicts	Tree Removal	WAC
FMR-3	FOUR MILE RUN STREAM CULVERT AT VAN BUREN	19	Low	25	Difficult	Yes	Few	Many	**Removal from Consideration Concurred by WAC**
TR-10C	HILLWOOD AVE OUTFALL STABILIZATION	21	Low	15	Difficult	Yes	Few	Many	**Removal from Consideration Concurred by WAC**

5.5 Project Data Sheets

PROJECT DATA SHEET
FMR-5A AND 5B



Address	300 Park Avenue 300-306 Great Falls Street 307 Little Falls Street
Location	City Hall Campus; Northeast Quadrant Great Falls and Little Falls Street
Land Owner	City of Falls Church (FMR-5A); Private Property (FMR-5B)
Parcel ID	1440, 1332, 1307, 1220
Control Type	Water quality and quantity control
Drainage Area	≈7.42 acres (FMR-5A) ≈3.72 acres (FMR-5B)
Impervious Area	≈2.57 acres (35%) ≈1.45 acres (39%)



Description: This project is designed to improve water quality from a large area of uncontrolled impervious surface cover by promoting stormwater infiltration and to mitigate roadway and backyard flooding in the northeast quadrant of the intersection of Great Falls Street and Little Falls Street caused by large volumes of water from City Hall campus and Great Falls Street. FMR-5A already has an area of permeable pavement and a bioretention facility to promote infiltration and improve water quality. Further improvements at City Hall may help reduce localized drainage and flooding problems. As a result, it is recommended that the projects be planned together so that the impact of any improvements at FMR-5A on baseline conditions at FMR-5B can be assessed.

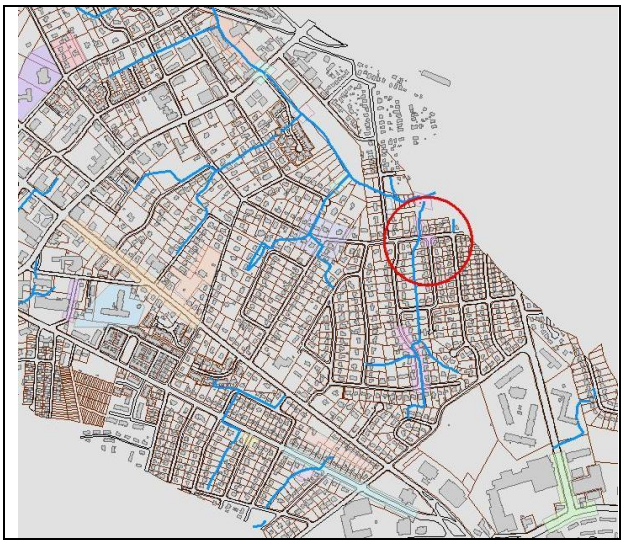
Specific project components include:

- Retrofit medians in the parking lot and the open area near the tennis court with bioretention facilities.
- Retrofit the buildings near the tennis courts with a cistern for rainwater harvesting to reduce the flow of runoff.
- Locate tree box filters and additional bioretention along the perimeter of the employee lot.
- Integrate permeable pavers in several areas of the parking lot to promote infiltration.
- Locate tree box filters along Great Falls Street.
- Replace and increase the capacity of storm sewers located in the northeast quadrant of Great Falls Street and Little Falls Street.

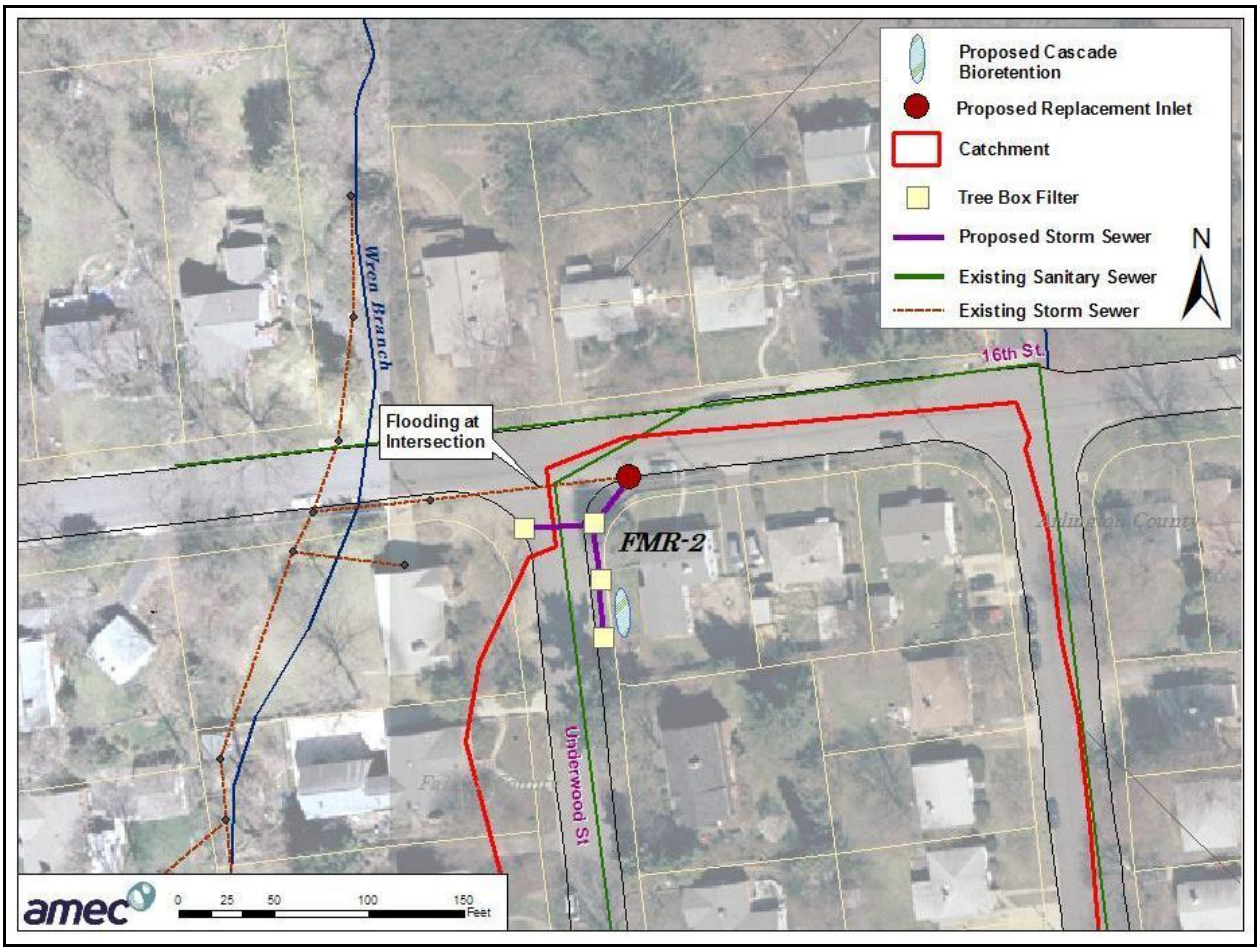
FMR-5A and 5B Planning Level Cost

Items	Quantity	Quantity Units	Unit Cost	Total
FMR-5A				
Storm sewer length (15”)	100	Ft	$49	$4,900
# of Inlets	0	EA	$5,000	$0
# of Tree Box Filters	4	EA	$10,000	$40,000
Bioretention	750	SY	$150	$112,500
Rainwater Harvesting	1	EA	$4,000	$4,000
Permeable Pavement	500	SY	$100	$50,000
FMR-5B				
Storm sewer length (18”)	1000	Ft	$60	$60,000
# of Inlets	4	EA	$5,000	$20,000
# of Tree Box Filters	4	EA	$10,000	$40,000
Base Construction Cost FMR 5A/5B (Subtotal 1)				**$331,400**
Mobilization (5%)				$16,570
Plantings (5%)				$16,570
Ancillary Items (5%)				$16,570
Erosion and Sediment Controls (10%)				$33,140
Subtotal 2				**$414,250**
Contingency (25%)				$103,562.50
Subtotal 3				**$517,812.50**
Engineering, Design, Surveys, Utility Relocation and Permits (45%)				$233,015.63
Total				**$750,828.13**
Estimated Planning Level Project Cost				**$750,000**

PROJECT DATA SHEET
FMR-2



Address	6608 16th St. & 323 N Underwood St
Location	Columbia and Underwood Streets
Landowner	City of Falls Church
Parcel ID	2771, 2784
Control Type	Water quality and quantity control
Drainage Area	≈8 acres
Impervious Area	≈2.57 acres (32%)

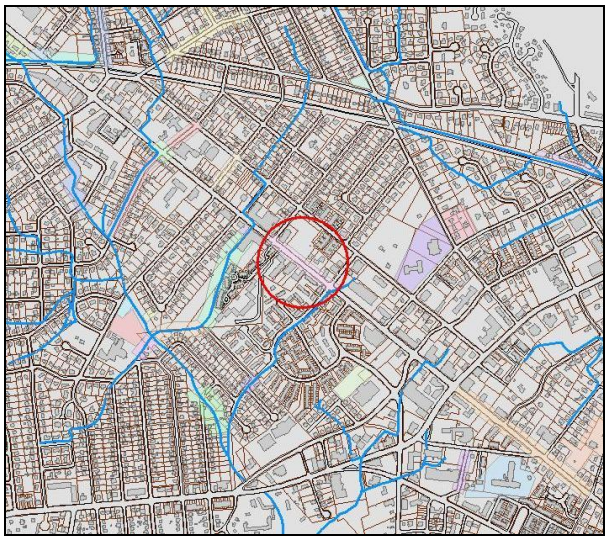


Description: This project is designed to control flooding at the intersection of Columbia Street and Underwood Street. The existing inlet along Columbia Street is in poor condition and needs to be replaced as per design capacity. Additional inlets need to be installed on Underwood Street to alleviate flooding. All inlets can be retrofitted with tree box filters to improve water quality from this relatively large drainage shed.

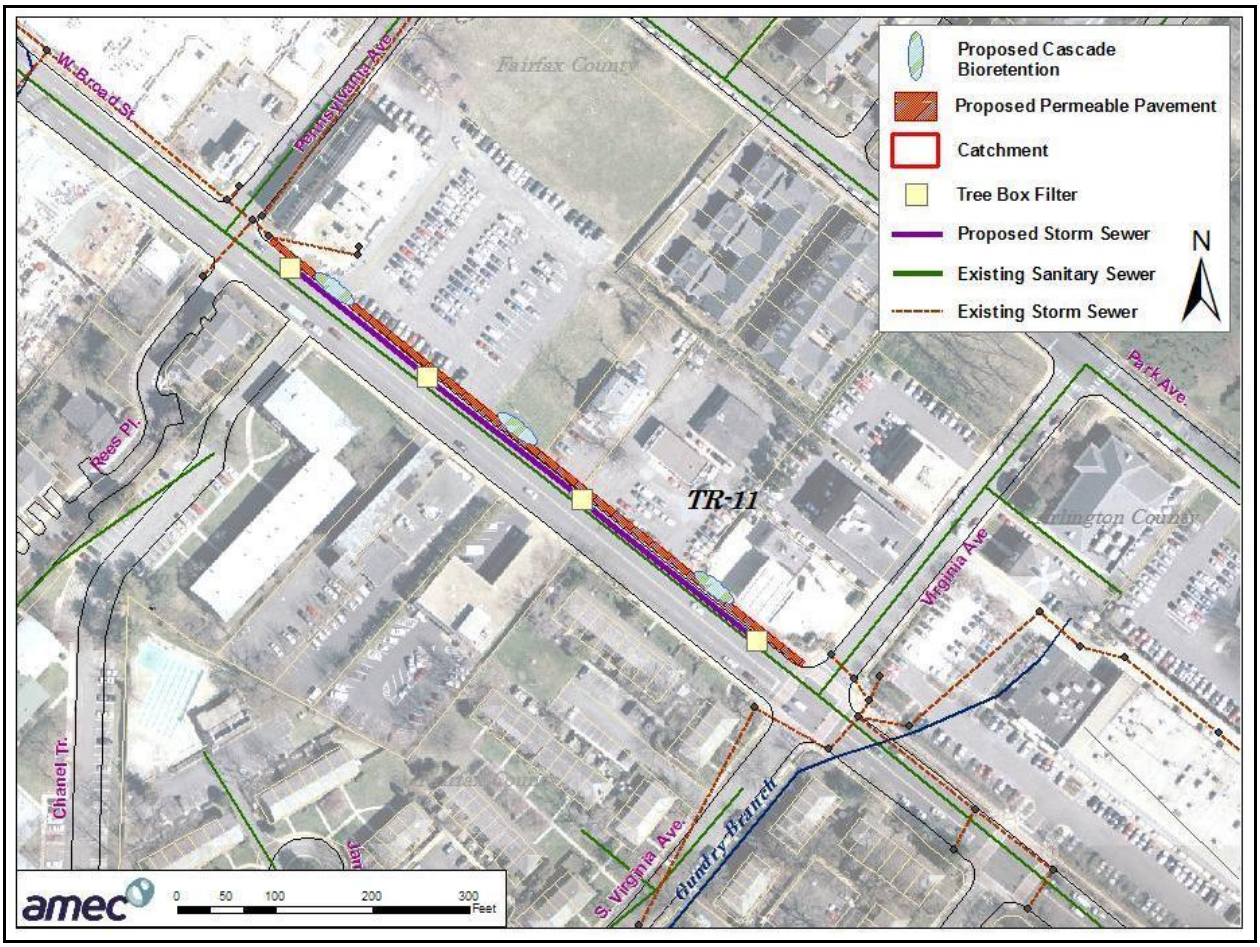
FMR-2 Planning Level Cost

Items	Quantity	Quantity Units	Unit Cost	Total
Storm sewer length	1650	Ft	$49	$80,850
# of Inlets	16	EA	$5,000	$80,000
# of Tree Box Filters	8	EA	$10,000	$80,000
Bioretention	0	SY	$150	$0
Rainwater Harvesting	0	EA	$4,000	$0
Permeable Pavement	0	SY	$100	$0
Stream Restoration	0	LF	$300	$0
Planting (stream restoration only)	0	AC	$25,000	$0
Clear and Grub	0	AC	$10,000	$0
Base Construction Cost (Subtotal 1)				**$240,850**
Mobilization (5%)				$12,043
Plantings (5%)				$12,043
Ancillary Items (5%)				$12,043
Erosion and Sediment Controls (10%)				$24,085
Subtotal 2				**$301,062.50**
Contingency (25%)				$75,265.63
Subtotal 3				**$376,328.13**
Engineering, Design, Surveys, Utility Relocation and Permits (45%)				$169,347.66
Total				**$545,675.78**
Estimated Planning Level Project Cost				**$550,000**

PROJECT DATA SHEET
TR-11



Address	400, 402, 412, 444 & 450 West Broad Street
Location	West Broad Street between Virginia and Pennsylvania
Land Owner	City of Falls Church
Parcel ID	1553, 1456, 1431, 1242
Control Type	Water quality and quantity control
Drainage Area	≈2.0 acres
Impervious Area	≈1.82 acres (91%)



Description: This project is designed to reduce sheet flow during storms on Broad Street due to lack of stormwater inlets. There are no inlets from Virginia Avenue to the intersection at Pennsylvania Avenue. In addition, some existing inlets are undersized. The project is an opportunity to improve water quality from a highly impervious area.

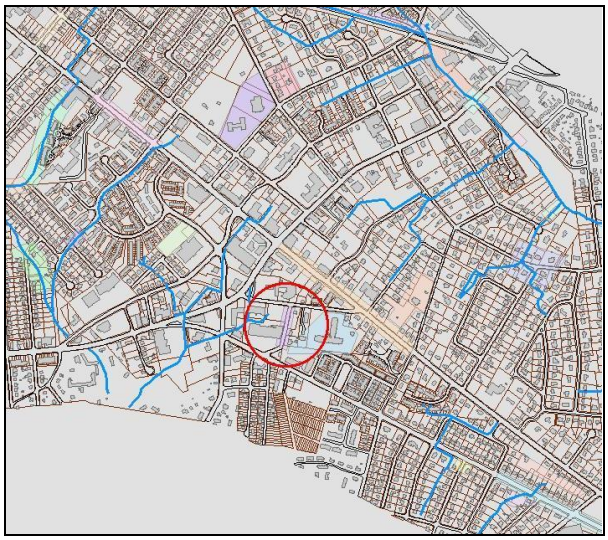
Specific project components include:

- Reduce flooding and improve water quality by adding drainage inlets in combination with tree box filters.
- Replace sidewalk pavement with permeable pavers.
- Retrofit existing island with cascade bioretention (see page 5-20 for an example).

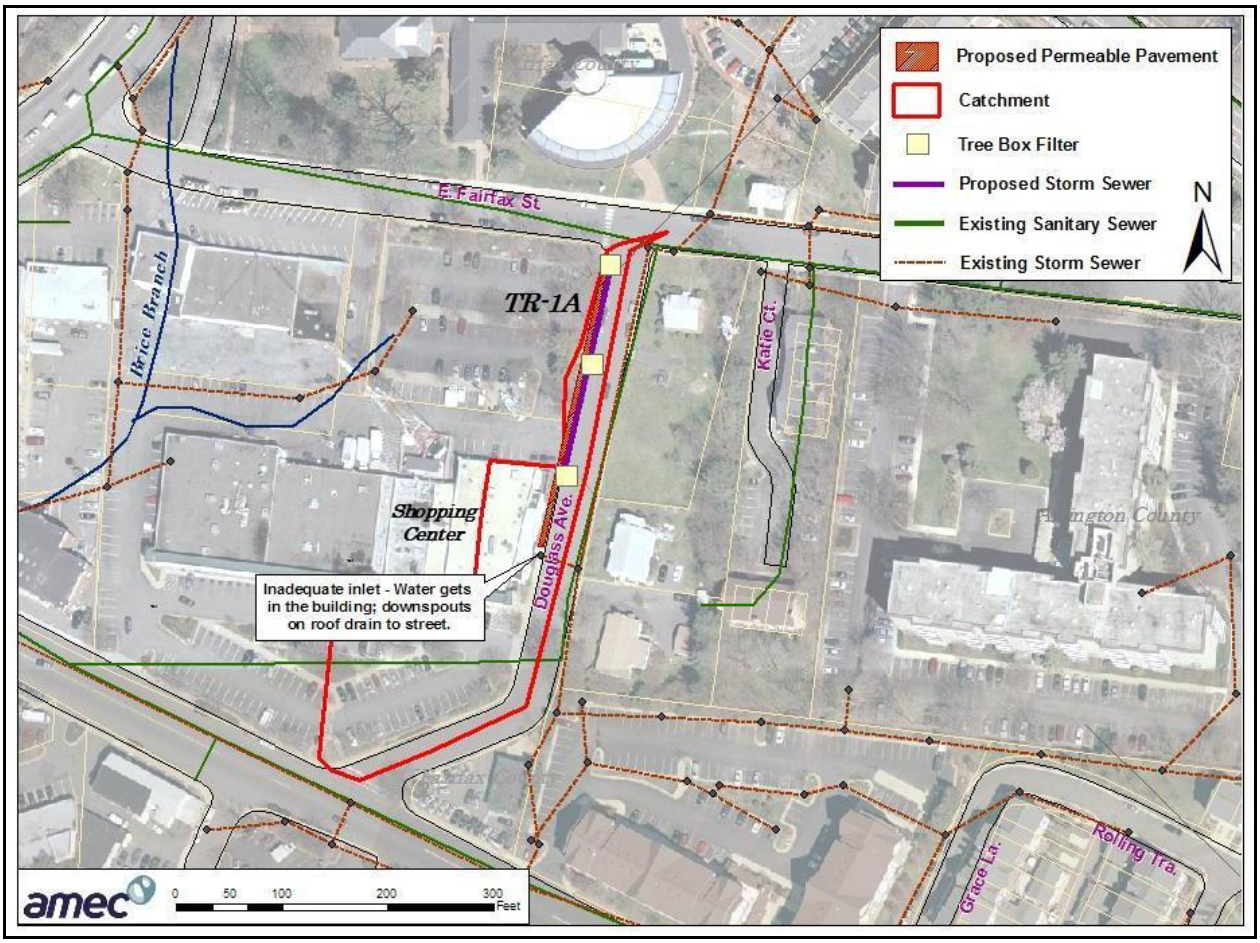
TR-11 Planning Level Cost

Items	Quantity	Quantity Units	Unit Cost	Total
Storm sewer length	600	Ft	$87	$52,200
# of Inlets	4	EA	$5,000	$20,000
# of Tree Box Filters	4	EA	$10,000	$40,000
Bioretention	100	SY	$150	$15,000
Rainwater Harvesting	0	EA	$4,000	$0
Permeable Pavement	400	SY	$100	$40,000
Stream Restoration	0	LF	$300	$0
Planting (stream restoration only)	0	AC	$25,000	$0
Clear and Grub	0	AC	$10,000	$0
Base Construction Cost (Subtotal 1)				**$167,200**
Mobilization (5%)				$8,360
Plantings (5%)				$8,360
Ancillary Items (5%)				$8,360
Erosion and Sediment Controls (10%)				$16,720
Subtotal 2				**$209,000**
Contingency (25%)				$52,250
Subtotal 3				**$261,250**
Engineering, Design, Surveys, Utility Relocation and Permits (45%)				$117,562.50
Total				**$378,812.50**
Estimated Planning Level Project Cost				**$380,000**

PROJECT DATA SHEET
TR-1A



Address	155 Hillwood Avenue
Location	Douglass and Hillwood Avenues – Eastern side of Shopping Center
Land Owner	City of Falls Church
Parcel ID	3076, 3098, 3106, 3207, 3320, 3392
Control Type	Water quality and quantity control
Drainage Area	≈1.09 acres
Impervious Area	≈0.95 acres (87%)



Description: This project is designed to address a capacity issue where stormwater runoff jumps the curb and floods neighboring properties. The project also presents an opportunity to improve water quality in this highly impervious area.

