

**Implementation Plan  
for the  
Fecal Coliform TMDL (Total Maximum Daily Load)  
for Four Mile Run, Virginia**



Prepared by: ***NVRC***  
**Northern Virginia Regional Commission**  
7535 Little River Turnpike, Suite 100  
Annandale, Virginia 22003

Prepared for:  
**Virginia Department of Environmental Quality and  
Virginia Department of Conservation and Recreation**

March 31, 2004



The Northern Virginia Regional Commission (NVRC) developed this TMDL for the Commonwealth of Virginia. NVRC's project manager and primary author of this report is Bill Hicks, P.E.. This TMDL IP has been strengthened by contributions from numerous sources, many of which are cited in the acknowledgements below and in the reference section.

## ACKNOWLEDGEMENTS

Jutta Schneider, Virginia Department of Environmental Quality (VADEQ)  
Katherine Bennett, VADEQ  
David Lazarus, VADEQ  
Marc Aveni, Virginia Department of Conservation and Recreation  
Jason Papacosma, Arlington County Department of Environmental Services (DES)  
Jeff Harn, Arlington County DES  
Aileen Winquist, Arlington County DES  
Howard Hudgins, Arlington County Parks, Recreation and Community Resources  
Greg Zell, Arlington County Parks, Recreation and Community Resources  
Allan Rowley, Arlington County Department of Public Works  
Elenor Hodges, Arlingtonians for a Clean Environment  
Carey Johnston, P.E. Arlington Forest Civic Association  
Isabel Kaldenbach, Arlington Dogs  
Suzanne Bolton, Shirlington Dogs  
Kevin Shunk, P.E., City of Alexandria Transportation and Environmental Services  
Fred Rose, Fairfax County Department of Public Works and Environmental Services (DPWES),  
Stormwater Planning Division  
Matt Meyers, P.E., Fairfax County DPWES, Stormwater Planning Division  
Ifty Khan, DPWES, Wastewater Collection Division  
Paul McCray, Northern Virginia Regional Park Authority  
Annette Mills, Falls Church, Department of Public Works (DPW)  
Moe Wadda, Falls Church, DPW  
Robert Etris, P.E., Falls Church, DPW  
Helen Reinecke-Wilt, Falls Church Department of Planning  
Howard Herman, Falls Church, Department of Parks and Recreation  
Dave Eckert, Falls Church Village Society  
Joseph G. Battiata, P.E. Virginia Department of Transportation (VDOT)  
Timothy J. Murphy, Metropolitan Washington Council of Governments  
Brian Rustia, P.E., Metropolitan Washington Council of Governments  
Don Waye, US Environmental Protection Agency  
Katherine Mull, Northern Virginia Regional Commission (NVRC)  
Judy Buchino, George Mason University, Department of Environmental Science and Policy

**Funding for this study was generously provided by the Virginia Department of Environmental Quality through federal CWA 604(b) funds administered by the Environmental Protection Agency.**

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## List of Abbreviations

The following abbreviations are used throughout this document. To better aid the reader in comprehension of the document each abbreviation is defined here.

BMP	– Best Management Practice
BST	– Bacteria Source Tracking
CSO	– Combined Sewer Overflow (or Outfall)
DES	– Department of Environmental Services
DNA	– Desoxyribonucleic Acid
DPRCR	– Parks, Recreation and Community Resources
DPW	– Department of Public Works
DPWES	– Department of Public Works and Environmental Services
E. coli	– Escherichia coli
FC	– Fecal Coliform
IP	– Implementation Plan
LA	– Load Allocation
MOS	– Margin of Safety
MS4	– Municipal Separate Storm Sewer System (or storm drain network)
MWCOG	– Metropolitan Washington Area Council of Governments
NRCS	– Natural Resources Conservation Service
NVRC	– Northern Virginia Regional Commission
NVRPA	– Northern Virginia Regional Park Authority
P2	– Pollution Prevention
SSO	– Sanitary Sewer Overflow
T&ES	– Transportation and Environmental Services Department (Alexandria)
TAC	– Technical Advisory Committee (for this Implementation Plan)
TMDL	– Total Maximum Daily Load (Study)
USACE	– United States Army Corps of Engineers
USEPA	– United States Environmental Protection Agency
USGS	– United States Geological Survey
VAC	– Virginia Administrative Code
VADCR	– Virginia Department of Conservation and Recreation
VADEQ	– Virginia Department of Environmental Quality
VPDES	– Virginia Pollutant Detection and Elimination System
VDH	– Virginia Department of Health
VDOT	– Virginia Department of Transportation
WLA	– Waste Load Allocation
WPCP	– Water Pollution Control Plant (Arlington County's WWTP)
WQMIRA	– Water Quality Monitoring, Information and Restoration Act
WWTP	– Waste Water Treatment Plant

## 1.0 Executive Summary

### 1.1 Introduction

This Implementation Plan (IP) is a companion document to the report, "Fecal Coliform TMDL (Total Maximum Daily Load) Development for Four Mile Run, Virginia" (TMDL Study). The Four Mile Run TMDL Study set allocations to limit bacteria pollutant loads discharged to the run to levels that were modeled to achieve compliance with the state water quality criteria for bacteria. This IP bridges the gap between those specified pollutant load allocations and actual reductions in bacteria counts in Four Mile Run by recommending a set of actions to be taken in the watershed during a ten year project timeframe.

Four Mile Run is approximately 9 miles in length with the last 1.5 miles tidally influenced in concert with the neighboring Potomac River to where the run discharges. In the run's 19.7 square mile watershed reside 183,000 people. The roadways, roof tops, and parking lots serving that population comprise the majority of the watershed's 7.8 square miles of impervious (impenetrable to rainwater) surface. Several issues confront the health of Four Mile Run:

- *Quantity of Water / flooding*
- *Sediment Transport*
- *Litter*
- *Excess Nutrients*
- *Water Quality Criteria*
- *Loss of Habitat*
- *Public Access and Perception*

All of the issues cited above can be attributed to the dense urbanization found in the Four Mile Run watershed. The management strategy outlined in this IP targets only the water quality criteria issue, and specifically focuses on the water quality criteria for bacteria.

### 1.2 State and Federal Requirements

Three sets of regulatory requirements for the development of TMDL IPs are applicable in the state of Virginia.

- Virginia Water Quality Monitoring, Information and Restoration Act of 1997 (*WQ MIRA*)
- §303(d) of the Federal Water Pollution Control Act of 1972 commonly known as the *Clean Water Act (CWA)*
- Requirements for Funding under §319 of the CWA

WQMIRA requires that the State: to develop reports assessing water quality of state waters, to provide data to develop programs addressing water quality impairments, to

develop TMDLs and to develop IPs. CWA strives “to restore and maintain the chemical, physical, and biological integrity of the Nation’s waters.” The inception of the federal TMDL program is found in section 303(d) of that legislation. Section 319 of the CWA provides for a federal grant program to target nonpoint source pollution.

### 1.3 Review of Four Mile Run TMDL

Through water quality data collected on Four Mile Run VADEQ in 1996 cited the run as impaired due to high levels of fecal coliform bacteria. Fecal Coliform and E. coli bacteria live in the intestinal tracts of warm blooded animals and are excreted through their feces. Levels of those bacteria in the water column suggest comparative risk levels of human illness associated with contact with the water. The run was again listed as impaired in 1998 and subsequently was required to undergo a TMDL study to determine the load allocations required to bring the run into compliance the applicable water quality criteria, in this case the criteria for bacteria. The following modeling scenario from the TMDL Study presents a set of bacteria reductions intended to reduce the bacteria loading to Four Mile Run sufficiently to bring the run into compliance with the water quality standards for bacteria.

**Table 1.1. TMDL Reduction in Loadings from Existing Conditions**

Reduction in Loadings from Existing Conditions (%)					% days > than 1000 MPN/100mL
Waterfowl	Raccoon	Human	Dog	Other Wildlife	
95	95	98	98	95	0.1

The core of this IP is a set of actions found in Chapter 6 aimed to reduce the levels of fecal coliform and E. coli (*Escherichia coli*) bacteria in Four Mile Run. The actions chiefly target bacteria from human and canine sources (“anthropogenic” sources). This reflects the staged implementation recommended by the Virginia Department of Environmental Quality and explicitly stated by USEPA in their decision rationale included with the TMDL approval letter.

### 1.4 Public Participation

Two public meetings were held in the watershed with a twofold purpose: 1) to notify the public of the development of this IP; and, 2) to seek public input for this document. Public announcements were made through US Postal Service mailings, e-mail distribution lists, website postings, and by word of mouth.

Additional to the public meetings a website was established for the project <http://www.novaregion.org/tmdlresource.htm>. The website was regularly updated and included background information, a project timeline, project contact information, a downloadable copy of the original TMDL study and archives of all meeting summaries and presentations. Also in effect throughout the IP development period were postings on the VADEQ TMDL website <http://www.deq.state.va.us/tmdl/>. The postings included

a project fact sheet and meeting announcements as well as a downloadable copy of the original TMDL document.

## 1.5 Implementation Actions

The management strategy outlined in this IP seeks to leverage implementation actions with existing programs and efforts. It is expected that this approach will build synergies with related projects and programs within the watershed. Through this synergistic approach the IP efforts will maximize benefits, and minimize any duplication of labor. Beyond the concept of synergy the approach for this IP outlines a three pronged strategy to limit anthropogenic bacteria in the Four Mile Run:

1. **Pollution Prevention**
2. **Mitigation Measures**
3. **Indirect Measures**

The threefold strategy mirrors similar trends regarding other types of pollution control.

**Pollution Prevention** targets bacteria at its source. If bacteria are prevented from entering surface water the absent bacteria will not contribute to the bacteria levels in Four Mile Run. The pollution prevention efforts included in this plan primarily target human and canine sources of bacteria loading and include:

- a. Sanitary Sewer Maintenance
- b. Inappropriate (Illicit) Discharge Controls
- c. Septic System Maintenance
- d. Proper Pet Waste Disposal

Once bacteria have been transported into the surface waters of the watershed **Mitigation Measures** remove or render lifeless the bacteria. Technologies also considered mitigation measures for inclusion in this IP are those measures that reduce the stormwater runoff that discharges to Four Mile Run and its tributaries. Because the anthropogenic bacteria are not segregated in the water column the mitigation measures included in this plan target all bacteria in the surface waters draining to the measures installed not just anthropogenic bacteria. The following measures were considered for this plan:

- a. Stormwater Treatment
- b. Street and Storm Drain Infrastructure
- c. Stream Corridor Restoration
- d. Stormwater Reduction and Reuse
- e. UV Disinfection
- f. Ozone Treatment
- g. Flocculant Treatment

Although **Indirect Measures** do not immediately affect bacteria levels in Four Mile Run they may prove to have the broadest impact on bacteria levels in the run. These

indirect measures included in this plan intend to change behaviors and attitudes of watershed citizenry through outreach and education. The indirect measures considered by this plan include the following:

- a. General Outreach
- b. Directed Outreach
- c. Signage

For each of the three strategies, ongoing activities in each jurisdiction are presented. Stakeholder commitments are presented in boxed areas at the end of each section.

## **1.6 Associated Costs and Benefits**

Because actions in this IP overlap and combine with the many ongoing water quality efforts in the watershed the actual costs associated with this plan are difficult to parse out and once separated those costs would not well represent the infrastructure need to implement the actions (e.g. the Fairfax County Stormwater Planning Division infrastructure needed to manage its Chesapeake Bay Preservation Ordinance, etc.) In an effort to include costs associated with this IP the total annual budgetary costs are included for each jurisdiction's water quality programs. These costs include both stormwater management programs (including outreach) and sanitary sewer management programs in the Four Mile Run watershed. Additional to the ongoing program costs are costs for one time projects, e.g. sanitary sewer rehabilitation project, etc. At the end of the costs section is a list of broad projects that given unlimited funding resources the implementation of those projects would benefit the efforts of this IP.

The primary benefit for executing this IP will be the lowering of bacteria levels in Four Mile Run with the possibility of removing Four Mile Run from the Virginia State Impaired Waters Lists. Secondary benefits include the synergies developed with related programs and projects and the watershed-wide incorporation of the bacteria issue into nonpoint source pollution outreach efforts.

## **1.7 Measurable Goals and Milestones**

The goal of the TMDL developed for Four Mile Run reflects that of the federal program: to bring the impaired water segment that is the focus of the Four Mile Run TMDL study into compliance with the applicable bacteria water quality standard. Once that water segment achieves compliance with the bacteria criteria, then the segment can be removed from the 303(d) Impaired Waters List.

Throughout the ten year project timeframe, VADEQ will routinely monitor bacteria levels in Four Mile Run at a single station, e.g. the trend station at West Glebe Road. Two cycles of VADEQ rotational monitoring will occur in the watershed where two additional stations will be added and monitored bimonthly also for bacteria. Project progress will be assessed during the fifth year and again at the end of the ten year timeframe.

Currently, VADEQ does not have a dedicated system in place for reporting TMDL implementation efforts. All four jurisdictions and VDOT have ongoing relationships with VADEQ through their respective MS4 permits. Those permits require annual reporting to VADEQ on permit compliance. This IP proposes that an additional section be added to each MS4 permit report to include efforts related to this IP. NVRC will work with the individual jurisdictions and VADEQ to develop a structure for that section.

## **1.8 Stakeholders' Roles and Responsibilities**

Stakeholders are individuals who live or have land management responsibilities in the watershed, including government agencies, businesses, private individuals and special interest groups. Stakeholder participation and support is essential for achieving the goals of this TMDL effort (*i.e.* improving water quality and removing Four Mile Run from the impaired waters list). Stakeholders for this project were identified at the beginning of IP development and invited to sit on the Technical Advisory Committee (TAC) for the project.

## **1.9 Watershed Planning Efforts in the Four Mile Run Watershed**

Several existing plans and water quality management programs exist in the watershed. For this IP, programs considered related to bacteria reduction include, sanitary sewer rehabilitation, Municipal Separate Storm Sewer System (MS4) Permits, and watershed plans. Since the Four Mile Run watershed covers portions of four localities and each locality is a separate political entity asserting its own unique priorities and resource limitations there are several locality-specific plans related to this IP.

## **1.10 Potential Funding Sources**

In general, funding for the actions contained in this Implementation Plan (IP) could potentially come from these general sources:

- Locality funds
- Private / nonprofit funds
- Virginia State funds
- Federal funds

When shaping the approach for this IP consensus centered on leveraging existing programs and resources to tackle this TMDL implementation. To that end, the approach developed by this IP is one that aims to build synergies and share resources with other programs in the watershed including: local Chesapeake Bay Preservation Ordinance programs, Municipal Separate Storm Sewer System (MS4) permits, Potomac Tributary Strategies and sanitary sewer rehabilitation programs.

## 2.0 Introduction

### 2.1 Purpose, Scope and Timeframe

This Implementation Plan (IP) is a companion document to the report, “Fecal Coliform TMDL (Total Maximum Daily Load) Development for Four Mile Run, Virginia,” which will henceforth be referred to as the TMDL Study. Where the TMDL Study set allocations to limit bacteria pollutant loads to the run the IP aims to bridge the gap between those specified pollutant load allocations and actual reductions in bacteria counts in Four Mile Run. The core of this IP is a set of actions found in Chapter 6 focused on reducing the levels of fecal coliform and *E. coli* (*Escherichia coli*) bacteria in Four Mile Run from human and canine sources, with the final goal of complying with the State of Virginia water quality criteria for bacteria. This IP generally follows the State guidance for TMDL implementation plans published on the Virginia Department of Environmental Quality (VADEQ) website at: <http://www.deq.state.va.us/tmdl/ipguide.html> .

Fecal Coliform and *E. coli* bacteria live in the intestinal tracts of warm blooded animals and are excreted through their feces. Levels of those bacteria in the water column suggest comparative risk levels of human illness associated with contact with the water.

The original Four Mile Run TMDL study that was approved by the US Environmental Protection Agency (USEPA) in May 2002 examined the Four Mile Run watershed, its characteristics, and the sources of fecal coliform watershed-wide. Through detailed study, allocations, or maximum allowable loads, from each of the sources of bacteria in the watershed were established to bring Four Mile Run into compliance with the water quality standard. The following modeling scenario from the TMDL Study presents a set of bacteria reductions needed to reduce the bacteria loading to Four Mile Run sufficiently to bring the run into compliance with the water quality standard for bacteria.

**Table 2.1. TMDL Reduction in Loadings from Existing Conditions**

Reduction in Loadings from Existing Conditions (%)					% days > than 1000 MPN/100mL
Waterfowl	Raccoon	Human	Dog	Other Wildlife	
95	95	98	98	95	0.1

To move Four Mile Run toward compliance with the water quality standard, this IP forms a partial strategy around the reductions stated in the TMDL by focusing on actions that will reduce bacteria resulting from human and canine sources. The corrective actions included in this IP are those committed to by various stakeholders in the watershed and expected to be implemented within a ten-year timeframe.

The IP encompasses the efforts and collaboration of multiple agencies in all four watershed jurisdictions: Fairfax and Arlington Counties and the Cities of Falls Church and Alexandria, several state agencies including: the Virginia Departments of Environmental Quality (VADEQ) and Conservation and Recreation (VADCR) and

Transportation (VDOT), several non-profit organizations and individual stakeholders in the watershed. The purpose of this IP is threefold:

1. To provide in writing a list of agreed upon actions with responsible parties. Those actions are intended to limit the bacteria loading to Four Mile Run from human and canine sources.
2. To meet the requirements of Virginia's 1997 Water Quality Monitoring, Information and Restoration Act (§62.1-44.19:4 through 19:8 of the Code of Virginia) (WQMIRA)
3. To develop synergies with existing watershed and pollutant control programs that could incorporate or enhance bacteria related efforts.

Although the TMDL cites many sources of bacteria in the watershed and allocates loads to those various sources only bacteria specifically from human and canine sources are targeted by this plan. Throughout implementation of this plan, VA DEQ and the local governments will continue to evaluate whether other sources of bacterial pollution are also controllable and to evaluate the appropriateness of instituted control measures. If at a later date additional sources are deemed controllable they will be incorporated into this implementation plan. The targeting of anthropogenic (or human-caused) sources reflects a position stated explicitly by VADEQ in the TMDL and by USEPA in their decision rationale included with the TMDL approval letter:

*"A phased implementation plan will be developed for all streams in which the TMDL calls for reductions in wildlife. In the first phase of the implementation, the Commonwealth will begin implementing the reductions (other than wildlife) called for in the TMDL." (USEPA, May 2002)*

Phase 1 targets the "controllable" sources of human and canine bacteria loading. Phase 2 represents a follow-up study, a Use Attainability Analysis (UAA). Should the efforts described in this plan not result in Four Mile Run complying with the water quality standard a UAA could be performed to determine what level of bacteria occurs naturally in the watershed. With such a study, a request could be made to change the designated use of Four Mile Run from Swimmable-Fishable / Primary Contact to a Secondary Contact Use. A secondary use designation would mean protecting water quality in Four Mile Run for such activities as wading but not for swimming. If such a use designation change was successful, this would result in less stringent water quality criteria for Four Mile Run. The third phase (Phase 3), as described by USEPA, runs concurrent with all phases of implementation and constitutes the ongoing water quality monitoring for Four Mile Run.

*No attempt is made by this IP to promote a Use Attainability Analysis study nor does this IP suggest that a change in the water quality standard applicable for Four Mile Run is warranted. Only after implementing Phase 1 actions and evaluating those successes or shortcomings will such an analysis be considered.*

Throughout implementation of this plan, VADEQ and the local governments will continue to evaluate whether other sources of bacterial pollution are also controllable and the appropriateness of control measures. If at a later date additional sources are deemed controllable they will be incorporated into this implementation plan. Chapters 1-4 of this document provide an executive summary of the document, an introduction, a description of the applicable State and Federal Requirements, and a review of the original TMDL report. Chapter 6, the core of the IP, describes the implementation approach and strategy and outlines specific actions stakeholders will take over the ten-year project timeframe. Chapters 7-11 outline measurable goals and milestones, the roles and responsibilities of stakeholders, other Four Mile Run watershed programs and potential funding sources for project implementation.

A ten year timeframe was chosen for this project with a midway and an end of period assessment. For communication purposes the following convention is employed: the ten year timeframe is divided into 10 one-year increments, implementation years (IYs) where IY-1 is the first year subsequent to finalizing the IP, IY-5 is the fifth year, etc. Some of the actions prescribed by this plan are discrete actions, e.g., mapping sanitary sewer crossings of stream segments, that will occur during a single or multiple IYs. Other actions are ongoing activities, e.g., inspection of sanitary sewer lines at crossings with stream segments. These ongoing actions will occur for the duration of the project. All actions are affixed with a time constraint outlining the years where activity regarding that action will occur, e.g. Mapping IY-1, Inspections IY-1 thru IY-10.

## **2.2 Regulatory Background**

In 1972, the US Congress enacted the Federal Water Pollution Control Act known as the "Clean Water Act" (CWA). The founding objective of that legislation was well defined in its opening paragraph,

*"to restore and maintain the chemical, physical, and biological integrity of the Nation's waters."*

The legislation covers a range of water quality efforts aimed at reaching this objective. Immediately relevant to this project are the requirements that states develop and promulgate water quality standards for waters within their jurisdictions. In section 303(d) of the Act, the federal government requires states to identify those water bodies not meeting the published water quality standards for any given pollutant. This list is often called the "303(d) list" or the "impaired waters list." Virginia's first impaired waters list was published and reported to USEPA in 1994. Recently, the 303(d) list has been combined with the 305(b) water quality assessment report which describes the overall quality of a state's waters. This "305(b)/303(d) Integrated Report" is published and submitted to USEPA every two years.

An additional section 303(d) condition requires that, if a particular water body is listed as “impaired,” the state must develop a “total maximum daily load” for the exceeded standard for the water body. The “total maximum daily load” or TMDL is essentially a “water pollution budget.” By undertaking a TMDL study the state determines for that particular water body the pollutant loading allowed from all sources of that pollutant in the watershed that, when combined in the water body will be low enough to keep the water body in compliance with the water quality standard.

Once a water body is listed as impaired and a subsequent TMDL has been developed then the watershed stakeholders must implement a strategy that that will limit the pollutant loadings to those levels allocated in the TMDL study. Such a strategy must contain actions that will work to achieve the reduced pollutant loadings needed to bring the water body into compliance with the standard. Although such Implementation Plans are alluded to in the CWA they are not a requirement of the act. Such Implementation Plans are, however, a requirement of the 1997 Virginia Water Quality Monitoring, Information, and Restoration Act (WQMIRA).

### **2.3 Four Mile Run TMDL Efforts**

VADEQ listed Four Mile Run on the Commonwealth’s 1996 303(d) TMDL Priority List of Impaired Waters (VADEQ, 1996) for exceeding the water quality criterion for fecal coliform bacteria. The run was subsequently listed as impaired for fecal coliform bacteria in 1998 and 2002 (no such impaired waters list was published in 2000.) A TMDL study and subsequent report, “Fecal Coliform TMDL (Total Maximum Daily Load) Development for Four Mile Run, Virginia” was prepared for VADEQ and was approved by the USEPA on May 31, 2002.

Development of this IP began in May of 2003 with the formation of a Technical Advisory Committee (TAC). Throughout the process, the TAC has provided leadership to steer the development of this plan. TAC membership was comprised of staff from the environmental services departments, public works departments, parks departments and health departments from each of the four Four Mile Run watershed jurisdictions. Staff from the Virginia Department of Conservation and Recreation and the Department of Environmental Quality, a citizen from Arlington Forest Civic Association, staff and members from two watershed nonprofit organizations (Falls Church Village Society and Arlingtonians for a Clean Environment), and staff from the Northern Virginia Regional Commission also served on the TAC.

### **2.4 Four Mile Run and Watershed**

Four Mile Run is a direct tributary of the Potomac River and is located in Virginia River Segment VAN-A12R. The Shenandoah-Potomac River Basin cradles the Four Mile Run watershed and ultimately drains it to the Chesapeake Bay. For its approximate 9.2-mile length, Four Mile Run flows through some of Northern Virginia’s most densely populated areas. Data from the 2000 census show that the 19.7 square mile watershed

is home to 183,000 people or approximately 9,000 people per square mile. With no less than seven central business districts the watershed population during business days exceeds that of its permanent residents. Two major interstate highways, I-66 and I-395, cross the watershed. Those highways along with numerous arterial and secondary roadways, and densely sited buildings with their associated parking areas, contribute to the watershed's total impervious coverage which is estimated at 40% of the total watershed area. The entire watershed can be classified as highly urbanized with no agricultural uses beyond a backyard or community garden.

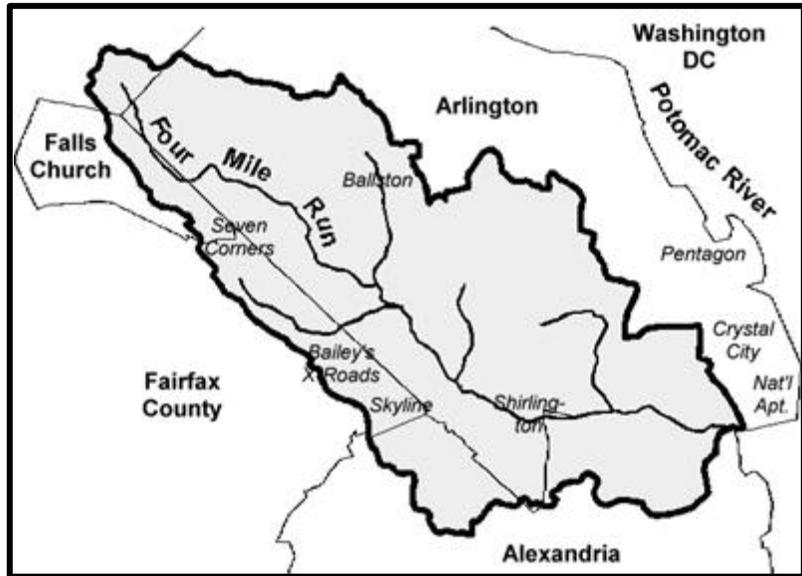


Figure 2.1. Four Mile Run Watershed

Four Mile Run rises in Fairfax County and flows downstream through the City of Falls Church and on to Arlington County. The final 2.3 miles of the run, before it opens to the Potomac River, are contained in a flood control channel designed by the US Army Corps of Engineers (USACE). That channel straddles the jurisdictional boundary between Arlington County and the City of Alexandria.

Although the entire Four Mile Run watershed blankets 19.7 square miles of Northern Virginia and includes portions of Arlington and Fairfax Counties and the Cities of Alexandria and Falls Church, only 17.0 square miles of the entire watershed were considered for the original TMDL study. Subsequently, only that 17.0 square mile portion was considered for this Implementation Plan. All four political jurisdictions are included in the TMDL watershed. The percentage of the TMDL watershed that corresponds to each watershed is depicted in Table 2.2. The division between the TMDL watershed and the remainder of the watershed occurs at the tidal/nontidal boundary with the upstream nontidal portion included in TMDL study and this IP. The transition from nontidal flow to tidally influenced flow occurs approximately 1.5 miles upstream from the mouth of Four Mile Run, or just upstream from Mt. Vernon Avenue.

**Table 2.2. Jurisdictional Percentage of Total TMDL Watershed**

Jurisdiction	Percentage of TMDL Watershed
City of Alexandria	10%
Arlington County	74%
Fairfax County	12%
City of Falls Church	4%

It should be noted that there are only two permitted point sources for industrial process effluent in the entire watershed that fall under Virginia's Pollutant Discharge Elimination System (VPDES) permit program. The first is Arlington County's Water Pollution Control Permit. The VPDES permit for that facility limits bacteria discharges for Four Mile Run; however, the entire facility and its discharge point are located in the tidal portion of the run and are therefore not considered by this plan. The second VPDES permitted discharge is an industrial facility with limits only to the pH range of its effluent.