Specific project components include:

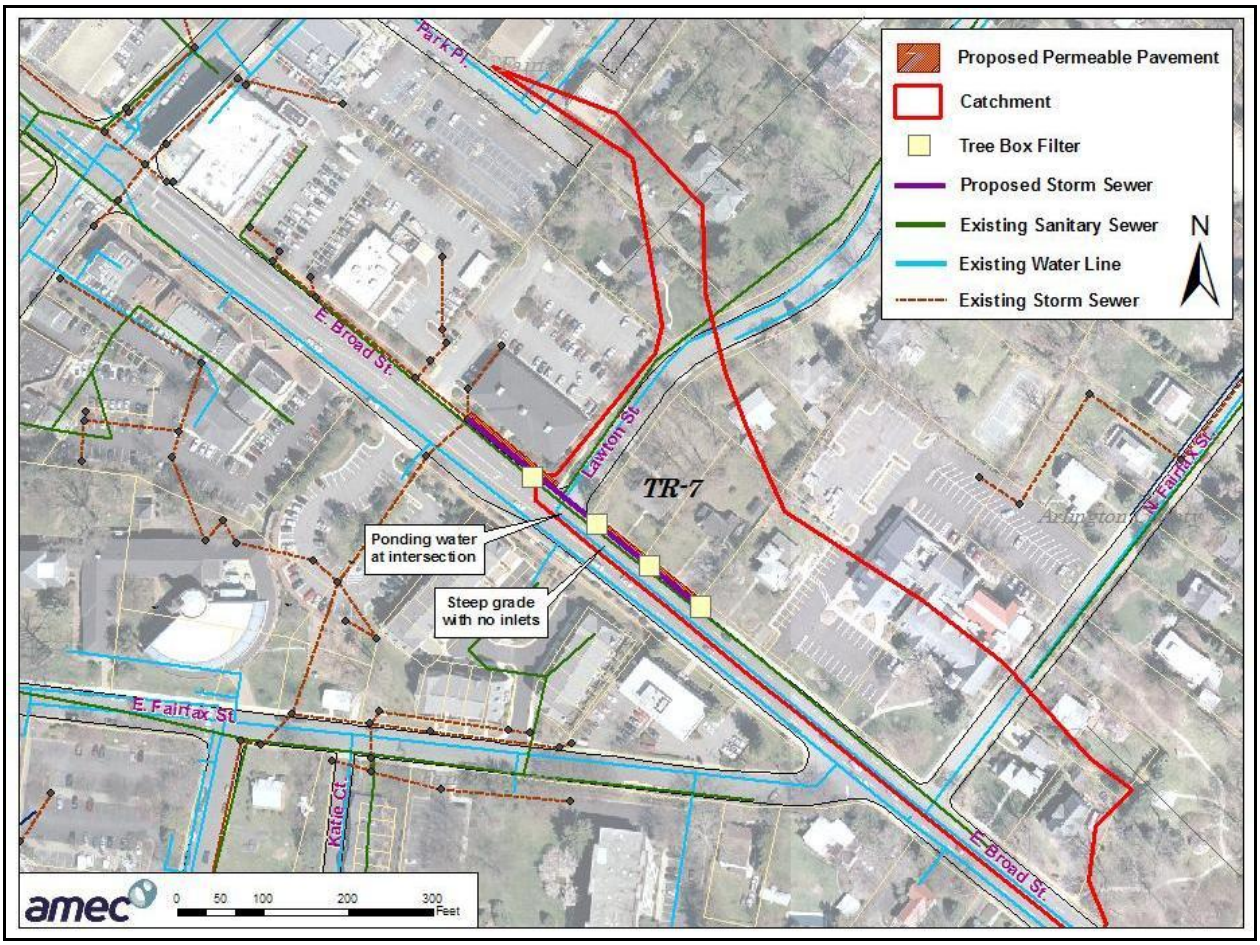
- New storm drain and inlets along Douglass Avenue.
- Retrofit of existing inlets and outfitting of new inlets with tree box filters to improve water quality.
- Integration of permeable pavers in sidewalk area along the west side of Douglass Avenue to reduce runoff.

TR-1A Planning Level Cost

Items	Quantity	Quantity Units	Unit Cost	Total
Storm sewer length	300	Ft	$49	$14,700
# of Inlets	2	EA	$5,000	$10,000
# of Tree Box Filters	2	EA	$10,000	$20,000
Bioretention	0	SY	$150	$0
Rainwater Harvesting	0	EA	$4,000	$0
Permeable Pavement	130	SY	$100	$13,000
Stream Restoration	0	LF	$300	$0
Planting (stream restoration only)	0	AC	$25,000	$0
Clear and Grub	0	AC	$10,000	$0
Base Construction Cost (Subtotal 1)				**$57,700**
Mobilization (5%)				$2,885
Plantings (5%)				$2,885
Ancillary Items (5%)				$2,885
Erosion and Sediment Controls (10%)				$5,770
Subtotal 2				**$72,125**
Contingency (25%)				$18,031.25
Subtotal 3				**$90,156.25**
Engineering, Design, Surveys, Utility Relocation and Permits (45%)				$40,570.31
Total				**$130,726.56**
Estimated Planning Level Project Cost				**$130,000**

PROJECT DATA SHEET
TR-7

Address	131, 201 – 303 East Broad Street
Location	East Broad between Washington and Cherry Streets
Land Owner	City of Falls Church
Parcel ID	3112, 3070, 2907, 2809, 2872, 2830, 2791, 2628
Control Type	Water quality and quantity control
Drainage Area	≈4.02 acres
Impervious Area	≈2 acres (50 %)

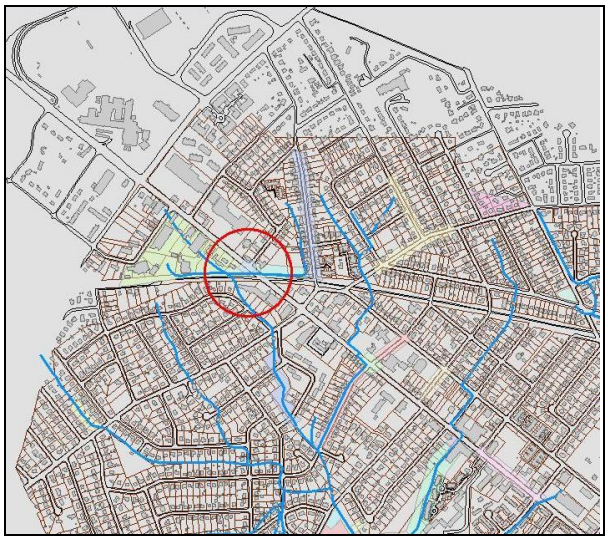


Description: This project is designed to address standing water issues at the low spot on Lawton Street. The entire area between Washington and Cherry is subject to excess sheet flow due to lack of inlets. The East Broad Street intersection problem will be fixed by adding more drainage inlets along the road and the low spot location. The addition of drainage inlets will reduce flooding and the spread causing hydroplane for vehicles. To provide water quality improvement, the drainage inlets can be combined with tree box filters. The sidewalks along the streets can also be replaced with permeable pavers to provide stormwater infiltration.

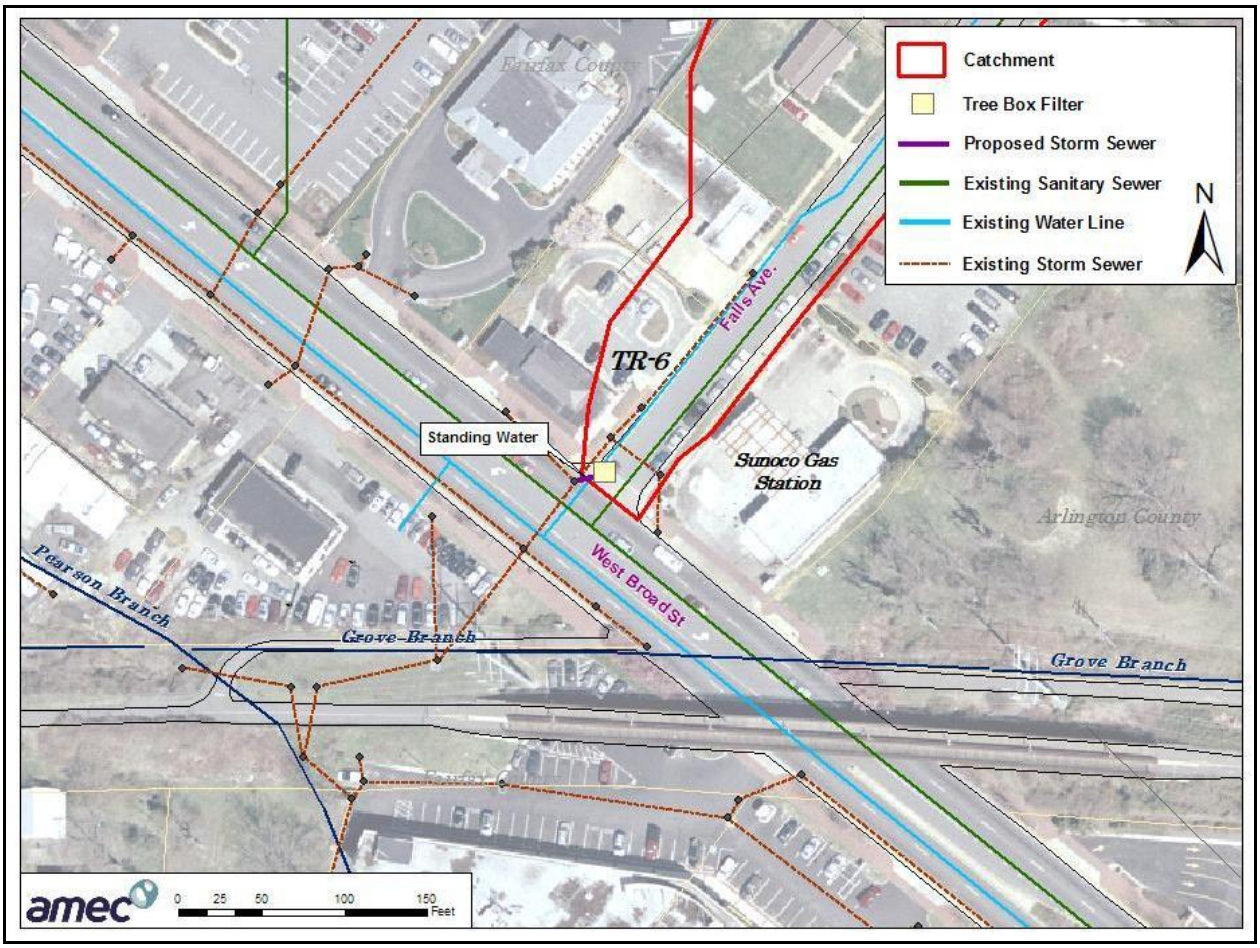
TR-7 Planning Level Cost

Items	Quantity	Quantity Units	Unit Cost	Total
Storm sewer length	1000	Ft	$60	$60,000
# of Inlets	8	EA	$5,000	$40,000
# of Tree Box Filters	4	EA	$10,000	$40,000
Bioretention	0	SY	$150	$0
Rainwater Harvesting	0	EA	$4,000	$0
Permeable Pavement	350	SY	$100	$35,000
Stream Restoration	0	LF	$300	$0
Planting (stream restoration only)	0	AC	$25,000	$0
Clear and Grub	0	AC	$10,000	$0
Base Construction Cost (Subtotal 1)				**$175,000**
Mobilization (5%)				$8,750
Plantings (5%)				$8,750
Ancillary Items (5%)				$8,750
Erosion and Sediment Controls (10%)				$17,500
Subtotal 2				**$218,750**
Contingency (25%)				$54,687.50
Subtotal 3				**$273,437.50**
Engineering, Design, Surveys, Utility Relocation and Permits (45%)				$123,046.88
Total				**$396,484.38**
Estimated Planning Level Project Cost				**$400,000**

PROJECT DATA SHEET
TR-6



Address	1050, 1100 & 1103 West Broad Street
Location	West Broad and Falls Avenue
Land Owner	City of Falls Church
Parcel ID	402, 424, 454
Control Type	Water quality and quantity control
Drainage Area	≈7.3 acres
Impervious Area	≈2.8 acres (38%)

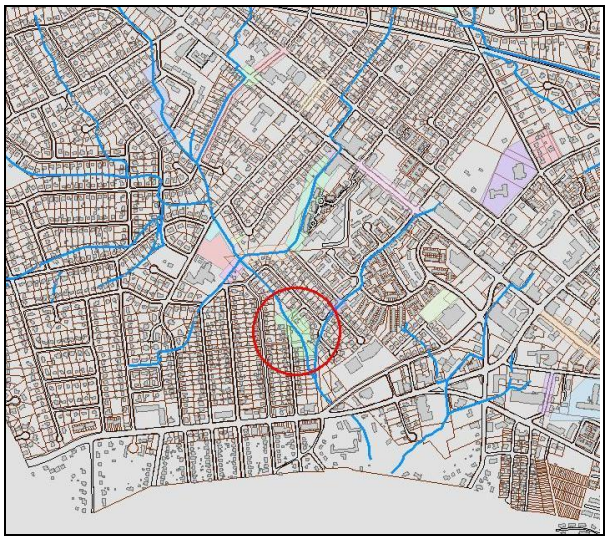


Description: This project is designed to address standing water in the intersection of West Broad Street and Falls Avenue. The addition of a drainage inlet near the West Broad and Falls Avenue intersection will help resolve standing water issues. In addition, inclusion of a tree box filter will provide water quality benefit for this highly impervious area.

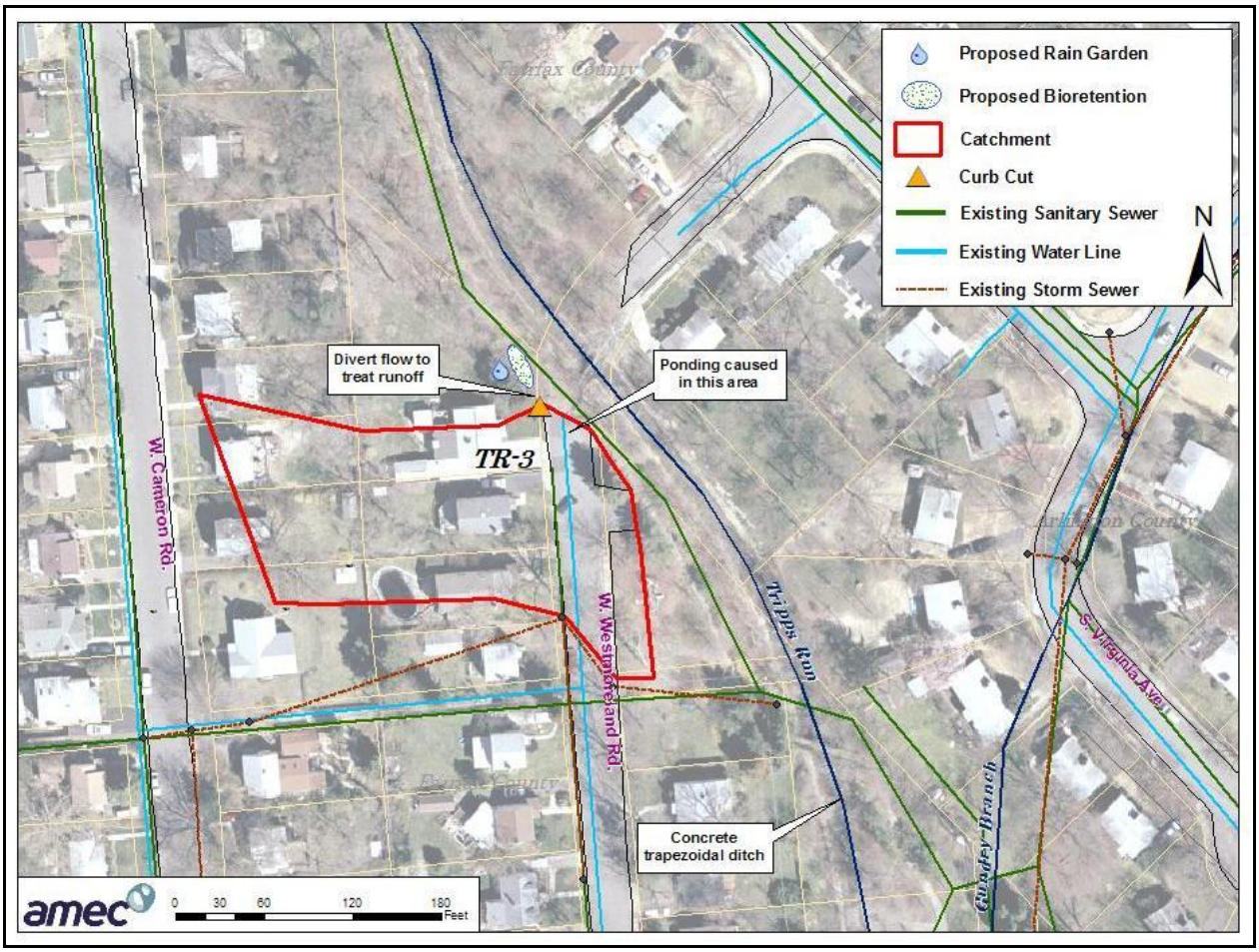
TR-6 Planning Level Cost

Items	Quantity	Quantity Units	Unit Cost	Total
Storm sewer length	1300	Ft	$60	$78,000
# of Inlets	16	EA	$5,000	$80,000
# of Tree Box Filters	8	EA	$10,000	$80,000
Bioretention	0	SY	$150	$0
Rainwater Harvesting	0	EA	$4,000	$0
Permeable Pavement	0	SY	$100	$0
Stream Restoration	0	LF	$300	$0
Planting (stream restoration only)	0	AC	$25,000	$0
Clear and Grub	0	AC	$10,000	$0
Base Construction Cost (Subtotal 1)				**$238,000**
Mobilization (5%)				$11,900
Plantings (5%)				$11,900
Ancillary Items (5%)				$11,900
Erosion and Sediment Controls (10%)				$23,800
Subtotal 2				**$297,500**
Contingency (25%)				$74,375
Subtotal 3				**$371,875**
Engineering, Design, Surveys, Utility Relocation and Permits (45%)				$167,343.75
Total				**$539,218.75**
Estimated Planning Level Project Cost				**$540,000**

PROJECT DATA SHEET
TR-3



Address	207 W Westmoreland Road
Location	Drainage at West Westmoreland Road
Land Owner	City of Falls Church
Parcel ID	2571
Control Type	Water quality and quantity control
Drainage Area	≈0.8 acres
Impervious Area	≈0.3 acres (38%)

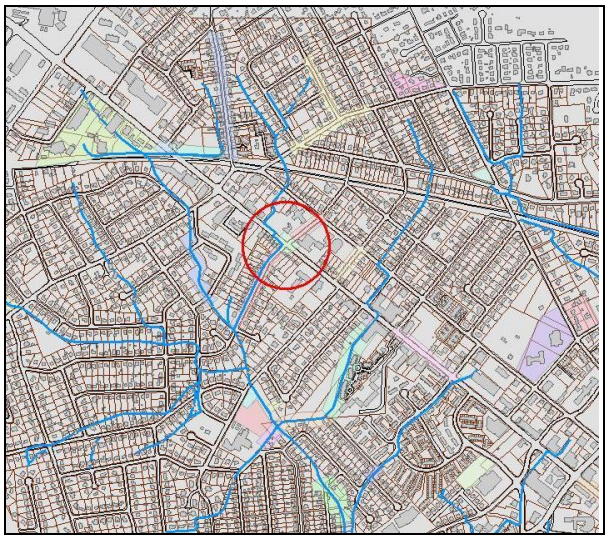


Description: This project is designed to address flooding in the street due to poor grading and no inlet. The project will also help address drainage issues identified at 207 West Westmoreland Road. Finally, the project will provide water quality benefits to this area. The project consists of diverting flow from the northwest side of West Westmoreland Road using a rock lined channel that would flow to a proposed rain garden/biofiltration facility. The entrance channel will alleviate the ponding that is occurring due to the build-up of leaves and debris at the end of West Westmoreland Road.

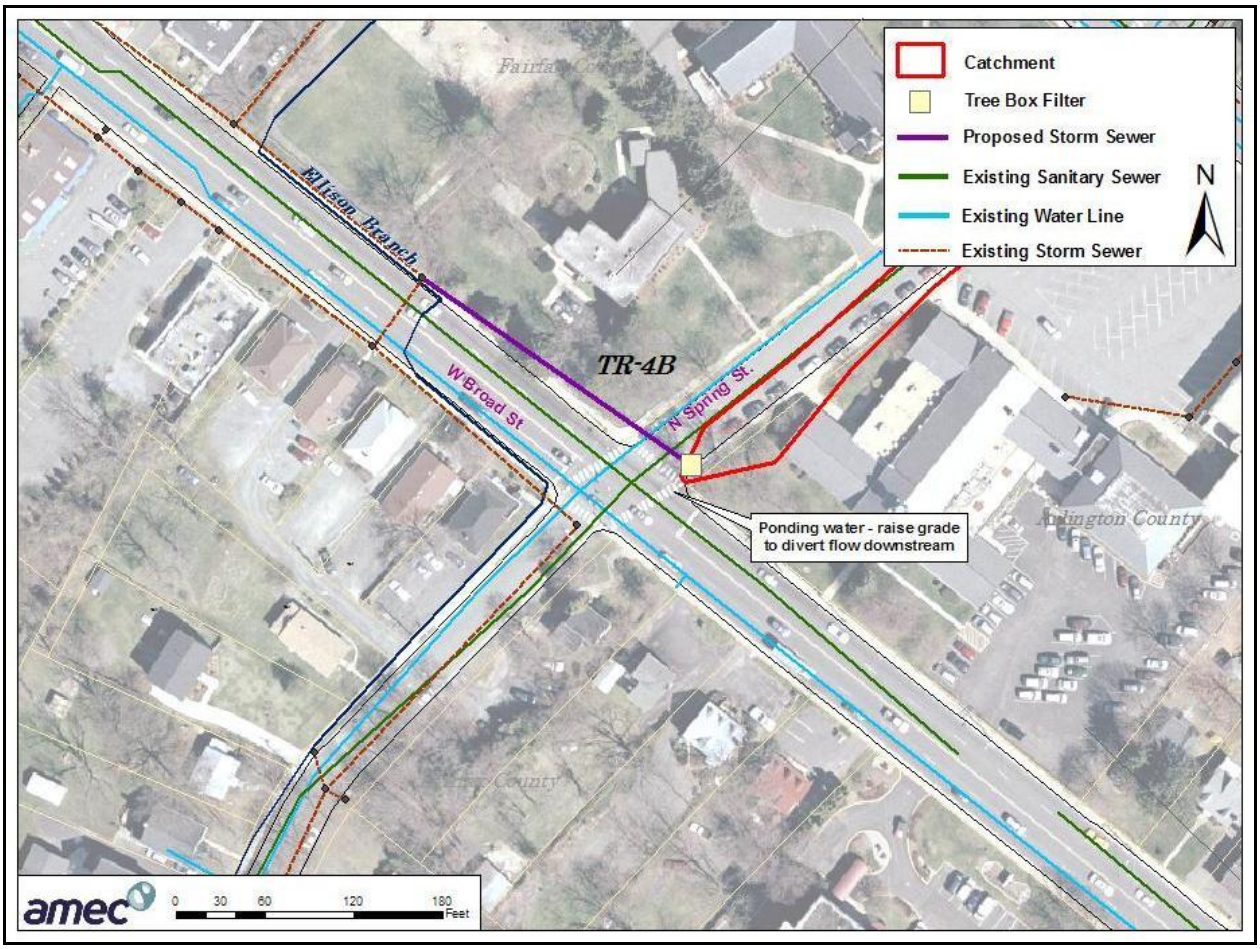
TR-3 Planning Level Cost

Items	Quantity	Quantity Units	Unit Cost	Total
Storm sewer length	0	Ft	$49	$0
# of Inlets	0	EA	$5,000	$0
# of Tree Box Filters	0	EA	$10,000	$0
Bioretention	75	SY	$150	$11,250
Rainwater Harvesting	0	EA	$4,000	$0
Permeable Pavement	0	SY	$100	$0
Stream Restoration	0	LF	$300	$0
Planting (stream restoration only)	0	AC	$25,000	$0
Clear and Grub	0	AC	$10,000	$0
Base Construction Cost (Subtotal 1)				**$11,250**
Mobilization (5%)				$562.50
Plantings (5%)				$562.50
Ancillary Items (5%)				$562.50
Erosion and Sediment Controls (10%)				$1,125
Subtotal 2				**$14,062.50**
Contingency (25%)				$3,515.63
Subtotal 3				**$17,578.13**
Engineering, Design, Surveys, Utility Relocation and Permits (45%)				$7,910.16
Total				**$25,488.28**
Estimated Planning Level Project Cost				**$30,000**

PROJECT DATA SHEET
TR-4B



Address	905 Park Avenue
Location	West Broad and North Spring Streets
Land Owner	City of Falls Church
Parcel ID	700, 799, 887, 902, 917, 949, 966
Control Type	Water quality and quantity control
Drainage Area	≈0.29 acres
Impervious Area	≈0.24 acres (83%)

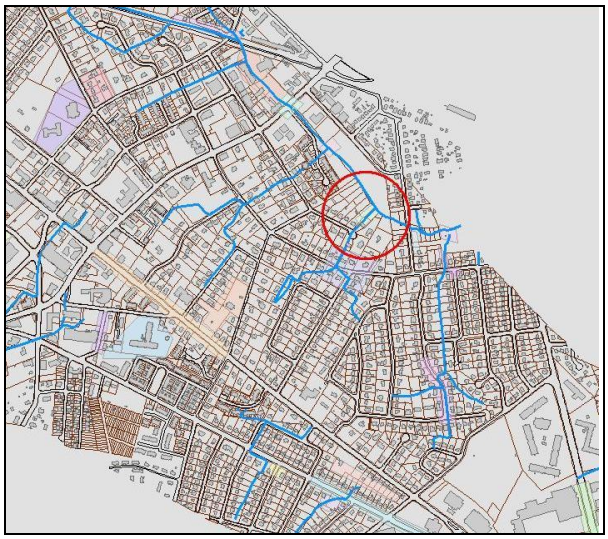


Description: This project is designed to address standing water in the intersection of West Broad Street and North Spring Street. Improvements can also be coupled with techniques to improve water quality from this highly impervious area. The project includes raising the grade near the handicap ramp at the intersection of West Broad Street and North Spring Street to divert flow downstream and prevent ponding. A drainage inlet with a tree box filter will also be added along North Spring Street to divert the flow and provide water quality benefits.