## **2.5 Designated Use and Water Quality Standards**

All waters in the Commonwealth of Virginia have been designated for the following uses regardless of size, depth, location, water quality or actual use:

- Recreational Use
- Aquatic Life Use
- Wildlife Use
- Natural Resources Use

The State expects that by protecting these uses other uses including industrial water supply, irrigation and navigation are also protected. In regards to the Recreational Use, all Virginia streams are further designated as "primary contact" allowing for full body contact with the water. Four Mile Run is no different; it is designated for primary contact recreational use, as well as aquatic life and wildlife use.

In general, water quality standards consist of two parts: a designated use and a water quality criterion. Virginia has historically designated all water bodies for the four uses described above, and the single set of water quality standards found in Virginia Administrative Code (VAC) 9 VAC 25-260-5 et seq. reflects this.

*It should be noted that at the time of writing this document VADEQ is awaiting USEPA approval of an additional recreational use designation to the VAC. This new use designation was approved by the State Water Control Board in August 2003 to recognize that 1) achieving water quality levels necessary to assure minimal risk to human health with the full body immersion associated with primary contact use may be impracticable and inappropriate for certain streams, and; 2) the possibility that achieving such standards given the background levels of bacteria due to wildlife in the watershed may be out of reach. Such a "secondary contact recreation use," once approved by USEPA, would not be applicable to Four Mile Run without development of a Use Attainment Analysis (UAA) and petition to and approval from the State Water Control Board for such a change. Neither a UAA nor a petition of the State Water Control Board is considered within the scope or the ten year timeframe of this current project.*

Three sets of Virginia water quality criteria for bacteria are applicable to this IP:

1. Previous fecal coliform criteria
2. New/interim fecal coliform criteria
3. New E. coli criteria

The first, the previous fecal coliform criteria, were the basis for listing Four Mile Run as impaired and for subsequent TMDL development. Fecal coliform (FC) levels have long been used as an indicator of the presence of more harmful waterborne pathogens. Although FC has been the standard for many years research studies indicate that measurements of E. coli levels correlate more closely with the risk of illness to humans than do fecal coliform levels. These studies have prompted USEPA to encourage states to change from fecal coliform criteria to E. coli criteria. The second and third criteria, adopted in January 2003, reflect Virginia's movement from fecal coliform to E. coli in response to USEPA concerns.

The following excerpt from the Four Mile Run TMDL Study describes both the previous criteria and the violations leading to the listing of Four Mile Run as impaired:

*"For a non-shellfish supporting waterbody to be in compliance with Virginia fecal coliform standards for contact recreational use, VADEQ specifies the following criteria (9 VAC 25-260-170):*

*'...the fecal coliform bacteria shall not exceed a geometric mean of 200 fecal coliform bacteria per 100 mL of water for two or more samples over a 30-day period, or a fecal coliform bacteria level of 1,000 per 100 mL at any time.'*

*If the waterbody exceeds either criterion more than 10% of the time, the waterbody is classified as impaired and a TMDL must be developed and implemented to bring the waterbody into compliance with the water quality criterion. Based on the sampling frequency, only one criterion is applied to a particular datum or data set (9 VAC 25-260-170). If the sampling frequency is one sample or less per 30 days, the instantaneous criterion is applied; for a higher sampling frequency, the geometric criterion is applied. The fecal coliform instream water quality data used in the development of the Four Mile Run TMDL consists of quarterly-to-bimonthly VADEQ samples, as well as samples taken by NVRC and Arlington County, for a total of 25 samples from January 1, 1999 to May 31, 2001 (the study period for this TMDL). Eleven of these 25 samples were collected by VADEQ.”*

The second and third bacteria criteria have replaced the previous ones and both are currently applicable. The new/interim fecal coliform criteria are as follows:

*“1. Fecal coliform bacteria shall not exceed a geometric mean of 200 fecal coliform bacteria per 100 ml of water for two or more samples over a calendar month nor shall more than 10% of the total samples taken during any calendar month exceed 400 fecal coliform bacteria per 100 ml of water. This criterion shall not apply for a sampling station after the bacterial indicators described in subdivision 2 of this subsection have a minimum of 12 data points or after June 30, 2008, whichever comes first.”*

The “subdivision 2” referenced describes the new E. coli criteria. They are as follows:

*“2. E. coli and enterococci bacteria per 100 ml of water shall not exceed the following:*

	<i>Geometric Mean<sup>1</sup></i>	<i>Single Sample Maximum<sup>2</sup></i>
<i>Fresh water<sup>3</sup></i>		
<i>E.coli</i>	126	235”

Where:

<sup>1</sup> *For two or more samples taken during any calendar month.*

<sup>2</sup> *No single sample maximum for enterococci and E. coli shall exceed a 75% upper one-sided confidence limit based on a site-specific log standard deviation. If site data are insufficient to establish a site-specific log standard deviation, then 0.4 shall be used as the log standard deviation in freshwater and 0.7 shall be as the log standard deviation in saltwater and transition zone. Values shown are based on a log standard deviation of 0.4 in freshwater and 0.7 in saltwater.*

<sup>3</sup> *See 9 VAC 25-260-140 C for freshwater and transition zone delineation.”*

The following table summarizes the changes to the state's bacteria criteria:

**Table 2.3. Comparison of TMDL Criteria**

	<b>Previous Fecal Coliform Criteria</b>	<b>New / Interim Fecal Coliform Criteria</b>	<b>New E. coli Criteria</b>
<b>Instantaneous Maximum</b>	<b>1000 MPN/100mL</b>	<b>400 cfu/100mL</b>	<b>235 cfu/100mL</b>
<b>Geometric Mean</b>	<b>200 MPN/100mL</b>	<b>200 cfu/100mL</b>	<b>126 cfu/100mL</b>

By examining the table it becomes obvious that the previously used instantaneous criterion for fecal coliform has been replaced with a more stringent new/interim fecal coliform criterion. What is not obvious from the table is how the instantaneous E. coli criterion correlates with the fecal coliform criterion or how the change will affect the monitoring results for Four Mile Run. The following table summarizes data collected by VADEQ for Four Mile Run at station 1AFOU001.92 located at West Glebe Road.

**Table 2.4. Monitoring Data at Four Mile Run Station 1AFOU001.92**

<b>Sampling Date</b>	<b>Fecal Coliform</b>	<b>E. Coli</b>
<b>18-Nov-2003</b>	<b>Lower Detection Limit 25 (cfu/100 mL)</b>	<b>50 (cfu/100 mL)</b>
<b>16-Sep-2003</b>	<b>Off Scale High, 2000 (cfu/100 mL)</b>	<b>Off Scale High, 2000 (cfu/100 mL)</b>
<b>07-Jul-2003</b>	<b>Off Scale High, 2000 (cfu/100 mL)</b>	<b>Off Scale High, 800 cfu/100 mL</b>
<b>25-Jun-2003</b>	<b>400 cfu/100 mL</b>	<b>150 cfu/100 mL</b>
<b>20-Mar-2003</b>	<b>950 cfu/100 mL</b>	<b>Off Scale High, 800 cfu/100 mL</b>
<b>03-Feb-2003</b>	<b>550 cfu/100 mL</b>	<b>280 cfu/100 mL</b>
<b>16-May-2002</b>	<b>150 cfu/100 mL</b>	<b>200 cfu/100 mL</b>

It is evident from these data is that the new/interim fecal coliform criterion closely tracks with the new E. coli criterion. When fecal coliform levels exceed 400 cfu/100mL, E. coli levels exceed 235 cfu/100mL and vice versa.

### 3.0 State and Federal Requirements

#### 3.1 Background

There are three sets of regulatory requirements for the development of TMDL Implementation Plans (IPs) in the state of Virginia.

- Virginia Water Quality Monitoring, Information and Restoration Act of 1997 (*WQ MIRA*)
- §303(d) of the Federal Water Pollution Control Act of 1972 commonly known as the *Clean Water Act (CWA)*
- Requirements for Funding under §319 of the CWA

#### 3.2 State Requirements

The TMDL IP is a requirement of Virginia's 1997 Water Quality Monitoring, Information, and Restoration Act (§62.1-44.19:4 through 19:8 of the Code of Virginia), or WQMIRA. WQMIRA directs the Virginia Department of Environmental Quality (VADEQ) to "develop and implement a plan to achieve fully supporting status for impaired waters." In order for an IP to be approved by the State Water Control Board the IP must meet the requirements outlined in WQMIRA.

**WQMIRA requires that IPs include the following:**

- date of expected achievement of water quality objectives;
- measurable goals;
- necessary corrective actions;
- associated costs, benefits, and environmental impact of addressing the impairment.

IPs **must** include these four elements in order to meet the requirements of WQMIRA.

#### 3.3 Federal Recommendations

Section 303(d) of the CWA and current USEPA regulations do not require the development of implementation strategies. USEPA does, however, outline the minimum elements of an approvable IP in its 1999 "Guidance for Water Quality-Based Decisions: The TMDL Process." The document cites the following elements:

- a description of the implementation actions and management measures,
- a time line for implementing these measures,
- legal or regulatory controls,
- the time required to attain water quality standards, and
- a monitoring plan and milestones for attaining water quality standards.

These recommendations closely track the State's WQMIRA requirements.

### **3.4 Federal Consent Decree**

The Commonwealth of Virginia was a signatory to the June 11, 1999 consent decree settling federal case no. 98-979-A "American Canoe Association, Inc. and the American Littoral Society v. USEPA and USEPA – Region III" The USEPA. By signing the consent decree, Virginia committed to develop TMDL studies by 2010 for all Virginia water segments listed on the 1998 303(d) Impaired Waters list.

### **3.5 Requirements for Section 319 Fund Eligibility**

Beyond the regulatory requirements listed above the CWA was amended in 1987 to establish the Nonpoint Source Management Program in §319 of that act. Through that program States, Territories, and Native American Tribes can receive grant monies for a variety of activities including the restoration of impaired stream segments. Because the efforts described in this document will require substantial amounts of money to execute the requirements for §319 fund eligibility are also discussed within this chapter. The Virginia Department of Conservation and Recreation strongly suggests that these USEPA recommendations be addressed in the IP (in addition to the required components as described by WQMIRA).

The USEPA develops guidelines that describe the process and criteria to be used to award CWA §319 nonpoint source grants to States. The guidance is subject to revision and the most recent version should be considered for IP development. The "Supplemental Guidelines for the Award of Section 319 Nonpoint Source Grants to States and Territories in FY 2003" identifies the following nine elements that must be included in the IP to meet the 319 requirements:

1. Identify the causes and sources of groups of similar sources that will need to be controlled to achieve the load reductions estimated in the watershed-based plan;
2. Estimate the load reductions expected to achieve water quality standards;
3. Describe the NPS management measures that will need to be implemented to achieve the identified load reductions;
4. Estimate the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon to implement the watershed-based plan.
5. Provide an information/education component that will be used to enhance public understanding of the project and encourage the public's participation in selecting, designing, and implementing NPS management measures;
6. Provide a schedule for implementing the NPS management measures identified in the watershed-based plan;
7. Describe interim, measurable milestones for determining whether NPS management measures or other control actions are being implemented;

8. Identify a set of criteria for determining if loading reductions are being achieved and progress is being made towards attaining water quality standards, and if not, the criteria for determining if the watershed-based plan needs to be revised; and
9. Establish a monitoring component to evaluate the effectiveness of the implementation efforts.

## 4.0 Review of the Four Mile Run TMDL

### 4.1 Watershed Characteristics

Four Mile Run is an urban stream that spans most of Arlington County and parts of three other localities: Fairfax County, the City of Alexandria and the City of Falls Church. The stream flows from west to east, with a slight southerly tilt. The TMDL, developed for Four Mile Run and approved by the USEPA on May 31, 2002, addresses a fecal coliform bacteria impairment identified by VADEQ. Although both the tidal and nontidal portions of Four Mile Run have been listed as impaired since 1996, the 2002 TMDL was only developed for the nontidal segment. A TMDL for the tidal portion of Four Mile Run will be developed prior to 2010. The impairment for the nontidal segment begins at the headwaters of Four Mile Run just over nine miles upstream of its confluence with the Potomac River and extends to the tidal/non-tidal boundary approximately 1.5 miles

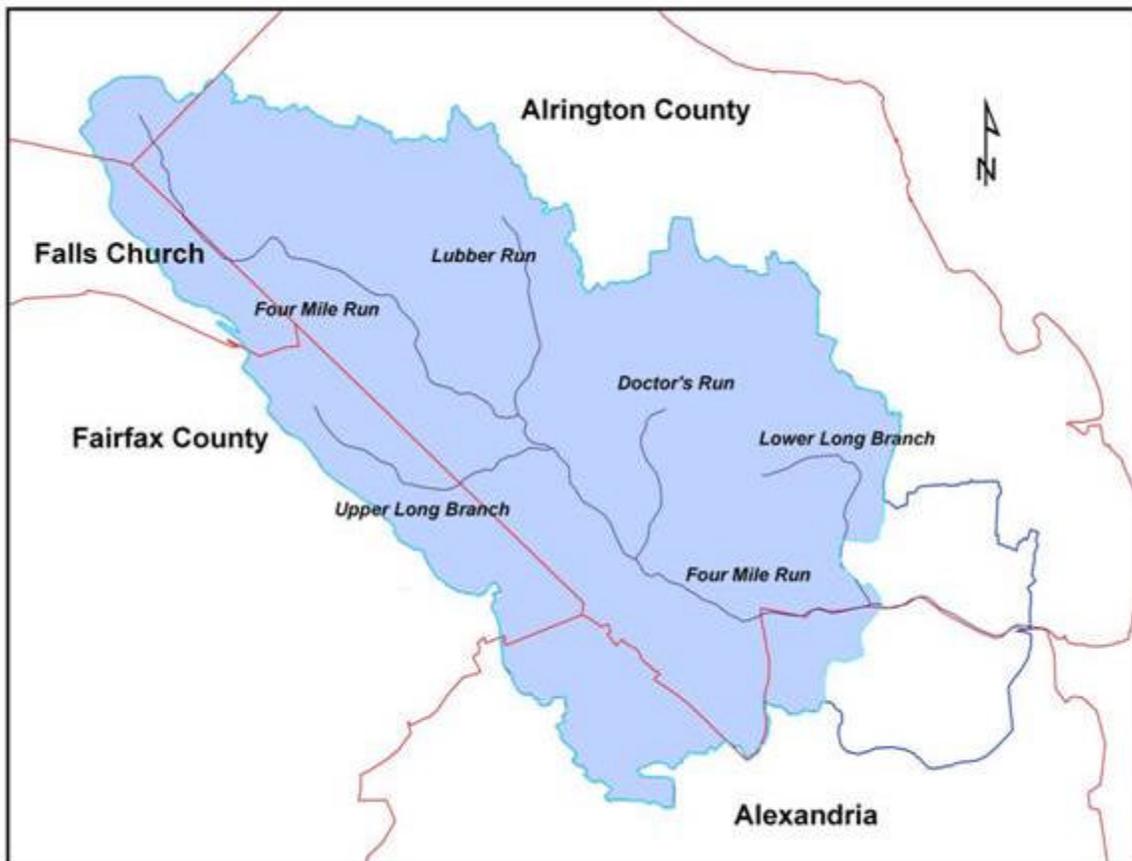


Figure 4.1. Four Mile Run TMDL Watershed

upstream from the Potomac River. Figure 4.1 shows the location of the Four Mile Run watershed with the TMDL watershed highlighted. While the entire watershed blankets 19.7 square miles, the nontidal portion of the watershed covered by the TMDL is 17.0 square miles.

The watershed is home to 183,000 people, or just over 9,000 persons per square mile (NVRC staff analysis of 2000 U.S. Census data). The dominant land use is medium to high density residential housing. Within the entire 19.7 square mile (12,600 acre) watershed are no less than seven central business districts (CBDs), including Ballston, Seven Corners, Baileys Crossroads, Skyline, Shirlington, Crystal City, and East Falls Church. Not surprisingly, Four Mile Run has a higher daytime population during the workweek than its 183,000 full time residents. As can be seen on Figure 4.2, two interstate highways, I-66 and I-395, pass through the watershed, as well as, numerous primary and secondary roadways. The expansive roadways, roof tops and parking lots comprise most of the watershed approximate 40% impervious coverage (7.8 square miles). The impervious areas are impenetrable to rainwater and as those areas have increased through urbanization the natural hydrologic (rain cycle) processes have been short circuited causing an array of surface water issues.

## 4.2 Climate

The Four Mile Run watershed straddles the Mid-Atlantic piedmont and coastal plain physiographic provinces approximately 50 miles east of the Blue Ridge Mountains, and 35 miles west of the Chesapeake Bay. Watershed elevations range from sea level to 425 feet above mean sea level. Four Mile Run is a tributary to the Potomac River, and enters the river on its western shore at the southern end of Ronald Reagan National Airport (formerly Washington National Airport).

Climate data for this area have been kept continuously since November 1870. Official observations have been recorded since June 1941 at Ronald Reagan Washington National Airport. This airport is at the center of the urban heat island associated with the greater Washington, D.C. area. Consequently, low temperatures recorded at the airport are approximately 10 to 15 degrees higher than the surrounding suburban areas (NWS, 2002). The recorded high temperatures are not as greatly affected by the urban heat island effect, so there is less variation in high temperature readings between urban and suburban locations.

Winters are usually mild, with an average temperature in the mid 20's (°F). Spring and fall are generally mild climates, with very pleasant weather. Summers can be hot and humid, with temperatures averaging about 80°F. The average date of the last freeze in spring is April 1, and the average date for the first freeze in the fall is November 10.

Precipitation is generally evenly distributed throughout the year, with an annual rainfall of 39 inches per year. Snowfalls average 18 inches per year, with perhaps only one or two major snowfalls in a season. It is unusual to have a snowstorm of 10 inches or more within any one particular day. However, there have been rare occurrences of 25-inch snowstorms.

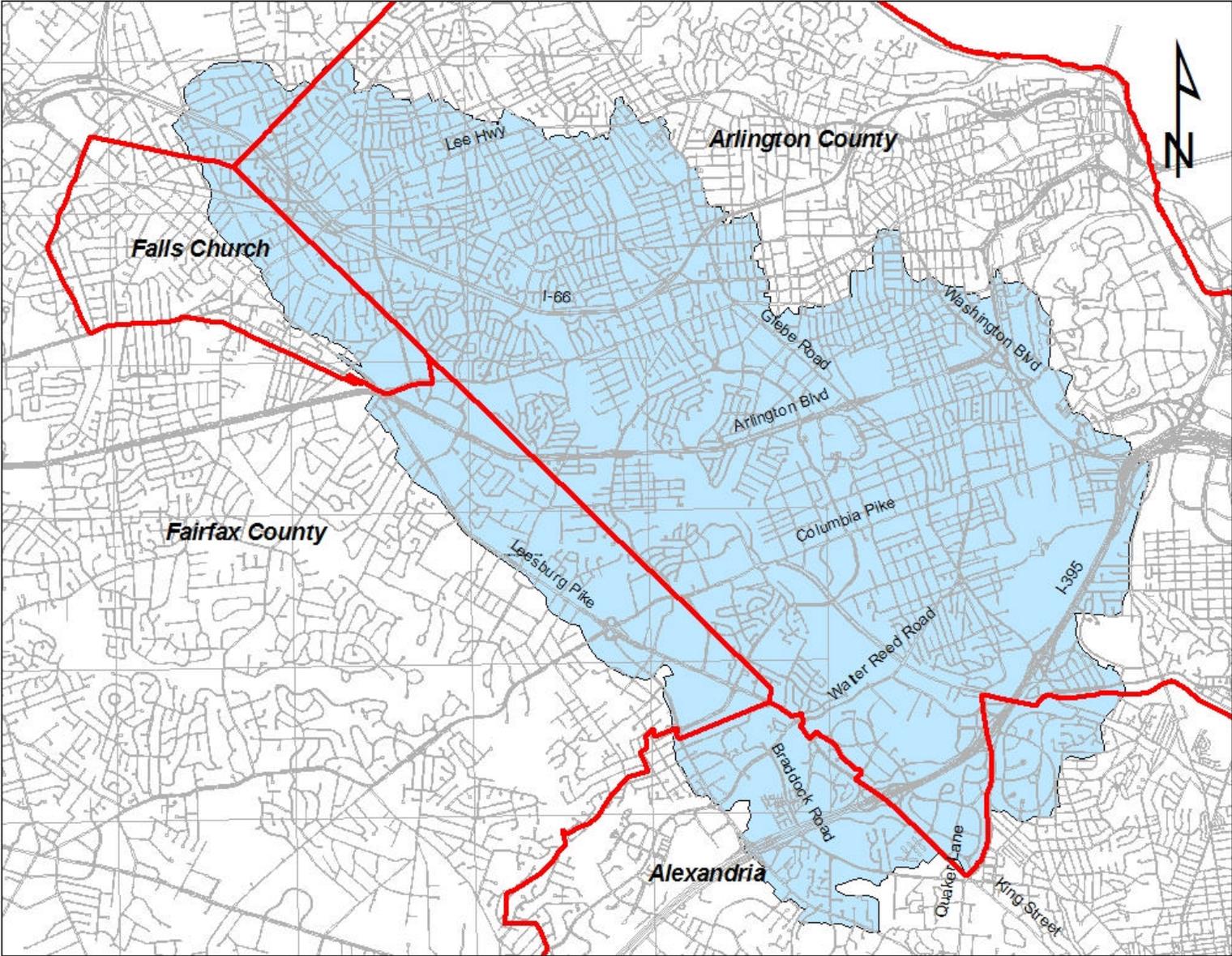


Figure 4.2. Four Mile Run TMDL Watershed Roadmap

Late spring and summer afternoons can bring locally intense thunderstorms with occasionally significant local flooding. Late summer can bring tropical storms or hurricanes, with their accompanying heavy rains, high winds, and flooding. Winds of up to 100 mph and rainfall exceeding seven inches have occurred with these types of storms. The greater Washington, DC metropolitan area is also subject to rare tornadoes and springtime hailstorms, both of which can result in significant damage.

### **4.3 Land Use**

Land use is a predominant determining factor for source of fecal coliform deposition. For example, wildlife is more common in open space and parkland than highway corridors and high-density development. Likewise, pet populations are associated with residential lands more so than commercial or industrial areas. There are no large-scale agricultural operations in the Four Mile Run watershed that would discharge stormwater with contaminants associated with those types of land uses.

Land use information was obtained for the TMDL model from NVRC's own Northern Virginia regional land use GIS layer with a multi-jurisdictional 15-key land use classification. A sixteenth land use category was culled from this GIS layer by parsing major highways from the "Public Open Space" category they shared with open parkland. Other minor cleaning of this layer was performed to ensure the final accuracy of this important model input. It should be noted that two typical land uses in this regional GIS layer are absent from the watershed—open water and rural residential/agricultural. Thus, the model uses 14 land uses. The determination and distribution of watershed imperviousness was derived from the supplied land use information. The quality of this land use information is a large reason the hydrology calibration of the model has an exceptionally good fit.

The nontidal portion of the Four Mile Run watershed is 10,874 acres, or 17.0 square miles. Table 4.1 shows the acreage of each existing land use in the nontidal portion of the watershed and the average estimated impervious land use. Using the data in the table yields an overall imperviousness for the watershed of 41.5%. This value is consistent with other estimates from watershed localities and NVRC's Four Mile Run SWMM Model, which place the watershed within the 35 to 45 percent impervious range.

**Table 4.1. Land Use Classification by Model Segments in Acres**

<b>Land Use</b>	<b>Impervious</b>	<b>Total</b>
Open Space/Parks	2%	610
Highway	90%	469
Medium to High Density Mixed Use	65%	417
Medium to High Density Industrial	80%	154
Public/Conservation/Golf	8%	559
High Density Residential	75%	300
Medium Density Residential	40%	4,251
Medium to High Density Residential	50%	1,736
Medium to High Density Commercial	70%	255
Low to Medium Density Residential	20%	1,043
Low Density Commercial	40%	541
Low Density Industrial	65%	60
Low Density Mixed Use	30%	201
Federal	50%	278
<b>Total</b>		<b>10,874</b>

#### 4.4 Impaired Status

Prior to completion of the TMDL, five groups had performed fecal coliform monitoring of Four Mile Run: VADEQ, NVRC, the Fairfax County Health Department, the Arlington County Parks Division, and the Arlington Chapter of the League of Women Voters. All found elevated levels of fecal coliform bacteria in the Four Mile Run watershed. Between 1990 and 2002, over 700 fecal coliform samples were taken from Four Mile Run and its tributaries. Nearly half of those samples were determined to be over 1,000 most probable number (MPN) per 100 mL, the previous Virginia water quality criterion for fecal coliform bacteria.

Importantly, there is little manufacturing industry to generate point source discharges. While there are two regulated point source discharges in the watershed, one is a small concrete batch plant with a pH discharge regulation only and the other is Arlington's modern sewage treatment plant (STP), which provides tertiary treatment and easily complies with its 200 colony forming units (cfu) per 100 milliliters (mL) permit limit for fecal coliform bacteria (NVRC analysis of Arlington ST daily discharge monitoring records, 1998 – 2001). This plant discharges in the tidal portion of Four Mile Run near the Potomac River, and is thus outside the TMDL watershed area.

There are no combined sewers in the Four Mile Run watershed. However, each jurisdiction has had to deal with aging sanitary sewer infrastructure. As sanitary sewer

systems reach the end of their useful life the pipe network often develops cracks or other failures that allow infiltration of groundwater to enter the pipe network. That infiltration coupled with inappropriate areaway or rooftop connections to the sanitary sewers that allow surface water to inflow to the sanitary sewer system can overwhelm the system forcing sanitary sewer overflows (SSOs) in the watershed. The only sanitary sewer pumping station in the watershed is located in Alexandria, downstream of the TMDL watershed. Sanitary sewer serves more than 99.9% of the watershed's residents, and the number of septic systems in the watershed is believed to be less than 5.

TMDL development greatly benefited from a NVRC genetic fingerprinting or bacteria source tracking (BST) study in the Four Mile Run watershed performed by D. George Simmons of Virginia Tech's Biology Department. The 2000 study took E. coli samples at outfalls throughout the watershed. There are variations in the DNA structure of the E. coli across the spectrum of host mammals, i.e., DNA from E. coli from human fecal matter vary from the DNA of E. coli from canine or deer feces. In the Four Mile Run study, the DNA of the E. coli was compared to several libraries of E. coli DNA. The following pie chart (Figure 4.2) shows the resulting percentages of E. coli sources, thought to be similar to the fecal coliform distribution, in the watershed.

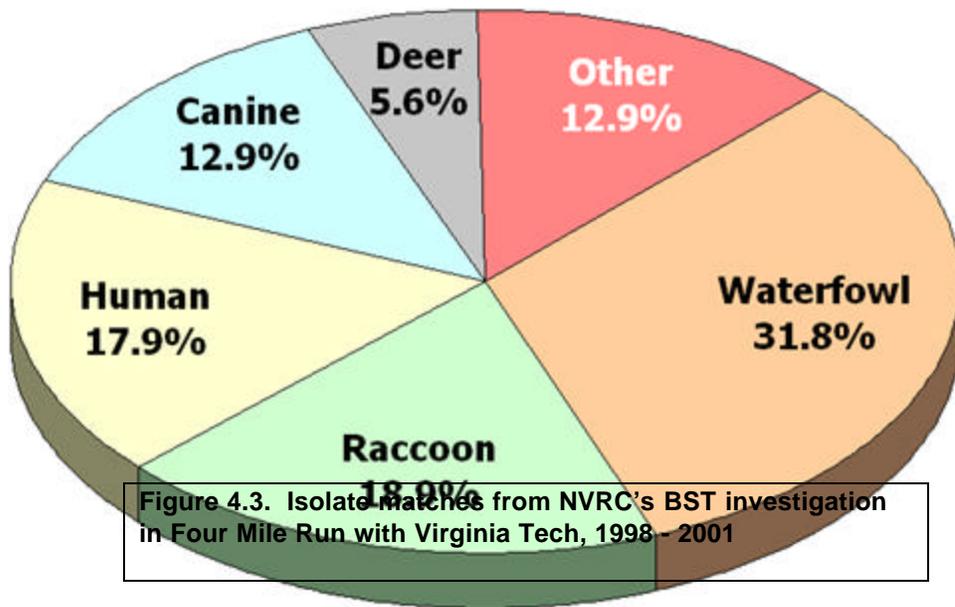


Figure 4.3. Isolate matches from NVRC's BST investigation in Four Mile Run with Virginia Tech, 1998 - 2001

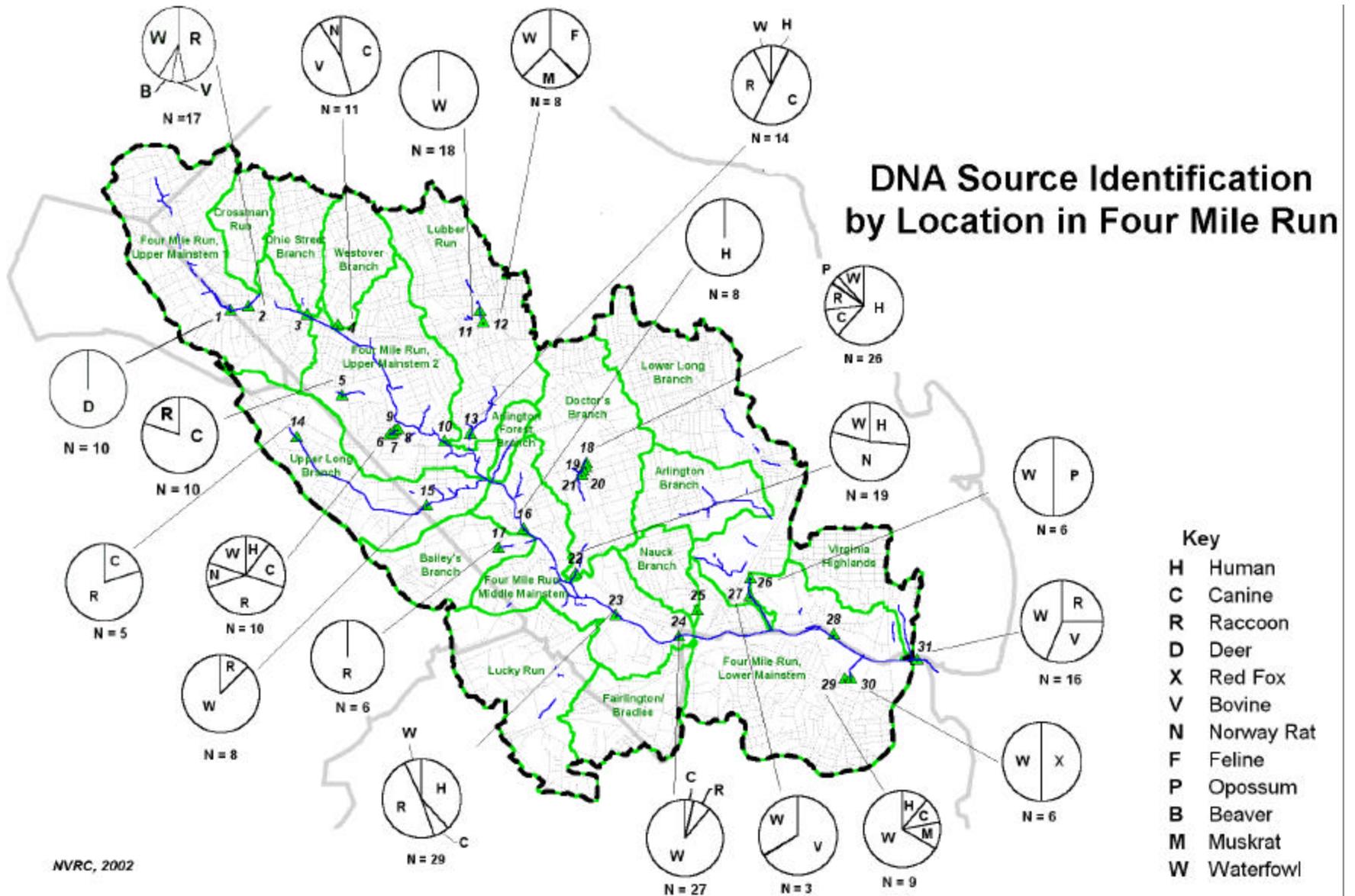


Figure 4.4. DNA Profiles by Location at 31 Sites in Four Mile Run

#### 4.5 Water Quality Data Used for TMDL Development

Four Mile Run water quality data used for the development of the Four Mile Run TMDL was compiled from the following sources:

- Virginia Department of Environmental Quality (VADEQ)
- Arlington County Department of Parks, Recreation, and Community Resources (DPRCR)
- Northern Virginia Regional Commission (NVRC).

The VADEQ data compiled for the Four Mile Run TMDL was collected at least quarterly and at most semi-monthly at a single station in the nontidal portion of Four Mile Run since 1991. Prior to this, some sampling by VADEQ was performed during the 1970s, but this sampling was discontinued by 1980. VADEQ's identifier for this station is 1AFOU004.22, and it is located along the Four Mile Run mainstem directly under the Columbia Pike (Virginia Route 244) bridge. This station is often referred to as Four Mile Run at Columbia Pike. Data from 1999 through 2001 are plotted in Figure 2-2. Except for a single value of 25 on January 29, 2001, this dataset is constrained by a minimum detection limit of 100 cfu/100 mL. Similarly, except for a solitary value of 9,200 from October 16, 1991, the dataset is constrained by a maximum detection limit of 8,000 cfu/100 mL.

Data collected by the Arlington County DPRCR supports its annual put-and-take trout stocking program in Four Mile Run. County park naturalists collect fecal coliform bacteria data, along with dissolved oxygen and pH, to gauge stream conditions leading up to opening day of trout season, which is usually in late March. As a result, a variable number of samples is collected from early February to mid-March most years at four locations along Arlington's greenway park system that straddles the middle section of Four Mile Run's mainstem. Unfortunately, no data were collected by DPRCR during calendar year 2000, and only one value was obtained for calendar year 2001. One of the DPRCR stations, designated as FMR3, is located approximately 800 feet upstream from Columbia Pike on Four Mile Run. As there are no tributaries or other significant drainage between FMR3 and Columbia Pike, and the reach is reasonably uniform along this section, data collected at this location was deemed appropriate to include with the other observed data collected at Four Mile Run and Columbia Pike. All data collected at Columbia Pike and FMR3 during the period simulated by the TMDL model (January 1, 1999 through May 31, 2001) were used for calibration and verification.

Five fecal coliform values were collected by NVRC and Virginia Tech at Columbia Pike and Four Mile Run during the period simulated by the TMDL. These data were collected to support the NVRC/Virginia Tech BST study previously described. The upper detection limit used for this dataset was 1,600 cfu/100 mL. While fecal coliform bacteria data were collected at 31 locations in the watershed to support the BST study, only the data collected at Columbia Pike was directly useful for calibrating and verifying the Four Mile Run TMDL computer model.

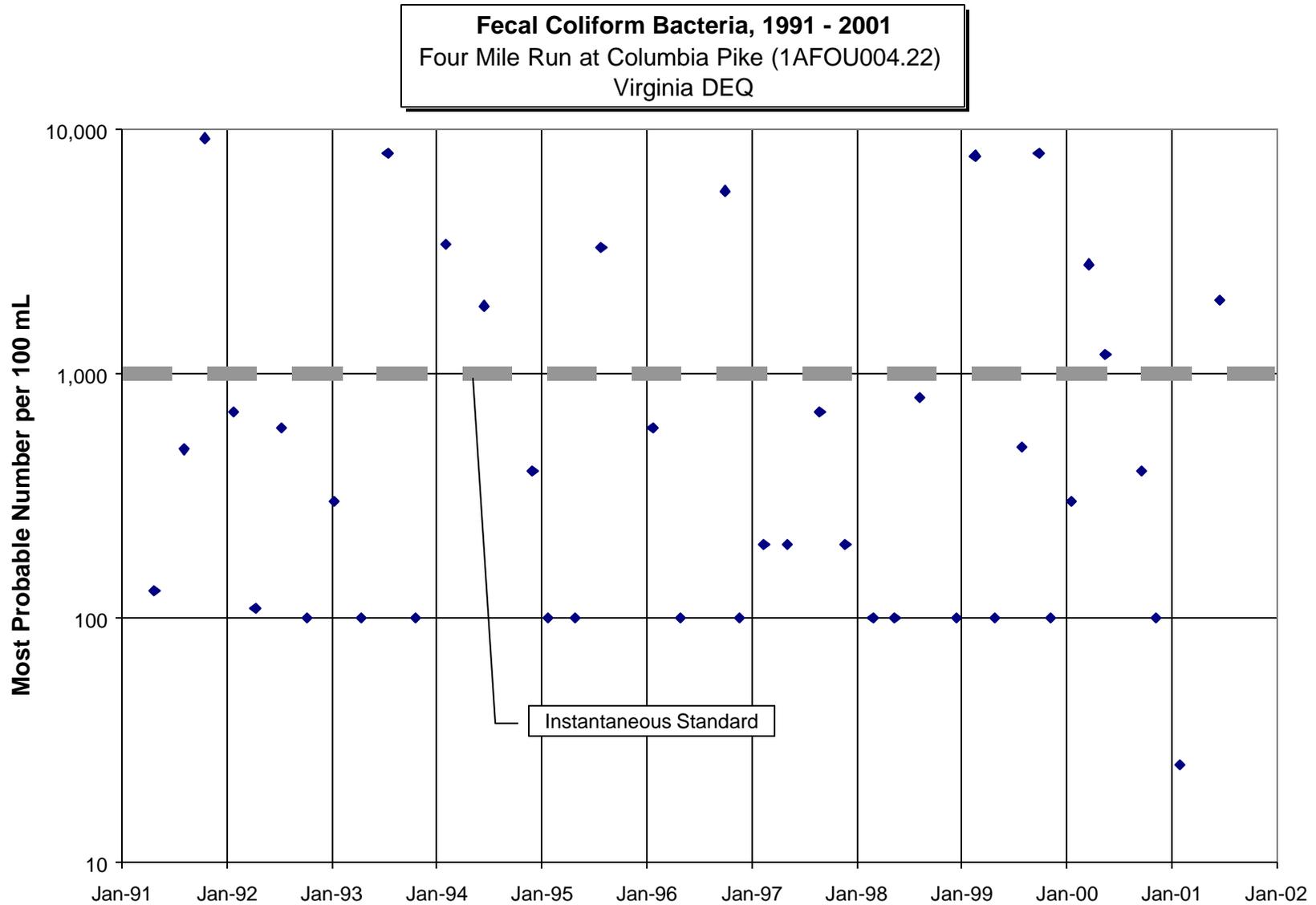
The combined dataset for Four Mile Run at Columbia Pike is shown graphically in Figure 2-3. The period from July 1998 to May 2001 is plotted. These datasets can be characterized by the percent of violations of Virginia's previous instantaneous criterion of 1,000 cfu/100 mL. The following table shows the frequency of violation by source and location from 1991 through the most recently available data.

**Table 4.2. Fecal Coliform Standard Violation Frequency in the Four Mile Run Watershed**

<b>Source</b>	<b>Location(s)</b>	<b>Years</b>	<b># of Observations</b>	<b>Frequency of Violations for Instantaneous Standard*</b>
VADEQ	Four Mile Run at Columbia Pike	1991 - 2001	41	27%
Arlington County Parks	4 sites along Four Mile Run mainstem from Bon Air Park to Barcroft Park	1998 - 2002	63	14%**
NVRC	29 sites throughout nontidal portion of watershed, including tributary streams	1998 - 2000	42	33%
All Sources	Combined	1991 - 2002	146	23%

\* 1,000 counts (most probable number) per 100 mL of stream water

\*\* Arlington limits data collection to late winter (February to mid-March) in association with its annual trout stocking program. See Table 2-3 for seasonal distributions.



**Figure 4.5. Fecal Coliform Densities in Four Mile Run at Columbia Pike, VADEQ Data Only, 1991 – 2001**



## 4.6 Seasonal Analysis

Seasonal variation for instream fecal coliform concentration was performed for Four Mile Run. The seasonal cutoffs used in this analysis were the actual calendar dates for each season, and were not rounded by month. Thus, data collected on different days of a month that straddled two seasons were split between those seasons. Data from VADEQ and other sources were analyzed both separately and together. Figures 4-4 and 4-5 present these seasonal mean values for the VADEQ station at Columbia Pike and the non-VADEQ data respectively. Figure 4.6 presents the seasonal mean values for the combined data sources at all nontidal stations. The graph shows that bacteria counts are somewhat higher on average in the summer and fall than during winter and springtime.

While this simple analysis of the data shows a trend toward somewhat higher bacteria counts in the summer, this trend is not as strong as seasonal trends observed in less urbanized watersheds; for instance, the agricultural-dominated Pleasant Run watershed in Virginia's Shenandoah Valley (Virginia Tech, 2000). Caution should be used when interpreting these bar charts, as data values at the detection limits can influence the mean values in non-intuitive ways.

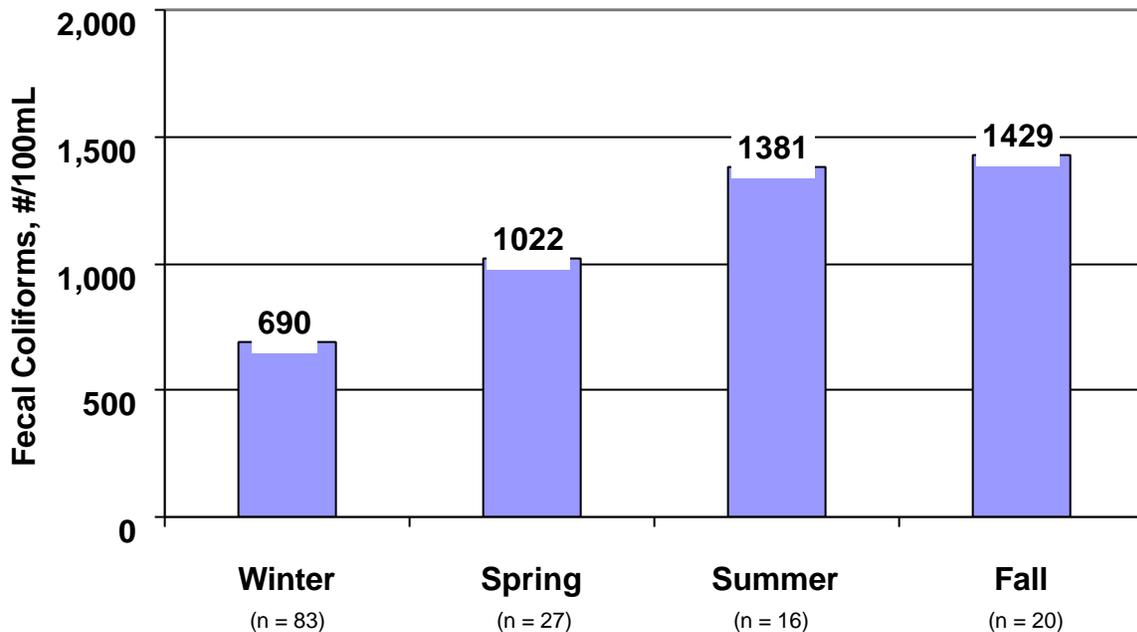


Figure 4.7. Mean Fecal Coliform Concentrations by Season from 1991 – 2001

The seasonal frequency of violation was evaluated for VADEQ and NVRC stations. Violations of the instantaneous standard were greatest in the springtime.

**Table 4.3. Fecal Coliform Standard Violation Frequency by Data Source and Season**

	Frequency of Violations for Instantaneous Standard*	
	VADEQ + NVRC + Arlington	
	%	# of obs.
Winter	16%	83
Spring	46%	27
Summer	25%	16
Fall	20%	20
Overall	23%	146

\* 1,000 counts/100 mL

#### 4.7 Four Mile Run TMDL Model

The model selected for Four Mile Run TMDL development was HSPF—Hydrologic Simulation Program – Fortran. HSPF is a set of computer programs that simulate the hydrology of the watershed, nutrient and sediment nonpoint sources loads, and the transport of these loads in rivers and reservoirs. The watershed was partitioned into three smaller sub-watersheds (upper, middle and lower Four Mile Run) for use with HSPF. Data on land uses and nonpoint sources were entered into the model for each sub-watershed.

#### 4.8 TMDL Load Allocations

After building and calibrating the HSPF model for Four Mile Run with known hydrologic and water quality data for the watershed the TMDL allocations could be generated. Waste load allocations (WLAs) represent the portion of bacteria loading allocated to point sources in the watershed. Similarly, load allocations (LAs) reflect the allocated loads from nonpoint sources. For the Four Mile Run TMDL watershed the WLAs were attributed to the impervious surfaces draining to Municipal Separate Storm Sewer Systems (both those with phase 1 permits and those allotted for phase 2 permits.) The LAs were allotted to all other areas of the watershed based on land use. A five percent margin of safety (MOS) was included in the calculations. The total sum of the WLA, LA and MOS produces the TMDL. The portions are broken out in Table 4.4.

**Table 4.4. Annual Fecal Coliform Loadings (counts/year) Used for Developing the Fecal Coliform TMDL for Four Mile Run**

Parameter	WLA	LA	MOS*	TMDL
<i>Fecal coliform</i>	2.04E+13	9.61E+14	4.91E+13	1.03E+15

\* Five percent of the TMDL

Given the above TMDL allocations several scenarios were run to determine the reductions in source loading needed to meet the TMDL allocations and, subsequently, to comply with the water quality criteria in Four Mile Run.

**Table 4.5. Existing Conditions and TMDL Allocation Scenarios**

	Reduction in Loadings from Existing Conditions (%)					% days > than 1000 MPN/100mL
	Waterfowl	Raccoon	Human	Dog	Other Wildlife	
Existing Conditions	0	0	0	0	0	24
Scenario 1	0	0	95	95	0	17
Scenario 2	50	50	95	95	0	13
Scenario 3	80	80	98	98	80	4
Scenario 4	95	95	98	98	95	0.1

The TMDL modeling suggests that the reductions of bacteria source loading indicated in scenario 4 are necessary to achieve compliance in the nontidal segment of Four Mile Run.

*The ultimate goal for the Four Mile Run TMDL program is to bring Four Mile Run fully into compliance with Virginia water quality criteria; however, the actions described in this IP outline the actions focused on only anthropogenic sources. While the intent of the plan is to target only the anthropogenic bacteria sources in the watershed many of the mitigation measures will reduce overall bacteria levels in the water column irrespective of the bacteria source. Inherent to all modeling efforts and scientific studies is a certain amount of uncertainty. By their very nature models rely on statistical calculations to make use of incomplete data sets or to smooth the model functions. Assumptions and approximations bridge between the mathematical model and actual conditions. Often these uncertainties are compensated for including a "margin of safety" in the calculations as was done in the Four Mile Run TMDL. By including a margin of safety a conservative bias is incorporated into the model. It is expected that the conservative trends inherent in the model and the indiscriminant effect on all bacteria in the water column of the mitigation measures included in this plan will combine to bring Four Mile Run into compliance.*

## 5.0 Public Participation

### 5.1 Background

This TMDL IP document ties together the needs to control the anthropogenic source loading of bacteria with the commitments of stakeholders in the watershed. The document contains background information on the Four Mile Run watershed, information on applicable federal and state regulations, and details on the related municipal programs affecting bacteria levels in the run. The core of the document is found in the Chapter 6, which outlines the commitments or actions that each of the responsible TMDL partners will take during the next ten years to control bacteria in the run. Those commitments have arisen through the partnerships forged through the development of this IP. By growing those partnerships through the course of this project, it is hoped that resources will be made available for implementing actions, outreach efforts will touch more than those already “in the know” and behaviors of the Four Mile Run watershed residents will change to meet the needs of the implementation strategy.

Because each of the commitments outlined in Chapter 6 list a responsible party one might surmise that this project is one that can find success without public support. To make such an assumption would underestimate the scope of the issue and underestimate the power of the watershed residents to effect success or failure of this endeavor.

### 5.2 Watershed Partnerships

At the outset of the development of this IP, the Technical Advisory Committee (TAC) sought to partner with existing institutions in the watershed. Included in this list of institutions were municipal agencies, nonprofit organizations, and regional governments or authorities. It was expected that by reaching those groups, their “constituent” base would also be reached. Each group has contact with the community through different mechanisms and the membership reached is assumed to vary across the spectrum of institutions.

The first set of partnerships forged through this IP comprised those partnerships developed through creation of the TAC itself. Included on the TAC were people from the following organizations:

- Arlingtonians for a Clean Environment
- Falls Church Village Society
- Arlington Forest Civic Association
- George Mason University, Department of Environmental Science and Policy
- Arlington County, Department of Environmental Services
- City of Alexandria, Department of Transportation and Environmental Services
- City of Falls Church, Department of Environmental Services
- Fairfax County, Department of Public Works and Environmental Services
- Arlington County Health Department

- Fairfax County Health Department
- City of Alexandria Health Department
- Metropolitan Washington Council of Governments
- Virginia Department of Conservation and Recreation
- Virginia Department of Environmental Quality
- Northern Virginia Regional Commission

When the TAC wished for more insight regarding pet waste disposal issues the following dog park sponsoring groups and park officials were invited to participate in a focus meeting:

- Arlington Dogs
- Banneker Dogs
- Tower Dogs
- Douglass Dogs
- Fair Dogs
- Shirlington Dogs
- Glen Carlyn Dogs
- Arlington County, Department of Parks, Recreation and Community Resources
- City of Alexandria, Department of Recreation, Parks and Cultural Activities
- Fairfax County Park Authority
- City of Falls Church, Department of Parks and Recreation
- Northern Virginia Regional Park Authority

It is expected that these partnerships will remain throughout the IP's ten year term.

### **5.3 Media Campaigns**

In order to raise public awareness of the IP development, several efforts were made. Two public meetings were held to solicit input regarding the IP development. The first meeting was held on June 11, 2003. The second meeting was held on December 10, 2003. Both meetings were advertised by e-mail distribution lists, website postings, and notifications in local papers including the Alexandria Gazette Packet, the Arlington/Alexandria Journals, and the Washington Post.

A website was also created for the project at <http://www.novaregion.org/tmdlresource.htm>. The website offers background information, a project timeline, project contact information, a downloadable copy of the original TMDL study, and archives of all meeting summaries and presentations. The dates for public meetings were also prominently displayed on the main page. The website was kept up to date throughout project development. Also in effect throughout the IP development period were postings on the VADEQ TMDL website <http://www.deq.state.va.us/tmdl/>. The postings included a project fact sheet and meeting announcements, as well as a downloadable copy of the original TMDL document.

## 5.4 Target Audiences

In seeking input for this IP, four groups of people were targeted:

1. Local governments including public works, parks and health departments;
2. Environmentally-concerned citizens;
3. Health departments; and,
4. Dog owners.

Input from **local governments** was needed for this project chiefly because much of the burden of implementing this project will be borne by those groups. The willingness of the local governments to dedicate staff time and to allocate financial resources to many of the actions described in this plan will determine the success or failure of this project. Finding consensus with governmental groups about what is feasible and achievable in the ten year timeframe was of primary concern. To that end governmental agencies have been represented on the TAC and have been involved in each step of the IP's development.

Central to the concerns of local governments has been the expected allocation of resources. The staff time needed to implement IP actions will be staff time that is not available for other efforts. The financial obligations for those actions will mean that funding allocated for the actions described in this IP will not be available for other programs. The approach taken by this IP has been one of building synergies between existing programs and enhancing those efforts, rather than building a project with a single narrowly-focused effort. By working closely with the local governments, opportunities for this kind of "synergy" arose.

**Environmentally-concerned citizen** involvement is woven into this IP through several important threads. The first and most obvious is through the two public meetings held during the IP development process. Citizens were invited through internet postings, e-mail distribution lists, mailings and by word of mouth to participate in the two public meetings. Presentations at the public meetings provided background on statutory requirements surrounding the project, as well as details concerning the TMDL study and the IP development process. Citizens posed questions and made comments reflecting both concern and support for the effort.

Citizen concern ranged widely in content from the validity of the TMDL efforts to date to the importance of the issue of bacteria as a pollutant. Much concern was voiced over how dog owners and dog parks would be impacted by implementation efforts.

**Health Departments** were invited to participate on the TAC. A special meeting was held for those departments in July to update them on project development and seek their input. Concern expressed from this group raised the issue of actual versus perceived risk associated with the bacteria impairment in Four Mile Run.

In an effort to gain better insight into the pet waste disposal issue, the TAC created a pet waste focus group to discuss the matter. **Dog owners** and park officials were invited to participate in the pet waste focus group. In Arlington County each dog park has a citizen sponsoring organization to care for the park. An umbrella group, Arlington Dogs, includes approximately 500 members. These seven dog sponsoring groups were used in the focus group meeting as proxy for all dog owners.

***Arlington County Dog Sponsoring Organizations in the TMDL watershed:***

- Arlington Dogs
- Banneker Dogs
- Tower Dogs
- Shirlington Dogs
- Glen Carlyn Dogs
- Douglass Dogs
- Fair Dogs

During the discussions participants provided much positive input including willingness to commit to outreach efforts during the ten year project timeframe. At the same time the focus group articulated well their concerns over the IP direction. The two items below mark their primary concerns:

- Dog park goers are unfairly targeted by the IP efforts. More effort should be directed to less responsible dog walkers.
- Canine sources of bacteria are a relatively small contributor (13%) in comparison to other sources of bacteria in the watershed; therefore efforts targeting dogs should be proportional.

**5.5 Outreach for Public Input**

Early in the IP development process the TAC built channels through which the public would participate. They are listed below

- Access to TAC meeting summaries including the update meeting with with the Health Departments
- Mail & e-mail to announce both public meetings
- Initial Public meeting to notify the public of the TMDL IP
- Informal visits to dog parks to speak with owners
- Focus Group meeting with park representatives and dog park sponsoring groups
- Presentation to Four Mile Run Restoration Citizen Taskforce Public Meeting
- 2<sup>nd</sup> Public meeting to present the draft plan and seek comment
- 30 day Public comment period associated with both public meetings
- Dedicated webpage to project / updated with all meeting summaries and presentations
- Approvals to be sought from Fairfax and Arlington County Boards and City Councils of Falls Church and Alexandria

## 6.0 Implementation Actions

### 6.1 Introduction

In developing the Four Mile Run TMDL Implementation Plan the Technical Advisory Committee (TAC) emphasized that this TMDL IP project leverages existing programs and efforts. With this approach synergies can be built with related projects and programs within the watershed. Through a synergistic approach the IP efforts will maximize benefits, and minimize any duplication of labor. To that end the following strategies and stakeholder commitments cited in this chapter coalesce current projects and programs with enhanced or new efforts targeting bacteria.

Each of the Four Mile Run jurisdictions has multiple programs that relate to protecting Four Mile Run from elevated levels of bacteria. Each jurisdiction has a sanitary sewer program that maintains the integrity of that system to limit the possible exposure of partially or untreated sewage to the environment. All four jurisdictions manage stormwater discharges through several programs, all of which overlap with the efforts of this TMDL IP. Virginia's 1988 Chesapeake Bay Act requires management of stormwater discharges to protect the Chesapeake Bay. The State of Virginia is currently working to develop a Potomac Tributary Strategy which will mandate decreases of nutrients and sediments discharged from each municipality to the Potomac River and its tributaries. Jurisdictional floodplain overlay districts and their corresponding ordinances work to moderate the volume of surface water.

Beyond the aforementioned programs each jurisdiction is subject to a Municipal Separate Storm Sewer System (MS4) Virginia Pollutant Discharge Elimination System Permit. Those MS4 permits dictate activities required of the municipality to control the quality of stormwater discharged from the storm drain system. VADEQ is the state agency responsible for issuing MS4 permits and will ensure that the requirements of each permit reflect the goals of any related TMDL efforts.

Beyond the concept of synergy the approach for this IP outlines a three pronged strategy to limit anthropogenic bacteria in the Four Mile Run:

1. **Pollution Prevention**
2. **Mitigation Measures**
3. **Indirect Measures**

The threefold strategy mirrors similar trends regarding other types of pollution control.