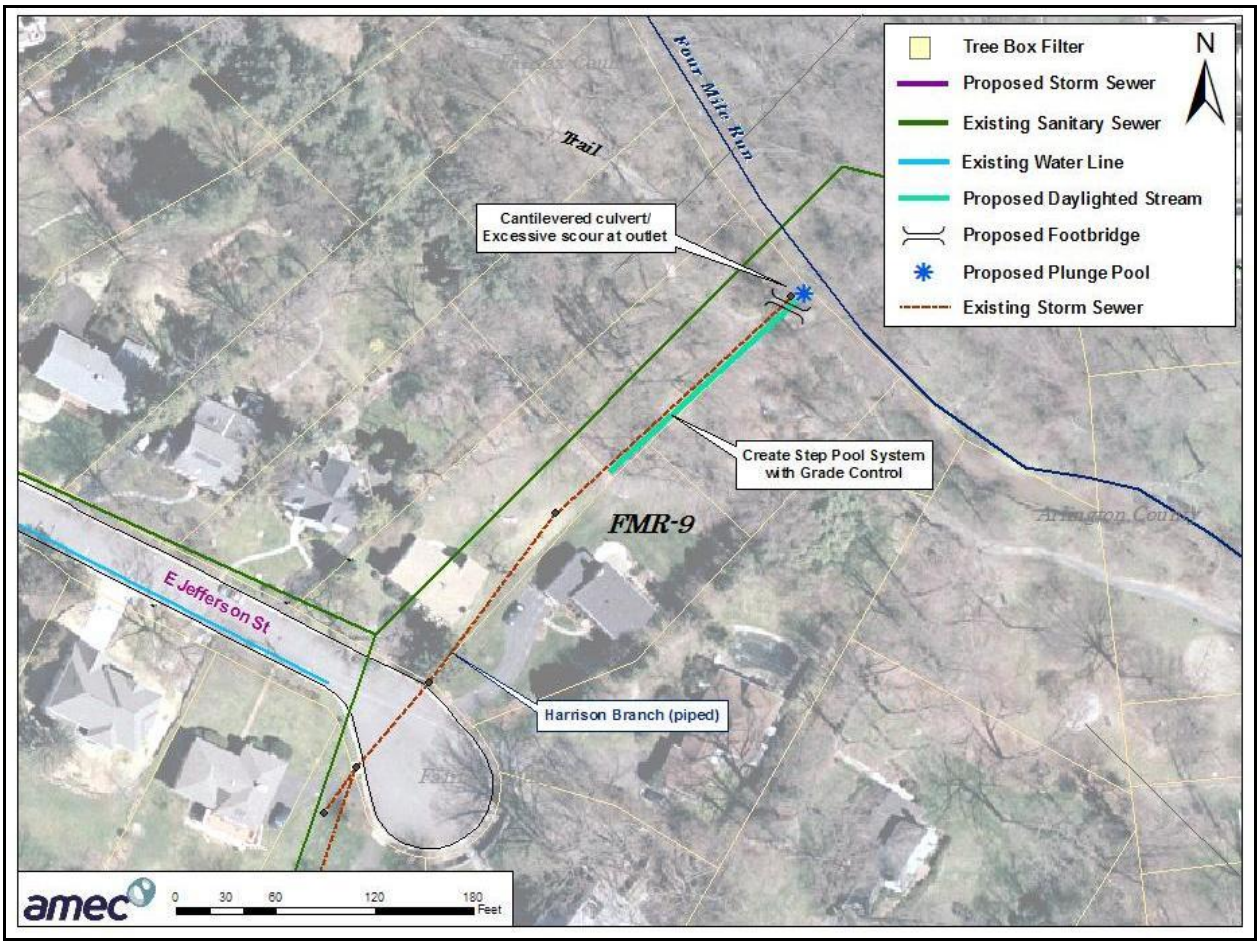
TR-4B Planning Level Cost

Items	Quantity	Quantity Units	Unit Cost	Total
Storm sewer length	225	Ft	$60	$13,500
# of Inlets	1	EA	$5,000	$5,000
# of Tree Box Filters	1	EA	$10,000	$10,000
Bioretention	0	SY	$150	$0
Rainwater Harvesting	0	EA	$4,000	$0
Permeable Pavement	0	SY	$100	$0
Stream Restoration	0	LF	$300	$0
Planting (stream restoration only)	0	AC	$25,000	$0
Clear and Grub	0	AC	$10,000	$0
Base Construction Cost (Subtotal 1)				**$28,500**
Mobilization (5%)				$1,425
Plantings (5%)				$1,425
Ancillary Items (5%)				$1,425
Erosion and Sediment Controls (10%)				$2,850
Subtotal 2				**$35,625**
Contingency (25%)				$8,906.25
Subtotal 3				**$44,531.25**
Engineering, Design, Surveys, Utility Relocation and Permits (45%)				$20,039.06
Total				**$64,570.31**
Estimated Planning Level Project Cost				**$65,000**

PROJECT DATA SHEET
FMR-9



Address	419 East Jefferson Street
Location	Harrison Branch Outfall and Four Mile Run
Land Owner	City of Falls Church
Parcel ID	4141, 4152, 4217, 4258, 4265, 4273
Control Type	Water quality and quantity control
Drainage Area	≈73 acres
Impervious Area	≈23 acres (32%)

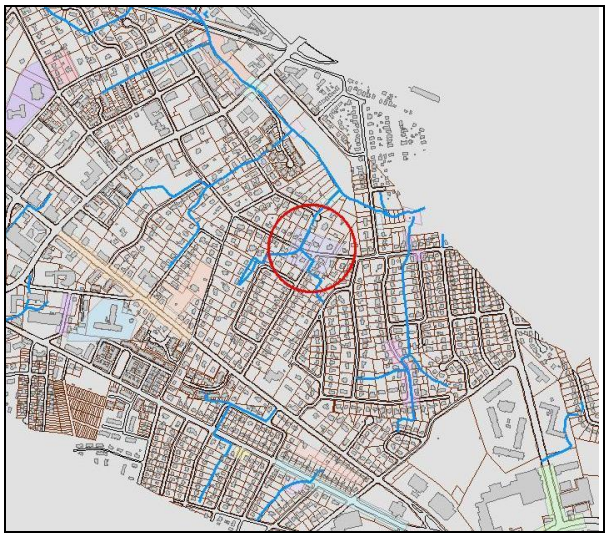


Description: This project is designed to improve water quality and habitat by remediating a blowout where the 48" pipe containing Harrison Branch enters Four Mile Run. The blowout contributes to total suspended solids in the water through erosion of the stream bank and outfall area. The project will day-light approximately 150 feet of pipe and will create a step pool system with grade control. The project will fix the cantilevered culvert and excessive scour at the outlet.

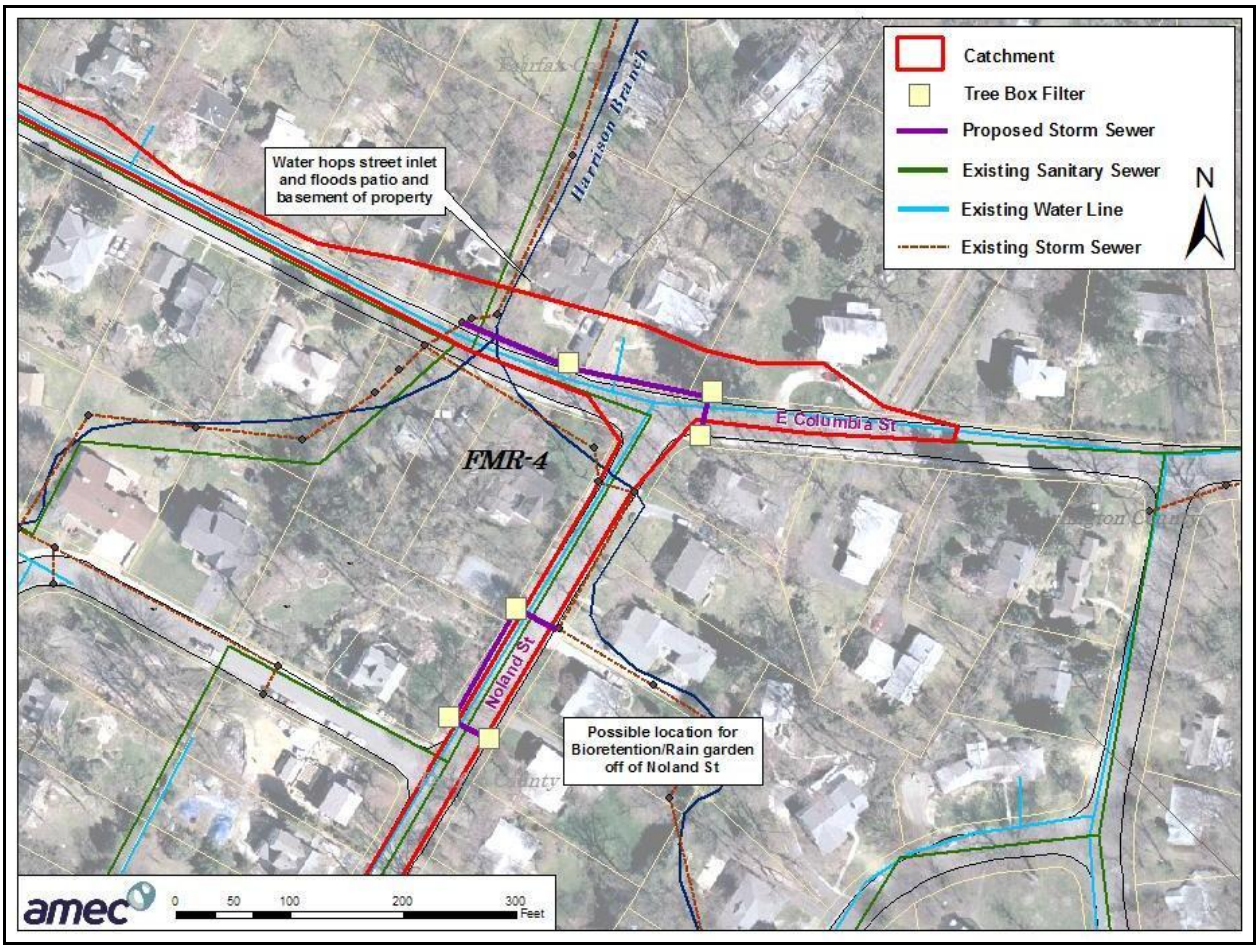
FMR-9 Planning Level Cost

Items	Quantity	Quantity Units	Unit Cost	Total
Storm sewer length	0	Ft	$49	$0
# of Inlets	0	EA	$5,000	$0
# of Tree Box Filters	0	EA	$10,000	$0
Bioretention	0	SY	$150	$0
Rainwater Harvesting	0	EA	$4,000	$0
Permeable Pavement	0	SY	$100	$0
Stream Restoration	200	LF	$300	$60,000
Planting (stream restoration only)	0.5	AC	$25,000	$12,500
Clear and Grub	0.5	AC	$10,000	$5,000
Base Construction Cost (Subtotal 1)				**$77,500**
Mobilization (5%)				$3,875
Plantings (5%)				$3,875
Ancillary Items (5%)				$3,875
Erosion and Sediment Controls (10%)				$7,750
Subtotal 2				**$96,875**
Contingency (25%)				$24,218.75
Subtotal 3				**$121,093.75**
Engineering, Design, Surveys, Utility Relocation and Permits (45%)				$54,492.19
Total				**$175,585.94**
Estimated Planning Level Project Cost				**$180,000**

PROJECT DATA SHEET
FMR-4



Address	Multiple addresses near the intersection of Columbia and Noland Streets
Location	Columbia and Noland Streets
Land Owner	City of Falls Church
Parcel ID	2611, 2771, 2798, 2881, 2756
Control Type	Water quality and quantity control
Drainage Area	≈1.62 acres
Impervious Area	≈1.1 acres (69%)

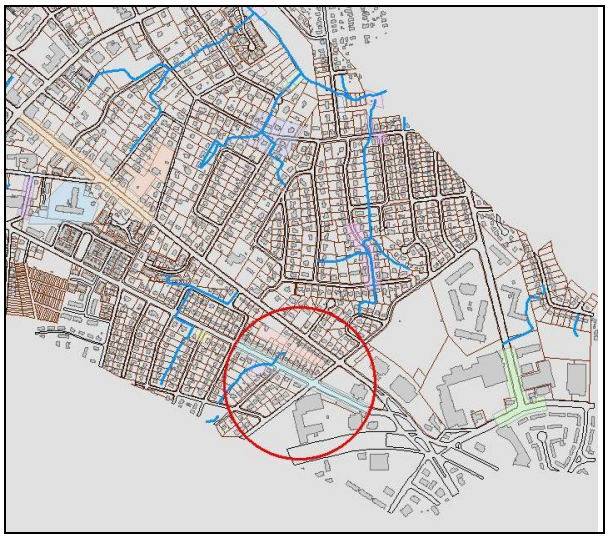


Description: This project is designed to address flooding and drainage issues for individual homes (431, 432, and 434 Columbia Street). The project will also improve water quality for this highly impervious area. The primary issue is a lack of storm sewer inlets along Noland Street and Columbia Street where the water eventually collects and overtops the inlet in front of 431 Columbia Street. This project involves the addition of new storm sewer infrastructure consisting of inlets, storm sewers, and tree box filters (to improve water quality).

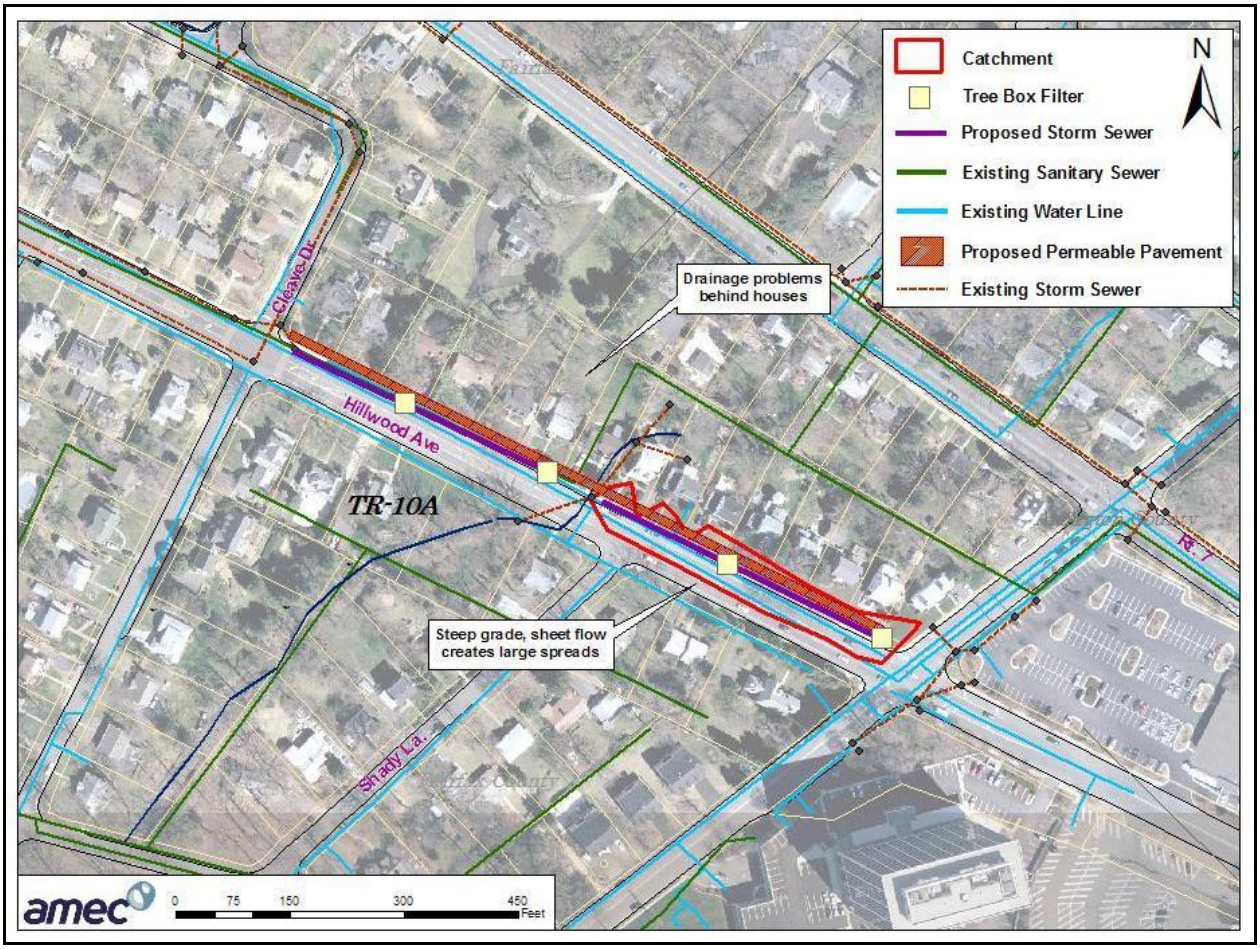
FMR-4 Planning Level Cost

Items	Quantity	Quantity Units	Unit Cost	Total
Storm sewer length	1200	Ft	$60	$72,000
# of Inlets	4	EA	$5,000	$20,000
# of Tree Box Filters	4	EA	$10,000	$40,000
Bioretention	0	SY	$150	$0
Rainwater Harvesting	0	EA	$4,000	$0
Permeable Pavement	0	SY	$100	$0
Stream Restoration	0	LF	$300	$0
Planting (stream restoration only)	0	AC	$25,000	$0
Clear and Grub	0	AC	$10,000	$0
Base Construction Cost (Subtotal 1)				**$132,000**
Mobilization (5%)				$6,600
Plantings (5%)				$6,600
Ancillary Items (5%)				$6,600
Erosion and Sediment Controls (10%)				$13,200
Subtotal 2				**$165,000**
Contingency (25%)				$41,250
Subtotal 3				**$206,250**
Engineering, Design, Surveys, Utility Relocation and Permits (45%)				$92,812.50
Total				**$299,062.50**
Estimated Planning Level Project Cost				**$300,000**

PROJECT DATA SHEET
TR-10A



Address	Multiple addresses along Hillwood Avenue
Location	Hillwood Avenue between Cleave Drive and East Broad Street
Land Owner	City of Falls Church
Parcel ID	4140, 4147, 4154, 4162, 4159, 4165, 4174, 4179, 4187, 4193, 4200, 4207, 4216, 4221, 4228
Control Type	Water quality and quantity control
Drainage Area	≈0.58 acres
Impervious Area	≈0.35 acres (60%)



Description: This project is designed to reduce excess sheet flow during storms, which causes flooding and hydroplaning along Hillwood Avenue. The project is also an opportunity to improve water quality in this highly impervious area.

Specific project components include:

- New storm sewer line and inlets on the north side of Hillwood Avenue.
- Outfit new inlets with tree box filters to improve water quality.
- Retrofit sidewalks with permeable pavers to improve water qualtiy.

TR-10A Planning Level Cost

Items	Quantity	Quantity Units	Unit Cost	Total
Storm sewer length	300	Ft	$60	$18,000
# of Inlets	2	EA	$5,000	$10,000
# of Tree Box Filters	2	EA	$10,000	$20,000
Bioretention	0	SY	$150	$0
Rainwater Harvesting	0	EA	$4,000	$0
Permeable Pavement	275	SY	$100	$27,500
Stream Restoration	0	LF	$300	$0
Planting (stream restoration only)	0	AC	$25,000	$0
Clear and Grub	0	AC	$10,000	$0
Base Construction Cost (Subtotal 1)				**$75,500**
Mobilization (5%)				$3,775
Plantings (5%)				$3,775
Ancillary Items (5%)				$3,775
Erosion and Sediment Controls (10%)				$7,550
Subtotal 2				**$94,375**
Contingency (25%)				$23,593.75
Subtotal 3				**$117,968.75**
Engineering, Design, Surveys, Utility Relocation and Permits (45%)				$53,085.94
Total				**$171,054.69**
Estimated Planning Level Project Cost				**$171,000**

6. Funding Options

The purpose of this section is to provide background on funding options for implementation of the watershed management plan, and in particular the projects identified in Section 5. Recognizing the need for significant improvements to the City's stormwater infrastructure – both to deal with aging infrastructure and state and federal regulatory requirements – the fundamental issue that the WAC was asked to address is whether the City should shift its basic philosophy for funding stormwater management. Currently, the City funds stormwater (both operations and capital) primarily through the use of the general fund. The general fund, in turn, is largely reliant on real estate taxes. In response to similar challenges, many localities nationally have shifted from using the general fund to an enterprise fund approach – similar to the way that the City now manages water and wastewater.

6.1 Overview of Current Program Costs and Revenue

Any decision concerning funding of the stormwater program must take in to consideration the City's overall budget situation. Like many localities, the City has experienced stagnant or declining tax revenue over the past few years accompanied with increasing costs. As a result, the FY 2012 budget adopted by the City Council contained several cuts to City services and increased the real estate tax from $1.24 to $1.25 per $100 of assessed property value.

The following provides budget highlights in the areas affecting stormwater management.