**Pollution Prevention** targets bacteria at its source. If bacteria are prevented from entering surface water the absent bacteria will not contribute to the bacteria levels in Four Mile Run. The pollution prevention efforts in this plan primarily target human and canine sources of bacteria loading and include:

- a. Sanitary Sewer Maintenance
- b. Inappropriate (Illicit) Discharge Controls
- c. Septic System Maintenance
- d. Proper Pet Waste Disposal

Once bacteria have transported into the surface waters of the watershed **Mitigation Measures** remove or render lifeless the bacteria. Technologies also considered mitigation measures for inclusion in this IP are those measures that reduce the stormwater runoff that discharges to Four Mile Run and its tributaries. Because the anthropogenic bacteria are not segregated in the water column the mitigation measures included in this plan target all bacteria in the surface waters draining to the measures installed not just anthropogenic bacteria. The following measures were considered for this plan:

- a. Stormwater Treatment
- b. Street and Storm Drain Infrastructure
- c. Stream Corridor Restoration
- d. Stormwater Reduction and Reuse
- e. UV Disinfection
- f. Ozone Treatment
- g. Flocculant Treatment

Although **Indirect Measures** do not immediately affect bacteria levels in Four Mile Run they may prove to have the broadest impact on bacteria levels in the run. These indirect measures included in this plan intend to change behaviors and attitudes of watershed citizenry through outreach and education. The indirect measures considered by this plan include the following:

- a. General Outreach
- b. Directed Outreach
- c. Signage

For each of the three strategies, this chapter first describes the ongoing activities in each jurisdiction. Stakeholder commitments are presented in boxed areas at the end of each section. Those commitments, particularly those related to continuing implementation of existing programs, are subject to change under each jurisdiction's annual budgeting process, which is governed by a public process outside the purview of the plan's authors.

## 6.2 Pollution Prevention

Pollution Prevention efforts aim to limit the bacteria at their sources. These measures target specific points where bacteria are discharged into the environment, e.g. sanitary sewer overflows or fugitive pet waste. Because these measures eliminate bacteria before it enters Four Mile Run or its tributaries the cost of subsequently removing the bacteria from the water is averted. The preventative measures employed by this IP target only the anthropogenic and canine sources of bacteria.

### **Pollution Prevention: Combined Sewer Overflows**

Combined Sewer Systems combine both sanitary sewage and stormwater in one system of pipes. Under dry conditions or times when only a small amount of rain falls those pipes carry the mixed water to the waste water treatment plant (WWTP) for treatment prior to discharge to the nearby stream or river. However, during times of larger rain events those pipes do not have the capacity to carry all of the mixed water to the WWTP. During those times a portion of the bacteria laden water overflows the pipes and is discharged untreated, or partially treated, into the adjacent stream.

Of the four jurisdictions only Alexandria has a collection system regulated as a combined sewer system. That combined sewer system, including all of its outfalls, is located entirely outside of the Four Mile Run TMDL watershed area and thus, will not be addressed here.

It is likely, if not probable, that all four jurisdictions have non-sanitary connections to their respective sanitary sewer systems. Those connections can include roof drains, areaway drains, and sump pump discharges. Although these types of connections effectively combine sanitary and storm sewer flows they are not regulated as a combined sewer system. Following that logic, such connections will be addressed in the sanitary sewer overflows section that follows.

### **Pollution Prevention: Sanitary Sewer Overflows**

Sanitary sewer overflows (SSOs) do not regularly occur in the watershed and when they do occur they are short lived. Many of the residents in the watershed have basements in their homes where a drain is below the nearest manhole rim elevation. This means that if a sewer line blockage occurs causing a sewage backup the resulting discharge will occur at the lower elevation in the nearby basement. Although the unpleasantness to the homeowner of such a scenario is significant the stream environment is protected for several reasons. The first reason is that all bacteria laden material is contained within the basement versus discharging such material directly to the environment. The second reason is that such backups are typically short-lived in an effort to prevent further damage thus limiting the material escaping the system. The third reason is one of attitude; because damage from such a blockage is immediate and word of such an

incident typically reaches an influential ear, preventive maintenance operations on the municipality side are regularly performed.

Another limiting factor regarding SSOs is the density of the watershed's population. Even the forested areas in the watershed have regularly trafficked commuter and pedestrian trails and when an SSO does occur it will readily be reported and quickly brought under control.

SSOs typically occur for one of three overriding reasons: 1) a portion of the sewer system needs routine maintenance (e.g. a line needs cleaning, a junction has a blockage); 2) a portion of the sewer system has failed due to systemic lack of capacity (this type of failure is often evidenced during wet weather conditions due to inflow and infiltration of surface water into the sanitary sewer system); or, 3) the existence of an acute structure failure in the system. The SSO result from either type of failure is no different regarding the havoc wreaked in the watershed. The first type of failure, one of maintenance, can be addressed through Routine Inspection and Maintenance of the system and the second and third types of failures can be addressed through a system Sewer Rehabilitation Program.

A specific scenario could exist whereby an overflow from the sanitary system can be caused by systemic under capacity or an acute problem at the waste water treatment plant (WWTP). Typically, any resulting overflow will geographically occur in the vicinity of the WWTP. As the only WWTP in the Four Mile Run watershed, the Arlington County Water Pollution Control Plant, is located outside of the Four Mile Run TMDL watershed such a scenario is not addressed in this implementation plan.

Although not directly an SSO, the following scenario was considered as part of the IP. If a backup does occur it may be possible that during cleanup operations the backed up sewage could be pumped directly or indirectly to the storm sewer. If the failure is limited to only a residential or commercial lateral pipe connection it is highly unlikely that sufficient water will back up to warrant pumping of material. This said, educating private contractors in handling such backed up wastewater was considered as part of this plan and is reflected in the commitments contained herein. If the failure is located within the municipal infrastructure then there will be at least two municipal workers on hand to ensure proper disposal of such backed up water. Committing training of appropriate municipal staff regarding proper disposal of such waters was considered for this IP and is also reflected in the commitments contained herein.

The measures included in this section can be considered 100 percent effective in controlling bacteria from reaching Four Mile Run. That is to say, when a SSO does not occur all bacteria laden material is conveyed to the WWTP for treatment prior to discharge.

## **City of Alexandria**

### **Sewer Rehabilitation Program**

Alexandria has two non-contiguous sections of the Four Mile Run watershed. The first and older section lies east of Quaker Lane and the second, newer section lies south of King Street starting two blocks west of Quaker Lane. The City completed a detailed sewer evaluation study of the Four Mile Run (east of Quaker Lane), the Commonwealth, and Taylor Run sewer sheds in early 2003. Only a portion of the western section of the Four Mile Run sewer shed lies inside of the TMDL watershed.

The eastern portion of the Four Mile Run sewer shed drains north to a pump station facility at the north end of Commonwealth Avenue and is highly influenced by infiltration and inflow (I & I) activity. Two temporary sewage holding tanks holding a total volume of one million gallons were installed in 1995 and 1998 at the pump station. The pump station and its overflow tanks are located outside of the TMDL watershed; however, the holding tanks provide the entire system with additional capacity, which minimizes the overflows in the system throughout the basin. The sanitary sewers west of Quaker Lane are thought to be in better condition and less influenced by I & I activity. No evaluation effort is underway nor planned at this time for that sewer shed.

The City is committed to improving the quality of its sewer infrastructure and has budgeted \$18 million for sewer rehabilitation in the three surveyed sewer sheds. The City is beginning this process in the Four Mile Run sewer shed. Request for proposals are due in December 2003 for the Four Mile Run area and the work is scheduled for completion by January 2005. The work will involve rehabilitation of 58,000 linear feet of sewer and 700 manholes by means of pipe lining, pipe replacement, and manhole lining and replacement. The house lateral connections (to the property line) will be repaired by the City in conjunction with the rehabilitation work being planned for the street sewers. Additionally, some inspections of house laterals between the street sewer and residences or buildings will be conducted to obtain information on the condition of these pipes. This project will not involve repair of private laterals.

#### **Work to be done in the Four Mile Run Watershed**

Rehabilitation of sanitary sewer	58,000 ft.
Rehabilitation of Manholes	700 manholes

### **Routine Inspection and Maintenance**

The City completed an inspection project in early 2003. This project involved metering major sanitary lines during dry weather and wet weather conditions. Based on the results of the metering phase, a priority list was created for sanitary improvements, which was discussed previously. The priority sewer sheds were inspected by camera to determine the required rehabilitation.

The City recently released a Request for Proposal for a sanitary and storm sewer mapping project. The result of this project will be a GIS database of the locations and sizes of all sewers in the City. This information will assist the City in planning for future sewer improvements.

Inspection & Maintenance of the remaining system will continue to be performed on an as needed or requested basis. The Alexandria Sanitation Authority owns and maintains a portion of the sanitary system in the City. Typically these lines are the larger trunk mains and interceptors.

## **Arlington County**

Arlington County adopted an updated Sanitary Sewer Master Plan on December 8, 2003. In that plan Arlington County describes its system as 474 miles of sanitary sewer, 14,000 manholes, 36,000 building connections, 12 lift pumping stations and a wastewater treatment plant. All twelve of the lift pumping stations and the WWTP lie outside of the TMDL watershed and thus are not considered in this management plan.

### **Routine Inspection and Maintenance**

The average age of the sewer lines in Arlington County is approximated to be 55-years with an average life expectancy estimated at 75-years. Ongoing inspection efforts for the sewage collection system are on a ten year cycle; thus, all lines and manholes are inspected every ten years with closed circuit television camera (CCTV.) Maintenance of individual lines occurs on three schedules: 1) Each grid of the sewer system is flushed on a 4-year cycle, 2) Hot spot areas of the County system are targeted for routine flushing and cleaning, and 3) Lines are flushed or otherwise cleaned on an as needed basis. Such cleaning can include root control or line flushing. An earlier system of inspection and targeted maintenance was replaced by the aforementioned system in 1992. System data collected on blockages shows an average of 46 public stoppages and 120 private stoppages per year. By comparison, a 1981 survey conducted by the National Urban Institute indicated an average of 827 backups per 1000 miles of sewer; pro-rated for the size of Arlington's system, that average would be approximately 392 stoppages per year, more than 8 times the number of stoppages experience by Arlington on average (Sanitary Sewer Collection System Master Plan – Adopted December 8, 2003.)

Beyond ongoing maintenance of existing lines, replacement of the sewage collection infrastructure has occurred on 1% annual basis. A 1% annual replacement rate could be thought of replacing each sewer line every 100 years, where 100 years exceeds the 75-year life expectancy of the sewer lines. The new Sanitary Sewer Master Plan recommends that the sewer line replacement rate be raised to 1.5% annually to lower the average age of sewer line infrastructure. A 1.5% annual replacement would mean that on average sewer lines would be replaced every 66 years and within the 75-year expected life of sewer lines.

## Fairfax County

### Sewer Rehabilitation Program

During the 1994/1995 timeframe, Fairfax County began a program to evaluate and rehabilitate their sanitary sewer system. Fairfax County has two non-contiguous sections of the Four Mile Run watershed. Both sewer sheds ultimately drain to the Arlington County Water Pollution Control Plant (WPCP). The southwestern portion of the watershed located in Fairfax County just south of Falls Church happened to coincide with the first sanitary sewer area in the County to be evaluated. The area had some of the oldest sewers in the County and thus was believed a priority area. All lines in the area have been inspected and video taped with CCTV. The resulting videos were evaluated and a plan with priority ratings was developed to repair all severally deteriorating line segments and manholes. Since 1995, Fairfax County has used a variety of techniques including Fold-&-Form and Cure-In-Place insitu methods, robotic point repairs and excavation and replacement to effect those repairs. However, most all sewer rehabilitation work is currently completed by cure-in-place and robotic repair methods.

The next area of Fairfax County to be evaluated coincided with the other section of the Four Mile Run watershed. It lies just north of the Falls Church political boundaries. To date, at an estimated cost of \$2,041,000, Fairfax County has completed the following in the Four Mile Run watershed:

#### Completed Work

Cured in Place Lining (CIPP)	36,677 ft.
Fold and Form Lining	11,431 ft.
Slipline	499 ft.
Robotic Repairs (KA-TE)	36 repairs

Based on the current structural condition the following work will be scheduled during the next five years at an estimate cost of \$960,000.

#### Work to be done

Lining	28,909 ft.
Robotic	43 repairs

### Routine Inspection and Maintenance

Although Inspection & Maintenance is currently performed on an as needed (or requested) basis Fairfax County has suggested that they can commit to performing regular staff inspections once per year. The current technique for this operation is visually inspecting the manhole and using a mirror placed appropriately in the manhole

to view the incoming and outgoing sewer lines. With training one can properly inspect approximately 150 LF of sewer line in each direction. The County is considering the use of portable cameras for this work.

## **City of Falls Church**

### **Sewer Rehabilitation Program**

The City of Falls Church has recently undergone a study of the City's entire sanitary sewer system to develop a "Comprehensive Sanitary Sewer System Improvement Plan." The plan was completed in August 2003 and presents a 30-year plan for focused evaluation and rehabilitation of the City's sanitary sewer system. The plan divides the City into 10 geographic areas that represent three-year phases of the 30-year plan. The phase numbering represents the priority given to each corresponding area with Phase 1 being the highest priority and Phase 10 being the lowest. The prioritization was based on the areas thought most in need of rehabilitation. The areas/phases of the plan located in the Four Mile Run TMDL watershed are Phase 3, Phase 8, Phase 9, and Phase 10. Although physically the work can be done in a much shorter period of time, the project pace is slated for thirty years due to expected funding availability. The first area of the Four Mile Run TMDL watershed to be addressed by this plan is Phase 3, and it will not start until Project Year 7; this is likely to coincide with IY- 7. As the plan currently stands, phases 8, 9, and 10 will not be addressed until Project Years 21- 30, well outside of the 10 year IP project; however, it is the Phase 3 area that is most threatening to the Four Mile Run watershed.

### **Routine Inspection and Maintenance**

Maintenance for the sanitary sewer infrastructure is accomplished by regular inspection and cleaning; spot repairs of failed sections of sewer line.

## ***Sanitary Sewer Infrastructure Commitments***

- ***City of Alexandria, Department of Transportation and Environmental Services***
  - will rehabilitate the portion of the sewers in Four Mile Run watershed. That portion, called the Four Mile Run sewer shed, represents the most critical area of Infiltration and Inflow problem in the Alexandria portion of the Four Mile Run watershed. (IY-1)
  - will annually inspect all sanitary sewer crossings and sanitary trunk lines parallel to and in the stream corridors of the Four Mile Run watershed. Any parallel lines or crossings found to be failing will receive a high priority rating to ensure timely repair efforts. (IY-1 thru IY-10)
  - will maintain the sanitary sewer infrastructure on an as needed basis and by developing a GIS database of the sanitary sewer system that will aid in projecting an efficient maintenance strategy. (IY-1 thru IY-10)
  - will train appropriate personnel on proper sewage disposal during sanitary sewer backups and subsequent repair work. (IY-1 thru IY-10)

## **Sanitary Sewer Infrastructure Commitments (continued)**

- **Arlington County, Department of Public Works**
  - will train appropriate municipal personnel on proper sewage disposal during sanitary sewer backups and subsequent repair work. (IY-1 thru IY-10)
  - will continue their sanitary sewer infrastructure maintenance program at its current level of service. (IY-1 thru IY-10)
  - plans to increase the rate of replacement of sanitary sewers from 1% annually to 1.5% annually over the course to ten year IP timeframe. (IY-1 thru IY-10)
  
- **Arlington County, Departments of Public Works and Environmental Services**
  - will inspect all sanitary sewer crossings in the stream corridors of the Four Mile Run watershed as part of the MS4 Permit dry weather inspections program. Any stream crossings found to be failing will receive a high priority rating to ensure timely repair efforts. (IY-1 thru IY-10)
  
- **Fairfax County Wastewater Collection Division**
  - will inspect each sanitary sewer line and manhole within the Fairfax County portion of the watershed. Portable personal cameras may be employed for this effort. Such coverage includes all sanitary sewer stream crossings and sanitary trunk lines parallel to and in the stream corridors of the Four Mile Run watershed. Any parallel lines to stream channels or stream crossings found to be failing will receive a high priority rating to ensure timely repair efforts. (IY-1 thru IY-10)
  - will train appropriate personnel on proper sewage disposal during sanitary sewer backups and subsequent repair work. (IY-1 thru IY-10)
  
- **City of Falls Church Department of Environmental Services**
  - will inspect all sanitary sewer crossings and sanitary trunk lines parallel to and in the stream corridors of the Four Mile Run watershed. Any parallel lines to stream channels or stream crossings found to be failing will receive a high priority rating to ensure timely repair efforts. (IY-1 thru IY-10)
  - will begin a three-year project to evaluate and rehabilitate a priority sewer basin within the City limits. (IY-7 thru IY-10)
  - will maintain the sanitary sewer infrastructure by regular inspection and cleaning; spot repairs of failed sections of sewer line. (In addition to 30-year program.) (IY-1 thru IY-10)
  - will train appropriate personnel on proper sewage disposal during sanitary sewer backups and subsequent repair work. (IY-1 thru IY-10)
  
- **Northern Virginia Regional Commission**
  - will work with the watershed jurisdictions to map all sanitary sewers in the stream corridors. (IY-1)
  - will investigate ways to educate private contractors in proper sewage disposal. This may include information included at licensure. (IY-2)

### **Commitments Beyond the 10-year Timeframe**

- **City of Falls Department of Environmental Services**
  - will completely evaluate and rehabilitate the sanitary sewer infrastructure within its corporate limits by year 2034. (Beyond IY-10)

## **Pollution Prevention: Inappropriate (Illicit) Connections**

Inappropriate or illicit connections are cross connections to the storm drain system that are not rainwater or sump pump out connections. Such cross connections are not permitted by VADEQ or the municipality. The generic case of concern is the connection of a sanitary line or lateral to the storm drain network. Such a cross connection would result in the discharge of untreated or partially treated sewage directly to a stream or tributary. The bacteria laden water discharged from one of these cross connections could consistently elevate the levels of bacteria in the run.

Outfalls are the locations where the storm system discharges to a stream or its tributaries. An outfall marks the end of the subsurface storm water conveyance system and the confluence with the exposed stormwater conveyance system that includes ditches, lakes, ponds, streams, rivers, etc. Monitoring the effluent at these outfall locations offers evidence to the quality of water in the storm drain network upstream of these sites. "Outfall monitoring" is typically employed to look for cross connections to the storm drain network. In 1999 an optical brightener study of all outfalls in the Four Mile Run watershed was undertaken by NVRC. Through that study 7 to 10 composite samples were taken at each outfall in the watershed. Those samples were analyzed for evidence of optical brighteners found in laundry detergent which indicates the possibility of an inappropriate connection upstream of the sampling site.

As with the measures used to prevent sewage overflows, inappropriate discharge and elimination programs can be 100 percent effective when employed. The difficulty in ensuring a programs efficacy comes from the frequency of monitoring. If an inappropriate discharge occurs only sporadically an infrequent grab sample taken at a downstream outfall may not detect the inappropriate discharge. Without detection the inappropriate discharge corrective actions will not likely occur.

### **City of Alexandria**

Required by Alexandria's new MS4 Phase 2 permit the City will enhance program efforts to limit inappropriate discharges directly to the storm sewer system. This will be done in two ways:

- 1) A City ordinance (Environmental Offenses Ordinance {Ordinance number 4211, Title 11, Chapter 13 of the City Code} Section 11-13-2 (a)). was established June 16, 2001 that disallows discharges other than stormwater to the separate stormwater system unless specifically permitted by law or an applicable permit.
- 2) A pilot program will be developed by 2007 to investigate, detect, and eliminate inappropriate discharges through the evaluation of representative outfalls. The pilot program will be focused on the Four Mile Run watershed to coincide with this TMDL IP effort.

## **Arlington County**

Through the County's renewed MS4 Phase 1 permit Arlington County has a program to limit inappropriate discharges directly to the storm sewer system. This is done in three ways:

- 1) In 2001, section 45 of Chapter 26, the County's Utilities Ordinance was revised to disallow discharges other than stormwater to the separate stormwater system unless specifically permitted by either the County under the authorities given through their MS4 Permit or by the Virginia Department of Environmental Quality.
- 2) A program was developed to investigate, detect, and eliminate such inappropriate discharges through the evaluation of representative outfalls. The County has used a dry weather screening process at its outfalls to determine if there is a presence of sewage in the discharge at the storm drain outfalls. Previous work indicates 11 suspicious outfalls county-wide (six are in the County's portion of the Four Mile Run watershed.) An additional 15 outfalls were cited as suspicious during the NVRC optical brightener monitoring project. Those 26 outfalls will be the focus of continued county-wide effort through the current MS4 permit cycle. Techniques based on the modified Lalor and Pitt flowchart (reference) will be employed for the effort.
- 3) The County has a program where the storm sewer lines are inspected by CCTV. By visual inspection with aid of County mapping most connections can be determined legitimate or inappropriate.

It should be noted that when original planning for the County's storm and sanitary sewer networks occurred, the County Board prohibited the connection of surface water drainage to the sanitary sewer system in its 1935 plumbing ordinance . As this has been the case for nearly 70 years, very few inappropriate connections are found in Arlington County.

## **Fairfax County**

By virtue of their MS4 permit Fairfax County has a program to limit inappropriate discharges directly to the storm sewer system. This is done in two ways:

- 1) County code, Chapter 105. Pollution of State Waters (December 21, 1955) was established that disallowed discharges other than stormwater to the Municipal Separate Storm Sewer System (MS4). Currently stormwater and other discharges specifically listed in the County's MS4 permit or

discharges where VADEQ specifically informs the County that the discharge has a separate VPDES permit are acceptable to be discharged under the County's MS4 Permit.

- 2) A program was developed to investigate, detect, and eliminate such inappropriate discharges through the evaluation of representative outfalls.

Fairfax County is currently combining all in-stream monitoring activities under a Stormwater Planning Division program. This program will combine biological monitoring, MS4 compliance monitoring (including outfall monitoring for inappropriate discharge detection) and bacteria monitoring previously performed by the County Health Department. By this effort, Fairfax County expects greater efficiency in monitoring efforts and more coordinated use of the monitoring results.

Fairfax County's program to detect inappropriate connections and discharges has previously covered all County outfalls on a five-year cycle (i.e. covering all Four Mile Run outfalls every five years.) The new program is in its formative stage and will not be put in place until spring 2004. This said, some foundations that will be incorporated are as follows:

- Inappropriate Discharge Detection will be performed through a combination of visual & odor inspections, grab samples, optical brightener monitoring and biological inspections.
- The need to fully execute the strategies laid out in the Implementation Plan for the Four Mile Run TMDL will be prominently regarded while shaping the overall County monitoring program.

### **City of Falls Church**

The City of Falls Church was recently awarded a Phase 2 MS4 permit. Through that permit the City must search for and eliminate inappropriate discharges to the storm drain system. To do this three requirements were included in the City's permit:

- 1) Develop an ordinance disallowing non-stormwater discharges to the separate storm drain system.
- 2) Develop a pilot program for detection and elimination of inappropriate discharges in 2006.
- 3) Develop a city-wide program for detection and elimination of inappropriate discharges in 2007.

The portion of the Four Mile Run watershed within the City's jurisdictional boundaries will be addressed as the program moves city-wide in 2007 coinciding with IY-4.

## **Virginia Department of Transportation**

The Virginia Department of Transportation Northern Virginia District (VDOT) was awarded a VPDES Phase 2 Permit for Stormwater Discharges from Municipal Separate Storm Sewer Systems (MS4s). This permit commits VDOT to developing, implementing, and enforcing a program to detect, eliminate, and prohibit illicit discharges into its system. The roads or right of ways within the Four Mile Run watershed that are operated and maintained by VDOT defines the limits of VDOT's MS4s. Some jurisdictions, such as Arlington County and the City of Alexandria, maintain all the roads and accompanying MS4s within their jurisdiction (with the exception of Interstates and some limited access Primary Collectors). Other jurisdictions, such as Fairfax County, request the transfer of operation and maintenance of local primary and secondary roads, including the accompanying MS4, to VDOT. This often results in interconnected MS4s, and requires that VDOT and the local jurisdictions develop a coordinated approach to illicit discharge detection and elimination.

VDOT's MS4 Permit Minimum Control Measure 3: Illicit Discharge Detection and Elimination commits to the following:

- a. Develop a comprehensive storm sewer system map to locate the MS4 major outfalls and, if possible, identify the contributing drainage system.
- b. Develop supplemental guidance for storm sewer systems inspection and maintenance activities, to include protocols for illicit discharge inspection, documentation, and tracking.
- c. Implement specific Land Use Permit language to effectively prohibit any illicit discharges into VDOT's MS4 from private drainage connections, overland flow, or other sources from outside the public right of way.

The major outfalls of VDOT's MS4s within the Four Mile Run watershed will be addressed through years IY1 – 4.

## ***Inappropriate (Illicit) Discharges Commitments***

- ***City of Alexandria***
  - will enforce their Environmental Offenses Ordinance, Title 11, Chapter 13 of the City Code which prohibits non-stormwater discharges to the storm sewer system without specific permits. (IY-1 thru IY-10)
- ***City of Alexandria, Department of Transportation and Environmental Services***
  - will develop an inappropriate (illicit) discharge detection program for their portion of the Four Mile Run watershed. Such a program will build upon the optical brightener monitoring previously performed throughout the watershed and will comply with the City's MS4 requirements. A plan will be developed to eliminate any discovered inappropriate discharges to the storm system. (IY-5 thru IY-10)
- ***Arlington County***
  - will continue enforcement of its stormwater Utilities Ordinance Section 26-45 which prohibits discharges of non-stormwater without a specific permit. (IY-1 thru IY-10)
- ***Arlington County, Department of Public Works***
  - will continue their storm sewer infrastructure inspection program including CCTV inspection of all storm sewer lines. Suspect connections identified during inspections will be investigated and appropriate action taken. (IY-1 thru IY-10)
- ***Arlington County Department of Environmental Services***
  - will build upon their previous MS4 Outfall monitoring program to target 21 suspect outfalls for follow-up monitoring in the Four Mile Run watershed. Optical brightener monitoring will be used in coordination with visual and odor inspections and grab sampling. Additionally biological monitoring data collected by volunteer teams will be analyzed in coordination with regular outfall monitoring. Any discovered inappropriate discharges will be eliminated from the storm system. (IY-1 thru IY-10)
- ***Fairfax County***
  - will continue enforcement of county codes, sections 105 and 106 which prohibit discharges of non-stormwater without a separate VPDES permit. (IY-1 thru IY-10)
- ***Fairfax County Stormwater Planning Division***
  - will combine and coordinate all in stream monitoring (MS4, Health Dept. bacteria, and biological monitoring). The program will have a focus on the Four Mile Run watershed and the strategies described in the Implementation Plan. The monitoring program will incorporate optical brightener monitoring, odor and visual inspections, biological monitoring and grab sampling. Any discovered inappropriate discharges will be eliminated from the storm system. (IY-1 thru IY-10)

## ***Inappropriate (Illicit) Discharges Commitments (Continued)***

- ***City of Falls Church***
  - will continue enforcement of Solid Waste Ordinance Section 13-7(a), which prohibits non-stormwater discharges into any streams or drainage areas in the city. (IY-1 thru IY-10)
  
- ***City of Falls Church Department of Environmental Services***
  - will develop an inappropriate (illicit) discharge program for their portion of the Four Mile Run watershed. This new program will build upon the optical brightener monitoring previously performed throughout the watershed. Any discovered inappropriate discharges will be eliminated from the storm system. (IY-4)
  
- ***Virginia Department of Transportation***
  - will develop an Illicit Discharge Detection, Elimination, and Prohibition Program, to include mapping, inspection, reporting, and enforcement protocols. (IY-4)

## Pollution Prevention: Septic Systems

Properly functioning septic systems do not threaten nearby waters with discharges of material laden with high bacteria counts but faulty septic systems and failing drain fields have the potential to allow partially or untreated sewage to enter the surface waters of the watershed. Uncontrolled sewage could result in elevating bacteria levels in the run. However, as only four documented septic systems remain in the Four Mile Run watershed such a risk is minimal. Those remaining septic systems, located in Arlington County, are regulated by the Virginia Department of Health (VDH) through the Arlington County Health Department. Through state regulations including the Virginia Chesapeake Bay Preservation Act regulations all septic systems are required to be pumped out every 5 years and inspected regularly.

The installation of the existing septic systems in the watershed predates sanitary sewer availability in those areas. Siting new septic systems in the watershed is unlikely for two reasons: 1) Stringent VDH siting criteria will require that much expensive real estate be set aside for a drainage field and offsets; and, 2) The watershed is almost entirely covered by sewerage collection systems so new sanitary laterals will be connected to the municipal sanitary sewer network.

Through regular inspection of the remaining septic systems in the watershed releases of untreated domestic sewage to Four Mile Run will be fully controlled. When septic systems are found to be failing all future sewage releases will be averted by immediately correcting the system or connecting that home to the municipal sanitary sewer collection system.

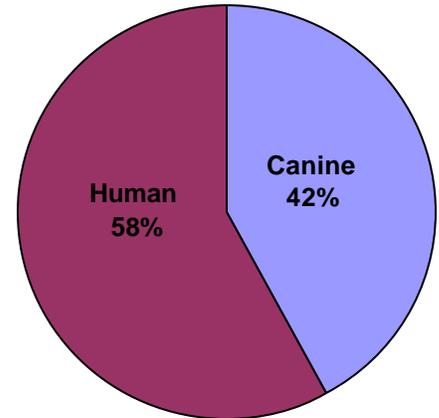
### Septic Systems Commitments

- **City of Alexandria**
  - will continue to ensure that all buildings have access to the public sewer system. New buildings must to connect to the municipal system. (IY-1 thru IY-10)
- **Arlington County Environmental Health**
  - *will attempt to verify the locations of all septic systems in the watershed (approximately 4). However, because of the age of these systems and the absence of records prior to the 1970s, absolute verification of system locations is difficult. Staff will use the best available information to locate these systems in the field. For those systems located, Environmental Health will place these systems on a pump-out schedule.* (IY-1)
- **Arlington County, Department of Environmental Services**
  - *will use the new mapping as a tool in their dry weather monitoring program required through their MS4 VPDES Permit for helping to track down any potential inappropriate discharges discovered.* (IY-2 thru IY-10)

## Pollution Prevention: Proper Pet Waste Disposal

The 2001 DNA source tracking study for Four Mile Run, “Estimating Nonpoint Fecal coliform Sources in Northern Virginia’s Four Mile Run Watershed,” identified bacteria from canine fecal sources as 12.9% of the bacteria load to Four Mile Run. If the controllable portion of the total bacteria source load is considered to be only the human and canine contributions then the canine source represent 42% of the controllable loads addressed by this IP. To address the canine portion this IP focuses on two related and overlapping areas. The first, Proper Pet Waste Disposal, is described hereinafter; the second is through education and is described in the General Outreach Section.

Dog parks are a benefit to the community for a variety of reasons, and can be considered a water quality Best Management Practice (BMP) themselves. Chiefly, the dog park environment encourages park goers to pick up after their pets and it allows owners and outside groups to share common concerns like this TMDL effort through newsletters or bulletin board postings.



**Figure 6.1. Portions of the Controllable Sources of Bacteria in Four Mile Run (Data from TMDL / DNA Studies, 2001, 2002)**

At the same time, the two dog parks in the watershed where dogs have free, unleashed access to the stream represent a potential source of bacteria loading to Four Mile Run that could be better controlled. It is likely that unleashed dogs in the water at these two parks account for only a small portion of the overall bacteria loadings to Four Mile Run from canine sources. However, the commitments in this plan that focus on these two locations are intended to make sure that these two dog parks are evaluated for consistency with the TMDL implementation plan requirement to address controllable bacteria sources.

It is estimated that the vast majority of dog owners in the watershed are not regular patrons of the watershed’s dog parks. Many dog owners exercise their pets in neighborhoods utilizing sidewalks and rights-of-way areas. Some property owners have fenced areas where their pets stay confined. Many of the commitments in this section and the later sections regarding indirect measures focus on pet waste disposal practices away from the sanctioned dog parks.

As with the measures used to prevent sewage discharges full compliance with local pick-up ordinances will prevent nearly 100 percent of the fecal matter from pets from being released to the surface waters of Four Mile Run. Difficulty in ensuring full compliance with the pick-up ordinances arises from the lack of consistency with multiple related ordinances and resident understanding of what is required by the ordinance.

## **City of Alexandria**

The City has four dog parks located in the Four Mile Run watershed but only one lies in the Four Mile Run TMDL portion of the watershed, North Fort Ward Park east of Park Road. There are no sponsoring groups for any dog parks in the City. The City's Master Plan for Dog Exercise Areas and Fenced Dog Parks, created by the Park and Recreation Commission and approved by City Council in September 2000, dictates operation and maintenance of dog parks in the City. In addition, the Park and Recreation Commission has created guidelines for new dog exercise areas and fenced dog parks. Those guidelines stipulate that new dog parks shall be located 60 feet from the top of bank from a body of water. Additionally, those new dog parks must also meet the intent of the City's Chesapeake Bay Preservation Ordinance (Article XIII, Environmental Management Ordinance.) The master plan does not currently recommend any additional dog exercise areas or fenced dog parks within the City.

The master plan describes the items that the City will provide at all dog exercise areas and dog parks. These include, among others, covered trash receptacles, dog feces pick-up bags, and posted rules. The posted rules include a requirement that dog owners/handlers must immediately pick up and dispose of all dog feces in trash receptacles.

The Master Plan provides a list of enforcement officers who will enforce the ordinances and issue citations pertaining to dog exercise areas and fenced dog parks. These include, Animal Welfare League Animal Control Officers (four total), City Police Officers, Deputy Director of Parks and Natural Resources, Park Superintendents, Assistant Park Superintendents, and Park Facility Specialist. The noted City staff members are to be trained by the City Police Department. Violators are faced with a citation and a fine.

## **Arlington County**

Arlington County has six dog parks in the Four Mile Run watershed. Each has a citizen sponsoring group.

<b>Park</b>	<b>Sponsoring Group</b>
Fort Bernard	Douglas Dogs
Glen Carlyn	Glen Dogs
Benjamin Banneker	Banneker Dogs
Towers Park	Towers Park Community
Shirlington Park	Shirlington Dogs
Utah Park	Fair Dogs

The County provides a mailbox style receptacle for recycling plastic grocery bags. The County also provides trash pick-up and lawn service. The sponsoring group provides other maintenance which primarily includes self policing. No additional parks are

planned at this time but currently, the County is considering evaluating and planning for the total number of dog parks and their geographic spacing within the County.

There are standards to which all new dog parks must be built. Existing dog parks are being retrofitted to meet those standards. Those standards, however, were not developed with regard to the Four Mile Run bacteria impairment or the TMDL process. Arlington County is considering forming a task force to evaluate and revised the current dog park standards.

Three entities are tasked with the enforcement of leash and pet waste pick-up laws in the County:

1. Arlington County Police
2. Animal Control Officers
3. Park Officials (Park Rangers and certain park supervisors have limited enforcement capabilities regarding the ParkSafe program.)

Violators can be faced with both a citation and a fine or, through a new mechanism, park authorities can issue a citation and fine for the first offense and permanent park expulsion from all County park facilities for a second offense. The second offense can be for violating the same rule or any other park rule. Leash and pet waste pick-up rules are eligible offenses.

### **Fairfax County**

Although there are several sanctioned dog parks in Fairfax County there are no dog parks existing or planned for the Fairfax County portion of the watershed. The nearest dog park to the watershed is located in the Mason District Park. For a new dog park to be established the County must be approached by a sponsoring group. The County will then determine if it the potential site fits with the master plan and may adjust the plan, with public input, as needed. Once the park is established, the County will provide pick-up bags and trash and lawn service for the dog park. Other maintenance will be provided by the sponsoring group.

### **City of Falls Church**

No dog parks or citizen sponsoring groups exist in the City of Falls Church. No dog parks are planned for the City. Newly placed bags and receptacles are located in every municipal park.

The City has both a leash law (City Code Section 4-15a) and a pet waste pick-up law (City Code Section 4-15b). The police division (animal control officer) is tasked with enforcement of these laws. Violations result in a citation and a fine.

## **Northern Virginia Regional Park Authority (NVRPA)**

The Northern Virginia Regional Park Authority manages a linear park / multiuse trail in the Four Mile Run watershed called the W&OD trail. The W&OD trail runs parallel to Four Mile Run for much of length of the run. Due to the narrowness of the park and its proximity to the Four Mile Run no dog parks exist on NVRPA property in the Four Mile Run watershed, however, pickup bags and receptacles are located periodically on the W&OD trail.

### ***Proper Pet Waste Disposal Commitments***

- ***City of Alexandria, Department of Recreation, Parks and Cultural Activities***
  - will consider adding new locations for pick-up bags and receptacles within their municipal parks. Informative Signage will be considered at strategic locations in the watershed. (IY-1 thru IY-10)
  - will operate and maintain the dog park located at Fort Ward Park in accordance with the Master Plan for Dog Exercise Areas and Fenced Dog Parks. (IY-1 thru IY-10)
  
- ***City of Alexandria, Department of Recreation Parks and Cultural Activities and Department of Transportation and Environmental Services***
  - will explore requesting developers to proffer the provision of pick-up bags and receptacles for pet waste disposal with informative signage on larger multi-family development projects through the site plan development process. (IY-1 thru IY-10)
  - will review its enforcements tools (ordinances, etc.) to ensure that the tools are consistent with one another and with the goals of the TMDL. Presentations or other training methods will be employed to educate Police, Animal Control Officers and City staff about the TMDL water quality effort and the related enforcement tools. Efforts will also be made to reach the general population of the City regarding these tools. Such efforts may include articles published in the City newsletters, brochures, discussions with dog groups or postings on the City website. (IY-1 thru IY-10)
  
- ***Arlington County Department of Parks, Recreation, and Community Resources***
  - will continue to operate and maintain the six dog parks in the TMDL watershed, as dog parks are considered an asset in terms of the TMDL and water quality in general. (IY-1 thru IY-10)
  - will add informative signs at strategic locations both within the dog parks and in the municipal parks. Additional locations for placement of pick-up bags and receptacles beyond dog parks will be considered. (IY-1 thru IY-10)
  - in coordination with the Department of Environmental Services (DES), VADEQ, VADCR, and NVRC will investigate funding sources to retrofit existing dog parks with BMPs. (IY-1 thru IY-10)

## **Proper Pet Waste Disposal Commitments (continued)**

- **Arlington County Department of Parks, Recreation, and Community Resources (continued)**
  - will consider forming a committee consisting of DPRCR and DES staff and various stakeholder groups such as the Parks & Recreation Commission, the Environment & Energy Conservation Commission and Arlington Dogs, for the purpose of evaluating and improving current dog park standards in light of the bacteria TMDL. Items for consideration will include installation of best management practices, and the development of guidelines for education and outreach materials for park users as well as dog owners County-wide, and stream access for dogs consistent with County Pet Leash and Waste Pickup Ordinances as well as stream and riparian management programs. (IY-2 thru IY-4)
  - will explore a master plan approach to dog park siting to better ensure a sufficient number of parks in Arlington County that are geographically distributed within the County. (IY-1 thru IY-2)
- **Arlington County Department of Environmental Services**
  - will review the County's enforcement tools (ordinances, etc.) to ensure that those tools are consistent with one another and with the goals of the TMDL. Presentations or other outreach methods will be employed to educate Police, Animal Control Officers and other County staff regarding the TMDL water quality effort and the related enforcement tools. Efforts will also be made to reach the general population of Arlington County regarding these tools. Such efforts may include articles published in the "Citizen" etc., discussions with dog sponsoring groups or postings on the County website. (IY-1 thru IY-10)
  - will explore requesting developers to include the provision of pick-up bags and receptacles for pet waste with informative signage on larger multi-family development projects through the site plan development process. (IY-1 thru IY-10)
- **Fairfax County Park Authority**
  - will provide receptacles in the Four Mile Run watershed park locations. Informative signs will be added at appropriate locations. (IY-1 thru IY-10)
- **Fairfax County Department of Public Works and Environmental Services**
  - will explore requesting developers to proffer the provision of pick-up bags and receptacles for pet waste with informative signage on larger multi-family development projects through the site plan development process. (IY-1 thru IY-10)
- **Fairfax County Stormwater Planning Division**
  - will review its enforcements tools (ordinances, etc.) to ensure that the tools are consistent with one another and with the goals of the TMDL. Presentations or other training methods will be employed to educate Police, Animal Control Officers and park staff the TMDL water quality effort and the related enforcement tools. Efforts will also be made to reach the general population of Fairfax County regarding these tools. Such efforts may include articles published in the County newsletters, etc., discussions with dog sponsoring groups or postings on the County website. (IY-1 thru IY-10)

## **Proper Pet Waste Disposal Commitments (Continued)**

- **City of Falls Church Environmental Services Department**
  - will explore requesting developers to proffer the provision of pick-up bags and receptacles for pet waste with informative signage on larger multi-family development projects through the site plan development process. (IY-1 thru IY-10)
  - will review its enforcements tools (ordinances, etc.) to ensure that the tools are consistent with one another and with the goals of the TMDL. Presentations or other training methods will be employed to educate police and park staff about the TMDL water quality effort and the related enforcement tools. Efforts will also be made to reach the general population of the City regarding these tools. Such efforts may include articles published in City newsletters, discussions with dog sponsoring groups and/or postings on the City website. (IY-1 thru IY-10)
- **City of Falls Church Parks and Recreation Department**
  - will maintain and operate the newly installed pick-up bags and receptacles at all of their municipal parks. Informative signs will be added at appropriate locations. (IY-1 thru IY-10)
- **The Northern Virginia Regional Park Authority**
  - will continue to provide pick-up bags and receptacle stands along the W&OD trail. NVRPA will add informative signs to those stands and consider installing additional stands. (IY-1 thru IY-10)
- **Northern Virginia Regional Commission**
  - will monitor the progress of Arlington County's dog park standards evaluation and revision process and keep the other Four Mile Run jurisdictions updated on its progress. (IY-1 thru IY-10)
  - will produce a map that overlays the Four Mile Run DNA Study, Municipal Parks and Trails and Dog Parks to help guide implementation efforts. The mapping will include information regarding monitoring data including DNA source tracking information as it is available. (IY-1 thru IY-10)

### 6.3 Mitigation Measures

Once fecal matter is deposited on the ground in the watershed and rainwater sweeps it off or fecal matter is discharged directly into surface water channels or the storm drain network another set of measures must be employed to control the bacteria levels in Four Mile Run. **Mitigation Measures** are designed to remove bacteria from the water column or exterminate it with measures like ultraviolet radiation or ozone treatment. Typically mitigation measures are more expensive than the aforementioned pollution prevention measures. The need for widespread coverage and ongoing maintenance increases their costs substantially compared to the costs associated with preventing the pollution in the first place. Although the costs associated with mitigation measures may be greater than costs associated with preventative measures it should be noted that these measures target all bacteria in the water column, not just those associated with anthropogenic, or human-caused, sources.

#### Mitigation Measures: Stormwater Treatment

Stormwater Treatment has historically been accomplished through the installation of structural “Best Management Practices” or BMPs. These are filtering or settling devices that typically target particulates in the water column. Such settling or filtering BMPs include: stormwater management ponds, sand filters, and hydrodynamic facilities. There is, however, another class of BMPs that through biological or chemical means remove soluble pollutants in the water column. Such BMPs include enhanced stormwater ponds, stormwater wetlands and bioretention facilities.

Bacteria in the water column behave similarly to particulates. Both the USEPA and the American Association of Civil Engineers (ASCE) through the International Stormwater Best Management Practices (BMP) Database have provided data showing that most BMPs already employed in the stormwater industry are effective at removing bacteria from the water column (<http://www.bmpdatabase.org/>).

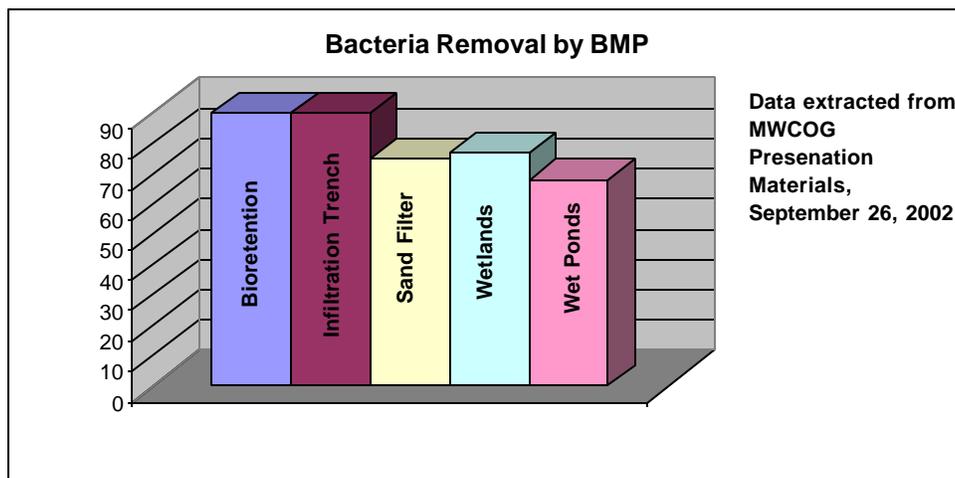


Figure 6.2. Approximate Removal Efficiencies for Various Structural BMPs.

Structural BMPs are incorporated into the watershed on two different levels:

- 1) Privately installed BMPs (and typically privately maintained.)  
These BMPs are usually installed during site plan development and are typically designed to serve only that site.
- 2) Regional facilities having drainage areas that incorporate multiple sites as well as public streets.

All four municipalities are subject to Virginia's 1988 Chesapeake Bay Preservation Act meaning that each jurisdiction has a local Chesapeake Bay Preservation Ordinance requiring each jurisdiction to address the stormwater quality impacts of development and redevelopment on local streams and subsequently the Chesapeake Bay. This mitigation is often accomplished through a combination of onsite BMPs and regional stormwater management programs. It happens that many of the BMPs used for phosphorous reduction, one of the keystone pollutant in Virginia's stormwater quality programs, are the same BMPs that also reduce bacteria loads.

### **City of Alexandria**

The City has a Chesapeake Bay Preservation Ordinance that requires BMPs to treat water from all impervious surfaces associated with new and redevelopment sites.

A regional water quality pond located on a tributary of Four Mile Run, Lucky Run, is currently being expanded. The pond treats a total drainage area of 225 acres, of which 133 acres (59%) is impervious.

The City of Alexandria recently constructed a new regional wetland, restored an existing wetland and rehabilitated a tributary stream segment in the Four Mile Run Park. However, all three improvements are located downstream of the TMDL watershed.



**Figure 6.3. Ballston Beaver Pond in Arlington**

### **Arlington County**

Arlington County has a Chesapeake Bay Preservation Ordinance requiring the installation of BMPs for "hotspots" (vehicle-related pavement) at new development and redevelopment projects. The balance of projects, those without such "hotspots," contribute to the County's Watershed Management Fund for use in jurisdiction-wide watershed management efforts. Typically all BMPs installed through this program are privately owned and privately maintained.

Additional to the County's Chesapeake Bay efforts there are several ongoing regional BMP projects in the County. A constructed wetland retrofit of Sparrow Pond was completed in FY 2002. This regional BMP treats drainage from the Arlington Forest Branch area. Planning efforts are underway to retrofit the Ballston Beaver Pond stormwater management facility as a water quality facility. This BMP retrofit will treat runoff from 300 acres around the Ballston / I-66 area of Arlington County. Additionally, the County Trades Center will receive significant BMP retrofits within the next two years. Arlington is also evaluating the incorporation of hydrodynamic BMPs into their current storm sewer infrastructure.

### **Fairfax County**

Fairfax County has a Chesapeake Bay program requiring the installation of BMPs for new development and redevelopment projects. Additional to this program, Fairfax County, in support of Virginia's goal to develop watershed plans for 2/3 of the watersheds in Virginia, will develop a watershed management plan for the County portion of the Four Mile Run watershed. In developing the watershed plan for that portion of the watershed stakeholders will consider various options for incorporation into the watershed. Options to be considered will include retrofitting the watershed with stormwater treatment facilities.

### **City of Falls Church**

The City of Falls Church has a Chesapeake Bay Ordinance that requires BMPs to treat water from all impervious surfaces associated with new and redevelopment sites located in the Chesapeake Bay overlay district. The City currently has no regional BMPs.

### **Virginia Department of Transportation**

The Virginia Department of Transportation Northern Virginia District (VDOT) implements stormwater management on regulated land disturbing activities in accordance with the VDOT Erosion and Sediment Control & Stormwater Management Program Specifications. These specifications are reviewed and approved annually by the Department of Conservation and Recreation as consistent with the Virginia Stormwater Management Laws and Regulations. The implementation of this program also satisfies the water quality technical criteria found in the Chesapeake Bay Preservation Act.

The development of these specifications is currently being updated to include provisions for cooperative watershed solutions between VDOT and the local jurisdictions and other watershed stakeholders. The specifications will include provisions for BMP placement, BMP design (innovative BMPs - structural and non-structural), BMP maintenance, and

off-site compensatory treatment, such as participation in local regional programs, stream channel restoration and stabilization, etc.

These provisions are part of an overall program update as part of VDOT's MS4 Permit.

## **Stormwater Treatment Commitments**

- **City of Alexandria, Department of Transportation and Environmental Services**
  - will continue to explore BMP retrofit opportunities for the watershed. These efforts will include ongoing work with the US Army Corps of Engineers, US Environmental Protection Agency, Arlington County, a bi-jurisdictional citizen task force and the Northern Virginia Regional Commission to develop a feasibility study focused on the Four Mile Run flood control channel. (IY-1 thru IY-10)
  - will continue to manage and enforce its Chesapeake Bay Act & MS4 Programs. The Department will also prepare to meet the challenges of the upcoming Potomac Tributary Strategies Program. (IY-1 thru IY-10)
  - will ensure proper maintenance of the newly retrofitted regional pond on Lucky Run for proper function as a BMP. (IY-1 thru IY-10)
  
- **Arlington County Departments of Environmental Services, Public Works and Parks, Recreation and Community Resources**
  - plan to retrofit the Ballston Beaver Pond for enhanced water quality treatment. (IY-1 thru IY-8)
  
- **Arlington County, Department of Parks, Recreation and Community Resources**
  - will continue to manage the Sparrow pond to ensure its effectiveness as a BMP. (IY-1 thru IY-10)
  
- **Arlington County Office of Support Services**
  - will retrofit the municipal Trades Center with BMPs. (IY-1 thru IY-3)

## **Stormwater Treatment Commitments (continued)**

- **Arlington County Environmental Services and Public Works Departments**
  - will continue to explore BMP retrofit opportunities for the watershed. These efforts will include continued implementation of the County's Watershed Management Plan as well as ongoing work with the US Army Corps of Engineers, US Environmental Protection Agency, City of Alexandria, a bi-jurisdictional citizen task force and the Northern Virginia Regional Commission to develop a feasibility study focused on the Four Mile Run flood control channel. (IY-1 thru IY-10)
  
- **Arlington County, Department of Environmental Services**
  - will continue to manage and enforce its Chesapeake Bay & MS4 Programs. The Department will also prepare the County to meet the challenges of the upcoming Potomac Tributary Strategies Program. (IY-1 thru IY-10)
  
- **Fairfax County, Department of Public Works and Environmental Services**
  - will continue to manage and enforce its Chesapeake Bay & MS4 Programs and prepare to meet the challenges of the upcoming Potomac Tributary Strategies Program. (IY-1 thru IY-10)
  - will form a working group consisting of staff and watershed stakeholders to develop a watershed management plan for their portion of the Four Mile Run watershed. Included in that work will be consideration and siting of possible regional BMPs. (IY-1 thru IY-4)
  
- **City of Falls Church, Department of Environmental Services**
  - will continue to manage and enforce its Chesapeake Bay & MS4 Programs. The Department will also prepare to meet the challenges of the upcoming Potomac Tributary Strategies Program. (IY-1 thru IY-10)
  
- **Northern Virginia Regional Commission**
  - in coordination with all participating jurisdictions will revise the 1992 "Northern Virginia Regional BMP Handbook" to include information related to bacteria BMPs. (IY-1 thru IY-4)
  
- **Virginia Department of Transportation**
  - will continue to update and implement its Stormwater Program Specifications, to include coordination with local governments and watershed groups on the implementation of stormwater BMPs within the Four Mile Run Watershed. (IY-1 thru IY-10)

## Mitigation Measures: Street and Stormwater Infrastructure Management

A Wisconsin Study (Bannerman, Owens, Dodds, & Hornewer, 1993) examined the land usages and pollutant loadings in an urban area in Wisconsin. Although the study did not collect data that would single out the various types of bacteria sources the study did implicate a wide range of land covers in residential, commercial and industrial areas as contributors to fecal coliform bacteria levels downstream. Land covers cited in the study were streets, parking lots and roof tops. Other studies indicate that bacteria counts in the sediments found in catch basins or the storm drain network range between 100 to 1000 times those of the surrounding water column (Donsel, 1971). One such study measure bacteria levels as high as 2,200 times that of the adjacent water (Crabill, 1999).

Because the data used to develop the DNA Source Tracking Study (reference) for the Four Mile Run TMDL study was collected at the outfalls to Four Mile Run and did not sample basins small enough to distinguish single land coverage, e.g. roof tops, parking lots, it is difficult to say “that there are no bacteria from human sources on the parking lot areas” or “that there are no bacteria from dogs on roof tops” although both statements are probable. What can be said is that if there are bacteria from any source on these land covers or in the storm drain network then those bacteria likely “congregate” with or adhere to the sediments in the water column or the sediments that have fallen out of suspension.

When a rain event occurs sediments, and the associated bacteria, can be re-suspended in the water column. Once re-suspended the bacteria are swept in the flowing water downstream to Four Mile Run resulting in the elevation of bacteria levels in the run. Following such logic the next set of measures typically noted for sediment removal also purge bacteria from the drainage system (i.e. street gutters and storm drains) and therefore was considered for inclusion in this IP:



**Figure 6.4. Arlington County Regenerative Air Street Sweeper**

- Street Sweeping
- Catch basin Cleaning
- Storm Drain Maintenance

The current widely available research does not clearly define the effectiveness of sediment removal by the technologies readily employed in the watershed with regard to removal of bacteria (i.e. regenerative air street sweeping). What is clear is that bacteria

numbers tend to build-up between rain events. Those bacteria will tend to cling to small sediments. Then when it rains those sediments and bacteria can be swept into the storm drain network and carried to Four Mile Run. If those sediments and attached bacteria are removed from the system they will be prevented from reaching Four Mile Run. The street and stormwater infrastructure measures described in this section have the potential to prevent bacteria along with sediments and litter from reaching Four Mile Run and therefore, have been included in this IP.

### **City of Alexandria**

Alexandria has a municipal street sweeping program. All guttered streets within the TMDL watershed are swept monthly (12 times / year) with the exception of King Street and 100 feet of all intersecting streets to King Street which are swept weekly (52 times / year). Further, the City has a leaf collection program that separates the City into five zones. During the months between October through December, each zone has six pickups.

The City of Alexandria has a catch basin cleaning program within the Combined Sewer District, which is not within the Four Mile Run watershed. All other catch basins within the City are inspected and cleaned or repaired on an as needed or requested basis.

The City recently released a Request for Proposal for a sanitary and storm drain mapping project. The result of this project will be a graphical information system (GIS) database containing the locations and sizes of all sewers in the City. This information will assist the City in planning for future sewer improvements.

### **Arlington County**

Arlington County has a municipal street sweeping program. Since the fall of 2001, when the County reinstated its residential street sweeping program, Arlington County has swept residential streets 5 to 6 times per year, commercial streets (outside of Crystal City and the Rosslyn-Ballston Corridor) 13 times per year, and the commercial areas of Crystal City and the Rosslyn-Ballston Corridor weekly, 52 times per year. The County uses regenerative air sweepers for this work.