<u>Operating Expenditures</u>

The Department of Public Works represents approximately 8% of the City's operating budget. Overall, the FY 2012 budget decreased expenditures for DPW from $5,602,470 in FY 2011 to $5,442,917 in FY 2012, or a 2.85% decrease. Table 6-1 shows the past few budgets by cost center. Business lines most closely associated with watershed management activities include Administration, Stormwater System Maintenance, Street Cleaning, and Urban Forestry. Watershed management related elements within each of those cost centers are so noted.

Significant changes from FY 2010 through FY 2012 include the following:

- The decrease in Administration reflects the loss of the City's only dedicated GIS staff position, which will limit overall mapping capabilities.

- The FY 2012 decrease in Stormwater System Maintenance reflects a one-time capital outlay for a new vacuum truck purchased in FY 2011. In FY 2010 contracted services to clean and repair the stormwater system were eliminated. This function was taken over by in-house crews and equipment.

- Cuts from FY 2011 reduced the frequency of sweeping, meaning that the tons of debris collected annually has been reduced from nearly 600 tons to about 250 tons. The issue of sweeping frequency may be a factor in whether the City's program can be used to help meet the Chesapeake Bay TMDL.

- The FY 2012 decrease in Urban Forestry reflects a reduction in irrigation and landscape maintenance.

Table 6-1. FY 2012 Operating Budget for the Department of Public Works

Cost Center	FY 10 Actual	FY 11 Adopted	FY 12 Adopted	% Change
Administration • Leadership and Support Staff • Contracts Management • Development Plan Review for Stormwater • Erosion and Sediment Control • GIS	612,073	682,744	682,461	-0.04%
Solid Waste & Recycling	828,166	797,755	818,476	2.60%
Highways, Streets, & Sidewalks	913,201	1,215,491	1,221,770	0.52%
• Stormwater System Maintenance • System Inspection and Cleaning • Stormwater Planning • Small Repairs • BMP Inspections • MS4 Permit Compliance • Stormwater Education	464,860	410,342	311,217	-24.16%
Snow & Ice Removal	444,361	148,181	149,129	0.64%
Traffic Sign Maintenance	268,312	360,519	331,960	-7.92%
Street Cleaning • Part of MS4 Permit	42,633	36,667	36,667	0.00%
Leaf Collection	143,711	180,471	184,891	2.45%
General Services	538,511	722,043	652,513	-9.63%
Fleet Maintenance	702,062	467,137	481,068	2.98%
Urban Forestry • Role in Chesapeake Bay Protection Ordinance	490,380	581,120	572,767	-1.44%
Total DPW	**5,448,269**	**5,602,470**	**5,442,917**	**-2.85%**

Capital Improvements

While funding for operations has declined or stayed flat, the 5-Year Capital Improvements Program (FY 2012 through FY 2016) for stormwater increases significantly in anticipation of the requirements of the Chesapeake Bay TMDL. Specifically, the CIP includes the addition of $4.92 million in new capital funding for the Storm Water Facility Improvement Project Fund. This brings the total 5-Year CIP to $8 million, which includes both stream daylighting/restoration ($250,000 each for FY2015 and FY2016) and the Storm Water Facility Improvement Project Fund (the remaining amount).

However, that the proposed CIP states ***"Given that revenues will not be increasing at the past rates, the City needs to identify an alternate revenue source. One possible concept is a stormwater utility fee. For FY2012 through FY2016, the full CIP stormwater project can only be funded if an alternative revenue source is established or debt financing is utilized."***

Sources of Operating Revenue

A significant majority of revenue for watershed-related activities is the City's general fund. Of the business lines most associated with watershed management activities (Administration, Stormwater Sewer, Street Cleaning, and Urban Forestry), 89% of revenue is from the general fund. The remaining sources of revenue come from licenses and fees (7.4%), grants (2.2%), and service charges and fines (less than 1%). These percentages vary slightly from year to year.

6.2. Revenue Needs

The WAC identified several issues that have the potential to become programmatic or capital recommendations with cost implications for the City. However, the pending Chesapeake Bay TMDL and Virginia Stormwater Management Regulations will have the most significant fiscal impact on the City in the near future.

6.2.1 Chesapeake Bay TMDL

The current 5-Year CIP includes an additional $4.92 million (approximately $984,000 per year) for stormwater capital projects in the 5-Year CIP to address the Chesapeake Bay TMDL. However, the CIP states that additional revenue is needed to finance the projects. The recommended capital funding is in addition to funding already set aside for stream daylighting/restoration and other system upgrades (including localized repairs and replacement of corrugated metal pipe), thus bringing the total CIP funding level for watershed management projects to $8 million.

The Virginia WIP will require that reductions be phased in over three permit cycles, starting with the re-issuance of the City's MS4 Phase II permit, which is likely to occur in July 2013, in accordance with the following:

- Permit Cycle 1 (July 1, 2013 to June 30, 2018) – Meet 5% of Required Reduction
- Permit Cycle 2 (July 1, 2018 to June 30, 2023) – Meet Additional 35% of Required Reduction
- Permit Cycle 3 (July 1, 2023 to June 30, 2028) – Meet All Required Reductions

This approach presents an opportunity by allowing additional time for planning and to get funding mechanisms in place. However, it will also require the City to think strategically about long-term funding so that tax payers are not faced with a very high burden, or "funding bubble," during Permit Cycle 3.

To assist localities with long-range planning, Virginia DCR developed a draft tool that allows "what if" scenarios to estimate the types of control measures needed to meet pollutant reduction requirements within the prescribed time periods. While the draft tool is still under development and additional information will be required (including more specific information on impervious versus pervious cover, the amount of stormwater draining to the City-owned or operated storm drains, and the cost of specific retrofit techniques), a preliminary run of the spreadsheet model by AMEC indicates that the following actions could satisfy the City's pollutant reduction obligations (see Appendix H for the Excel spreadsheet).

Table 6-2. Preliminary Scenario to Achieve City Chesapeake Bay TMDL Pollutant Reductions[17]

	Actions to Satisfy Requirements	Cost Estimate[18]	Notes
Permit Cycle 1 (2013-2018)	Projects recommended from Section 4.	$3.50 million	Total cost is less than the amount in the 5-Year CIP. Note that this provides an opportunity to reduce the increased burden expected in the second permit cycle.
	Annual Cost for Cycle 1	$699,200	
Permit Cycle 2 (2018-2023)	Projects not recommended for short-term implementation in Section 5 but still identified as viable.	$790,000	This does not include stream restoration projects since they are currently considered outside of the City's MS4 permit area for tracking and credit purposes.
	Continue to implement the City's street sweeping program.	Unknown	A major assumption is that the City's street sweeping program (72 lane miles) will be sufficient to meet the Chesapeake Bay Program's qualifying standards. Because the street sweeping program was reduced due to budget cuts, it may be necessary to increase sweeping frequency to get pollutant reduction credit.
	Stormwater controls on an additional 46 acres of impervious area.	$4.14 million	Assumes a combination of bioretention and tree box filters and selection of projects solely based on water quality treatment (no flood control component). If flood control is incorporated, cost will increase.
	Annual Cost for Cycle 2	$986,000	
Permit Cycle 3 (2023-2028)	Stormwater controls on an additional 179 acres of impervious area.	$16.11 million	Same assumptions as above.
	Annual Cost for Cycle 3	$3,222,000	
Total	**Over 15 Year Permit** **Annualized Cost**	**$24.54 million** **$1,636,000**	

Overall, the draft compliance strategy developed using the DCR spreadsheet would require the retrofit of approximately 277 acres of the City with stormwater best management practices at a total estimated capital cost of $24.54 million, or an average annual cost of $1.636 million per year in 2011 dollars. Taking into account an average historical inflation rate of 3.24% annually, this amount comes to $33.54 million total assuming the timing presented in Table 6-2. These figures do not include the added burden placed on the City to manage construction of these projects or to operate, inspect, and maintain these facilities in the future. While the amount in the current 5-Year CIP is sufficient for the first five year permit cycle and will only need to be increased slightly for the second five year permit cycle, the amount needed annually triples in the third permit cycle. Adequate planning to help smooth these costs over time will be a critical component of the City's funding strategy.

Several unknowns may result in additional savings or result in significant additional costs. Further, these figures do not include the added burden placed on the City to operate and maintain these facilities. One potential way to reduce costs is that the Virginia WIP contains a provision that will potentially allow

[17] Draft spreadsheet model provided by the Virginia Department of Conservation and Recreation and populated by AMEC. Cost estimates based on spreadsheet developed by AMEC Environment and Infrastructure, Inc. All figures are in 2011 dollars.

[18] All figures rounded. Cost assumes $100,000 per acre treated by bioretention and $80,000 per acre treated by tree box filters. Figures are based on experience of City staff in implementing these practices in Falls Church. Cost may vary considerably depending on site complexity.

areas like Falls Church to "purchase" retrofit credits through a Virginia Nutrient Credit Exchange Program. Whether or not to take advantage of such a credit program is a policy decision that the City will need to evaluate in the future.

A disadvantage that the City faces is that there are few, if any, opportunities to retrofit existing flood control facilities to provide for water quality control. Dry ponds, for example, are a common flood control feature incorporated into development built in the 1980s and 1990s that can be modified to provide water quality benefits at a relatively low cost. Falls Church was built without the benefit of such flood control facilities and therefore it is likely to be more difficult and expensive to achieve similar pollutant reduction requirements.

6.2.1 Other Revenue Needs

Due to current budget constraints, it is recognized that the City is not likely to take on major new discretionary spending in the near future without a new source of revenue. However, several issue areas have been identified in Section 4 that could be medium or long-term program objectives. Should the City engage in a process to investigate a stormwater utility or other funding mechanism, these costs should be further developed and their inclusion considered as part of a proposed level of service.

6.3. Funding Methods and Revenue Generating Capacity

Traditionally, most localities in Virginia have relied on general fund appropriations (largely generated through real estate taxes) in combination with limited permit fees and state and federal grants to fund stormwater management. As a result, funding tends to be "flashy," with major swings in the resources available for maintenance and infrastructure upgrades depending on the current economy and competition with other core government services. This makes long-term planning difficult and often results in under-funding of the overall stormwater infrastructure.

With stormwater management increasingly driven by federal and state regulation that provide for achieving specific milestones and significant penalties for non-compliance, many localities have been re-assessing their funding mechanisms. The shift is not very different from how localities changed their approach to funding for water and wastewater services several decades ago. Today, a majority of MS4 Phase I localities and a growing number of Phase II localities in Virginia have enacted dedicated sources of revenue for stormwater management to either augment or completely replace the use of general funds.

The fundamental issue considered by the WAC was whether Falls Church should change its basic philosophy in terms of how the stormwater program is financed. The first question was whether the City should move to an enterprise approach to funding stormwater management. An enterprise funding is defined as:

> **Enterprise fund – "A fund that accounts for the income, expense, assets and liabilities of financing specific services to the public, where the governing body intends to recover the costs of providing the services through user charges."**

Under an enterprise system where user fees are the primary revenue source, the program of services is established first, and then a rate or charge is set that is sufficient to fund the program, calculated in a rate model. If the City decides to move forward with an enterprise fund approach, the next step is determining the right mix of revenue sources that will go into the enterprise fund.

Because Virginia is a "Dillon Rule" state, where the City may only exercise those authorities specifically granted in the Code of Virginia, there are specific funding mechanisms at the City's disposal. These options can be described as "primary" approaches that have the capacity to support the entire program and "secondary" methods that are applicable to special needs or situations. The primary funding methods might be used as sole sources of funding for the program, or could be used in combination. The secondary funding methods could be used to augment one or more of the primary funding methods. Table 6-3 outlines major primary and secondary funding mechanisms available in Virginia.

Table 6-3. Primary and Secondary Stormwater Funding Mechanisms in Virginia

Primary Funding Mechanisms	Secondary Funding Mechanisms
General Fund Appropriations	Special Assessments
Stormwater Service District	Pro-Rata Share Programs
Stormwater Service Fee (Stormwater Utility)	Watershed Improvement Districts
	Fee-in-Lieu-of Construction Programs
	Permit Fees
	Grants

6.3.1 Primary Funding Methods

Over the past several years, two primary stormwater funding strategies (other than the general fund) have emerged in Virginia – the Stormwater Service District and the Stormwater Service Fee, otherwise known as a Stormwater Utility. The following provides a brief description of the two approaches and the advantages and challenges associated with each approach.

Stormwater Service District

The stormwater service district is a relatively new approach, at least in terms of funding stormwater management. It was first implemented by Arlington County using the authority under Section 15.2-2400 of the Code of Virginia. This section of the Code authorizes localities to establish "service districts" for the provision of stormwater services, as well as other enumerated services, and to levy and collect an annual tax on any real property in the service district. The mechanics of establishing a service district are relatively simple, with a locality adopting an ordinance setting forth the following in accordance with Section 15.2-2402 of the Code of Virginia:

1. The name and description of the boundaries of the proposed district and specify any areas within the district that are to be excluded;
2. The purposes of the district and the facilities and services proposed within the district;
3. A proposed plan for providing such facilities and services within the district; and
4. The benefits which can be expected from the provision of such facilities and services within the district.

While the Code does not specify the way that the tax is levied, from a practical standpoint the levy is based on the value of real property in the same way as the real property tax and is included as a separate line item on the real property tax bill. Arlington County's FY 2011 levy is 1.3¢ per $100 of the assessed real estate value. In addition to Arlington County, Fairfax County (in FY2010) and the City of

Alexandria (in FY2011) have also adopted stormwater service districts. Fairfax County charges 1.5¢ per $100 of assessed real estate value while Alexandria charges 0.5¢ per $100 of assessed real estate value.

Since the stormwater service district levy is based on real estate value, it is relatively simple to determine the levy needed to meet a specific revenue generation target. Each additional penny on the real estate tax generates approximately $310,000.[19] Therefore, if the City wanted to generate $1.636 million annually in new revenue (the amount estimated to meet the Chesapeake Bay TMDL not considering inflationary factors), it would need to impose a levy of 5.28¢ per $100 of the assessed real estate value.

While the mechanics of a stormwater service district are relatively simple, this approach does produce a level of inequity in that some properties that place demands on the stormwater system are exempt from property taxes. Specifically, Code of Virginia 15.2-2403.6 states that "Such tax may be levied on taxable real estate." As a result, tax exempt property owners (including exempted religious, charitable, patriotic, historical, benevolent, cultural, and state and federal government uses) do not participate in funding stormwater management even though they contribute to the system. Similarly, some private properties, e.g. parking lots and storage warehouses that have large expanses of impervious coverage, do not pay property taxes commensurate with the demands they impose on the stormwater system. That is, there is no nexus between property value and the amount of stormwater runoff from a site. Conversely, some properties that have little impact on stormwater runoff but pay proportionately higher property taxes are paying more for stormwater management through a stormwater service district than they would through funding methods based on the actual demands they place on the stormwater program and system.

Stormwater Service Fees (Stormwater Utility)

Stormwater service fees, or stormwater utilities, are an increasingly popular source of dedicated stormwater funding – with well over a thousand established nation-wide, including communities in Virginia. The City investigated the feasibility of a stormwater utility in 2003 when faced with increased costs associated with the then new MS4 Phase II permit requirements. While not implemented, the report, entitled "Revenue Requirements and Fee Evaluation for Stormwater Utility," outlined programmatic and capital needs at the time and provided recommendations on the structure for a potential utility.

Stormwater utilities are authorized under Section 15.2-2114 of the Code of Virginia. The general standard applied to utility service fees is that the rate methodology and resultant charges must bear a substantial relationship to the cost of providing the services and facilities. In Virginia, stormwater service fees must be "based upon an analysis that demonstrates the rational relationship between the amount charged and the services provided." The rational relationship is typically established by charging a fee based on the amount of impervious surface cover draining from the site. This represents a significant difference from a levy imposed under a stormwater service district, where the charge per property does not have to relate to the specific service being provided.

The revenue generation capacity of a stormwater utility is similar to that of the real estate tax except that the utility fee is directly linked to impervious surface cover, rather than assessed value. Determining a legally defensible rate needed to generate revenue sufficient to finance the City's stormwater needs will require that the City complete a "stormwater utility rate study." During this study, important policy decisions will be made that can have significant implications for the selected rate. Major policies questions include the following.

[19] Based on January 1, 2011taxable real estate valuation of $3.1 billion.

- General Fund – Will the stormwater utility pay for current program elements, or only for program enhancements and capital costs for new projects?
- Special Fees and Other Revenue – What additional revenue sources will be used or created to support the stormwater program?
- Financial Factors – What is the fund balance test that must be maintained? What is the bad debt factor?
- Reserves – Will an emergency reserve be established to address catastrophic failures?
- Bonds – Will revenue bonds be used to pay for the capital improvement program?
- Credit Policy – What will be considered for "credits" under the program? For instance, how much, if any, credit will someone get for maintaining a stormwater management facility that treats for flood control, water quality, or both?
- Billing – Will the bill be sent via the water utility bill, or the real property tax bill? Will the bill go to the owners or the current water utility customer?
- Rate Policy – Is it the goal of the rate to be held constant for a certain number of years? Or will it be adjusted annually?

In addition to representing a more equitable way of distributing the cost of system improvements, a stormwater utility also captures fees from properties that would be otherwise exempt from the real estate tax. Because a utility is a "fee for service," it must be paid by non-profits and state and federal government agencies (except VDOT roads and government facilities that are covered by a separate MS4 permit). A federal law (S. 3481) passed the U.S. Congress in 2010 that requires all federal properties to pay utility fees established by local governments. A utility fee also allows a local government to reward certain actions by private property owners that result in a decreased cost to the public system through the use of credits. Amendments adopted during the 2011 session of the Virginia General Assembly (HB1737) significantly increases the flexibility that a locality has in terms of granting credits for both structural and non-structural stormwater control practices.

There are two primary challenges associated with the stormwater utility approach. The first is that to be defensible, a locality must maintain a methodology to assign fees to all properties within the jurisdiction, usually accomplished through an impervious cover GIS layer. While not cost prohibitive, this does represent an administrative expense not associated with a stormwater service district. In many localities, to minimize this administrative burden, all single-family detached residential properties are charged the same base rate. As a result, digitization of impervious cover is only required for non-single family detached properties. The second challenge, which applies to any new fee or tax, is public education and outreach. While the cost to the average homeowner is typically less under a stormwater utility as compared to a stormwater service district, a stormwater utility is often perceived as a new government cost whereas a stormwater service district is viewed as an increase in an existing tax that is re-adjusted on an annual basis anyway. While both strategies require a robust public education and outreach effort, a stormwater utility is often the more difficult approach.

Table 6-4 provides an overview of localities in Virginia that have implemented stormwater utilities and localities that have implemented stormwater service districts.

Table 6-4. Summary of Stormwater Utilities and Service Districts in Virginia

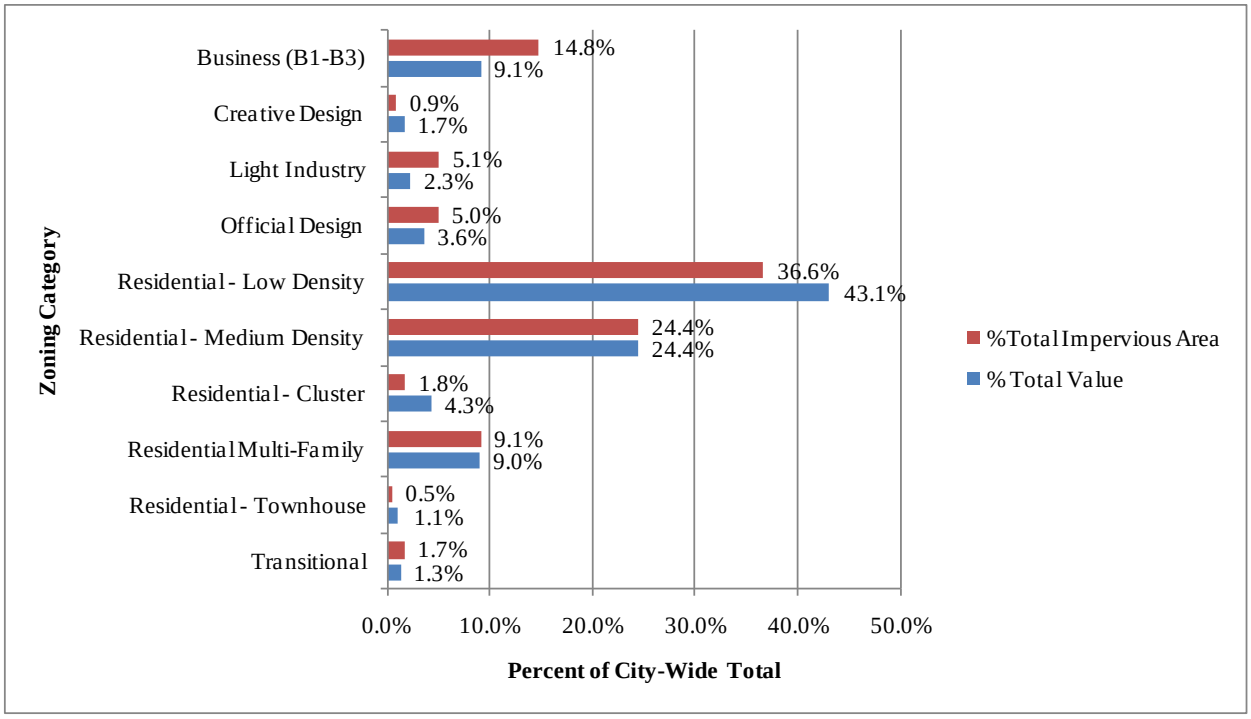
Stormwater Utilities	Rate/Year/Per Unit – Annual Revenue
City of Richmond	$45.00/$3.1M Annual
City of Norfolk	$102.96/$746K Annual
City of Virginia Beach	$87.97/$21.1M Annual
City of Portsmouth	$84.00/$5.7M Annual
City of Newport News	$65.40/$9.1M Annual
City of Hampton	$55.20/$585K Annual
City of Chesapeake	$88.20/$14.4M Annual
City of Staunton	$38.40/$680K Annual
Prince William County	$26.36/$8.0M Annual
Stormwater Service Districts	**Rate on Real Property – Annual Revenue**
Fairfax County	1.5¢ on Real Property Tax/$28M Annual
Arlington County	1.3¢ on RPT/$7M Annual
City of Alexandria	0.5¢ on RPT

6.3.2 Distribution of Cost Burden Between Stormwater Service District and Stormwater Utility

Figure 6-1 demonstrates the "equity" issues involved in a real estate tax versus utility fee approach to stormwater funding. In general, a high value, low footprint property will pay less under a utility fee approach since it has less impervious surface cover. Likewise, a low value property that has a large amount of impervious cover will pay more under the utility fee approach. City staff used GIS analysis of impervious surface cover by zoning district (excluding rights-of-way) to demonstrate the shift in burden if stormwater funds were financed based on impervious area versus property value.

As shown in the chart, some categories such as "Residential – Medium Density" and "Residential Multi-Family" demonstrate very little shift in burden. Other categories such as "Residential – Low Density, "Business," and "Light Industry" demonstrate a significant shift in burden. It should be noted that these are generalized statistics that do not take into account property-by-property differences or the final structure of any service district or stormwater utility.

Figure 6-1. Generalized Shift in Funding Burden Between a Service District and Utility Fee



6.3.3 Secondary Funding Methods

While the focus of the WAC's efforts will be on discussing primary funding methods, secondary methods that the City may wish to consider to supplement the program include the following:

Plan Review Fees

Most jurisdictions, including the City of Falls Church, offset the cost to review plans and issue permits related to stormwater by imposing various fees. The following examples with stormwater components apply in the City.