Also in Arlington County, **VDOT Headquarters I-395** performs street sweeping on Arlington primary roads at a frequency of 4 times per year. Those primary roads include:

- Columbia Pike
- Washington Blvd
- Route 110
- Route 50
- Glebe Road
- Lee Highway
- Fairfax Drive
- Old Dominion
- Chain Bridge
- I-395
- I-66

Arlington County has approximately 10,000 catch basins (non-sump type) within the County. The Arlington County Department of Public Works inspects half of all of the catch basins in the County (5,000) each year and cleans all catch basins found in need of cleaning. It can therefore be said that all catch basins in the Arlington County portion of the TMDL watershed are inspected and cleaned, if necessary, bi-annually.

Arlington began a regular storm sewer inspection and maintenance program in FY 2002. The program includes inspection with closed circuit television cameras. In 2002 they inspected 55,583 linear feet of storm sewer in the Four Mile Run watershed and removed 86 tons of debris. In 2003 157,677 linear feet of storm sewer were inspected county-wide (much of that in the Four Mile Run watershed) and 229 tons of material were removed.

As the catch basin cleaning and CCTV inspection programs become more established resource may be shifted between the programs to maximize their combined effectiveness.

### **Fairfax County**

Unlike in Arlington County or the Cities of Falls Church and Alexandria all non private roads in Fairfax County are owned by the State. For this reason Fairfax County does not have a street sweeping program; such maintenance is performed by the Virginia Department of Transportation (VDOT.)

**VDOT Merrifield Office** sweeps all non-private streets with gutters once per year (1/year). The interstate roadways in the County, I-395 and I-66, are swept at a frequency of four times per year (4/year) by the **VDOT Headquarters I-395 Office**. Both offices use a mechanical type sweeping machine for the work.

Fairfax County has a catch basin cleaning program. Through that program the County inspects all County-owned catch basins and all VDOT-owned catch basins that discharge directly into the County storm drain network on a five year cycle. All catch basins found in need of cleaning are cleaned following inspection.

Fairfax County is in the process of digitizing their storm drain network. As part of this process the storm drains are inspected and deficiencies corrected.

### **City of Falls Church**

Falls Church has a municipal street sweeping program that is in the process of being upgraded through increased frequency and effectiveness. (The current contract expires in December 2003). It is anticipated that, beginning in 2004, the program will include the following:

1. Commercial areas (mainly along Broad Street and Washington Street) will be swept twice per month (24 times / year).
2. Residential areas (the remainder of the public streets with gutters) will be swept monthly (12 times / year).
3. The type of sweeper to be used will be a Schwarze A7000 regenerative air sweeper or comparable piece of equipment.

In addition, the City is committed to providing increased oversight of contractor operators.

The City of Falls Church has approximately 600 catch basins/storm structures in the Four Mile Run watershed. The City's catch basin/storm structure cleaning program includes inspection and cleaning of these facilities at least four times a year.

The City recognizes that an ongoing storm sewer maintenance program is essential for keeping sediment and debris from clogging the system and causing pipes to overflow and flood adjacent properties. The City is developing a proactive program to address these and other structural problems in the system. Currently, the City has an active maintenance program whereby all of the storm structures are cleaned several times a year. This program appears to be effective in some areas. However, there are some locations where utilities cross through the storm sewer pipes, causing debris to accumulate behind these obstructions. The City plans to identify locations of all junction boxes where such utility crossings exist. Furthermore, the City will increase the frequency of cleaning of all storm structures, particularly during the fall season when foliage debris is in abundance.

### **Virginia Department of Transportation**

The Virginia Department of Transportation Northern Virginia District (VDOT) will continue to implement the current level of service within the Four Mile Run Watershed as the maintenance budget allows. Prioritizing the street sweeping and system maintenance budget may allow enhanced levels of service within one watershed as deemed necessary.

VDOT is currently updating the VDOT ESC & SWM Program Specifications to document the benefits of street sweeping, catch basin cleaning, and storm sewer system maintenance as it relates to the Virginia Stormwater Management Regulations. Where the implementation of stormwater management basins on new projects may be of marginal cost-benefit value to the environment, VDOT will evaluate cost-benefit of the allocation of those funds to a more effective strategy such as the purchase of high efficiency street sweepers and an increased frequency and range of sweeping.

VDOT Asset Management anticipates conducting a cost-benefit analysis of the current implementation schedule of numerous maintenance activities related to the stormwater infrastructure, including street sweeping and catch basin, ditch, and pipe system

cleaning. The results of this analysis will identify where these programs can and should be expanded to achieve the greatest benefit.

VDOT will explore the benefits of expanding these infrastructure management programs within the Four Mile Run Watershed by utilizing the results of the cost-benefit analysis and a system of prioritizations to be documented and approved within the VDOT ESC & SWM Program Specifications.

## **Street and Stormwater Infrastructure Management Commitments**

- **City of Alexandria, Department of Transportation and Environmental Services**
  - will continue its street sweeping program at its current level. (IY-1 thru IY-10)
  - will inspect, and clean as needed, catch basin on its portion of the Four Mile Run watershed. (IY-1 thru IY-10)
- **Arlington County Department of Environmental Services**
  - will continue its street sweeping program at its current level. (IY-1 thru IY-10)
  - will explore opportunities to expand its current street sweeping program by increasing the coverage and frequency or by employing enhanced sweeping techniques as they become environmentally justified and economically viable. (IY-1 thru IY-10)
- **Arlington County Department of Public Works**
  - will inspect, and clean as needed, every catch basin in its portion of the TMDL watershed bi-annually. (IY-1 thru IY-10)
- **Fairfax County, Department of Public Works and Environmental Services**
  - will form a working group consisting of staff and watershed stakeholders to develop a watershed management plan for their portion of the Four Mile Run watershed. Various BMPs including street sweeping will be considered for implementation for retrofitting uncontrolled areas. (IY-1 thru IY-4)
  - will routinely inspect, and clean as needed, all catch basins directly leading to the County storm sewer network at least once every five years or as problems are reported. (IY-1 thru IY-10)
- **City of Falls Church Department of Environmental Services**
  - plans to increase the frequency and effectiveness of its current street sweeping program. (IY-1 thru IY-10)
  - will inspect, and clean as needed, every catch basins in its portion of the Four Mile Run watershed four times annually. The City will seek opportunities to increase the frequency of inspection and cleaning. (IY-1 thru IY-10)
- **Virginia Department of Transportation**
  - will continue its street sweeping program at its current level. (IY-1 thru IY-10)
  - will explore opportunities to expand its current street sweeping program by increasing the coverage and frequency or by employing enhanced sweeping techniques as they become environmentally justified and economically viable. (IY-1 thru IY-10)
  - will explore opportunities to expand its current catch basin cleaning program as it becomes environmentally justified and economically viable. (IY-1 thru IY-10)
  - will explore opportunities to expand its current storm sewer maintenance program as it becomes environmentally justified and economically viable. (IY-1 thru IY-10)

## **Mitigation Measures: Stream Corridor Restoration**

DNA fingerprinting pioneer Dr. George Simmons and author of the DNA Source Tracking study for the original Four Mile Run TMDL Study is quoted in the USEPA's New-Notes (2003, Issue #73) that the consistently high bacteria levels of a stream "indicate a microbial community that is out of balance." It is the predator-prey relationship to which Dr. Simmons refers. His hypothesis is that there is an absence or a limited number of the bacterivores that consume fecal coliform bacteria and, as a result, the fecal coliform bacteria thrive unchecked in the watershed. Stream corridor restoration has been included in this IP in hopes that by repairing the stream beds, banks and riparian areas of Four Mile Run and its tributaries a more balanced ecology will arise. Stream corridor restoration is also an important component of each jurisdiction's overall watershed management program and, as such, represents another key synergy that maximizes the benefits of this IP.

It is also known that ultraviolet (UV) radiation in the quantities reaching the earth from the sun will eradicate exposed bacteria. One specific type of stream corridor restoration, "daylighting" previously piped or undergrounded streams, may help expose bacteria to this natural eradication process, although in a healthy stream corridor with significant riparian vegetation and canopy cover, the amount of UV radiation reaching the water surface may be limited. Perhaps more importantly, stream daylighting can also help restore the microbial diversity that may be lacking in a storm sewer pipe and, in combination with some increase in UV exposure, may achieve bacterial reduction benefits similar to the stream corridor restoration described in the above paragraph.

Stream Corridor Restoration Techniques may include:

1. Restoration of stream beds, banks & riparian areas
2. Spot repairs to stream segments
3. Daylighting of stream segments

It is unknown exactly how effective stream corridor restoration will be at reducing bacteria levels in Four Mile Run. However, the potential exists that stream corridor restoration can create an environment conducive to harbor predator organisms that will reduce the bacteria levels in the run. Stream corridor restoration can be an expensive endeavor preventing its use if the sole benefit of its employ is the potential for bacteria reduction. However, stream corridor restoration offers more than potential bacteria level reduction. By stabilizing stream banks and stream beds, erosion that produces significant sediment loads can be limited. Wildlife habitat adjacent to streams and aquatic habitat within stream channels can be cultivated. And, in the Four Mile Run watershed where stream corridors offer one of the last visages of the natural environment, stream corridor restoration offers an opportunity to reunite watershed residents with the nature.

It is also fitting to mention invasive species removal in this discussion of stream corridor restoration. Invasive species removal constitutes those efforts aimed at removing or

limiting the hold of non-native flora in an area where they have become “biologically established” to the detriment of native species. Although such efforts are not limited solely to stream corridors, much of the “undeveloped land” (park land, etc.) in the Four Mile Run watershed coincides with the Four Mile Run stream network. The removal of invasive species like English Ivy, Phragmites or Kudzu limits the areas in the watershed at risk of becoming (or have already become) monocultures. These monocultures encourage or create imbalances in the local ecology by eliminating diverse habitats. Such monocultures can harbor unnatural fauna populations, i.e. higher than normal rodent populations, elimination of predator populations, etc. All four jurisdictions have, to varying degrees, efforts aimed at removing invasive species.

### **City of Alexandria**

Alexandria is beginning a two phase project to fully assess the stream corridors in the City. The phases are separated by activity not geographically. The first phase will classify all streams in the City as perennial, intermittent, or ephemeral. The second phase of the project will evaluate the condition of the City’s streams and prioritize restoration work. The first phase will be completed in January 2004 and the second phase will begin in the spring of 2004. At the end of the second phase a list of priority projects will be compiled, that will include erosion areas, daylighting opportunities, stream restoration opportunities, and storm sewer outfall locations.

Alexandria is also working on a project with Arlington County, the USACE and the USEPA on an environmental restoration project focused on the 2.3 mile flood control section of Four Mile Run. Projects comprising this effort may include stream restoration and wetlands creation.

### **Arlington County**

Stream restoration is an important component of Arlington County’s watershed management program because of the significant water quality and habitat benefits that can be realized through comprehensive stream restoration. The County’s Watershed Management Plan outlines a blueprint for stream restoration throughout the County, and both CIP and other funding sources have been programmed for stream restoration projects.

A comprehensive stream restoration project involving more than 3,000 linear feet of stream is underway in the Donaldson Run watershed, which lies outside of the Four Mile Run watershed. Within the Four Mile Run watershed, similar stream restoration projects are likely but no specific project is planned at this time. Since 2002, Arlington County has been working in Benjamin Banneker park on a 120-foot section of Four Mile Run as part of a demonstration project to enhance the riparian buffer and to stabilize a severely eroded stream bank using bioengineering techniques.

Arlington County is also working on a project with the City of Alexandria, the USACE and the USEPA on an environmental restoration project focused on the 2.3 mile flood control section of Four Mile Run. Projects comprising this effort may include stream restoration and wetlands creation.

### **Fairfax County**

In 2002 Fairfax County completed the first phase of a project on Long Branch, a tributary of Four Mile Run. The second phase of this project is in the planning stage. Phase one consisted of stabilizing 2000 feet of stream using the following techniques: plunge pools, step pools, rock veins and weirs, root wads, coir matting and plantings.



**Figure 6.5. Potential Site on Four Mile Run For Stream Corridor**

### **City of Falls Church**

The City of Falls Church recently daylighted a portion of Four Mile Run near Fire Station #6 on N. Washington Street. At the City Manager's direction, the City will investigate opportunities for, and feasibility of, daylighting and wetlands creation for such tributaries as the Harrison Branch, Trammell Branch, and Crossman Branch, particularly at the outfalls into Four Mile Run.

## **Virginia Department of Transportation**

The Virginia Department of Transportation Northern Virginia District (VDOT) implements the VDOT ESC and SWM Program Specifications as approved by the Virginia Department of Conservation and Recreation. As part of the updates to those program specifications, VDOT is developing a stream restoration policy that will help to quantify the benefits of stream corridor restoration for compliance with Virginia Stormwater Management regulations. When appropriate, VDOT will consider stream corridor restoration as an alternative to on-site stormwater management basins if such an alternative is considered to be environmentally justified and economically viable.

## **Stream Corridor Restoration Commitments**

- **City of Alexandria, Department of Transportation and Environmental Services**
  - will assess all stream segments in the watershed. Each stream segment will be evaluated and if restoration is warranted a work priority will be assigned. All stream segments in the Four Mile Run watershed will be given a priority that reflects the impairment and associated needs of Four Mile Run. (IY-1 thru IY-3)
  - will explore opportunities through the City site plan process and municipal projects to daylight under-grounded stream segments of Four Mile Run and its tributaries. (IY-1 thru IY-10)
  - will consider stream restoration and stream bank stabilization projects when allocating funds in the Environmental Restoration Account and Alexandria Water Quality Improvement Account. (IY-1 thru IY-10)
- **Arlington County, Departments of Environmental Services, Public Works, and Parks Recreation and Community Resources**
  - will continue to implement the County's adopted Watershed Management Plan, which provides a blueprint for long-term stream management and restoration projects. Projects implemented by the County will emphasize stream corridor restoration that focuses on re-establishing 'dynamic equilibrium' between streams and watersheds so that sediment transport is in balance and water quality and in-stream habitat are improved. (IY-1 thru IY-10)
- **Arlington County Departments of Environmental Services and Parks Recreation and Community Resources**
  - will continue to work with the sponsoring dog groups at the Glen Carlyn and Shirlington dog parks to restore eroded streambanks at these two locations. (IY-1 thru IY-5)
- **Arlington County, Department of Environmental Services**
  - will explore opportunities through the County site plan process and municipal projects to daylight under-grounded stream segments of Four Mile Run and its tributaries as appropriate. (IY-1 thru IY-10)
- **Fairfax County Department of Public Works and Environmental Services**
  - will form a working group consisting of staff and watershed stakeholders to develop a watershed management plan for their portion of the Four Mile Run watershed. Included in that work will be consideration of stream segment restoration needs in the Four Mile Run watershed. (IY-1 thru IY-4)
  - will explore opportunities through the County Watershed Planning process to daylight existing under-grounded stream segments of Four Mile Run and its tributaries. (IY-1 thru IY-4)
- **City of Falls Church Department of Environmental Services**
  - will, where appropriate and directed by the City Manager/City Council, explore opportunities through the City site plan process and municipal projects to daylight outfalls and underground stream segments of Four Mile Run and its tributaries. (IY-1 thru IY-10)
- **Virginia Department of Transportation**
  - will consider stream corridor stabilization in lieu of on site stormwater basins when environmentally justified and economically viable. (IY-1 thru IY-10)

## **Mitigation Measures: Stormwater Runoff Reduction and Reuse**

Oft cited as “Low Impact Development” (LID), “Green Building” technologies or “Better Site Design”, the techniques included in the section aim to reduce the amount of runoff generated from or leaving a site. Various measures employed for stormwater runoff reduction and reuse include:

- Rain barrels / cisterns
- Green roof construction
- Infiltration systems (e.g., permeable paving, bioretention basins, etc.)
- Other site specific drainage designs that control runoff rate, volume, frequency and quality

Although these stormwater runoff reduction and reuse measures do not remove bacteria by themselves, they more importantly reduce the amount of stormwater runoff and, as a result, the absolute amount of pollutant loads, including bacteria, that are exported from a site with stormwater runoff

### **City of Alexandria**

The City of Alexandria at the City Council level is considering instituting a green building program for the City. As a starting point, the program may investigate green building techniques for City facilities and ways to promote new private development to use these technologies.

Through the site plan review process, the City encourages developers to incorporate green building technologies into their designs.

### **Arlington County**

Through its Chesapeake Bay Preservation Ordinance as well as its commercial and residential Green Building programs, Arlington County encourages stormwater runoff reduction and reuse techniques such as vegetated roofs, permeable paving, and rainwater collection/reuse systems, where appropriate.

### **Fairfax County**

The Fairfax County Board in September 2003 requested that the County form an internal work group to investigate the incorporation of green roof technologies within the County. The work group consists of staff from public works, parks and the Fairfax County Schools. Program points to be considered by the work group include retrofits to existing municipal facilities, new municipal facilities and new private development.

## **Stormwater Runoff Reduction and Reuse Commitments**

- **City of Alexandria, Department of Transportation and Environmental Services**
  - will continue to work to include stormwater runoff reduction and reuse technologies in their Chesapeake Bay Program. (IY-1 thru IY-10)
  - will strive to ensure that municipal projects include stormwater runoff reduction and reuse technologies where appropriate. (IY-1 thru IY-10)
- **Arlington County, Departments of Environmental Services and Public Works**
  - will continue to work to include stormwater runoff reduction and reuse technologies in their Chesapeake Bay and Green Building programs. (IY-1 thru IY10)
  - will continue to strive to ensure that municipal projects include stormwater runoff reduction and reuse technologies where appropriate. (IY-1 thru IY-10)
- **Arlington County Department of Environmental Services**
  - will continue to encourage stormwater runoff reduction and reuse by property owners through its outreach and education programs. (IY-1 thru IY-10)
- **Fairfax County, Department of Public Works and Environmental Services**
  - will work to include appropriate Green Roof technologies as one of several tools being used in implementing LID for new and existing developments. (IY-1 thru IY-10)
  - is evaluating the possibility of consolidating all County stormwater management requirements in a document separate from the Fairfax County Public Facilities Manual. This document will include LID technologies. (IY-1 thru IY-4)
  - will work to include stormwater runoff reduction and reuse in their stormwater management Programs. (IY-1 thru IY-10)
- **Fairfax County, Stormwater Planning Division**
  - will strive to ensure that municipal projects include stormwater runoff reduction and reuse technologies where appropriate. (IY-1 thru IY-10)
  - will head an internal work group to examine the incorporation of Green Roof technologies on a programmatic scale. (IY-1 thru IY-3)
- **Fairfax County, Stormwater Management Division**
  - will develop a watershed plan for the Four Mile Run watershed. Included in those discussions will be the use of stormwater runoff reduction and reuse technologies in the watershed. (IY-1 thru IY-4)
- **City of Falls Church, Department of Environmental Services**
  - will work to include stormwater runoff reduction and reuse technologies in their Chesapeake Bay Program. (IY-1 thru IY-10)
  - will strive to ensure that municipal project include stormwater runoff reduction and reuse technologies where appropriate. (IY-1 thru IY-10)
- **Northern Virginia Regional Commission**
  - will work with the four watershed jurisdictions to develop stormwater runoff reduction and reuse criteria for inclusion in the "Northern Virginia BMP Handbook." (IY-1 thru IY-4)
  - will facilitate adoption of any new state-issued Low Impact Development criteria and model ordinances. (IY-1 thru IY-10)

## Mitigation Measures: UV Disinfection

Ultraviolet (UV) radiation technology was considered for inclusion in this IP. UV radiation technology works by channeling water through a UV lit chamber at a flow rate low enough to ensure proper exposure to irradiate the water. Although UV disinfection has been employed by the water treatment and waste water treatment industries since the 1900's (Metcalf & Eddy, 1991, p 351) the technology's use in the stormwater field is at its infancy. Depending of the power of the UV energy and the contact duration with the water UV radiation can be highly effective at eradicating bacteria in the water column.

Combining the high energy demands required by UV disinfection systems with the high level of maintenance associated with scaling of the lamps increases the costs of UV technology. Those costs combined with the need for high water clarity for effective treatment UV disinfection has not been employed on a wide scale in the stormwater industry. There are a few budding installations in California sited at coastal outfalls discharging to highly trafficked swimming destinations. These installations are aimed at assuring safe human contact with the water in high frequency recreational waters and thusly target the low flow conditions outside of rain events.

Four Mile Run is not typically considered a high frequency swimming destination and with the wide-scale use of the technology yet unproven, the high expected operation and maintenance costs of UV disinfection would be hard to justify. That coupled with the possible unintended environmental consequences the TAC has chosen not to include UV disinfection for use with storm or surface waters in the watershed. Instead the TAC will monitor the success of the California projects for possible consideration of the technology at a later time.

### **UV Disinfection Commitments**

- **Northern Virginia Regional Commission**
  - will on behalf of the Four Mile Run jurisdictions continue to monitor UV Disinfection technologies as projects are installed around the country. If at a later date these are deemed appropriate for use in the Four Mile Run watershed they will be presented for incorporation into this implementation plan. NVRC will investigate whether local universities or schools have interest in providing funds or services to explore demonstration projects within the TMDL watershed.

(IY-1 thru IY-10)

## Mitigation Measures: Ozone Treatment

Ozone treatment technology was considered for inclusion in this IP. Ozone Treatment technology works by channeling water through an ozone injection chamber at a flow rate low enough to ensure proper exposure to eradicate the bacteria. Although ozone disinfection has been employed by the water treatment and waste water treatment industries for a number of years the technology's use in the stormwater field is at its infancy. Unlike UV disinfection ozone treatment is less hampered by the lack of water clarity typical to stormwater.

Such installations would be analogous to a small (and abbreviated) treatment plant complete with a power source, ozone producing equipment and regular maintenance inspections and service. Ozone treatment indiscriminately kills bacteria and microorganisms in the chamber. As was stated in the Mitigation Measures: Stream Corridor Restoration section it is hoped that a balanced micro-ecosystem would allow for competing organisms in the water column. Ozone treatment would have its effect indiscriminant of ecological balance. It is unclear what may happen by destroying all of the microorganisms in the water column. Would a balanced predator-prey ecosystem develop or would opportunistic microorganisms fill the void in imbalanced proportions?

The expected high energy demands required by ozone treatment systems combined with a burdensome maintenance costs have hampered ozone treatment use on a wide scale in the stormwater industry. There is a new installation at Dana Point California aimed at protecting a nearby beach area.

Four Mile Run is not typically considered a high frequency swimming destination and with the wide scale use of the technology yet unproven, the high expected installation and operation and maintenance costs of ozone treatment would be hard to justify. That coupled with the possible unintended consequences of such technology the TAC has chosen not to include ozone treatment for use with storm or surface waters in the watershed but decided to monitor the success of projects like the Dana Point project.

### **Ozone Treatment Commitments**

- **Northern Virginia Regional Commission**
  - will on behalf of the Four Mile Run jurisdictions continue to monitor Ozone Treatment technologies as projects are installed around the country. If at a later date these are deemed appropriate for use in the Four Mile Run watershed they will be presented for incorporation into this implementation plan. NVRC will investigate whether local universities or schools have interest in providing funds or services to explore demonstration projects within the TMDL watershed. (IY-1 thru IY-10)

## Mitigation Measures: Flocculant Usage

Flocculant use was considered for inclusion in this IP. Flocculant technology works by channeling water through an injection chamber at a flow rate low enough to ensure proper exposure to the injected floc agent. With proper pH balance and proper dosing particles in the water column will begin to aggregate or “floc”. This material can be settled or filtered out of the water column. Flocculant use is common in both the water supply and the waste water treatment industries.

Florida is a leader in this field with 30 alum injection systems installed at outfalls discharging into several local lakes. Costs associated with such systems can be quite high: capital costs, regardless of basin size, are estimated at \$250,000 with annual operation costs varying \$25,000 to \$50,000 (England, 2000) Those high costs coupled with the precision needed in pH balance of the water limit flocculant usage in the stormwater industry.

Four Mile Run is not typically considered a high frequency swimming destination and with the widescale use of flocculant technology yet unproven in the stormwater industry, the high expected installation and operation and maintenance costs of flocculant systems would be hard to justify. The TAC has chosen not to include flocculant usage on a wide-scale effort in the watershed. USEPA staff have encouraged the TAC to investigate the creation of a pilot project utilizing floc logs at a few chosen outfalls to Four Mile Run.

### **Flocculant Treatment Commitments**

- **Northern Virginia Regional Commission**
  - Northern Virginia Regional Commission will on behalf of the Four Mile Run jurisdictions continue to monitor flocculant technologies as projects are installed around the country. If at a later date these are deemed appropriate for use in the Four Mile Run watershed they will be presented for incorporation into this implementation plan. NVRC will investigate whether local universities or schools have interest in providing funds or services to explore demonstration projects within the TMDL watershed. (IY-1 thru IY-10)
  - will on behalf of the Four Mile Run jurisdictions investigate the creation of a pilot project examining the use of floc-log technologies at specific outfalls in the watershed. Such locations may include areas where minimizing fecal loading may prove difficult, i.e. areas with large wildlife populations like the Ballston Beaver Pond. (IY-1 thru IY-10)

## 6.5 Indirect Measures

**Indirect Measures** are typically outreach measures. Indirect Measures do not immediately affect bacteria levels in Four Mile Run; however, they may have the greatest potential for minimizing bacteria levels in the run because these measures have the possibility to change the behaviors and attitudes of the watershed citizenry:

The following excerpt taken from a NVRC draft “Northern Virginia Regional Pollution-Prevention (P2) Media Strategy suggests the following insight for efficacy in outreach efforts:

*‘Recommendations for simple, clear and compelling communications are best summed up by U.S. Environmental Protection Agency focus group research. The focus group study found that it is “important to demonstrate cause-and-effect relationships in all marketing efforts. Simply being told about a problem is insufficient. According to focus group research, people want to be told specifically what actions they need to take to correct the problem. At the same time, respondents emphasized that they do not want to be told too many things at one time. The best approach is to identify one or two problems related to nonpoint source pollution and then provide the corrective actions.” Focus group respondents also felt it was important to “develop a series of interrelated multimedia messages with a single ‘look and feel.’” ’*

### **Indirect Measures: General Outreach**

#### **City of Alexandria**

The City of Alexandria provides general outreach regarding nonpoint source pollution as part of their MS4 permit. To meet this requirement, the City intends to develop a more comprehensive public outreach and education program, which could include collaboration with for the Northern Virginia Regional Pollution-Prevention (P2) Media Strategy program coordinated by NVRC. One of the three target components of that the P2 program is to change poor dog walking practices through media outreach.

The City actively promotes the use of storm drain inlet markers throughout the City and in the Four Mile Run watershed specifically. These markers are affixed to storm drains and inform citizens that the inlet is not for dumping and that the water in the inlet drains directly to a specific water body, which is identified on the marker. During the site plan review process, the City requires developers to mark new storm sewer inlets and public inlets within 50 feet of the project with appropriate inlet markers.

Additionally, the City works with non-profit groups and civic associations to install storm drain inlet markers. This effort is primarily concentrated in the Four Mile Run watershed. During these events, door hangars are placed on houses that inform residents of the new inlet markers and issues facing our surface waters.

The City of Alexandria is working in cooperation with Arlingtonians for a Clean Environment to organize watershed stewardship teams. Selected watershed residents were trained in an award winning approach to neighborhood based environmental protection. Each resident then led a team of neighbors to learn about and take action on changing their behavior to prevent non point source pollution.

The City holds an annual, local Earth Day celebration in the spring. This activity brings together approximately 500 people each year to celebrate the natural resources in the City. Educational booths and projects help to teach children and adults about non-point source pollution, tree stewardship, litter control, and other environmentally related activities. The event is usually held at Four Mile Run Park, which is located along the Run downstream of Mt. Vernon Avenue. While the location is outside of the TMDL watershed, the outreach efforts affect citizens throughout the City.

### **Arlington County**

Arlington County's Department of Environmental Services, in partnership with other local governments and local community and non-profit groups, conducts education and outreach about a wide range of watershed management activities, including illicit discharges, non-point source pollution, household hazardous waste, and stormwater management, as part of the department's mission. Overall, Arlington County and its partners conducted 85 presentations and volunteer events during FY 2003, reaching approximately 6,200 citizens.

#### ***NPS pollution education***

Arlington County has recently used some multi-media methods to conduct outreach on NPS pollution and water quality. In 2002, the County conducted an education campaign with water quality ads in all Arlington County Metro stations, reaching a potential of 170,000 people per day, or 5.5 million people for the month of May while the ads were displayed. In 2003, Arlington County ran educational water quality ads at a local movie theater for six months, with a total of 780,000 viewings. Arlington County is working with NVRC staff on developing a Regional education campaign on reducing NPS/stormwater pollution. This campaign will include media tools such as radio or print advertisements.

DES staff also conduct educational presentations at schools, community groups, and workshops. During the past year, staff conducted five classroom presentations and nine community group presentations about water quality. Staff participated in educational booths at Clarendon Day in Arlington, a "Watershed Year" Kickoff, the Peru Festival, the Bolivia festival, and the annual County Fair, which has over 60,000 visitors. DES distributed 490 "Enjoying Arlington's Streams" brochures (270 in English, and 220 in Spanish), which describe how stormwater impacts streams and ways that residents can

reduce non-point source pollution. DES distributed 200 brochures about Project Watershed Watch volunteer activities, 150 brochures on protecting urban streams, and 2,000 magnets with the DES web site and phone numbers for the household hazardous waste program and reporting stream pollution.

ACE is a non profit educational and service organization serving the residents of Arlington County, presents information to students and adults about local issues including non point source pollution and the Chesapeake Bay. Several schools participate each year in ACE educational programs reaching 78 classrooms and close to 2,000 students in 2002. ACE publishes a quarterly newsletter, "The Arlington Environment," highlighting environmental issues that impact Arlington County residents. Approximately 1,600 copies are mailed and 1,350 are distributed by ACE every quarter. ACE also distributes volunteer and educational opportunities to its e-mail listserve with 350 subscribers. In 2002, ACE published a Spanish language edition of The Arlington Environment newsletter focusing on watersheds and streams and continues its distribution to provide valuable information to Spanish-speaking neighborhoods in the County.

In 2003, ACE piloted a new education program in the Four Mile Run watershed, organizing watershed stewardship teams. Selected watershed residents were trained in an award winning approach to neighborhood based environmental protection. Each resident then led a team of neighbors to learn about and take action on changing their behavior to prevent non point source pollution. The training was part of a national pilot and was funded by the National Fish and Wildlife Foundation and was organized by ACE working in partnership with Arlington County as well as the Cities of Alexandria and Falls Church. This pilot project has been funded for a second year, in which the number of watershed stewardship teams will expand.

### ***Stream volunteer activities***

Arlington County and ACE offer many stream volunteer opportunities for citizens. In 2003, Arlington County expanded its storm drain marking program due to popular demand. Arlington County ordered 1,000 additional storm drain markers, customized for all the sub-watersheds in Arlington County. To date, approximately 1,000 storm drains have been marked, and 3,500 educational door hangers in English and Spanish were distributed. The educational door hanger includes a reminder for people to pick up pet waste. This program reminds people that dumping in storm drains is illegal, and also gives the name of their local watershed.

Staff also helped organize training classes for stream monitors and stream stewards. Stream monitors are citizens who volunteer to do water quality monitoring in Arlington streams, and stream stewards are citizens that volunteer to conduct educational programs and projects related to watersheds and water quality. Since the inception of the stream monitoring program, seven teams have been formed that monitor at seven sites around the County.

## **Fairfax County**

Fairfax County is required to provide general outreach regarding nonpoint source pollution in their MS4 permit. To meet this requirement, the County intends to develop a more comprehensive public outreach and education program which could include collaboration with for the Northern Virginia Regional Pollution-Prevention (P2) Media Strategy program coordinated by NVRC. One of the three target components of that the P2 program is to change poor dog walking practices through media outreach.

## **City of Falls Church**

### ***Public Education and Volunteer Participation***

Falls Church City Department of Environmental Services, in partnership with other local governments and volunteer groups, conducts education and outreach about a wide range of watershed management activities. During the past 18 months, the City of Falls Church initiated or continued the following outreach activities to educate citizens on watershed protection:

- Stream Stewards program, through which a corps of citizen volunteers make presentations to community and school groups to advocate individual and group behavior change leading to improved stormwater quality.
- Storm drain marking program, through which citizen volunteers have applied educational decals next to 100 of the 150 storm drains in the City portion of the Four Mile Run watershed. Approximately 1,000 educational door hangers have been distributed in the affected neighborhoods to announce the storm drain marking project and to remind residents that dumping in storm drains is illegal.
- Articles on stormwater management appear at least quarterly in the *FOCUS* section of the *Falls Church News-Press*.
- A new *Falls Church Environment* newsletter, distributed by recycling block captains to City residents, includes articles on stormwater management.
- Two neighborhood teams in the City have participated in the national pilot project, "Livable Neighborhood: Water Stewardship Program," which was funded through the NFWF grant in partnership with ACE, Arlington County, and the City of Alexandria. The program is being expanded to include additional neighborhood teams.
- A Watershed-friendly Garden Tour highlighted such features as rain gardens and rainwater collection at six private and public sites in the City. The tour will be sponsored annually and will include additional sites.
- Operation EarthWatch and Ecology Club programs targeting elementary school students in the City include activities that promote watershed awareness and action.

- Citywide cleanups held each spring and fall include stream cleanups and a “thank you” picnic program that focuses on watershed protection.

## **NVRC**

The Northern Virginia Regional Commission is developing a pollution-prevention (P2) media strategy project in coordination with Northern Virginia jurisdictions. The project will pool participating jurisdictions’ outreach funds to take advantage of the reach of mass media. Looking for opportunities to leverage local investment, NVRC also participated in the Chesapeake Bay Program’s efforts to conduct a similar campaign on a Greater Metropolitan Washington area scale.

While participating jurisdictions and NVRC continue to shape details of the program it is assured that the project will focus efforts on three issues: over-fertilization of lawns; car washing, where soapy water drains to storm drains and streams; and poor dog walking practices, where dog owners neglect to pick up after their dogs. Although the issue of poor dog walking practices was raised because of nutrient concerns with the Chesapeake Bay its message will directly apply to the aims of this IP.

## **Virginia Department of Transportation**

The Virginia Department of Transportation Northern Virginia District (VDOT) was awarded a VPDES Phase 2 Permit for Stormwater Discharges from Municipal Separate Storm Sewer Systems (MS4s). This permit commits VDOT to developing a Public Education and Outreach Program (Minimum Control Measure 1), and a Public Involvement/Participation Program. This program recognizes that VDOT is a watershed partner, and can best implement a public outreach program through the partnering of resources with the local jurisdictions in the development of educational programs, public service announcements. VDOT also will continue to develop and implement a Public Involvement and Participation Program.

## **General Education & Outreach Commitments**

- **City of Alexandria, Department of Transportation and Environmental Services**
  - will incorporate information regarding bacteria as a NPS pollutant into the general NPS brochures that are actively distributed. (IY-1 thru IY-10)
  - will consider funding to participate in the Northern Virginia Regional Pollution-Prevention (P2) Media Strategy program. (IY-1 thru IY-10)
  - publish one newsletter article concerning nonpoint source pollution and bacteria every other year in the newsletter, FYI Alexandria a City publication. Such articles will be made available to civic associations for inclusion in their publications. (IY-1 thru IY-10)
  - will include bacteria as a pollutant into general NPS outreach & education materials including presentations. (IY-1 thru IY-10)
  - will continue their storm drain marking program at current levels. (IY-1 thru IY-10)
  - will include information regarding bacteria as a NPS pollutant on their webpage. Where appropriate such information will include reference to this implementation plan and discussion of the City's proactive approach to the impairment. (IY-1 thru IY-10)
  
- **Arlington County, Department of Environmental Services**
  - will include bacteria as a pollutant into general NPS outreach & education materials including presentations and Internet materials. Where appropriate such information will include reference to this implementation plan and discussion of the County's proactive approach to the impairment. (IY-1 thru IY-10)
  - will incorporate information regarding bacteria as a NPS pollutant into the general NPS brochures that are actively distributed. (IY-1 thru IY-10)
  - will publish one newsletter article every other year in the "Citizen," a County publication. Those articles will cover nonpoint source pollution and bacteria and will be made available to civic associations for inclusion in their publications. (IY-1 thru IY-10)
  - will continue their storm drain marking program at current levels. (IY-1 thru IY-10)
  - will help fund the Northern Virginia Regional Pollution-Prevention (P2) Media Strategy program. (IY-1 thru IY-10)
  
- **Arlingtonians for a Clean Environment & Arlington County, Department of Environmental Services**
  - will continue the Stream Stewards Program and will incorporate bacteria as a NPS pollutant. (IY-1 thru IY-10)
  
- **Arlingtonians for a Clean Environment**
  - in coordination with Arlington County Department of Environmental Services, City of Fall Church Department of Environmental Services, and City of Alexandria Transportation and Environmental Services, will continue the Watershed Stewardship Program for IY-1 and seek funding for future years. (IY-1 thru IY-10)
  - will publish one newsletter article every year concerning nonpoint source pollution and bacteria in The Arlington Environment. (IY-1 thru IY-10)
  
- **Fairfax County**
  - will continue their volunteer storm drain marking program at current levels. (IY-1 thru IY-10)

## **General Education & Outreach Commitments (continued)**

- **Fairfax County Department of Public Works and Environmental Services**
  - will publish information regarding bacteria as a NPS pollutant for the general public through various means including the County's Web Site. (IY-1 thru IY-10)
  - will include bacteria as a pollutant into general NPS outreach & education materials including presentations. (IY-1 thru IY-10)
  - will collaborate on the implementation of the Northern Virginia Regional Pollution-Prevention (P2) Media Strategy program. (IY-1 thru IY-10)
  - will include information regarding bacteria as a NPS pollutant on their webpage. Where appropriate such information will include reference to this implementation plan and discussion of the County's proactive approach to the impairment. (IY-1 thru IY-10)
  
- **City of Falls Church Department of Environmental Services**
  - will continue the Stream Stewards Program and will incorporate bacteria as a NPS pollutant into general NPS outreach and education materials, including presentations. (IY-1 thru IY-10)
  - will incorporate information regarding bacteria as a NPS pollutant into the general NPS brochures that will be distributed via direct mail to all City residents. (IY-1 thru IY-10)
  - will publish articles regarding bacteria as a NPS pollutant in the FOCUS section of the Falls Church News-Press on a quarterly basis. In addition, similar articles will be published bi-annually in The Falls Church Environment newsletter. Such articles will be made available to civic associations for inclusion in their publications. (IY-1 thru IY-10)
  - will complete their storm drain marking program in 2004, resulting in the application of markers next to every storm drain in the City portion of the Four Mile Run watershed. (IY-1)
  - will include information regarding bacteria as a NPS pollutant on their webpage. Where appropriate, such information will include reference to this implementation plan and discussion of the City's proactive approach to the impairment. (IY-1 thru IY-10)
  - will include information regarding bacteria as a NPS pollutant through a scrolling text message on the City's public access cable channel. (IY-1 thru IY-10)
  - will include information regarding bacteria as a NPS pollutant in the Operation EarthWatch and Ecology Club programs that target elementary school students. (IY-1 thru IY-10)
  - will include information regarding bacteria as a NPS pollutant in the bi-annual City-wide cleanups. (IY-1 thru IY-10)
  - will seek funding to participate in the Northern Virginia Regional Pollution-Prevention (P2) Media Strategy program. (IY-1 thru IY-10)

## **General Education & Outreach Commitments (continued)**

- **Northern Virginia Regional Commission**

- will act as a clearing house for outreach & education materials. NVRC will also orchestrate meetings annually with watershed jurisdictions to discuss implementation progress, coordinate education & outreach and maintain a focus on the IP effort. (IY-1 thru IY-10)
- will coordinate a region-wide media campaign, Northern Virginia Regional Pollution-Prevention (P2) Media Strategy, to target pollution-causing behaviors, including improper dog-walking practices. Depending on the sum of locality contributions to the pollution-prevention outreach effort, the campaign's goal is to target dog walkers through the use of mass media. Media advertising will be supplemented with coordinated community outreach and corporate sponsorship campaigns, with special emphasis on Four Mile Run and other watersheds where streams are impaired for fecal coliform bacteria. (IY-1 thru IY-10)
- will maintain the TMDL Resource portion of the Four Mile Run website. It will be kept up to date with TMDL related efforts. (IY-1 thru IY-10)

- **Virginia Department of Transportation**

- will work towards providing services, resources, and/or manpower to supplement local/regional public outreach campaigns on the impacts of stormwater runoff. (IY-1 thru IY-10)

## **Indirect Measures: Directed Outreach**

Directed outreach measures are those outreach activities that focus solely on the behavior changes needed to reduce bacteria as a pollutant in Four Mile Run. A “Proper Pet Waste Disposal” campaign would be considered directed outreach where incorporating proper pet waste disposal into a classroom presentation about nonpoint source pollution is considered general outreach and has been included in the previous section.

### **City of Alexandria**

The City of Alexandria’s website has a section titled “Protection Alexandria’s Waters that describes the City’s efforts to study and correct the sanitary sewers in the City that contribute pollution to local streams. This effort will directly affect the pollution levels in several streams, in particular, Four Mile Run.

The City currently publishes and distributes a brochure titled “Your Dog and the Chesapeake Bay Have More in Common than You Think.” This brochure addresses fecal contamination in our waters and proper pet waste disposal procedures.

### **Arlington County**

From January through June 2003, Arlington County ran some educational ads at a local movie theater. These ads targeted four sources of nonpoint source pollution (pet waste, car washing, fertilizer, and cars leaking oil). In addition, many of the educational materials distributed about nonpoint source pollution specifically mention pet waste and the importance of cleaning up after pets.

In 2003, Arlington County expanded its storm drain marking program due to popular demand. Arlington County ordered 1,000 additional storm drain markers, customized for all the sub-watersheds in Arlington County. To date, approximately 1,000 storm drains have been marked, and 3,500 educational door hangers in English and Spanish were distributed. The educational door hanger includes a reminder for people to pick up pet waste. This program reminds people that dumping in storm drains is illegal, and also gives the name of their local watershed.

### **City of Falls Church**

Many of the educational materials distributed on nonpoint source pollution (e.g., newspaper and newsletter articles, storm drain marker doorhangers, etc.) specifically mention pet waste and the importance of cleaning up after pets.

## **Directed Outreach Commitments**

- **City of Alexandria, Department of Transportation and Environmental Services**
  - will update their brochure “Your Dog and the Chesapeake Bay Have More In Common Than You Think” to reflect the TMDL and Implementation Strategy. This brochure will be distributed at fair & festival exhibits and at City Park kiosks as well as made available at City offices. (IY-2 thru IY-10)
  
- **Arlington County Department of Environmental Services**
  - will continue to develop outreach materials directed at proper pet waste disposal, such as the movie theater and Metro station ads, as part of its overall outreach and education programs. (IY-1 thru IY-10)
  - will also support the Northern Virginia Regional P2 Strategy, which includes an emphasis on proper pet waste disposal (see ‘General Education and Outreach’ section). (IY-1 thru IY-10)
  
- **Arlington Dogs**
  - in coordination with *Shirlington Dogs, Banneker Dogs, Douglas Dogs, Glen Carlyn Dogs, Fair Dogs, Tower Dogs, and Arlington County, Departments of Parks Recreation and Community Resources and Environmental Services* will work to promote responsible dog owner habits regarding bacteria both within the dog parks and beyond. Efforts may include articles in newsletters, information posted at dogs parks, presentations to civic associations, etc. (IY-1 thru IY-10)
  
- **City of Falls Church Department of Environmental Services**
  - will develop a brochure “Your Dog and the Chesapeake Bay,” which will include information about the TMDL and Implementation Strategy. This brochure will be distributed to dog owners through a wide range of channels. (IY-2 thru IY-10)
  
- **Northern Virginia Regional Commission**
  - will prepare an electronic slide show for use by volunteers to present at civic association meetings, etc. (IY-1)
  - will host yearly meeting to coordinate outreach efforts. (IY-1 thru IY-10)

## Indirect Measures: Signage

Signage is a passive form of outreach. Signs can be either detailed with educational material or brief in nature focused on a particular message, i.e. "Receptacle for Pet Waste Disposal". Signs can be located in parklands adjacent to the run or throughout the watershed. Because impairments associated with bacteria often limit allowed activities in stream (swimming, and wading) signs posting related activity prohibitions are also discussed in this section.

All municipalities met at the NVRC offices in 2002 to discuss building consensus among the Northern Virginia localities regarding whether or not to post activity limiting signage along stream corridors. At that time there was little consensus among the jurisdictions regarding whether or not activity limiting signage should be posted in the watershed or not. During the development of this IP the TAC briefly considered this issue again but understood that the Virginia Department of Health (VDH) soon would be working with the local health departments to develop some uniform signage for Four Mile Run. The TAC decided to defer to the VDH process.



Figure 6.6. Activity Limiting Signs



Figure 6.7. Stream Crossing Sign

### **City of Alexandria**

Through work with ACE, Alexandria is planning to install a set of educational signs with three panels in Four Mile Run Park along the trail. The signs will be similar to the signs located in Barcroft Park in Arlington described below. Street signs are located at the three bridges that cross Four Mile Run that identify the Run and that it is in the Chesapeake Bay watershed. The City is also considering installing street signs to indicate where the Four Mile Run watershed begins.

### **Arlington County**

There is one set of signs addressing pollution in Four Mile Run that was developed by ACE at Barcroft Park on Four Mile Run. This sign consists of three panels: one showing the Chesapeake Bay Watershed, one showing the history of Four Mile Run, and one describing how “we all live downstream”. Additional copies of these signs will be located in four additional parks along Four Mile Run, as part of a grant received by ACE. In addition, stream crossing signs will be posted in eight locations identifying when a local road crosses Four Mile Run.

Arlington County has placed signs in park kiosks indicating the ‘don’ts’ (no swimming, no bathing, no dogs off leash, no drinking water, no car washing, no littering) associated with Four Mile Run.

### **City of Falls Church**

Through the NFWF grant with ACE, Arlington County, and the City of Alexandria, the City of Falls Church will receive educational signage in Banneker Park, near the boundary between Arlington and the City of Falls Church. This three panel sign will be similar to the one located in Barcroft Park in Arlington County (and described above.) In addition, stream crossing signs will be posted in two locations identifying when a local road crosses Four Mile Run. A sign is located in Crossman Park at Four Mile Run that indicates no swimming.

## Signage Commitments

- **City of Alexandria, Department of Transportation and Environmental Services**
  - will continue the City storm drain marking program as its current level. (IY-1 thru IY-10)
  - will provide input to the VDH signage discussion for Four Mile Run. (IY-1 thru IY-5)
  - will seek opportunities to place informative signs at strategic locations in the Four Mile Run watershed. Signs could be highly detailed and educational in nature or could be simple signs reminding park goers to pick up after one's pet. (IY-1 thru IY-10)
- **Arlingtonians for a Clean Environment**
  - in coordination with Arlington County and the City of Alexandria and the City of Falls Church will install 3 sets of educational signs in the watershed. (IY-1 thru IY-3)
- **Arlington County, Department of Environmental Services**
  - will continue there storm drain marking program as its current level. (IY-1 thru IY-10)
- **Arlington County, Departments of Environmental Services; Parks, Recreation and Community Resources; and Environmental Health**
  - will provide input to the VDH signage discussion for Four Mile Run. (IY-1 thru IY-5)
- **Arlington County, Departments of Environmental Services and Parks, Recreation and Community Resources**
  - will seek opportunities to place informative signs at strategic locations in the Four Mile Run watershed. Signs could be highly detailed and educational in nature or could be simple signs reminding park goers to pick up after one's pet. (IY-1 thru IY-10)
- **Fairfax County**
  - will continue their volunteer storm drain marking program as its current level. (IY-1 thru IY-10)
- **Fairfax County Department of Public Works and Environmental Services**
  - will provide input to the VDH signage discussion for Four Mile Run. (IY-1 thru IY-5)
- **City of Falls Church, Department of Environmental Services**
  - will seek opportunities to place informative signs at strategic locations in the Four Mile Run watershed. Signs could be highly detailed and educational in nature or could be simple signs reminding park goers to pick up after one's pet. (IY-1 thru IY-10)
  - will provide input to the VDH signage discussion for Four Mile Run. (IY-1 thru IY-5)
  - will complete their storm drain marking program in 2004, resulting in the application of markers next to every storm drain in the City portion of the Four Mile Run watershed. (IY-1)
- **Northern Virginia Regional Commission**
  - on behalf of the Four Mile Run jurisdictions will monitor the ongoing VDH effort considering signs for Four Mile Run and will request that VDH allow the environmental services departments from the Four Mile Run jurisdictions to participate in and provide input to the signage discussions. (IY-1 thru IY-5)

## **7.0 Associated Costs and Benefits**

### **7.1 Associated Costs**

Many, if not most, of the efforts committed under this Implementation Plan are efforts that are also part of each municipality's stormwater or sanitary sewer programs. Some efforts will require a new focus on bacteria, e.g. classroom presentations. Other implementation efforts will mean the reallocation of municipal resources to the activities described herein, e.g. inspection of sanitary sewer lines at stream channels. The costs associated with these efforts are very difficult to parse from the overall activity costs. For that reason costs have been included two ways in this plan. First, the costs of the municipality's stormwater and sanitary sewer programs associated with the IP commitments are included. These costs represent the costs of each program facet proportioned to the Four Mile Run watershed areas contained by the respective municipality. Second, costs associated with full implementation of a hypothetical ultimate design for the watershed are presented on a per unit basis.

#### **7.1.1 Program Costs by Jurisdiction**

The costs incurred by the actions prescribed by this plan are difficult to separate from ongoing efforts in the watershed. All four jurisdictions already have strong stormwater and sanitary sewer programs through which the majority of implementation actions will be instituted. Those programs have been established to meet a variety of goals including protecting public health and safety and compliance with state and federal regulatory requirements. Many of the actions chosen specifically for this plan meet multiple regulatory requirements, e.g. controlling sanitary sewer overflows meets both the intent of this IP as well as the US Environmental Protection Agency (USEPA) Sanitary Sewer Overflow regulations and treating stormwater through best management practices (BMPs) is a requirement in varying degrees of Municipal Separate Storm Sewer System (MS4) permits, the Virginia Chesapeake Bay Preservation Act, the upcoming Potomac Tributary Strategies.

Although every commitment in this IP has been included with due consideration by its responsible party no new resources were allocated by the municipalities to accomplish these tasks in the specific light of TMDL implementation. This said, no actions have been included in this plan that the responsible party did not have confidence that there would be resources available to execute the stated action. Thusly, the actions described by this plan are those where monies were previously allocated to that purpose or actions that will be executed by absorbing the resource demands of those actions by staff and budgets already in place. It is hoped that through grant funding or petitioning for future budget allocations that more implementation actions can be committed to and subsequently accomplished.

Because the programmatic infrastructure currently exists to execute the actions in this plan and because there are no new funds established for executing this plan there are

consequentially no incremental costs associated with this plan. Thusly, the costs included below represent those jurisdictional costs associated with the implementation actions prescribed by this IP but no attempt has been made to parse those costs from non-TMDL implementation program costs in the Four Mile Run watershed.

**Table 7.1. Program Costs**

<b>Jurisdiction</b>	<b>Estimated Annual Program Budgets*</b>
<b>City of Alexandria</b>	<b>\$ 515,000 (plus \$6,000,000 one time sanitary sewer rehabilitation project)</b>
<b>Arlington County</b>	<b>\$ 5,000,000</b>
<b>Fairfax County</b>	<b>\$95,000 (Plus \$960,00 over the first 5 years for sanitary sewer infrastructure rehabilitation.)</b>
<b>City of Falls Church</b>	<b>\$ 18,200 (Plus \$ 4,000,000 for sanitary sewer rehabilitation; and, \$1,000,000 for removing surface drainage connections from sanitary sewer system.)</b>

\* Dollar values are wholesale stormwater and sanitary sewer program costs prorated to the particular jurisdiction's portion of the Four Mile Run watershed. Budgets are subject to annual budget approval process.

**7.1.2 Estimated Costs of a Hypothetical “Ultimate Design”**

Four Mile Run and its watershed are faced with several issues that reflect the highly urbanized nature of the watershed. Often the costs associated with preserving an asset are far lower than restoring that asset once damage has occurred. In the case of Four Mile Run most of the development in the watershed occurred prior to stormwater management regulations. Now that the watershed is completely built out virtually all BMP installations are costly retrofit-type installations. Additionally, the degradation to the stream corridors in the Four Mile Run watershed is not a concept that future development with unmitigated impervious surfaces could cause; but, a real degradation that has mostly already occurred with few stream channel segments restored to date and little open space available to effect future restoration projects.

The following costs are presented here to give the reader an idea of the overall resources needed to effect restoration on a large scale in the Four Mile Run watershed.

- **Outreach Efforts** The Four Mile Run watershed covers four political boundaries and is locate adjacent to the nation’s capital, Washington, DC.

Reaching the diverse watershed populous could include a variety of mass media outlets including regional or local newspapers, subway advertisements, radio announcements and TV spots. Approximate costs for some specific opportunities are described below:

- \$11,000 would cover the costs associated with a ½ page ad in the Washington Post distributed in the Virginia distribution zone three times. (Does not include artwork costs.)
  - \$2,000 would cover a one time ¼ page ad in the Northern Virginia Publication “Connection” (Does not include artwork costs.)
  - \$12,000 would cover costs for 27 60-second spot advertisements per week for three weeks (81 total ads) on a local radio station. (Costs do not include production costs.)
- **Stream Corridor Restoration** Virtually all stream segments of Four Mile Run and its tributaries have been altered from their natural state. This has been accomplished either by directly moving or otherwise modifying the stream or through the destructive processes urbanization wreaks on downstream stream valleys. Of the more than 78,000 linear feet of stream channel remaining above ground (not buried in the storm pipe network) it can be assumed that 95% of those segments (74,100 linear feet) have been impacted or degraded to the point of requiring restoration. Using a price of \$400/linear feet, \$1,000,000 could fund the restoration of 2,500 linear feet of stream. Thus, restoration of all degraded stream channels in the TMDL watershed would cost \$29,640,000. This cost reflects gross construction costs alone and does not include any associated maintenance costs.
  - **Stormwater Treatment** The Four Mile Run watershed is 19.7 square miles in area. Assuming that 40% of the watershed is impervious and 95% of that impervious area allows stormwater to flow into Four Mile Run untreated, then there are approximately 6.5 square miles (4,160 acres) of impervious area in the Four Mile Run watershed in need of BMP retrofits. Using a range of capital costs for BMP retrofits of \$25,000 to \$50,000 / acre (costs are irrespective of BMP efficiency or post installation maintenance costs) \$1,000,000 would retrofit only 20 to 40 impervious acres (0.03 to 0.06 square miles) with BMPs. To retrofit all impervious areas of the watershed with BMPs would cost \$104,000,000 to \$208,000,000. Costs do not include associated maintenance costs.
  - **Daylighting Stream Channels** City staff in Falls Church have estimated that to restore a 100 linear foot section of the Harrison Branch tributary in a city park from a subsurface culvert to an exposed restored stream channel is estimated to cost over \$60,000. NVRC estimates that between 1917 and 1998 over 35 miles of natural drainage in the Four Mile Run watershed was replaced by subsurface storm drains. Using the \$60,000 per 100 Linear Feet of stream channel figure suggests that restoring all 35 miles of underground stream segments in the Four Mile Run watershed would cost \$110,880,000.