Table 6-5. Stormwater Related Fees in Falls Church

Permit/Review	Charge Descriptions
Review of a Water Quality Impact Assessment to comply with the provisions of the City's Chesapeake Bay Preservation Area Ordinance	$150 for less than one acre $600 for more than one acre
Landscape inspection by Urban Forestry under the Chesapeake Bay Preservation Area Ordinance	$150
Floodplain development permit	$150 for residential property $450 for all other property

Site plan review	Residential – Base fee of $2,000 plus 50 per dwelling unit and $100 per quarter acre Commercial/Other – Base fee of $2,000 plus $50 per 1,000 gross square feet and $100 per quarter acre for commercial property

The City is currently in the process of consolidating the City's Erosion and Sediment Control Ordinance and the Chesapeake Bay Preservation Area Ordinance and is considering the creation of a separate Stormwater Permit. This permit could include a charge or fee for plan or permit review. However, any such charge or fee would likely only cover a small part of the cost of doing business and would go toward operating expenses rather than capital projects.

Pro Rata Share Programs

Under the Section 15.2-2243 of the Code of Virginia, "A locality may provide in its subdivision ordinance for payment by a subdivider or developer of land the pro rata share of the cost of providing reasonable and necessary sewerage, water, and drainage facilities, located outside the property limits of the land owned or controlled by the subdivider or developer but necessitated or require, at least in part, by the construction or improvement of the subdivision or development:…" The enabling legislation specifically includes drainage work for the protection of water quality and the mitigation of increase stormwater flows as permissible uses of these funds. Typically, funds are held in cash escrow until such time as the stormwater management facilities or infrastructure are constructed.

Pro rata accounts are typically most effective for communities experiencing significant, sustained growth. Fairfax County, for example, had a vigorous program for several decades. However, since the program is largely driven by new development, the County anticipates that the program will cease to serve as a major revenue source in the near future.

In-Lieu-Of-Construction Fees

A major advantage of in-lieu-of-construction fees is that revenue from smaller projects can be combined to be used on a regional basis, or where measures can have the most impact. In-lieu-of-construction fees also allow a locality to gain some benefit if it is determined that a stormwater requirement should be waived or reduced due to site-specific constraints. A disadvantage of this approach is that the revenue stream is dependent on the pace and nature of development from year to year. Both Arlington County and the City of Alexandria have fee-in-lieu-of programs.

Notwithstanding their potential value, in-lieu-of-construction programs are likely to disappear over the next few years. Fee-in-lieu-of programs are mostly applicable to water quality impacts where it doesn't make as much difference where the specific improvement is made (as opposed to flood control or stormwater volume and velocity control where the impacts are localized). Recent changes to state law now allow for "by-right" nutrient offsets by developers for sites less than five acres. This means that it will usually be more cost effective for a developer to meet requirements through the use of an offset rather than by using a local fee-in-lieu-of program.

Federal and State Funding Opportunities

There are no federal and state funding mechanisms available to provide *ongoing* support for local stormwater management programs – a reason that stormwater programs are often referred to as unfunded mandates. Federal and state involvement in ongoing stormwater management (other than regulatory

programs) is typically limited to advisory assistance and cooperative programs such as those provided by the United States Geological Survey and the United States Army Corps of Engineers.

One way that many communities have succeeded in acquiring limited funding for stormwater management projects are through grants and cost share programs. While these can be very valuable, they are typically project-focused and limited in scope. Major sources of grant funding are the Virginia Water Quality Improvement Fund (administered by the Virginia Department of Conservation and Recreation) as well as the Chesapeake Bay Program's Small Watershed Grants Program. In 2010, the Virginia Water Quality Improvement Fund awarded $1,406,933 in grant funds, including $50,000 to the City of Falls Church for the construction of four bioretention facilities on park property.

6.4. Funding Recommendation

The WAC considered two major points in the discussion about funding recommendations to the City Council. First, the requirements of the Chesapeake Bay TMDL are non-discretionary and the City will be required to find funding sufficient to meet the requirements or face possible fines or other penalties. Second, it is not practical that the entire cost of compliance, in addition to other challenges being faced by the City including increased operational and maintenance costs for the existing system, can be absorbed by the General Fund. After discussion of the pros and cons of major funding approaches, the WAC made the following recommends:

- *Enterprise Fund Approach to Stormwater Management*. The City should shift to an enterprise fund approach to stormwater management. Many localities nationally and in Virginia have shifted from using general funds to a fee-for-service approach – similar to the way that the City now manages water and wastewater. This approach recognizes that funding for stormwater management is no longer discretionary and requires a long-term, stable source of revenue.

- *Use Impervious Cover as the Basis for a Stormwater Utility Fee*. Any fee for service should be based on the most equitable approach possible. The WAC recommends the use of a stormwater utility fee that recognizes that there is a direct correlation between the amount of impervious cover on a property and the burden a property places on the public stormwater management system.

- *Stormwater Utility Implementation Plan*. The WAC recommends that the City Council move forward with a stormwater utility fee based on impervious cover and that the next step should be the development of a Stormwater Utility Implementation Plan. The purpose of the plan will be to engage in additional public education and outreach, more specifically define the program levels of service that would be funded, develop a draft rate structure, examine credit policies, and investigate billing options. The goal will be to complete such study by January 2013 in order to give the City Council the option of moving forward with a stormwater utility as a part of the FY 2014 budget deliberations.

Table 6-6. Funding Option Considerations

Stormwater Utility Fee	Stormwater Service District
Is equitably distributed across all users (including non-taxed properties).	No relationship between the amount charged and stormwater contribution.
Credit can be provided for reducing stormwater impacts.	No credit for reducing stormwater impacts.
Is flexible and can be adjusted to reflect service level and community changes.	Is flexible and can be adjusted to reflect service level and community changes.
Once in place, provides a stable revenue source (during good or bad economic times).	Once in place, provides a stable revenue source – however, more susceptible to cuts since it is still a tax.
Requires development and maintenance of data and impervious surface information.	Relatively simple to implement; can bill from the real property tax rolls.
Requires comprehensive public education and outreach strategy to ensure public understanding.	Requires a comprehensive outreach strategy to explain the tax-based shift.

APPENDIX A

Acronyms

BMP .....Best Management Practice
BST .....Bacteria Source Tracking
CBIRT.....City Chesapeake Bay Interdisciplinary Review Team
CBLAB .....Chesapeake Bay Local Assistance Board
CBPA-OD .....Chesapeake Bay Preservation Area Overlay District
CIP .....Capital Improvement Program
CMP .....Corrugated Metal Pipe
COW .....Center for Watershed Protection Code and Ordinance Worksheet
CRS .....Community Rating System
CWA .....Federal Clean Water Act
CWP.....Center for Watershed Protection
DCR .....Virginia Department of Conservation and Recreation
DO.....Dissolved Oxygen
DEQ .....Virginia Department of Environmental Quality
DPW.....Department of Public Works
E&SC .....Erosion and Sediment Control
EPA.....U.S. Environmental Protection Agency
FEMA .....Federal Emergency Management Agency
GIS .....Geographic Information System
ICC.....Increased Cost of Compliance
LA .....Load Allocation
LID.....Low Impact Development
MCM.....Minimum Control Measure
MS4.....Municipal Separate Storm Sewer System
MWCOG.....Metropolitan Washington Council of Governments
NFIP.....National Flood Insurance Program
NPDES.....National Pollutant Discharge Elimination System
NVRC .....Northern Virginia Regional Commission
PCB.....Polychlorinated Biphenyl
RMA .....Resource Management Area
ROW .....Right of Way
RPA.....Resource Protection Area
RSAT .....Rapid Stream Assessment Technique
SUP .....Special Use Permit
TMDL .....Total Maximum Daily Load
TN .....Total Nitrogen
TP.....Total Phosphorus
TSS.....Total Suspended Solids
VSMP.....Virginia Stormwater Management Program
WAC .....Watershed Advisory Committee
WIP .....Virginia Watershed Implementation Plan
WLA .....Wasteload Allocation
ZOAC.....City Zoning Ordinance Advisory Committee

APPENDIX B

Stream Reach Field Investigation Sheets

Stream:	**Ellison Branch**	**Survey Date:**	**07/02/2009**
Reach:	**4**	**RSAT Score**	**N/A**

Transect Number	Top Channel Width (ft)	Bottom Channel Width (ft)	Wetted Perimeter (ft)	Mean Riffle Depth (in)	Mean Bank Height R (ft)	Mean Bank Height L (ft)	Mean Bank Stability R&L (%)
x-1	6’	3’	1’	NA	1’	4’	100%

Transect Number	Bank Material Type R	Bank Material Type L	Substrate Material	Mean Riffle Embeddedness (%)	Mean Substrate Fouling Level (%)	Riparian Vegetation R	Riparian Vegetation L
x-1	Sandy loam	Sandy loam	70% sand; 30% clay	75%	0%	Herbaceous ground cover	Herbaceous ground cover

Transect Number	Buffer Width R	Buffer Width L	Maximum Pool Depth (in)	Pool Habitat Quality	TDS mg/l	pH*	DO mg/l*
x-1	2’	4’	0”	Poor	NA	NA	NA

Transect Number	Air Temp. F	Water Temp. F	Oxidation-Reduction Potential (ORP)*	Notes
x-1	79	NA	NA	

*The Virginia Water Quality Standard for pH in Coastal and Piedmont waters is between 6.0 and 9.0
*The Virginia Water Quality Standard for DO is a minimum of 4.0 mg/l and a daily average of 5.0 mg/l.
*ORP in excess of 400 is considered harmful to aquatic life.

Stream:	**Grove Branch**	**Survey Date:**	**07/02/2009**
Reach:	**8**	**RSAT Score**	**N/A**

Transect Number	Top Channel Width (ft)	Bottom Channel Width (ft)	Wetted Perimeter (ft)	Mean Riffle Depth (in)	Mean Bank Height R (ft)	Mean Bank Height L (ft)	Mean Bank Stability R&L (%)
x-1	3.5'	3.5'	3.5'	NA	1.25’	2’	100%

Transect Number	Bank Material Type R	Bank Material Type L	Substrate Material	Mean Riffle Embeddedness (%)	Mean Substrate Fouling Level (%)	Riparian Vegetation R	Riparian Vegetation L
x-1	Sand, gravel, clay	Sand, gravel, clay	80% sand; 15% gravel; 5% clay	95%	NA	Herbaceous cover/vines; no trees	Herbaceous cover/vines; no trees

Transect Number	Buffer Width R	Buffer Width L	Maximum Pool Depth (in)	Pool Habitat Quality	TDS mg/l	pH*	DO mg/l*
x-1	10'	25'	8"	Poor	492	7.65	7.05

Transect Number	Air Temp. F	Water Temp. F	Oxidation-Reduction Potential (ORP)*	Notes
x-1	82	66.9	131.4	

*The Virginia Water Quality Standard for pH in Coastal and Piedmont waters is between 6.0 and 9.0
*The Virginia Water Quality Standard for DO is a minimum of 4.0 mg/l and a daily average of 5.0 mg/l.
*ORP in excess of 400 is considered harmful to aquatic life.

Stream:	**Grove Branch**	**Survey Date:**	**07/02/2009**
Reach:	**13**	**RSAT Score**	**N/A**

Transect Number	Top Channel Width (ft)	Bottom Channel Width (ft)	Wetted Perimeter (ft)	Mean Riffle Depth (in)	Mean Bank Height R (ft)	Mean Bank Height L (ft)	Mean Bank Stability R&L (%)
x-1	10’	4’	0’	NA	3’	3’	100%
x-2	NA	NA	NA	NA	NA	NA	NA

Transect Number	Bank Material Type R	Bank Material Type L	Substrate Material	Mean Riffle Embeddedness (%)	Mean Substrate Fouling Level (%)	Riparian Vegetation R	Riparian Vegetation L
x-1	Grass	Grass	85% sand; 5% gravel; 10% clay	100%	NA	None	None
x-2	NA	NA	NA	NA	NA	NA	NA

Transect Number	Buffer Width R	Buffer Width L	Maximum Pool Depth (in)	Pool Habitat Quality	TDS mg/l	pH*	DO mg/l*
x-1	NA	NA	NA	NA	NA	NA	NA
x-2	NA	NA	NA	NA	NA	NA	NA

Transect Number	Air Temp. F	Water Temp. F	Oxidation-Reduction Potential (ORP)*	Notes
x-1	82	NA	NA	
x-2	82	NA	NA	No longer a viable stream due to piping. Local homeowner noted to field crew that old channel becomes soggy after rainfall.

*The Virginia Water Quality Standard for pH in Coastal and Piedmont waters is between 6.0 and 9.0
*The Virginia Water Quality Standard for DO is a minimum of 4.0 mg/l and a daily average of 5.0 mg/l.
*ORP in excess of 400 is considered harmful to aquatic life.

Stream:	**Coe Branch**	**Survey Date:**	**07/06/2009**
Reach:	**3**	**RSAT Score**	**N/A**

Transect Number	Top Channel Width (ft)	Bottom Channel Width (ft)	Wetted Perimeter (ft)	Mean Riffle Depth (in)	Mean Bank Height R (ft)	Mean Bank Height L (ft)	Mean Bank Stability R&L (%)
x-1	1’	1’	0’	NA	1’	1’	100%

Transect Number	Bank Material Type R	Bank Material Type L	Substrate Material	Mean Riffle Embeddedness (%)	Mean Substrate Fouling Level (%)	Riparian Vegetation R	Riparian Vegetation L
x-1	Sand, cobble	Sand, cobble	60% sand; 40% cobble	50%	NA	Grass	Grass

Transect Number	Buffer Width R	Buffer Width L	Maximum Pool Depth (in)	Pool Habitat Quality	TDS mg/l	pH*	DO mg/l*
x-1	NA	NA	NA	NA	NA	NA	NA

Transect Number	Air Temp. F	Water Temp. F	Oxidation-Reduction Potential (ORP)*	Notes
x-1	78	NA	NA	Stream was dry. Likely wet only during rain events.

*The Virginia Water Quality Standard for pH in Coastal and Piedmont waters is between 6.0 and 9.0
*The Virginia Water Quality Standard for DO is a minimum of 4.0 mg/l and a daily average of 5.0 mg/l.
*ORP in excess of 400 is considered harmful to aquatic life.

Stream:	**Coe Branch**	**Survey Date:**	**06/30/2009**
Reach:	**11**	**RSAT Score**	**22**

Transect Number	Top Channel Width (ft)	Bottom Channel Width (ft)	Wetted Perimeter (ft)	Mean Riffle Depth (in)	Mean Bank Height R (ft)	Mean Bank Height L (ft)	Mean Bank Stability R&L (%)
x-1	12’	12’	12’	2”	2.5’	3’	50%

Transect Number	Bank Material Type R	Bank Material Type L	Substrate Material	Mean Riffle Embeddedness (%)	Mean Substrate Fouling Level (%)	Riparian Vegetation R	Riparian Vegetation L
x-1	90% sand; 10% gravel	90% sand; 10% gravel	70% sand; 30% gravel	75%	30%	Woody upland	Woody upland

Transect Number	Buffer Width R	Buffer Width L	Maximum Pool Depth (in)	Pool Habitat Quality	TDS mg/l	pH*	DO mg/l*
x-1	50'	10’	10”	Poor	244	7.61	8.29

Transect Number	Air Temp. F	Water Temp. F	Oxidation-Reduction Potential (ORP)*	Notes
x-1	80	66.5		

*The Virginia Water Quality Standard for pH in Coastal and Piedmont waters is between 6.0 and 9.0
*The Virginia Water Quality Standard for DO is a minimum of 4.0 mg/l and a daily average of 5.0 mg/l.
*ORP in excess of 400 is considered harmful to aquatic life.

Stream:	**Parker Branch**	**Survey Date:**	**07/02/2009**
Reach:	**12**	**RSAT Score**	**N/A**

Transect Number	Top Channel Width (ft)	Bottom Channel Width (ft)	Wetted Perimeter (ft)	Mean Riffle Depth (in)	Mean Bank Height R (ft)	Mean Bank Height L (ft)	Mean Bank Stability R&L (%)
x-1	NA	NA	NA	NA	NA	NA	NA

Transect Number	Bank Material Type R	Bank Material Type L	Substrate Material	Mean Riffle Embeddedness (%)	Mean Substrate Fouling Level (%)	Riparian Vegetation R	Riparian Vegetation L
x-1	NA	NA	NA	NA	NA	NA	NA

Transect Number	Buffer Width R	Buffer Width L	Maximum Pool Depth (in)	Pool Habitat Quality	TDS mg/l	pH*	DO mg/l*
x-1	NA	NA	NA	NA	NA	NA	NA

Transect Number	Air Temp. F	Water Temp. F	Oxidation-Reduction Potential (ORP)*	Notes
x-1	NA	NA	NA	Poorly defined channel. No longer a viable stream.

*The Virginia Water Quality Standard for pH in Coastal and Piedmont waters is between 6.0 and 9.0
*The Virginia Water Quality Standard for DO is a minimum of 4.0 mg/l and a daily average of 5.0 mg/l.
*ORP in excess of 400 is considered harmful to aquatic life.

Stream:	**Pearson Branch**	**Survey Date:**	**06/29/2009**
Reach:	**6**	**RSAT Score**	**23**

Transect Number	Top Channel Width (ft)	Bottom Channel Width (ft)	Wetted Perimeter (ft)	Mean Riffle Depth (in)	Mean Bank Height R (ft)	Mean Bank Height L (ft)	Mean Bank Stability R&L (%)
x-1	23’	8’8”	8’8”	1”	6’3”	6’10”	50%

Transect Number	Bank Material Type R	Bank Material Type L	Substrate Material	Mean Riffle Embeddedness (%)	Mean Substrate Fouling Level (%)	Riparian Vegetation R	Riparian Vegetation L
x-1	Sand, gravel, woody veg.	Sand, gravel, woody veg.	90% sand; 10% gravel	30%	10%	Woody upland	Shrubs

Transect Number	Buffer Width R	Buffer Width L	Maximum Pool Depth (in)	Pool Habitat Quality	TDS mg/l	pH*	DO mg/l*
x-1	10’	5’	12”	Poor	354	7.41	9.16

Transect Number	Air Temp. F	Water Temp. F	Oxidation-Reduction Potential (ORP)*	Notes
x-1		66.9	127.5	

*The Virginia Water Quality Standard for pH in Coastal and Piedmont waters is between 6.0 and 9.0
*The Virginia Water Quality Standard for DO is a minimum of 4.0 mg/l and a daily average of 5.0 mg/l.
*ORP in excess of 400 is considered harmful to aquatic life.

Stream:	**Tripp's Run**	**Survey Date:**	**07/06/2009**
Reach:	**9**	**RSAT Score**	**29**

Transect Number	Top Channel Width (ft)	Bottom Channel Width (ft)	Wetted Perimeter (ft)	Mean Riffle Depth (in)	Mean Bank Height R (ft)	Mean Bank Height L (ft)	Mean Bank Stability R&L (%)
x-1	15.5'	10.5'	10'	2"	4'	3'	70%

Transect Number	Bank Material Type R	Bank Material Type L	Substrate Material	Mean Riffle Embeddedness (%)	Mean Substrate Fouling Level (%)	Riparian Vegetation R	Riparian Vegetation L
x-1	Concrete, brick	Sand, gravel, cobble	60% sand; 20% gravel; 20% clay	75%	20%	Woody upland	Woody upland

Transect Number	Buffer Width R	Buffer Width L	Maximum Pool Depth (in)	Pool Habitat Quality	TDS mg/l	pH*	DO mg/l*
x-1	20'	15'	12"	Good	204	7.24	8.56

Transect Number	Air Temp. F	Water Temp. F	Oxidation-Reduction Potential (ORP)*	Notes
x-1	72	64.6	193	

*The Virginia Water Quality Standard for pH in Coastal and Piedmont waters is between 6.0 and 9.0
*The Virginia Water Quality Standard for DO is a minimum of 4.0 mg/l and a daily average of 5.0 mg/l.
*ORP in excess of 400 is considered harmful to aquatic life.

Stream:	**Tripp's Run**	**Survey Date:**	**06/30/2009**
Reach:	**7**	**RSAT Score**	**21**

Transect Number	Top Channel Width (ft)	Bottom Channel Width (ft)	Wetted Perimeter (ft)	Mean Riffle Depth (in)	Mean Bank Height R (ft)	Mean Bank Height L (ft)	Mean Bank Stability R&L (%)
x-1	31'	15'4"	15'4"	1"	6'	6'	100%

Transect Number	Bank Material Type R	Bank Material Type L	Substrate Material	Mean Riffle Embeddedness (%)	Mean Substrate Fouling Level (%)	Riparian Vegetation R	Riparian Vegetation L
x-1	Concrete	Concrete	Concrete	NA	20%	Woody upland	Woody upland

Transect Number	Buffer Width R	Buffer Width L	Maximum Pool Depth (in)	Pool Habitat Quality	TDS mg/l	pH*	DO mg/l*
x-1	6'	30'	2"	Poor	226	7.6	11.34

Transect Number	Air Temp. F	Water Temp. F	Oxidation-Reduction Potential (ORP)*	Notes
x-1	81	67.8	164.7	

*The Virginia Water Quality Standard for pH in Coastal and Piedmont waters is between 6.0 and 9.0
*The Virginia Water Quality Standard for DO is a minimum of 4.0 mg/l and a daily average of 5.0 mg/l.
*ORP in excess of 400 is considered harmful to aquatic life.

Stream:	**Tripp's Run**	**Survey Date:**	**07/06/2009**
Reach:	**10**	**RSAT Score**	**17 (x-1); 17 (x-2)**

Transect Number	Top Channel Width (ft)	Bottom Channel Width (ft)	Wetted Perimeter (ft)	Mean Riffle Depth (in)	Mean Bank Height R (ft)	Mean Bank Height L (ft)	Mean Bank Stability R&L (%)
x-1	35'	15'	10'	2"	10'	10'	100%
x-2	35'	15'	13'	3"	10'	10'	100%

Transect Number	Bank Material Type R	Bank Material Type L	Substrate Material	Mean Riffle Embeddedness (%)	Mean Substrate Fouling Level (%)	Riparian Vegetation R	Riparian Vegetation L
x-1	Concrete	Concrete	NA	NA	NA	Woody upland	Woody upland
x-2	Concrete, large rock	Concrete	NA	NA	NA	Woody upland	Woody upland

Transect Number	Buffer Width R	Buffer Width L	Maximum Pool Depth (in)	Pool Habitat Quality	TDS mg/l	pH*	DO mg/l*
x-1	50'	20'	4"	Poor	630	7.5	9.93
x-2	30'	20'	4"	Poor	619	7.94	10.06

Transect Number	Air Temp. F	Water Temp. F	Oxidation-Reduction Potential (ORP)*	Notes
x-1	76	69.0	168	
x-2	76	69.7	159	

*The Virginia Water Quality Standard for pH in Coastal and Piedmont waters is between 6.0 and 9.0
*The Virginia Water Quality Standard for DO is a minimum of 4.0 mg/l and a daily average of 5.0 mg/l.
*ORP in excess of 400 is considered harmful to aquatic life.

Stream:	**Trammel Branch**	**Survey Date:**	**07/07/2009**
Reach:	**17**	**RSAT Score**	**N/A (x-1); 21 (x-2)**

Transect Number	Top Channel Width (ft)	Bottom Channel Width (ft)	Wetted Perimeter (ft)	Mean Riffle Depth (in)	Mean Bank Height R (ft)	Mean Bank Height L (ft)	Mean Bank Stability R&L (%)
x-1	6’	3’	0’	NA	1.5’	1.5’	100%
x-2	23’	3’	3’	3”	4’	14’	60%

Transect Number	Bank Material Type R	Bank Material Type L	Substrate Material	Mean Riffle Embeddedness (%)	Mean Substrate Fouling Level (%)	Riparian Vegetation R	Riparian Vegetation L
x-1	Riprap	Riprap	100% Riprap	NA	NA	Woody upland	Woody upland
x-2	Sand, gravel	Sand, gravel	50% sand, 50% gravel	80%	60%	Woody upland	Woody upland

Transect Number	Buffer Width R	Buffer Width L	Maximum Pool Depth (in)	Pool Habitat Quality	TDS mg/l	pH*	DO mg/l*
x-1	30’	60’	NA	NA	NA	NA	NA
x-2	15’	10’	12”	Fair	117	6.62	8.4

Transect Number	Air Temp. F	Water Temp. F	Oxidation-Reduction Potential (ORP)*	Notes
x-1	73	NA	NA	Stream bed was dry, no water quality parameters tested.
x-2	75	63.5	148.5	

*The Virginia Water Quality Standard for pH in Coastal and Piedmont waters is between 6.0 and 9.0
*The Virginia Water Quality Standard for DO is a minimum of 4.0 mg/l and a daily average of 5.0 mg/l.
*ORP in excess of 400 is considered harmful to aquatic life.

Stream:	**Four Mile Run**	**Survey Date:**	**07/07/2009**
Reach:	**1**	**RSAT Score**	**21**

Transect Number	Top Channel Width (ft)	Bottom Channel Width (ft)	Wetted Perimeter (ft)	Mean Riffle Depth (in)	Mean Bank Height R (ft)	Mean Bank Height L (ft)	Mean Bank Stability R&L (%)
x-1	20’	12’	12’	8”	20’	3.5’	80%

Transect Number	Bank Material Type R	Bank Material Type L	Substrate Material	Mean Riffle Embeddedness (%)	Mean Substrate Fouling Level (%)	Riparian Vegetation R	Riparian Vegetation L
x-1	Wooden retaining wall	Sand, gravel, cobble	80% sand, 19% gravel, 1% cobble	75%	60%	NA	Woody upland

Transect Number	Buffer Width R	Buffer Width L	Maximum Pool Depth (in)	Pool Habitat Quality	TDS mg/l	pH*	DO mg/l*
x-1	NA	20’	24”	Good	374	7.43	8.65

Transect Number	Air Temp. F	Water Temp. F	Oxidation-Reduction Potential (ORP)*	Notes
x-1	78	68.2	135.2	

*The Virginia Water Quality Standard for pH in Coastal and Piedmont waters is between 6.0 and 9.0
*The Virginia Water Quality Standard for DO is a minimum of 4.0 mg/l and a daily average of 5.0 mg/l.
*ORP in excess of 400 is considered harmful to aquatic life.

Stream:	**Four Mile Run**	**Survey Date:**	**07/08/2009**
Reach:	**16**	**RSAT Score**	**27**

Transect Number	Top Channel Width (ft)	Bottom Channel Width (ft)	Wetted Perimeter (ft)	Mean Riffle Depth (in)	Mean Bank Height R (ft)	Mean Bank Height L (ft)	Mean Bank Stability R&L (%)
x-1	37’	33’	20’	2”	6’	6’	50%

Transect Number	Bank Material Type R	Bank Material Type L	Substrate Material	Mean Riffle Embeddedness (%)	Mean Substrate Fouling Level (%)	Riparian Vegetation R	Riparian Vegetation L
x-1	Clay, sand	Clay, sand	10% sand, 90% clay	50%	0%	Woody upland	Woody upland

Transect Number	Buffer Width R	Buffer Width L	Maximum Pool Depth (in)	Pool Habitat Quality	TDS mg/l	pH*	DO mg/l*
x-1	25’	100’	18”	Good	27	7.02	7.87

Transect Number	Air Temp. F	Water Temp. F	Oxidation-Reduction Potential (ORP)*	Notes
x-1	76	67.3	77.3	

*The Virginia Water Quality Standard for pH in Coastal and Piedmont waters is between 6.0 and 9.0
*The Virginia Water Quality Standard for DO is a minimum of 4.0 mg/l and a daily average of 5.0 mg/l.
*ORP in excess of 400 is considered harmful to aquatic life.

Stream:	**Crossman Branch**	**Survey Date:**	**07/08/2009**
Reach:	**2**	**RSAT Score**	**21**

Transect Number	Top Channel Width (ft)	Bottom Channel Width (ft)	Wetted Perimeter (ft)	Mean Riffle Depth (in)	Mean Bank Height R (ft)	Mean Bank Height L (ft)	Mean Bank Stability R&L (%)
x-1	15’	4’	4’	1”	3’	5’	70%

Transect Number	Bank Material Type R	Bank Material Type L	Substrate Material	Mean Riffle Embeddedness (%)	Mean Substrate Fouling Level (%)	Riparian Vegetation R	Riparian Vegetation L
x-1	Riprap	Sand, gravel	90% sand, 10% gravel	80%	10%	Woody upland	Woody upland

Transect Number	Buffer Width R	Buffer Width L	Maximum Pool Depth (in)	Pool Habitat Quality	TDS mg/l	pH*	DO mg/l*
x-1	5’	5’	5”	Poor	157	7.72	7.9

Transect Number	Air Temp. F	Water Temp. F	Oxidation-Reduction Potential (ORP)*	Notes
x-1	78	66.3	28.1	

*The Virginia Water Quality Standard for pH in Coastal and Piedmont waters is between 6.0 and 9.0
*The Virginia Water Quality Standard for DO is a minimum of 4.0 mg/l and a daily average of 5.0 mg/l.
*ORP in excess of 400 is considered harmful to aquatic life.

APPENDIX C

Monitoring and Assessment Options

One of the most challenging, aspects of a successful watershed plan is to develop the monitoring and assessment tools necessary to track progress in meeting established objectives. No two monitoring plans will be the same since each locality will have goals that are specific to its individual needs. For instance, monitoring for some localities is driven by the need to demonstrate compliance with water quality standards. In other localities, the goal is to measure the in-stream impacts of management activities. For most localities, a monitoring plan will take a wide range of considerations into account.

While there are a number of different approaches to establishing a monitoring plan, at its most basic level the plan must address the key questions of who, what, where, when, why, and how. For example:

- Who will be responsible for conducting the monitoring program (will it be run by volunteers, professional personnel, or a combination of both)?
- Who will have access to the data collected?
- What parameters will be monitored (and what methods and/or protocols will be used)?
- What monitoring indicators will be used to assess water quality?
- Where will monitoring activities occur (and will monitoring sites be permanent or temporary)?
- Where will the data be housed?
- When will monitoring occur (and should it be a one time or continuing effort)?
- Why are certain monitoring activities occurring (and other activities not occurring)?
- How will the monitoring program be funded and sustained?
- How will the information be made available (Internet, library system, etc.)?

Inherent to the discussion in Falls Church is whether the monitoring plan should address “trend monitoring,” “source area monitoring,” or both. Trend monitoring will generate data of sufficient duration and representation to assess long-term shifts in water quality and stream health. This is the type of monitoring needed to determine if BMPs implemented by the City are having a long-term positive impact. In contrast, source area monitoring focuses on identifying sources and quantities of specific water pollutants of concern. While trend monitoring is dependant on long-term sampling at a suite of permanent sampling sites, source area monitoring is meant to be both flexible and responsive to identify specific problem areas and/or to help prioritize future water quality improvement efforts.

The following provides a brief summary of different issues and options associated with monitoring the three major components of stream health – chemical, physical, and biological. Each discussion is followed by a table that outlines potential approaches and the pros and cons associated with each approach.

<u>Chemical Monitoring Options</u>

Chemical monitoring can be conducted for a variety of reasons, including identifying changes or trends in water quality over time, identifying specific existing or emerging water quality problems, gathering information to design specific pollution prevention or remediation programs, and determining whether program goals are being met. Chemical monitoring can be conducted at regular sites ("fixed stations") on a continuous basis, at selected sites on an as-needed basis to answer specific questions or to characterize a watershed, or on a temporary or seasonal basis. Some parameters can be tested automatically or in the field (DO, temperature, pH, etc.) while others require samples to be taken to a laboratory.

Based on state and federal regulatory drivers, likely candidates for monitoring include nutrients (nitrogen and phosphorus), TSS, and bacteria. All three parameters are already tested by Virginia DEQ, and so the question for the City is whether information more specific to Falls Church is worth the added time and expense. It is also worthwhile remembering that bacteria monitoring is also conducted by volunteers in Four Mile Run.

While City watersheds are included in the tidal Potomac River PCB impairment, PCBs are typically tested in sediments or fish tissue, and therefore is not a likely candidate for monitoring by the City.

Concern was also expressed by the WAC about chlorinated water from pools as well as petroleum products from industrial/automobile oriented land uses in the City. Because these pollutants are "event-driven," a meaningful program requires fairly continuous monitoring in order to detect a problem. The scope of any effort for petroleum hydrocarbons could be narrowed by focusing on only those subwatersheds with high concentrations of problem land uses. Similarly, a program for detecting chlorine could be conducted on a seasonal basis when pool water is most likely to be released and in areas where pools are known to be located (based on permitting or aerial photography).

Once the City determines the parameters to be tested, the next set of questions that need to be answered include the cost, frequency, and duration of monitoring needed and whether the benefit is worth the anticipated cost. The following table provides examples of monitoring approaches for chemical constituents along with pros and cons.

Parameter	Purpose	Approaches	Pros	Cons
Nutrients	The City will be accountable for phosphorus, nitrogen, and TSS once a WLA has been assigned through the Chesapeake Bay TMDL. Phosphorus is the keystone pollutant for determining whether new development and redevelopment meet Virginia's stormwater management regulations. Therefore, a reduction in phosphorus over time where BMPs have been installed indicates whether these practices are performing as expected. TSS is a key indicator of stream bank stability and is related to whether the stormwater management volume/velocity controls and erosion and sediment control practices are effective.	#1 Monitor for phosphorus and/or TSS at major stream points entering and exiting the City at a duration and frequency needed to establish trend data.	• Provides a better indication of City trends than DEQ monitoring or EPA Chesapeake Bay modeling. • Skill level and training are relatively low.	• Data is influenced from areas outside of Falls Church. • Monitoring on a large scale is unlikely to detect the impacts of plan implementation. • Will require moderate staff involvement. • Will not decrease or influence regulatory or BMP requirements.
		#2 Monitor for phosphorus at selected subwatersheds where management activities are being implemented.	• Same as #1. • Allows the City to test effectiveness of BMPs on a reasonable scale. • Approach allows City to test the effectiveness of retrofits.	• Will require moderate staff involvement. • Will not decrease or influence regulatory or BMP requirements.
Bacteria	The City is subject to a bacteria TMDL in Four Mile Run and will be subject to a bacteria TMDL in	#1 Monitor for bacteria at major stream points entering and exiting the	• Trend information on the	• Data is influenced from areas outside of

Parameter	Purpose	Approaches	Pros	Cons
	Tripp's Run. The City's VSMP MS4 permit requires some mechanism to determine the effectiveness of selected BMP measures – although in-stream monitoring is not required.	City at a duration and frequency needed to establish trend data.	effectiveness of City and regional activities.	Falls Church. • Monitoring on a large scale is unlikely to detect the impacts of plan implementation. • Majority of sources are wildlife and therefore out of the City's control. • May be redundant to volunteer monitoring efforts in Four Mile Run.
		#2 Identify problem areas that are likely human-caused based on an assessment of land use, development age, and reported problems. Establish subwatershed monitoring for a period of time and continually move upstream to identify the source of any problems.	• More likely to pinpoint acute problems with a consistent source of bacteria like cross connections.	• Labor intensive. • Still depends on monitoring at the "right time" to catch problems. • Will not effectively measure public education and outreach efforts.
PCBs	While City watersheds are included in the tidal Potomac River PCB impairment, PCBs are typically tested in sediments or fish tissue, and therefore is not a likely candidate for City monitoring.	NA	NA	NA
Chlorine	Several members of the WAC identified chlorine from pools as a potential pollutant of concern. High concentrations of chlorine in the water can be toxic to a wide range of aquatic species.	#1 Prioritize subwatersheds with high concentrations of residential pools or where problems have been reported. Conduct seasonal monitoring at a frequency designed to catch periodic discharges.	• Designed to maximize resources by focusing efforts where problems most likely exist.	• No specific goals have been established other than reducing pollutants to the maximum extent practicable. • Staff intensive. • Is this a problem for City streams compared to other items?
Petroleum	Several members of the WAC identified petroleum products from automotive businesses as a potential pollutant of concern. High concentrations of petroleum products in the water can be toxic to a wide range of aquatic species. City staff has also identified this as a pollutant of concern for specific subwatersheds.	#1 Prioritize subwatersheds with high concentrations of automotive uses. Establish subwatershed monitoring for a period of time and continually move upstream to identify the source of any problems.	• Designed to maximize resources by focusing efforts where problems most likely exist.	• Will require moderate staff involvement. • Because petroleum sheen is easier to see, simply increasing visual monitoring of outfalls may be more effective at tracking problems.

Physical Monitoring Options

Physical monitoring involves assessing the physical condition of a stream and how that condition impacts both aquatic habitats and downstream water quality (through bank erosion, etc.). There are a wide range of established techniques for physical monitoring depending on the needs of a community. The Stream Physical Assessment (SPA) protocol used by Fairfax County in 2002 and 2003 is a relatively comprehensive approach that assesses habitat conditions, instream habitat, epifaunal substrate conditions, the adequacy of buffer zones, bank stability, channel alteration, sediment deposition, and threats to infrastructure. The Rapid Geomorphic Assessment (RGA) technique used in Maryland localities such as Rockville focuses more on the details of stream physical structures and adjustment processes. Similarly, many localities simply conduct stream walks to identify areas of special concern for periodic monitoring where changes are likely to occur over time (bank erosion, undercut infrastructure, etc.).

Because of the small size of the City, once problem areas have been identified periodic stream walks are likely the most effective tool to measure whether problems are becoming worse or have stabilized. These can also be coordinated with the existing VSMP MS4 permit requirement to conduct stream walks and perform dry weather outfall reconnaissance. A more in depth technique such as SPA or RGA may be used on a less frequent basis to re-benchmark overall conditions and to identify trends in physical stream conditions. The fundamental question for the WAC then becomes how often to plan for these more frequent physical stream assessments and whether they are jurisdiction-wide or subwatershed specific.

Biological Monitoring Options

Biological monitoring involves assessing the biological indicators and habitats in a stream as a measure of system health. Biological monitoring is often combined with physical monitoring. While this type of monitoring is very valuable for providing a snapshot of stream health, frequent use is not likely to reveal useful information about short-term or mid-term trends. On a less frequent basis, it can provide an indication of whether habitats are generally improving or deteriorating. Not all sites are good candidates for biological monitoring since there are sometimes parameters that will keep a site from ever being viable. This is particularly true for streams that have been channelized or armored. Water quality and stability may be good, but the physical component will ultimately dictate the results.

The U.S. EPA has identified several levels of biological monitoring approaches based on the needs and resources of a particular locality. These include:

- *Stream Habitat Walks.* This approach, based on a protocol called Streamwalk, is used primarily to educate volunteers about their streams and for identifying severe pollution problems. Volunteers conduct simple visual assessments of habitat to gain a greater appreciation of local stream ecology.

- *Streamside Biosurvey.* This approach, modified by the Izaak Walton League and used as the basis for many volunteer monitoring programs in Northern Virginia, trains volunteers to collect macroinvertebrates and identify them to order level in the field. Monitors evaluate the community structure by sorting specimens into three general sensitivity categories.

- *Intensive Biosurvey.* This approach requires that volunteers work under the supervision of professional aquatic biologists. Volunteers undergo formal training and conduct quality-controlled sampling and analysis. Macroinvertebrates are identified to the family level (what types of stoneflies, mayflies, caddisflies, etc.). Analytical techniques are subsequently applied to the data to draw conclusions about the biological health of the sampled site.

The following provides additional information on each protocol that can be considered by the WAC in determining an appropriate level of effort for the City, if any.[20]

Elements	Stream Habitat Walk	Streamside Biosurvey	Intensive Biosurvey
Program Objectives	• Education/public awareness. • Gross problem identification.	• Education/public awareness. • Problem identification. • Preliminary ranking of sites for further study.	• Education/public awareness • Problem identification. • Assessing severity of problems • Ranking of sites for management action
Complexity	• Simple visual assessment of habitat and physical characteristics • Basic observational biological data recording general abundance/variety of macroinvertebrates and presence or absence of macrophytes, algae, and fish.	• Visual assessment of habitat and physical characteristics • In-streaming biota collected and evaluated at streamside for relative sensitivity/tolerance and identified to order/family level.	• Comprehensive habitat and physical assessment. • Instream biota collected, preserved, and identified in lab to family level (multimetric approach). • Reference sites or conditions identified.
Resource Investment	• Scientific personnel assist in project design, preparation of documentation and orientation of volunteers. • Minimal equipment (maps, manuals, forms).	• Scientific personnel involved in project design, preparation of documentation, training, and supervision of biosurveys. • Sampling gear, maps, manuals, forms, references.	• Scientific personnel active in all levels and mandatory for assessment and data interpretation.
Training	• Primarily self-instructional.	• Periodic workshops and streamside training sessions.	• Formal lab and field training with experienced team leaders before all assessments.

[20] Modified from http://www.epa.gov/volunteer/stream/vms50.html.

APPENDIX D

Virginia DCR Review of the City's Floodplain Overlay District

FEMA Region III Ordinance Review Checklist

Draft – May 5, 2009

NATIONAL FLOOD INSURANCE PROGRAM

Community: Falls Church **CID:** _____ **State:** VA

Reviewer: A. Meehan **Date:** 1/11/10 *(circle one)* **FEMA State Other:** _____

Reviewer's Determination: ☐ **Compliant** ☐ **NON - Compliant**

Approved by: _____ *(FEMA only)* **Date:** ___/___/___

NOTE: The "Item Description" is a synopsis of the regulatory requirement and should not be construed as a complete description. Refer to the actual language contained in the National Flood Insurance Program Rules and Regulations for complete descriptions of the required standards.

Flood Zones: A (AE) AE (w/o FW) AO AH V VE

Level of Regulations: a b c (d) e

(If a community has both floodways & coastal high hazard areas, circle d & e.)

Item Description *(Section reference to NFIP Regulations follows)*	State Model	Community's Ordinance Review	Community's Ordinance Approval
Required provisions for all ordinances			
1. Citation of Statutory Authorization. **[59.22(a)(2)]**			
2. Purpose section citing health, safety, and welfare reasons for adoption. **[59.22(1)]**		48-612	
(3) Adopt definitions of: ☑ Base Flood; ☑ Base Flood Elevation; ☐ Basement; ☑ Development; ☐ Existing Manufactured Home Park or Subdivision; ☑ Expansion to an Existing Manufactured Home Park or Subdivision; ☐ Flood Insurance Rate Map; ☐ Flood Insurance Study; ☑ Floodway; ☐ Lowest Floor; ☑ Manufactured Home; ☑ Manufactured Home Park or Subdivision; ☐ New Construction/Date _____; ☐ New Manufactured Home Park or Subdivision; ☑ Recreational Vehicle; ☐ Special Flood Hazard Area; ☑ Start of Construction; ☐ Structure; ☑ Substantial Damage; ☑ Substantial Improvement; ☐ Violation. & other definitions as appropriate such as: ☐ Floodproofing; ☐ Highest Adjacent Grade (A0); ☑ Historic Structures **[59.1]**	NOTE: Definitions for Existing, Expansion to An Existing, Manufactured Home Park or Subdivision or New Manufactured Home Park are not required if community requires elevation of all manufactured homes to the BFE (1986 regulations). ☐ Community requires elevation of all manufactured homes placed/substantially improved to the BFE (1986 regulations).	48-618 Add Missing Definitions	
(4) Adopt or reference correct Flood Insurance Rate Map (and where applicable, Flood Boundary Floodway Map) and date. **[60.2(h)]**		48-640 a Missing	
5. Adopt or reference correct Flood Insurance Study and date. **[60.2(h)]**		48-640a	
6. Include a reference to all subsequent revisions and amendments to above-referenced flood maps and Flood Insurance Study.		48-640a	
7. Adequate enforcement provisions including a violations/penalty section specifying community actions to assure compliance. **[60.2(e)]**		48-617	
8. Abrogation and Greater Restriction section. **[60.1(b)]**		48-615	

Community: _____ **Level of Regulations:** a b c d e

Item Description (Section reference of NFIP Regulations follows)	State Model	Community's Ordinance Review	Community's Ordinance Approval
Required provisions for all ordinances (continued)			
9. Disclaimer of Liability (Degree of flood protection required by the ordinance is considered reasonable but does not imply total flood protection.)		48-614	
10. Severability section. (If any section, provision or portion of the ordinance is deemed unconstitutional or invalid by a court, the remainder of the ordinance shall be effective.)		48-616	
11. Framework for administering the ordinance (permit system, establish office for administering the ordinance, *recordkeeping*, etc.) **[59.22(b)(1)]**		48-675	
12. Designate title of community Floodplain Administrator **[59.22 (b)]**		48-641	
13. Requirement to submit new technical data: within 6 months, notify FEMA of changes in the base flood elevation by submitting technical or scientific data so insurance & floodplain management can be based on current data. **[65.3]**		Missing Add Sect. 3.4 from model	
14. Variance section with evaluation criteria & insurance notice. **[60.6(a)]**		48-738	
15. For adopted ordinance: Signature of Appropriate Official & Certification. Date ordinance adopted: _____ ***Effective Date*** 7/16/04 ***Ordinance Number*** _____	N/A	Only applicable after adoption	
60.3 (a) When no SFHA's have been identified, no water surface elevation data has been provided, and floodways and coastal high hazards areas have not been identified and the community applies for participation in the NFIP, the following are required:			
16. Require permits for all proposed construction or other development including placement of manufactured homes. **[60.3(a)(1)]**	N/A for (b)-(e)	48-675	
17. Assure that all other State and Federal permits are obtained. **[60.3(a)(2)]**		48-675	
18. Review permits to assure sites are reasonably safe from flooding and require for new construction and substantial improvements in flood-prone areas: **[60.3(a)(3)]**		48-677	
(a) Anchoring (including manufactured homes) to prevent floatation, collapse, or lateral movement. **[60.3(a)(3)(i)]**	See Model for ideas	48-678 Add to 48-712 to	
(b) Use of flood-resistant materials. **[60.3(a)(3)(ii)]**		48-712 Needs model lang.	
(c) Construction methods/practices that minimize flood damage. **[60.3(a)(3)(iii)]**		48-683	
(d) Electrical, heating, ventilation, plumbing, air conditioning equipment, and other service facilities designed and/or located to prevent water entry or accumulation. **[60.3(a)(3)(iv)]**		48-683 d	
19. Review subdivision proposals to assure that: (a) Such proposals minimize flood damage. **[60.3(a)(4)(i)]**		Missing	
(b) Public utilities and facilities are located & constructed so as to minimize flood damage. **[60.3(a)(4)(ii)]**			
(c) Adequate drainage is provided. **[60.3(a)(4)(iii)]**			
20. Require new and replacement water supply and sanitary sewer systems to be designed to minimize or eliminate infiltration. **[60.3(a)(5) & (6)]**		48-683a	
21. Require on-site waste disposal systems be located to avoid impairment or contamination. **[60.3(a)(6)(ii)]**		48-683 c	

Community: _____ **Level of Regulations:** a b c d e

Item Description (Section reference of NFIP Regulations follows)	State Model	Community's Ordinance Review	Community's Ordinance Approval
60.3(b) When SFHA's are identified by the publication of a community's FHBM or FIRM, but water surface elevation data have not been provided or a floodway or coastal high hazard area has not been identified, then all the above ordinance provisions for 60.3(a) and the following are required:			
22. Require permits for all proposed construction and other development within SFHAs on the FIRM. **[60.3(b)(1)]**		48-675	
23. Require base flood elevation data for subdivision proposals or other developments greater than 50 lots or 5 acres. **[60.3(b)(3)]**		48-680	
24. In A Zones, in the absence of FEMA BFE data and floodway data, consider other available data as basis for elevating residential structures to or above base flood level, and for floodproofing or elevating nonresidential structures to or above base flood level. **[60.3(b)(4)]**		N/A	
25. Where BFE data are utilized, obtain and maintain records of lowest floor and floodproofing elevations for new construction and substantial improvements. **[60.3(b)(5)]**		48-675	
26. *In riverine areas,* notify neighboring communities of watercourse alterations or relocations. **[60.3(b)(6)]**		48-676	Sect. 48-676
27. Maintain flood carrying capacity of altered or relocated watercourse. **[60.3(b)(7)]**		Missing in sect. though	~~[illegible]~~ in 48-675
28. Require all manufactured homes to be elevated and anchored to resist flotation, collapse, or lateral movement. **[60.3(b)(8)]**		48-678	
60.3(c) When final flood elevations, but no floodways or coastal high hazard areas have been provided on a community's FIRM, then all the above ordinance provisions for 60.3(a) & 60.3(b) and the following are required:			
29. Require all new and substantially improved residential structures within A1-30, AE, and AH Zones have their lowest floor (including basement) elevated to or above the BFE. **[60.3(c)(2)]**		48-711 + 48-712	← change wording to elevated for residential + elevated or floodproofed for non-res.
30. In AO Zones, require that new and substantially improved residential structures have their lowest floor (including basement) at or above the highest adjacent grade at least as high as the FIRM's depth number. **[60.3(c)(7)]**	☑ Community has no AO zones.		
31. Require that new and substantially improved nonresidential structures within A1-30, AE, and AH Zones have their lowest floor elevated or floodproofed to or above the base flood elevation. **[60.3(c)(3)]**		48-711 + 48-712	
32. In AO Zones, require new and substantially improved nonresidential structures have their lowest floor elevated or completely floodproofed above the highest adjacent grade to at least as high as the depth number on the FIRM. **[60.3(c)(8)]**	☑ Community has no AO zones.		
33. Require that, for floodproofed non-residential structures, a registered professional/architect certify that the design and methods of construction meet requirements at (c) (3) (ii). **[60.3(c)(4)]**		Missing	

Community: _____ **Level of Regulations:** a b c d e

Item Description (Section reference of NFIP Regulations follows)	State Model	Community's Ordinance Review	Community's Ordinance Approval
60.3(c) (continued)			
34. Require, for all new construction and substantial improvements, that fully enclosed areas below the lowest floor that are usable solely for parking of vehicles, building access or storage have permanent openings designed to allow the entry and exit of flood waters in accordance with specifications of **60.3(c)(5).**		Missing	
35. Within Zones A1-30 and AE without a designated floodway, new development shall not be permitted unless it is demonstrated that the cumulative effect of all past and projected development will not increase the BFE by more than 1 foot. **[60.3(c)(10)]**	☑ All AE zones have floodways designated.	N/A	
36. In Zones AO and AH, require drainage paths around structures on slopes to guide water away from structures. **[60.3(c)(11)]**	☑ Community has neither AO nor AH zones.		
37. Require that manufactured homes placed or substantially improved within A1-30, AH, and AE Zones, which meet one of the following location criteria, to be elevated such that the lowest floor is at or above the BFE and be securely anchored: i. outside a manufactured home park or subdivision; ii. in a new manufactured home park or subdivision; iii. in an expansion to an existing manufactured home park or subdivision; iv. on a site in an existing park which a manufactured home has incurred substantial damage as a result of flood. **[60.3(c)(6)]**	☑ Community requires elevation of all manufactured homes placed/substantially improved to the BFE (1986 regulations).	Missing 48-679	
38. In A1-30, AH, and AE Zones, require that manufactured homes to be placed or substantially improved in an existing manufactured home park to be elevated so that: i. the lowest floor is at or above the BFE ***or*** ii. the chassis is supported by reinforced piers no less than 36 inches above grade and securely anchored. **[60.3(c)(12)]**	☐ Community requires elevation of all manufactured homes placed/substantially improved to the BFE (1986 regulations).	Missing ii 48-678	
39. In A1-30, AH, and AE Zones, all recreational vehicles to be placed on a site must be elevated and anchored ***or*** be on the site for less than 180 consecutive days ***or*** be fully licensed and highway ready. **[60.3(c)(14)]**		48-679	
60.3(d) When final flood elevations and floodway delineations have been provided on a community's FIRM, then all the above ordinance provisions for 60.3(a), 60.3(b) & 60.3(c) and the following are required:			
40. In a regulatory floodway, prohibit any encroachment which would cause any increase in the base flood level unless hydrologic and hydraulic analyses prove that the proposed encroachment would not increase flood levels during the base flood discharge. **[60.3(d)(3)]**		48-710	

APPENDIX E

Center for Watershed Protection Code and Ordinance Worksheet

CODE AND ORDINANCE WORKSHEET

The Code and Ordinance Worksheet allows an in-depth review of the standards, ordinances, and codes (i.e., the development rules) that shape how development occurs in your community. You are guided through a systematic comparison of your local development rules against the model development principles. Institutional frameworks, regulatory structures and incentive programs are included in this review. The worksheet consists of a series of questions that correspond to each of the model development principles. Points are assigned based on how well the current development rules agree with the site planning benchmarks derived from the model development principles.

The worksheet is intended to guide you through the first two steps of a local site planning roundtable.

Step 1: Find out what the Development Rules are in your community.

Step 2: See how your rules stack up to the Model Development Principles.

The homework done in these first two steps helps to identify which development rules are potential candidates for change.

PREPARING TO COMPLETE THE CODE AND ORDINANCE WORKSHEET

Two tasks need to be performed before you begin in the worksheet. First, you must identify all the development rules that apply in your community. Second, you must identify the local, state, and federal authorities that actually administer or enforce the development rules within your community. Both tasks require a large investment of time. The development process is usually shaped by a complex labyrinth of regulations, criteria, and authorities. A team approach may be helpful. You may wish to enlist the help of a local plan reviewer, land planner, land use attorney, or civil engineer. Their real-world experience with the development process is often very useful in completing the worksheet.

Identify the Development Rules

Gather the key documents that contain the development rules in your community. A list of potential documents to look for is provided in Table 1. Keep in mind that the information you may want on a particular development rule is not always found in code or regulation, and maybe hidden in supporting design manuals, review checklists, guidance document or construction specifications. In most cases, this will require an extensive search. Few communities include all of their rules in a single document. Be prepared to contact state and federal, as well as local agencies to obtain copies of the needed documents.

Table 1: Key Local Documents that will be Needed to Complete the COW
Zoning Ordinance
Subdivision Codes
Street Standards or Road Design Manual
Parking Requirements
Building and Fire Regulations/Standards
Stormwater Management or Drainage Criteria
Buffer or Floodplain Regulations
Environmental Regulations
Tree Protection or Landscaping Ordinance
Erosion and Sediment Control Ordinances
Public Fire Defense Masterplans
Grading Ordinance

Identify Development Authorities

Once the development rules are located, it is relatively easy to determine which local agencies or authorities are actually responsible for administering and enforcing the rules. Completing this step will provide you with a better understanding of the intricacies of the development review process and helps identify key members of a future local roundtable. Table 2 provides a simple framework for identifying the agencies that influence development in your community. As you will see, space is provided not only for local agencies, but for state and federal agencies as well. In some cases, state and federal agencies may also exercise some authority over the local development process (e.g., wetlands, some road design, and stormwater).

USING THE WORKSHEET: HOW DO YOUR RULES STACK UP TO THE MODEL DEVELOPMENT PRINCIPLES?

Completing the Worksheet

Once you have located the documents that outline your development rules and identified the authorities responsible for development in your community, you are ready for the next step. You can now use the worksheet to compare your development rules to the model development principles. The worksheet is presented at the end of this chapter. The worksheet presents seventy-seven site planning benchmarks. The benchmarks are posed as questions. Each benchmark focuses on a specific site design practice, such as the minimum diameter of cul-de-sacs, the minimum width of streets, or the minimum parking ratio for a certain land use. You should refer to the codes, ordinances, and plans identified in the first step to determine the appropriate development rule. The questions require either a yes or no response or specific numeric criteria. If your development rule agrees with the site planning benchmark, you are awarded points.

Calculating Your Score

A place is provided on each page of the worksheet to keep track of your running score. In addition, the worksheet is subdivided into three categories:

- Residential Streets and Parking Lots (Principles No. 1 - 10)
- Lot Development (Principles No. 11 - 16)
- Conservation of Natural Areas (Principles No. 17 - 22).

For each category, you are asked to subtotal your score. This "**Time to Assess**" allows you to consider which development rules are most in line with the site planning benchmarks and what rules are potential candidates for change.

The total number of points possible for all of the site planning benchmarks is 100. Your overall score provides a general indication of your community's ability to support environmentally sensitive development. As a general rule, if your overall score is lower than 80, then it may be advisable to systematically reform your local development rules. A score sheet is provided at end of the Code and Ordinance Worksheet to assist you in determining where your community's score places in respect to the Model Development Principles. Once you have completed the worksheet, go back and review your responses. Determine if there are specific areas that need improvement (e.g., development rules that govern road design) or if your development rules are generally pretty good. This review is key to implementation of better development: assessment of your current development rules and identification of impediments to innovative site design. This review also directly leads into the next step: a site planning roundtable process conducted at the local government level. The primary tasks of a local roundtable are to systematically review existing development rules and then determine if changes can or should be made. By providing a much-needed framework for overcoming barriers to better development, the site planning roundtable can serve as an important tool for local change.

Development Feature	Your Local Criteria

1. Street Width

What is the minimum pavement width allowed for streets in low density residential developments that have less than 500 daily trips (ADT)? 22 feet

*If your answer is between **18-22 feet**, give yourself **4** points* ☞ 4

At higher densities are parking lanes allowed to also serve as traffic lanes (i.e., queuing streets)? YES/ NO

*If your answer is **YES**, give yourself **3** points* ☞ No

Notes on Street Width (include source documentation such as name of document, section and page #):

2. Street Length

Do street standards promote the most efficient street layouts that reduce overall street length? YES/ NO

*If your answer is **YES**, give yourself **1** point* ☞ No

Notes on Street Length (include source documentation such as name of document, section and page #):

3. Right-of-Way Width

What is the minimum right of way (ROW) width for a residential street? 50 feet

*If your answer is **less than 45 feet**, give yourself **3** points* ☞ No

Does the code allow utilities to be placed under the paved section of the ROW? YES/ NO

*If your answer is **YES**, give yourself **1** point* ☞ 1

Notes on ROW Width (include source documentation such as name of document, section and page #):

4. Cul-de-Sacs

What is the minimum radius allowed for cul-de-sacs? 45 feet

*If your answer is **less than 35 feet**, give yourself **3** points* ☞

*If your answer is **36 feet to 45 feet**, give yourself **1** point* ☞ 1

Can a landscaped island be created within the cul-de-sac? YES/ NO

*If your answer is **YES**, give yourself **1** point* ☞ No

Are alternative turnarounds such as "hammerheads" allowed on short streets in low density residential developments? YES/ NO

*If your answer is **YES**, give yourself **1** point* ☞ 1

Notes on Cul-de-Sacs (include source documentation such as name of document, section and page #):

Code and Ordinance Worksheet *Subtotal Page 5* 7

5. Vegetated Open Channels

Allowed but not encouraged

Are curb and gutters required for most residential street sections? YES/ NO

*If your answer is **NO**, give yourself **2** points* ☞ [2]

Are there established design criteria for swales that can provide stormwater quality treatment (i.e., dry swales, biofilters, or grass swales)? YES/ NO

*If your answer is **YES**, give yourself **2** points* ☞ [2]

Notes on Vegetated Open Channel (include source documentation such as name of document, section and page #):

6. Parking Ratios

What is the minimum parking ratio for a professional office building (per 1000 ft^2 of gross floor area)? 3.3 spaces

*If your answer is **less than 3.0 spaces**, give yourself **1** point* ☞ [Ø]

What is the minimum required parking ratio for shopping centers (per 1,000 ft^2 gross floor area)? 4 spaces

*If your answer is **4.5 spaces or less**, give yourself **1** point* ☞ [1]

What is the minimum required parking ratio for single family homes (per home)? 1 spaces

*If your answer is **less than or equal to 2.0 spaces**, give yourself **1** point* ☞ [1]

Are your parking requirements set as maximum or median (rather than minimum) requirements? YES/ NO

Considering in Zoning Ordinance rewrite.

*If your answer is **YES**, give yourself **2** points* ☞ [NO]

Notes on Parking Ratios (include source documentation such as name of document, section and page #):

7. Parking Codes

Is the use of shared parking arrangements promoted? YES/ NO

*If your answer is **YES**, give yourself **1** point* ☞ [1]

Are model shared parking agreements provided? YES/ NO

*If your answer is **YES**, give yourself **1** point* ☞ [1]

Are parking ratios reduced if shared parking arrangements are in place? YES/ NO

*If your answer is **YES**, give yourself **1** point* ☞ [1]

If mass transit is provided nearby, is the parking ratio reduced? YES/ NO

*If your answer is **YES**, give yourself **1** point* ☞ [1]

Notes on Parking Codes (include source documentation such as name of document, section and page #):

Code and Ordinance Worksheet — *Subtotal Page 6* [10]

8. Parking Lots

What is the minimum stall width for a standard parking space? 8.5 feet

*If your answer is **9 feet or less**, give yourself **1** point* ☞ 1

What is the minimum stall length for a standard parking space? 18 feet

*If your answer is **18 feet or less**, give yourself **1** point* ☞ 1

Are at least 30% of the spaces at larger commercial parking lots required to have smaller dimensions for compact cars? YES/ NO

Had required, but Changed code a while ago.

*If your answer is **YES**, give yourself **1** point* ☞ No

Can pervious materials be used for spillover parking areas? YES/ NO

*If your answer is **YES**, give yourself **2** points* ☞ 2

Notes on Parking Lots (include source documentation such as name of document, section and page #):

9. Structured Parking

Are there any incentives to developers to provide parking within garages rather than surface parking lots? YES/ NO

*If your answer is **YES**, give yourself **1** point* ☞ 1

Notes on Structured Parking (include source documentation such as name of document, section and page #):

10. Parking Lot Runoff

Is a minimum percentage of a parking lot required to be landscaped? YES/ NO

*If your answer is **YES**, give yourself **2** points* ☞ 5% internal not including perimeter 1

Is the use of bioretention islands and other stormwater practices within landscaped areas or setbacks allowed? YES/ NO

*If your answer is **YES**, give yourself **2** points* ☞ Several implemented. 2

Notes on Parking Lot Runoff (include source documentation such as name of document, section and page #):

Code and Ordinance Worksheet *Subtotal Page 7* 8

Time to Assess: Principles 1 - 10 focused on the codes, ordinances, and standards that determine the size, shape, and construction of parking lots, roadways, and driveways in the suburban landscape. There were a total of **40** points available for Principles 1 - 10. What was your total score?

Subtotal Page 5 7 + Subtotal Page 6 10 + Subtotal Page 7 8 = 25

Where were your codes and ordinances most in line with the principles? What codes and ordinances are potential impediments to better development?

_____

_____

_____

_____

11. Open Space Design

Are open space or cluster development designs allowed in the community? YES/ NO
*If your answer is **YES**, give yourself **3** points* ☞
*If your answer is **NO**, skip to question No. 12*
3

Is land conservation or impervious cover reduction a major goal or objective of the open space design ordinance? YES/ NO
*If your answer is **YES**, give yourself **1** point* ☞ New code will focus more on this
No

Are the submittal or review requirements for open space design greater than those for conventional development? YES/ NO
*If your answer is **NO**, give yourself **1** point* ☞ Will meet with new Zoning Ordinance.
No

Is open space or cluster design a by-right form of development? YES/ NO
*If your answer is **YES**, give yourself **1** point* ☞
1

Are flexible site design criteria available for developers that utilize open space or cluster design options (e.g., setbacks, road widths, lot sizes) YES/ NO
*If your answer is **YES**, give yourself **2** points* ☞ New Code may address
No

Notes on Open Space Design (include source documentation such as name of document, section and page #):

Code and Ordinance Worksheet *Subtotal Page 8* 4

Development Feature	Your Local Criteria

12. Setbacks and Frontages

Are irregular lot shapes (e.g., pie-shaped, flag lots) allowed in the community?	YES/ NO
*If your answer is **YES**, give yourself **1** point* ☞	1
What is the minimum requirement for front setbacks for a one half (½) acre residential lot?	30 feet
*If your answer is **20 feet or less**, give yourself **1** point* ☞	∅
What is the minimum requirement for rear setbacks for a one half (½) acre residential lot?	40 feet
*If your answer is **25 feet or less**, give yourself **1** point* ☞	∅
What is the minimum requirement for side setbacks for a one half (½) acre residential lot?	15 feet
*If your answer is **8 feet or less**, give yourself **1** points* ☞	∅
What is the minimum frontage distance for a one half (½) acre residential lot?	75 feet
*If your answer is **less than 80 feet**, give yourself **2** points* ☞	1

Notes on Setback and Frontages (include source documentation such as name of document, section and page #):

13. Sidewalks

What is the minimum sidewalk width allowed in the community?	4 feet
*If your answer is **4 feet or less**, give yourself **2** points* ☞	2
Are sidewalks always required on both sides of residential streets?	YES/ NO
*If your answer is **NO**, give yourself **2** points* ☞	2
Are sidewalks generally sloped so they drain to the front yard rather than the street?	YES/ NO
*If your answer is **YES**, give yourself **1** point* ☞	No
Can alternate pedestrian networks be substituted for sidewalks (e.g., trails through common areas)?	YES/ NO
*If your answer is **YES**, give yourself **1** point* ☞	No

Notes on Sidewalks (include source documentation such as name of document, section and page #):

14. Driveways

What is the minimum driveway width specified in the community?	18 (two way) feet
*If your answer is **9 feet or less (one lane) or 18 feet (two lanes)**, give yourself **2** points* ☞	2

Code and Ordinance Worksheet — *Subtotal Page 9* 8

Can pervious materials be used for single family home driveways (e.g., grass, gravel, porous pavers, etc)? YES/ NO

*If your answer is **YES**, give yourself **2** points* ☞ [2]

Can a "two track" design be used at single family driveways? YES/ NO

*If your answer is **YES**, give yourself **1** point* ☞ [1]

Are shared driveways permitted in residential developments? YES/ NO

*If your answer is **YES**, give yourself **1** point* ☞ [1]

Notes on Driveways (include source documentation such as name of document, section and page #):

15. Open Space Management

Skip to question 16 if open space, cluster, or conservation developments are not allowed in your community.

Does the community have enforceable requirements to establish associations that can effectively manage open space? YES/ NO

*If your answer is **YES**, give yourself **2** points* ☞ [2]

Are open space areas required to be consolidated into larger units? YES/ NO

*If your answer is **YES**, give yourself **1** point* ☞ Encouraged but not required. [Ø]

Does a minimum percentage of open space have to be managed in a natural condition? YES/ NO

*If your answer is **YES**, give yourself **1** point* ☞ [Ø]

Are allowable and unallowable uses for open space in residential developments defined? YES/ NO

*If your answer is **YES**, give yourself **1** point* ☞ [Ø]

Can open space be managed by a third party using land trusts or conservation easements? YES/ NO

*If your answer is **YES**, give yourself **1** point* ☞ [1]

Notes on Open Space Management (include source documentation such as name of document, section and page #):

16. Rooftop Runoff

Can rooftop runoff be discharged to yard areas? YES/ NO

*If your answer is **YES**, give yourself **2** points* ☞ [2]

Do current grading or drainage requirements allow for temporary ponding of stormwater on front yards or rooftops? YES/ NO

*If your answer is **YES**, give yourself **2** points* ☞ [ ]

Notes on Rooftop Runoff (include source documentation such as name of document, section and page #):

Code and Ordinance Worksheet *Subtotal Page 10* [9]

Time to Assess: Principles 11 through 16 focused on the regulations which determine lot size, lot shape, housing density, and the overall design and appearance of our neighborhoods. There were a total of **36** points available for Principles 11 - 16. What was your total score?

Subtotal Page 8 4 + Subtotal Page 9 8 + Subtotal Page 10 9 = 21

Where were your codes and ordinances most in line with the principles? What codes and ordinances are potential impediments to better development?

_____

_____

_____

_____

_____

17. Buffer Systems

Is there a stream buffer ordinance in the community? YES/ NO

*If your answer is **YES**, give yourself **2** points* ☞ 2

If so, what is the minimum buffer width? 100 feet

*If your answer is **75 feet or more**, give yourself **1** point* ☞ 1

Is expansion of the buffer to include freshwater wetlands, steep slopes or the 100-year floodplain required? YES/ NO

*If your answer is **YES**, give yourself **1** point* ☞ Ø

Notes on Buffer Systems (include source documentation such as name of document, section and page #):

18. Buffer Maintenance

If you do not have stream buffer requirements in your community, skip to question No. 19

Does the stream buffer ordinance specify that at least part of the stream buffer be maintained with native vegetation? YES/ NO

*If your answer is **YES**, give yourself **2** points* ☞ 2

Does the stream buffer ordinance outline allowable uses? YES/ NO

*If your answer is **YES**, give yourself **1** point* 1

Code and Ordinance Worksheet *Subtotal Page 11* 6

Does the ordinance specify enforcement and education mechanisms? YES/ NO

*If your answer is **YES**, give yourself **1** point* ☞ [1]

Notes on Buffer Systems (include source documentation such as name of document, section and page #):

19. Clearing and Grading

Is there any ordinance that requires or encourages the preservation of natural vegetation at residential development sites? YES/ NO

*If your answer is **YES**, give yourself **2** points* ☞ [2]

Do reserve septic field areas need to be cleared of trees at the time of development? YES/ NO

*If your answer is **NO**, give yourself **1** point* ☞ [1]

Notes on Buffer Maintenance (include source documentation such as name of document, section and page #):

20. Tree Conservation

If forests or specimen trees are present at residential development sites, does some of the stand have to be preserved? YES/ NO

*If your answer is **YES**, give yourself **2** points* ☞ [2]

Are the limits of disturbance shown on construction plans adequate for preventing clearing of natural vegetative cover during construction? YES/ NO

*If your answer is **YES**, give yourself **1** point* ☞ [1]

Notes on Tree Conservation (include source documentation such as name of document, section and page #):

21. Land Conservation Incentives

Are there any incentives to developers or landowners to conserve non-regulated land (open space design, density bonuses, stormwater credits or lower property tax rates)? YES/ NO

*If your answer is **YES**, give yourself **2** points* ☞ [0]

Is flexibility to meet regulatory or conservation restrictions (density compensation, buffer averaging, transferable development rights, off-site mitigation) offered to developers? YES/ NO

*If your answer is **YES**, give yourself **2** points* ☞ [0]

Notes on Land Cons. Incentives (include source documentation such as name of document, section and page #):

Code and Ordinance Worksheet — *Subtotal Page 12* [7]

22. Stormwater Outfalls

Is stormwater required to be treated for quality before it is discharged? YES/ NO

*If your answer is **YES**, give yourself **2** points* ☞ [2]

Are there effective design criteria for stormwater best management practices (BMPs)? YES/ NO

*If your answer is **YES**, give yourself **1** point* ☞ [1]

Can stormwater be directly discharges into a jurisdictional wetland without pretreatment? YES/ NO

*If your answer is **NO**, give yourself **1** point* ☞ [1]

Does a floodplain management ordinance that restricts or prohibits development within the 100-year floodplain exist? YES/ NO

*If your answer is **YES**, give yourself **2** points* ☞ [2]

Notes on Stormwater Outfalls (include source documentation such as name of document, section and page #):

Code and Ordinance Worksheet *Subtotal Page 13* [6]

Time to Assess: Principles 17 through 22 addressed the codes and ordinances that promote (or impede) protection of existing natural areas and incorporation of open spaces into new development. There were a total of 24 points available for Principles 17 - 22. What was your total score?

Subtotal Page 11 6 + Subtotal Page 12 7 + Subtotal Page 13 6 = [19]

Where were your codes and ordinances most in line with the principles? What codes and ordinances are potential impediments to better development?

To determine final score, add up subtotal from each **Time to Assess**

Principles 1 - 10 (Page 8)	25
Principles 11 - 16 (Page 11)	21
Principles 17 - 22 (Page 13)	19
TOTAL	65

SCORING (A total of **100** points are available):		
Your Community's Score		
90- 100	☞	Congratulations! Your community is a real leader in protecting streams, lakes, and estuaries. Keep up the good work.
80 - 89	☞	Your local development rules are pretty good, but could use some tweaking in some areas.
79 - 70	☞	Significant opportunities exist to improve your development rules. Consider creating a site planning roundtable.
60 - 69	☞	Development rules are inadequate to protect your local aquatic resources. A site planning roundtable would be very useful.
less than 60	☞	Your development rules definitely are not environmentally friendly. Serious reform of the development rules is needed.

APPENDIX F

City-Wide List of Problem Areas

City of Falls Church Stormwater Problem Areas/Opportunities

December 8, 2010

P = Primary Issue
S = Secondary Issue/Opportunity

						Flooding									
	Project Name/Location	**Stream System**	**Study/Source**	**Year**	**Description/Notes**	**ROW/Public Safety**	**Structure Flooding w/ Public Source**	**Yard Flooding w/ Public Source**	**Park Only**	**Private Yard Flooding**	**Quality**	**Daylight**	**Restoration**	**Maintenance**	**Notes**
TR-1A	Douglass Avenue and Hillwood Avenue - Eastern Side of Shopping Center	Brice Branch	City Staff	2010	Capacity issue, stormwater runoff jumps curb and floods office space. Potential for box filter to improve water quality. Related to larger issues identified in TR-1B.	P	P				S				
FMR-1A	Van Buren Street Drainage Between Villa Ridge and Underwood	Wren Branch	City Staff	2010	Water from City ROW. Flooding in yards of 209, 2010, 211, 2121 Van Buren Street reported due to undersized pipes and poor layout. Wren Branch Daylighting at FMR-1B could help. Should be examined in tandem. Possible use of box filters for water quality.	P		P			S				
TR-2	Hillwood Avenue and Linden Lane	Ives Branch	City Staff	2010	Flooding reported on street and in yards near this intersection. Potential opportunity for box filters to improve water quality.	P		P			S				
TR-3	Drainage at West Westmoreland Road and Tripps Run Restoration	Tripps Run	Daylighting Opportunities Report	2005	Water in street due to poor grading and no inlet. Contributes to drainage issues identified at 207 Westmoreland Road. Possible water quality component. Tripp's Run in this area, which is a concrete trapezoidal channel, has high potential for stream restoration. Potential installation of bioretention at Cavalier Trail Park.	P		S			S		P		
TR-12A	Grove Avenue Between City Line and W&OD Trail	Grove Branch and Ellison Branch	City Staff	2010	Several downspouts and sump pumps drain to Grove Avenue creating icy conditions in the winter. Neighbors complain about high groundwater table and poor yard drainage. Restoration or better drainage in Grove Branch and Ellison Branch might be potential solutions. This project could be coordinated with restoration of downstream areas of Grove Branch in TR-12B.	P		S					S		
FMR-2	Columbia and Underwood Streets	Wren Branch	City Staff	2010	Flooding in the intersection; one inlet reported in poor condition. Possible incorporation of box filter for water quality.	P					S				
TR-10A	Hillwood Avenue Between Cleave Drive and East Broad Street	Robertson Branch	City Staff	2010	Excess sheet flow during storms. Not enough inlets. Box inlets could improve water quality. Project could possibly be coordinated with TR-10B and TR-10C.	P					S				
TR-11	West Broad Street Between Virginia and Pennsylvania	Coe Branch and Gundry Branch	City Staff	2010	Excess sheet flow during storms on Broad Street due to lack of inlets. Potential for incorporating water quality box filters into the ROW.	P					S				

						Flooding									
	Project Name/Location	Stream System	Study/Source	Year	Description/Notes	ROW/Public Safety	Structure Flooding w/ Public Source	Yard Flooding w/ Public Source	Park Only	Private Yard Flooding	Quality	Daylight	Restoration	Maintenance	Notes
TR-4B	West Broad Street and North Spring Street	Ellison Branch	City Staff	2010	Standing water in the intersections or curb; add new structure. Potential for box filter to improve water quality. Could be addressed in the larger context of TR-4A.	P					S				
TR-5	Oak Street Between Broad and Park	Coe Branch	City Staff	2010	Flooding on Oak Street between Park Avenue and Broad Street due to possibly undersized pipes. Potential for box filters to improve water quality.	P					S				
TR-6	West Broad and Falls Avenue	Grove Branch	City Staff	2010	Standing water in the intersections or curb; add new structure; investigate box filter.	P					S				
TR-7	East Broad Between Washington and Cherry Streets	Brice Branch	City Staff	2010	Standing water at low spot on Lawton Street. Add new structure. Entire area between Washington and Cherry is subject to excess sheet flow due to lack of inlets. Potential for box filters to improve water quality.	P					S				
TR-8	Highland Avenue and West Street Intersection Drainage	Ellison Branch	Stormwater System Performance Assessment	2007	The Stormwater System Performance Assessment identified three options for improving drainage problems at this intersection. (A) Improve system capacity by replacing inlets and pipes at existing alignment. (B) Reduce flows to system by diversion and pipe improvements. (C) Reduce flows by installing underground detention.	P					S				
TR-9	Roosevelt Blvd and Wilson Blvd	Unnamed	City Staff	2010	Capacity issue next to BJs commercial building. Inlet opening is partially collapsed. 1/4 of intersection goes under water during major storm events. Slope of pipe that causes clogging may also be a contributing factor. Highly impervious area. Potential porous pavement at walkways, potential for tree box filters, median could be converted to bioretention and used for quantity control.	P					S				
FMR-3	Four Mile Run Stream Culvert at Van Buren	Wren Branch	City Staff	2010	Undersized culvert causes backwater into East Falls Church Park.	P			P						
FMR-5A	City Hall Campus	Osborne Branch	City Staff	2010	Site already has some permeable pavement and a bioretention facility. Space may be available for additional box filters or bioretention along the perimeter of employee lot. Improvements may help drainage situation on Great Falls Street and private issues at FMR-5B.		S				P				
FMR-4	Columbia and Noland Streets	Harrison Branch	City Staff	2010	Drainage issues for individual homes (431, 432, and 434 Columbia Street). Potential capacity issue. Possible retrofit opportunity for water quality.		P				S				
FMR-5B	North Quadrant Little Falls Street and Great Falls Street	Osborne Branch	City Staff	2010	Significant water in backyards, with some from the street. 304 Great Falls Street and 307 Little Falls Street specifically noted by staff. Could link with bioretention or on-site storage at FMR-5A.			P			S				

						Flooding									
	Project Name/Location	**Stream System**	**Study/Source**	**Year**	**Description/Notes**	**ROW/Public Safety**	**Structure Flooding w/ Public Source**	**Yard Flooding w/ Public Source**	**Park Only**	**Private Yard Flooding**	**Quality**	**Daylight**	**Restoration**	**Maintenance**	**Notes**
FMR-6	Trammel Branch Daylighting Between W&OD Trail and 26th Street	Trammel Branch	Daylighting Opportunities Report	2005	"A" ranking. Individual home flooding is an issue in this area.			S				P			
FMR-9	Harrison Branch Outfall and Four Mile Run	Harrison Branch	Stream Assessment Report	2009	Blowout where 48" pipe containing Harrison Branch enters Four Mile Run. Potential for daylighting small portion and stabilizing outfall. Relatively easy project. Will reduce TSS from streambank erosion.						S	S		P	Brought in to first cut since this represents a relatively low level of effort that will immediately reduce TSS loads to Four Mile Run.
TR-1B	Merryl House Apartments and Douglas Avenue	Brice Branch	Stormwater System Performance Assessment	2007	The Stormwater System Performace Assessment identified three options for improving drainage issues in this area. (A) Improve system capacity by replacing inlets and pipes at existing alignment. (B) Reduce flows to system by diversion and pipe improvements. (C) Reduce flows by installing underground detention. Staff separately identified issues in TR-1A as a priority.	P					S				Removed from first cut since TR-1A addresses the more pressing/specific aspects of this potential project.
TR-4A	Spring Street Between Park Avenue and Lea Court	Ellison Branch	Stormwater System Performance Assessment and Stormwater Utility Infrastructure Plan	2007 and 2003	Stormwater Utility Infrastructure Plan identified needed improvements, including replacement of 23 pipes, several of which were identified as undersized. Potential for water quality functions to be incorporated include box filters and bioretention in medians. The Stormwater Performance Assessment identified three options for improving this area. (A) Improve system capacity by replacing inlets and pipes at existing alignment. (B) Reduce flows to system by diversion and pipe improvements. (C) Reduce flows by installing underground detention. Drainage issues identified in TR-4B are a subset of these larger issues.	P					S				Removed from first cut since TR-4B addresses the more pressing/specific aspects of this potential project.
FMR-1B	Wren Branch Daylighting North of 16th Street	Wren Branch	Daylighting Opportunities Report	2005	"B" ranking. Issues include residential landscaping and pipe condition. Could help with drainage issues upstream at FMR-10A.			S				P			
TR-17	Upper Pearson Branch Industrial Area Water Quality	Pearson Branch	City Staff	2010	Area is heavily paved and used for automotive purposes. Potential partnerships with businesses for installation of retrofits or enhanced monitoring and enforcement.						P				
FMR-11	Four Mile Run Restoration Near Fire Station	Four Mile Run	Stream Assessment Report	2009	Buffer reforestation plan could improve stream water quality/reduce temperatures.						S		P		
FMR-8	Four Mile Run Stream Culvert at North Washington Street and Gresham Place	Four Mile Run	City Staff	2010	The box culvert needs to be cleaned out and the retaining walls need to be repaired. The wall is undermining and causing the adjacent parking lot to settle. Additional erosion problem along the banks.						S			P	

						Flooding									
	Project Name/Location	**Stream System**	**Study/Source**	**Year**	**Description/Notes**	**ROW/Public Safety**	**Structure Flooding w/ Public Source**	**Yard Flooding w/ Public Source**	**Park Only**	**Private Yard Flooding**	**Quality**	**Daylight**	**Restoration**	**Maintenance**	**Notes**
TR-14	Berman Park Drainage	Pearson Branch	Watershed Management Master Plan and City Staff	1996 and 2010	The park is poorly graded and requires the installation of a yard inlet to remove standing water. Potential location for bioretention facility or daylighting. Pipe in upper part of park collapsed and needs repair.				P		S	S		P	
TR-16	Lincoln Park Drainage	Trammel Branch	City Staff	2010	Drainage problems, pipe cleaning has not helped. Park is poorly graded and may require installation of a yard inlet to remove standing water. Possible location for bioretention. Park only, no private property affected.				P		S				
TR-21	Tripps Run at West Street and Roberts Park	Tripps Run	City Staff/Daylighting Opportunities Report	2005	Fairfax County is stabilizing Tripps Run between Poplar Drive and Kennedy Street. Downstream section in the City is also in need of stabilization. Partnership developed but funding is an issue.						S	P	P		
FMR-9	Harrison Branch Daylighting at Crossman Park/Four Mile Run Park	Harrison Branch	Daylighting Opportunities Report/City Staff	2005 and 2010	"B" ranking. Identified for possible daylighting by parks and recreation. Boardwalk also identified for possible raising to address wetness/flooding issues.							P			
FMR-7	Small Tributary to Four Mile Run near Van Buren and Falls Church Community Park	Four Mile Run	Daylighting Opportunities Report	2005	"C" ranking. Small pipe, short length, located in park.							P			
TR-10C	Robertson Branch RPA Restoration	Robertson Branch	City Staff	2010	Streambank stabilization on private property needed at 904 Hillwood Avenue. Incised channel within RPA. Could coordinate with TR-10A and TR-10B.								P		
TR-12B	Grove Branch Restoration	Grove Branch	Stream Assessment Report	2009	Grove Branch runs parallel to the W&OD trail. It is a compacted earthen "V" shaped channel. Candidate for channel stabilization and retrofit for water quality purposes. Would require partnership with NVRPA. Could be coordinated with larger restoration of Grove Branch in TR-12A.								P		
TR-15	Big Chimneys Park Drainage	Henderson Branch	City Staff	2010	Drainage and wetness problems. Water on path and lower portions of park rendering much of this area unusable during wet periods				P						
TR-18A	Small Tributary to Tripps Run near Thomas Jefferson Elementary School - West Side of Tripps Run	Tripps Run	Daylighting Opportunities Report	2005	"C" ranking. Small pipe, located at elementary school athletic field.							P			
TR-18B	Small Tributary to Tripps Run near Thomas Jefferson Elementary School - East Side of Tripps Run	Tripps Run	Daylighting Opportunities Report	2005	"B" ranking. Small pipe, elementary school, short length.							P			
TR-18C	Thomas Jefferson Elementary School Drainage Improvements	Tripps Run	City Staff	2010	Two structures covered during installation of playground equipment. Both need to be uncovered and brought to grade so the playground and fields can drain properly.				P					P	
TR-19A	Middle Coe Branch Daylighting at Coe Branch South of West Broad	Coe Branch	Daylighting Opportunities Report	2005	"B" ranking. Limited space.							P			

						Flooding									
	Project Name/Location	**Stream System**	**Study/Source**	**Year**	**Description/Notes**	**ROW/Public Safety**	**Structure Flooding w/ Public Source**	**Yard Flooding w/ Public Source**	**Park Only**	**Private Yard Flooding**	**Quality**	**Daylight**	**Restoration**	**Maintenance**	**Notes**
TR-19B	Coe Branch Restoration Between Lee and Rees	Coe Branch	Stream Assessment Report	2009	Partially contained in park land. Cooperation of private property owners on east side required. Potentially good habitat.								P		
TR-19C	Lower Coe Branch Daylighting at Hamlet Park	Coe Branch	Daylighting Opportunities Report	2005	"A" ranking.							P			
TR-20	Reagan Branch Daylighting at Thomas Jefferson Elementary School	Reagan Branch	Daylighting Opportunities Report	2005	"B" ranking. Limited space.							P			
TR-22	Virginia Avenue and Rollins Street	Gundry Branch	City Staff		Storm sewer pipe is damaged and needs repair.									P	
TR-23	Frady Park Drainage	Harrison Branch	City Staff	2010	Flooding issues identified in lower 1/3 of park.				P						
TR-13	Backyard Flooding at Greenwich and West Streets	Coe Branch	City Staff	2010	Upstream new development outside of City has caused backyard flooding issues. Easements are an issue.					P					
TR-10B	Backyard Drainage - East Broad Street, Cleave Drive, South Roosevelt Street, and Hilllwood Avenue	Robertson Branch	City Staff	2010	Flooding and wetness issues in backyard areas leading to inlet points near Shady and Hillwood. No public source. Approximately 17-19 homes affected. May be coordinated with restoration of Robertson Branch TR-10C or sheet flow issues at TR-10A.					P			S		

APPENDIX G

Project Investigation Forms

Not included in the PDF version of this document. Visit the City of Falls Church Department of Public Works for a paper copy of the full plan.

APPENDIX H

Chesapeake Bay TMDL Compliance Scenarios

Falls Church Chesapeake Bay Reduction Determination Sheet	POTIF_VA	
	Impervious	Pervious
Acres served as of 12 months of issuance of permit	610	644
Nitrogen		
Annual Load Based on 2009 Progress on 2010 Land Use(lbs/acre/yr)	9.85	7.23
Total Current Load Based on 2009 Progress on 2010 Land Use(lbs)	6,005	4,652
Required Total Reduction based on difference in WIP and 2009 Progress on 2010 Land Use	0.89	0.43
Required Reduction based on difference in WIP and 2009 Progress on 2010 Land Use (lbs)	540	279
5% of Total Reduction Required by End of First Permit Cycle (lbs)	27	14
35% of Total Reduction Required by End of Second Permit Cycle (lbs)	189	98
Total Reduction Required by end of third permit cycle (lbs)	540	279
Phosphorus		
Annual Load Based on 2009 Progress on 2010 Land Use(lbs/acre/yr)	1.36	0.36
Total Current Load Based on 2009 Progress on 2010 Land Use(lbs)	828	232
Required Total Reduction based on difference in WIP and 2009 Progress on 2010 Land Use	0.22	0.03
Required Reduction based on difference in WIP and 2009 Progress on 2010 Land Use (lbs)	133	17
5% of Total Reduction Required by End of First Permit Cycle (lbs)	7	1
35% of Total Reduction Required by End of Second Permit Cycle (lbs)	46	6
Total Reduction Required by end of third permit cycle (lbs)	133	17
Sediment		
Annual Load Based on 2009 Progress on 2010 Land Use(lbs/acre/yr)	1,171.48	169.46
Total Current Load Based on 2009 Progress on 2010 Land Use(lbs)	714,332	109,102
Required Total Reduction based on difference in WIP and 2009 Progress on 2010 Land Use	234.30	14.83
Required Reduction based on difference in WIP and 2009 Progress on 2010 Land Use (lbs)	142,866	9,546
5% of Total Reduction Required by End of First Permit Cycle (lbs)	7,143	477
35% of Total Reduction Required by End of Second Permit Cycle (lbs)	50,003	3,341
Total Reduction Required by end of third permit cycle (lbs)	142,866	9,546

BMP Implementation after January 1, 2010, in Acres, on Acres Identified 12-months After Permit Issuance Unless Otherwise Stated					
	POTIF_VA		Efficiencies		
BMP	Impervious	Pervious	Nitrogen	Phosphorus	Sediment
Impervious Surface Reduction		0	19%	72%	87%
Forest Buffer			25%	50%	50%
Grass Buffer			13%	45%	60%
Tree Planting (Number of Trees)	0		63%	79%	54%
Wet Ponds and Wetlands			20%	45%	60%
Dry Detention and Hydrodynamic Structures			5%	10%	10%
Dry Extended Detention			20%	20%	60%
Infiltration Practices w/o Sand, Vegetation			80%	85%	95%
Infiltration Practices w/ Sand, Vegetation			85%	85%	85%
Filtering Practices	95	43	40%	60%	80%
Street Sweeping (Report in lbs. of Debris Collected)	105	0	3%	3%	9%
Urban Stream Restoration (Report in Linear Feet)					
Bioretention (C/D Soils, w/ underdrain)	95	43	25%	45%	55%
Bioretention (A/B Soils, w/ underdrain)			70%	75%	80%
Bioretention (A/B Soils, w/o underdrain)			80%	85%	90%
Vegetated Open Channels (C/D Soils, w/o underdrain)			10%	10%	50%
Vegetated Open Channels (A/B Soils, w/o underdrain)			45%	45%	70%
Bioswale			70%	75%	80%
Permeable Pavement w/o Sand, Vegetation, C/D Soils, underdrain			10%	20%	55%
Permeable Pavement w/o Sand, Vegetation, A/B Soils, underdrain			45%	50%	70%
Permeable Pavement w/o Sand, Vegetation, A/B Soils, no underdrain			75%	80%	85%
Permeable Pavement w/ Sand, Vegetation, C/D Soils, underdrain			20%	20%	55%
Permeable Pavement w/ Sand, Vegetation, A/B Soils, underdrain			50%	50%	70%
Permeable Pavement w/ Sand, Vegetation, A/B Soils, no underdrain			80%	80%	85%
Redevelopment of Pervious Acres to Impervious Acres based on VSMP 0.45/bs/ac/yr	0		19%	19%	13%
Redevelopment of Impervious Acres based on VSMP 20% reduction		0	20%	20%	20%
Development of Forested Acres Served by MS4 12 months after issuance of permit			-67%	-91%	-88%
Urban Nutrient Management	0		17%	22%	0%

Tracking Required Reductions on Urban Lands Identified as of 12-months of Issuance of Permit		
	POTIF_VA	
	Impervious	Pervious
Nitrogen		
5% of Total Reduction Required by End of First Permit Cycle (lbs)	27	14
35% of Total Reduction Required by End of Second Permit Cycle (lbs)	189	98
Total Reduction Required by end of third permit cycle (lbs)	540	279
Reductions Implemented since January 1, 2010	642	203
Additional Reductions Required to Reduce By 5%	(615)	(189)
Additional Reductions Required to Reduce By 35%	(452)	(105)
Additional Reductions Required to Meet Final Reductions	(101)	76
Phosphorus		
5% of Total Reduction Required by End of First Permit Cycle (lbs)	7	1
35% of Total Reduction Required by End of Second Permit Cycle (lbs)	46	6
Total Reduction Required by end of third permit cycle (lbs)	133	17
Reductions Implemented since January 1, 2010	140	16
Additional Reductions Required to Reduce By 5%	(134)	(15)
Additional Reductions Required to Reduce By 35%	(94)	(10)
Additional Reductions Required to Meet Final Reductions	(8)	0
Sediment		
5% of Total Reduction Required by End of First Permit Cycle (lbs)	7,143	477
35% of Total Reduction Required by End of Second Permit Cycle (lbs)	50,003	3,341
Total Reduction Required by end of third permit cycle (lbs)	142,866	9,546
Reductions Implemented since January 1, 2010	161,894	9,889
Additional Reductions Required to Reduce By 5%	(154,750)	(9,411)
Additional Reductions Required to Reduce By 35%	(111,890)	(6,547)
Additional Reductions Required to Meet Final Reductions	(19,027)	(342)