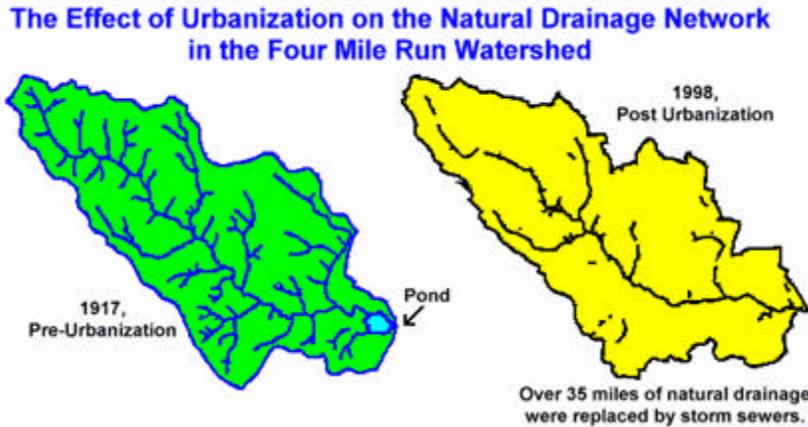


Figure 7.1. Effect of Urbanization in Four Mile

Most of the stream undergrounded segments in the watershed are not conveniently located in parklands but under roads, parking lots or other more difficult areas where restoration would cost substantially more or such restoration is not at all feasible.

## 7.2 Benefits

Overall, it is hoped that by implementing the actions outlined in this IP the bacteria levels in Four Mile Run will be reduced to a level compliant with the Virginia water quality criteria for bacteria. With lower bacteria levels the risk of human disease associated with contact with the water will also be reduced.

The pollution prevention measures included by this plan have the potential to remove 100% of the bacteria source contributions where employed (i.e. if a sanitary sewer does not overflow then all bacteria laden material is carried to the waste water treatment plant for proper disposal.) By preventing the release of sewage to the environment all of the contaminants associated with untreated sewage are shielded from the environment.

Mitigation measures are less directly tied to specific bacteria sources and have the potential to substantially reduce the bacteria levels in the water column passing through the device (i.e. a sand filter BMP may remove 75% of the bacteria in the water column reaching the filter.) Most of the IP mitigation measures will reduce not only bacteria levels in the water column but also sediments, nutrients, and other stormwater pollutants.

Indirect measures have multiple benefits that in varying degrees can affect bacteria levels in Four Mile Run. Outreach efforts often focus on changing the behaviors of

people and those behavior changes reduce bacteria levels in the run, e.g. a poster campaign in metro stops that encourages people to pick up after ones pets. Those same outreach efforts also have the potential to raise a broad concern over bacteria and nonpoint source issues in the watershed. With more concern and attention given to nonpoint source pollution it is hoped that more resources can be brought to bear on the issue.

In general, the actions included in this IP strive to lower bacteria levels in Four Mile Run but the breadth of those actions offer more than a singularly focused strategy. For example, by preventing sewage from being released to the environment through sanitary sewer overflows all of the myriad of contaminants attributed to sewage are also shielded from the environment and the risk of human exposure is minimized. By way of another example, a stream restoration or daylighting project not only may lower bacteria levels but can provide a natural wildlife habitat and offer the public a stronger connection to the stream.

By partnering with existing programs and projects synergies are expected to develop, that by combining multiple efforts “the sum is greater than its parts.” In explanation, one of the goals of the Potomac Tributary Strategies is to reduce sediment discharge in the Potomac Basin. Sediment can be controlled through many types of structural BMPs. These structural BMPs that may be employed for the Potomac Tributary Strategies may be the very same BMPs that are required by local Virginia Chesapeake Bay Preservation Act programs or MS4 permits. And those BMPs whether installed as part of a Chesapeake Bay Preservation Act requirement, a Potomac Tributary Strategies requirement or an MS4 requirement will also work to reduce bacteria levels in the water column passing through the BMP. Where feasible, the separate and distinct water quality protection programs can be addressed as whole to minimize labors and maximize benefits.

Also by teaming efforts through regional outreach programs like the developing Northern Virginia Regional Pollution-Prevention (P2) Media Strategy or through regular coordination meetings each entity can benefit from the successes or failures of the other participants. Consistent information in messages across jurisdictions and institutions will facilitate understanding by the target audiences.

## 8.0 Measurable Goals and Milestones

### 8.1 TMDL Program Goals

The goal of the TMDL program is straightforward: to bring impaired waters into compliance with applicable water quality standards. As waters achieve compliance with the water quality criteria they can be “delisted” or removed from the 303(d) List of Impaired Waters.

In general, the TMDL study process relies on both water quality and hydrologic monitoring data of the impaired watershed to develop models that represent the actual movement of water and pollutant through the watershed. With such models, scenarios are developed that represent actual pollutant loadings and hypothetical reduced pollutant loadings that will bring the water segment into compliance with the water quality standard. The hypothetical pollutant loading scenario that will allow the water segment to comply with the water quality criteria based on appropriate source allocations is adopted as the TMDL for the watershed. Once the pollutant loadings from all sources in the watershed allocated by the adoption of the TMDL an Implementation Plan (IP) is developed to identify the specific corrective actions needed to reduce pollutant loadings to those levels prescribed by the TMDL allocations.

If the modeling of the TMDL truly represents the watershed function, and the pollutant sources in the watershed adhere to the allocations set in the TMDL, then the water segment will come into compliance with the water quality standard through the actions presented in the IP.

### 8.2 Four Mile Run TMDL Program Goals

The goal of the TMDL developed for Four Mile Run reflects that of the federal program: to bring the impaired water segment that is the focus of the Four Mile Run TMDL study into compliance with the applicable bacteria water quality standard. Once that water segment achieves compliance with the bacteria criteria, then the segment can be removed from the 303(d) List of Impaired Waters.

Development of the Four Mile Run TMDL study resulted in the following compliance scenario:

**Table 8.1. TMDL Reduction in Loadings from Existing Conditions**

Reduction in Loadings from Existing Conditions (%)					% days > than 1000 MPN/100mL
Waterfowl	Raccoon	Human	Dog	Other Wildlife	
95	95	98	98	95	0.1

The compliance scenario indicates that in order for Four Mile Run to achieve compliance with the bacteria standard the bacteria source loads from human and canine sources (anthropogenic sources) must be reduced by 98% and the source loads from wildlife sources in the watershed must be reduced by 95%.

VADEQ is recommending a staged implementation approach for bacteria TMDLs. In approving the Four Mile Run TMDL, USEPA reflected this approach by stating the following in their decision rationale:

*“A phased implementation plan will be developed for all streams in which the TMDL calls for reductions in wildlife. In the first phase of the implementation, the Commonwealth will begin implementing the reductions (other than wildlife) called for in the TMDL.” (USEPA, May 2002)*

The ultimate goal for the Four Mile Run TMDL program is to bring Four Mile Run fully into compliance with Virginia water quality criteria; however, the actions described in this IP are associated only with the first phase of the staged approach proposed by VADEQ. While the intent of the plan is to target only the anthropogenic bacteria sources in the watershed many of the mitigation measures will reduce all bacteria levels in the water column irrespective of the source of the bacteria. It is hoped that substantial progress or even achievement of the bacteria water quality criteria will be made through the efforts prescribed by this plan. Throughout implementation of this plan, VADEQ will continue to evaluate whether other sources of bacterial pollution are also controllable and will continue to evaluate the appropriateness of additional control measures. If at a later date these sources are deemed controllable they will be incorporated into this implementation plan.

Inherent to all modeling efforts and scientific studies is a certain amount of uncertainty. By their very nature models and studies rely on statistical calculations to make use of incomplete data sets or to smooth the model functions. Assumptions and approximations are the bridge between the mathematical model and actual conditions. Often these uncertainties are compensated for in the model by including a “margin of safety” in the calculations. Each model assumption can be “conservative” to fully account for the situation or an umbrella margin of safety can be applied to the model as a whole. Through either approach a conservative bias is incorporated into the model. It is expected that the conservative trends inherent in the Four Mile Run TMDL model and the indiscriminant effect on all bacteria in the water column of the mitigation measures included in this plan will combine to bring Four Mile Run into compliance.

### **8.3 Implementation Plan Timeline**

The VADEQ and the TAC propose a ten year timeline for this phase targeting anthropogenic loads. The IP will cover activities projected 10 years into the future. The following is an expected timeline for the project:

<b>Project Timeline</b>	
■ 2004 (IY-1).....	<b>Adoption of Plan</b>
■ 2005 (IY-2).....	
■ 2006 (IY-3).....	
■ 2007 (IY-4).....	
■ 2008 (IY-5).....	<b>Reassess in 5th Year</b>
■ 2009 (IY-6).....	
■ 2010 (IY-7).....	
■ 2011 (IY-8).....	
■ 2012 (IY-9).....	
■ 2013 (IY-10).....	<b>Evaluate Plan Effectiveness</b>

(IY-# = Implementation Year)

If at the end of the ten year project timeframe the water quality standard for bacteria has not been met, a new DNA source tracking study, or similar study, will need to be performed to help distinguish the incremental successes and shortcomings of this IP. It is expected that there will be technological advances within the ten-year project timeframe. Such technological advances must be considered within the scope of future implementation actions.

#### **8.4 MS4 Permits**

All four jurisdictions and the Virginia Department of Transportation (VDOT) have MS4 VPDES Permits issued by the Virginia Department of Environmental Quality (VADEQ). Both Arlington and Fairfax Counties are Phase 1 communities and renewed their respective permits in 2002. The Cities of Falls Church and Alexandria as well as VDOT are Phase 2 communities and only recently received permits. Because there is inevitable overlap between the MS4 permit efforts and the efforts prescribed by the IP, and because the success or failure of measures employed by the IP may impact future MS4 permits, the timelines of the jurisdictions' permits are included on the next page:

**MS4 Permit Timelines**

- 2002.....Fairfax & Arlington Counties renew Phase 1 permits
- 2003.....Cities of Falls Church & Alexandria and VDOT receive Phase 2 permits
- 2004 (IY-1)...**Adoption of Implementation Plan**
- 2005 (IY-2)...
- 2006 (IY-3)...
- 2007 (IY-4)...Fairfax & Arlington Counties renew Phase 1 permits
- 2008 (IY-5)...**Reassess in 5th Year** / Cities of Falls Church & Alexandria and VDOT renew Phase 2 permits
- 2009 (IY-6)...
- 2010 (IY-7)...
- 2011 (IY-8)...
- 2012 (IY-9)...Fairfax & Arlington Counties renew Phase 1 permits
- 2013 (IY-10)..**Evaluate Plan Effectiveness** / Falls Church & Alexandria and VDOT renew Phase 2 permits

**8.5 Monitoring, Reporting and Evaluation**

**8.5.1 Monitoring**

Throughout the ten year timeframe, VADEQ will routinely monitor bacteria levels in Four Mile Run at a single station, e.g. the trend station at West Glebe Road. Two cycles of VADEQ rotational monitoring will occur in the watershed during the ten year implementation schedule. During rotational monitoring, two additional stations will be added and monitored bimonthly for bacteria. Project progress will be assessed during the fifth year and again at the end of the ten year timeframe.

**Project Timeline**

- 2004 (IY-1).....**Adoption of Plan**
- 2005 (IY-2).....July – Begin Rotational Monitoring
- 2006 (IY-3).....Continue Rotational Monitoring
- 2007 (IY-4).....June – End Rotational Monitoring
- 2008 (IY-5).....**Reassess in 5th Year**
- 2009 (IY-6).....
- 2010 (IY-7).....July – Begin Rotational Monitoring
- 2011 (IY-8)..... Continue Rotational Monitoring
- 2012 (IY-9).....June – End Rotational Monitoring
- 2013 (IY-10).....**Evaluate Plan Effectiveness**

(IY-# = Implementation Year)

Three discrete monitoring efforts will occur in the Four Mile Run watershed that relate to this IP:

- VADEQ Monitoring
- MS4 Permit Compliance / Municipal Monitoring
- Rainfall and Streamflow Gauging

**VADEQ** will maintain a monitoring station in the impaired segment of Four Mile Run. Since February 2003 VADEQ has been sampling bimonthly to quarterly at station 1AFOU001.92 located at Four Mile Run and West Glebe Road. Current sampling protocols have required monitoring for both fecal coliform and E. coli levels in the run.

VADEQ also has a 6-year rotational monitoring program that cycles around the state. When the cycle rotates to Four Mile Run from July 2005 through June 2007 and again from July 2010 through June 2012 VADEQ will collect data from two additional stations in the watershed. The combined data collected by VADEQ will be the primary data set used to determine the efficacy of IP efforts.

Both Arlington and Fairfax Counties are required to perform dry and wet weather screening for compliance with their respective **MS4 permits**. Arlington County currently maintains a wet weather station on a major sewer outfall to Four Mile Run near the County Trades Center. In addition to the Trades Center station, Arlington County will site a wet weather monitoring station on the upper mainstem of Four Mile Run during FY2004. The County also administers a volunteer stream monitoring program that includes three teams that monitor quarterly in the Four Mile Run watershed.

Fairfax County is currently combining all in-stream monitoring activities under a Stormwater Planning Division program. This program will combine biological monitoring, MS4 compliance monitoring (including outfall monitoring for inappropriate discharge detection) and bacteria monitoring previously performed by the County Health Department. By this effort, Fairfax County expects greater efficiency in monitoring efforts and more coordinated use of the monitoring results.

As a requirement of their MS4 permits, the Cities of Alexandria and Falls Church and VDOT must develop programs to detect inappropriate discharges to the separate storm drain network.

Since an upgrade to the existing gauging station on Four Mile Run at Shirlington Road in 1998, the US Geological Survey (USGS) and NVRC have partnered to provide near real time **rainfall and streamflow gauging** data for Four Mile Run at Shirlington Bridge. Annual peak flows for this station date back to 1952. Also in the larger Four Mile Run watershed (but outside of the TMDL watershed) is a National Weather Station located at Reagan National Airport. Temperature, rainfall and wind speed are recorded at this station.

## 8.5.2 Reporting

Currently, VADEQ does not have a dedicated system in place for reporting TMDL implementation efforts. All four jurisdictions and VDOT have ongoing relationships with VADEQ through their respective MS4 permits. Those permits require annual reporting to VADEQ on permit compliance. Through this IP, the TAC proposes that an additional section be added to each MS4 permit report to include efforts related to TMDL implementation. NVRC will work with the individual jurisdictions and VADEQ to develop a structure for the additional section.

The reassessment effort proposed for the fifth year of the project will compile all IP related activities watershed-wide into one comprehensive document to be submitted to VADEQ separately from MS4 permit reporting. NVRC will work with VADEQ to establish responsibility for this reassessment effort, for which funding is not yet allocated.

## 8.5.3 Assessment and Evaluation

Through an assessment and evaluation process the success of implementation efforts can be determined. Ultimately success will be determined by achievement of the water quality standard for Four Mile Run. Short of reaching that goal some interim criteria to be monitored throughout the project timeframe will give insights to the efficacy of the IP and the diligence of the plan's stakeholders. Two types of criteria should be monitored that will help to ensure plan implementation and evaluate its efficacy:

- **Actions taken**
- **Water quality data**

**Actions taken** are those corrective actions described in Chapter 6 of this IP that are designed to effect change in the bacteria levels in Four Mile Run. Each item listed in Chapter 6 in the commitments box for each measure represents a discrete action (or group of actions) for the timeframe given. The progress towards accomplishing those actions should be reported to VADEQ.

**Water quality data** will be reported both by VADEQ, through its own monitoring efforts previously described, and to VADEQ, through the MS4 compliance monitoring. The ultimate goal is for the water quality data for Four Mile Run to show compliance with the water quality standard for bacteria. Prior to achievement of the water quality standard trends in the water quality data should become apparent. As the corrective actions described in Chapter 6 are implemented in the watershed it is anticipated that the water quality data will show improved levels. However, if while the actions described in this plan are being implemented the water quality data show no improvement or a increasing trend, this may evidence a short-fall in the IP efficacy.

The local jurisdictions have committed to meet on a semiannual basis to discuss the progress with the project. These meetings will offer regular opportunities to examine available data, discuss technology advances, coordinate efforts, share successes, and caution one another on “lessons learned.” This continuous accountability will ensure that the goals of this IP remain in focus.

If at the end of the ten year project timeframe the water quality standard for bacteria has not been met, a new DNA source tracking study, or similar study, would need to be performed to help distinguish the incremental successes and shortcomings of this IP. It is expected that there will be technological advances within the ten-year project timeframe. Such technological advances must be considered within the scope of future implementation actions.

## **8.6 Timeline for Implementation Actions**

The following three tables summarize the implementation actions included in this IP. This format has been included to provide the reader with the continuous sequence of implementation actions. Detailed descriptions can be found in Chapter 6, Implementation Actions. Actions are grouped by category, i.e. Pollution Prevention, Mitigation or Indirect, and are attributed to the appropriate jurisdiction. The implementation year (IY) in which the action will occur is specific to each jurisdiction and is cited accordingly.

Table 8.2 Implementation Actions: Pollution Prevention

Implementation Actions		City of Alexandria	Arlington County	City of Falls Church	Fairfax County	
Pollution Prevention	Sanitary Sewer Infrastructure	Inspect sanitary sewer stream crossings	IY-1 thru IY-10	IY-1 thru IY-10	IY-1 thru IY-10	IY-1 thru IY-10
		Sewer rehabilitation and maintenance	IY-1 thru IY-10	IY-1 thru IY-10	IY-1 thru IY-10	IY-1 thru IY-10
		Train personnel in proper sewage disposal during sanitary sewer backups	IY-1 thru IY-10	IY-1 thru IY-10	IY-1 thru IY-10	IY-1 thru IY-10
	Illicit Discharges	Continued enforcement of existing ordinances	IY-1 thru IY-10	IY-1 thru IY-10	IY-1 thru IY-10	IY-1 thru IY-10
		Develop and/or continue a program to detect and eliminate inappropriate connections	IY-5 thru IY-10	IY-1 thru IY-10	IY-4 thru IY-10	IY-1 thru IY-10
	Septic Systems	Ensure access to sewer	IY-1 thru IY-10			
		Locate and inspect existing septic systems	N/A	IY-1	N/A	N/A
	Proper Pet Waste Disposal	Post informative signage, provide pick-up bags and /or receptacles	IY-1 thru IY-10	IY-1 thru IY-10	IY-1 thru IY-10	IY-1 thru IY-10
		Continue to operate and maintain dog parks	IY-1 thru IY-10	IY-1 thru IY-10	N/A	N/A
		Form a committee to evaluate current dog park standards and siting in light of the TMDL		IY-2 thru IY-4		
		Review existing ordinances to ensure consistency with the goals of the TMDL	IY-1 thru IY-10	IY-1 thru IY-10	IY-1 thru IY-10	IY-1 thru IY-10
		Explore requesting developers to provide signage, pick-up bags and receptacles at larger development sites	IY-1 thru IY-10	IY-1 thru IY-10	IY-1 thru IY-10	IY-1 thru IY-10

Table 8.3 Implementation Actions: Mitigation

Implementation Actions		City of Alexandria	Arlington County	City of Falls Church	Fairfax County	
Mitigation	Stormwater Treatment	Explore BMP retrofit <i>*Ballston Beaver Pond &amp; Trades Center opportunities</i>	IY-1 thru IY-10	IY-1 thru IY-8*		IY-1 thru IY-4
		Continue to enforce Chesapeake Bay Act and MS4 programs and comply with upcoming Potomac Tributary Strategy	IY-1 thru IY-10	IY-1 thru IY-10	IY-1 thru IY-10	IY-1 thru IY-10
		Ensure proper maintenance of newly retrofitted BMPs <i>**pond on Lucky Run</i> <i>***Sparrow pond</i>	IY-1 thru IY-10 **	IY-1 thru IY-10 ***		
	Street and Stormwater Infrastructure Management	Continue and/or expand current street sweeping	IY-1 thru IY-10	IY-1 thru IY-10	IY-1 thru IY-10	IY-1 thru IY-10
		Inspect and clean catch-basins	IY-1 thru IY-10	IY-1 thru IY-10	IY-1 thru IY-10	IY-1 thru IY-10
	Stream Corridor Restoration	Identify stream segments needing restoration	IY-1 thru IY-3	IY-1 thru IY-10		IY-1 thru IY-10
		Explore opportunities to daylight streams	IY-1 thru IY-10	IY-1 thru IY-10	IY-1 thru IY-10	IY-1 thru IY-10
		Work with sponsoring dog groups to restore eroded streambanks at the Glen Carlyn and Shirlington dog parks	N/A	IY-1 thru IY-5	N/A	N/A
	Stormwater Runoff Reduction and Reuse	Continue to include stormwater runoff reduction and reuse in Chesapeake Bay Program activities	IY-1 thru IY-10	IY-1 thru IY-10	IY-1 thru IY-10	IY-1 thru IY-10
		Ensure inclusion of stormwater runoff reduction and reuse in municipal projects	IY-1 thru IY-10	IY-1 thru IY-10	IY-1 thru IY-10	IY-1 thru IY-10
		Continue to encourage stormwater runoff reduction and reuse by property owners		IY-1 thru IY-10		

Table 8.4 Implementation Actions: Indirect

Implementation Actions		City of Alexandria	Arlington County	City of Falls Church	Fairfax County	
<b>Indirect</b>	<b>General Education and Outreach</b>	Incorporate information on bacteria into nonpoint source pollution brochures and presentations	IY-1 thru IY-10	IY-1 thru IY-10	IY-1 thru IY-10	IY-1 thru IY-10
		Continue/consider participation in the Northern Virginia Regional Pollution Prevention Media Strategy	IY-1 thru IY-10	IY-1 thru IY-10	IY-1 thru IY-10	IY-1 thru IY-10
		Include information on bacteria in publications and on website	IY-1 thru IY-10	IY-1 thru IY-10	IY-1 thru IY-10	IY-1 thru IY-10
	<b>Directed Outreach</b>	Develop outreach materials related to proper pet waste disposal	IY-1 thru IY-10	IY-1 thru IY-10	IY-1 thru IY-10	
	<b>Signage</b>	Work with VDH and/or citizens groups to develop appropriate signage	IY-1 thru IY-5	IY-1 thru IY-5	IY-1 thru IY-5	IY-1 thru IY-5
Continue storm drain marking		IY-1 thru IY-10	IY-1 thru IY-10	IY-1	IY-1 thru IY-10	

## 9.0 Stakeholders' Roles and Responsibilities

### 9.1 Who are the stakeholders?

Stakeholders are individuals who live or have land management responsibilities in the watershed, including government agencies, businesses, private individuals and special interest groups. Stakeholder participation and support is essential for achieving the goals of this TMDL (*i.e.* improving water quality and removing Four Mile Run from the impaired waters list). The purpose of this chapter is to identify and define the roles of the stakeholders who will work together to implement the TMDL. The roles and responsibilities of some of the major stakeholders are described below.

### 9.2 Federal Government

**U.S. Environmental Protection Agency (USEPA):** The USEPA has the responsibility of overseeing the various programs necessary for the success of the Clean Water Act. However, administration and enforcement of such programs falls largely to the states.

### 9.3 State Government

In the Commonwealth of Virginia, water quality problems are addressed thru legislation, incentive programs, education, and legal actions. Currently, there are a number of state agencies responsible for regulating and/or overseeing activities that impact water quality in Virginia. These agencies include: Virginia Department of Environmental Quality (VADEQ), Virginia Department of Conservation and Recreation (VADCR), Virginia Department of Agriculture and Consumer Services (VDACS), Virginia Department of Health (VDH), the Virginia Department of Forestry (VADOF), Virginia Cooperative Extension (VCE), and Virginia Department of Mines, Minerals and Energy (VDMME). The primary agencies applicable to the Four Mile Run watershed are VADEQ, VADCR and VDH.

**DEQ:** The State Water Control Law authorizes the State Water Control Board to control and plan for the reduction of pollutants impacting the chemical and biological quality of the State's waters resulting in the degradation of the swimming, fishing, shell fishing, aquatic life, and drinking water uses. For many years the focus of VADEQ's pollution reduction efforts was the treated effluent discharged into Virginia's waters via the VPDES permit process. The TMDL process has expanded the focus of VADEQ's pollution reduction efforts from the effluent of wastewater treatment plants to the pollutants causing impairments of the streams, lakes, and estuaries. The reduction tools are being expanded beyond the permit process to include a variety of voluntary strategies and BMPs. VADEQ is the lead agency in the TMDL process.

The Code of Virginia directs VADEQ to develop a list of impaired waters, develop TMDLs for these waters, and develop IPs for the TMDLs. VADEQ administers the TMDL process, including the public participation component, and formally submits the TMDLs to USEPA and the State Water Control Board for approval. VADEQ is also responsible for implementing point source allocations, assessing water quality across the state, and conducting water quality standard related actions.

**VADCR:** VADCR is authorized to administer Virginia's nonpoint source pollution reduction programs in accordance with §10.1-104.1 of the Code of Virginia and §319 of the Clean Water Act. USEPA is requiring that much of the §319 grant monies be used for the development of TMDLs. Because of the magnitude of the NPS component in the TMDL process, VADCR is a major participant in the TMDL process. VADCR has a lead role in the development of IPs to address correction of nonpoint source pollution contributing to water quality impairments. VADCR also provides available funding and technical support for the implementation of NPS components of IPs. The staff resources in VADCR's TMDL program focus primarily on providing technical assistance and funding to stakeholders to develop and carry out IPs, and support to VADEQ in TMDL development related to NPS impacts. VADCR staff also work with other state agencies, Soil and Water Conservation Districts, and watershed groups to gather support and to improve the implementation of TMDL plans thru utilization of existing authorities and resources.

**VDH:** VDH is responsible for maintaining safe drinking water measured by standards set by the USEPA. Their duties also include septic system regulation and regulation of the land application of biosolids. VDH is complaint driven; complaints can range from a vent pipe odor that is not an actual sewage violation and takes very little time to investigate, to a large discharge violation that may take many weeks or longer to effect compliance. For TMDLs, VDH has the responsibility of enforcing actions to correct failed septic systems and/or eliminate straight pipes (Sewage Handling and Disposal Regulations, 12 VAC 5-610-10 *et seq.*).

#### **9.4 Local Government**

Local government comprises a substantial group of stakeholders. The Four Mile Run watershed blankets portions of four localities: the Cities of Alexandria and Falls Church and Arlington and Fairfax Counties. Each jurisdictional government is divided into several departments and divisions. Each entity provides various service operations or resources that will be instrumental to the success of this IP. Municipal stakeholder departments were Public Works, Environmental Services, Parks, Health and Planning.

Given that the Four Mile Run watershed is divided among several regional governmental entities, the Northern Virginia Regional Park Authority (NVRPA) and the Northern Virginia Regional Commission (NVRC), are also stakeholders in this TMDL effort.

## 9.5 Nonprofit Organizations and Citizens

In the Four Mile Run watershed the following nonprofit organizations were identified as stakeholders instrumental to this TMDL IP effort:

- **Arlingtonians for a Clean Environment**
- **Arlington Forest Civic Association**
- **Arlington Dogs**
- **Douglas Dogs**
- **Glen Dogs**
- **Banneker Dogs**
- **Towers Park Community**
- **Shirlington Dogs**
- **Fair Dogs**

**Arlingtonians for a Clean Environment (ACE):** ACE is a non profit educational and service organization serving the residents of Arlington County. ACE presents information to students and adults about local issues including nonpoint source pollution and the Chesapeake Bay. Several schools participate each year in ACE educational programs allowing ACE to reach 78 classrooms and close to 2,000 students in 2002 alone. ACE publishes a quarterly newsletter, "The Arlington Environment," highlighting environmental issues that impact Arlington County residents. Approximately 1,600 copies are mailed and 1,350 are distributed by ACE every quarter. ACE also distributes volunteer and educational opportunities to its e-mail listserve with 350 subscribers. In 2002, ACE published a Spanish language edition of The Arlington Environment newsletter focusing on watersheds and streams and continues its distribution to provide valuable information to Spanish-speaking neighborhoods in the County.

**Arlington Forest Civic Association (AFCA):** Although not all civic associations participated on the IP Technical Advisory Committee AFCA was a participant. The Arlington Forest neighborhood is adjacent to the mainstem of Four Mile Run and straddles a tributary. Input from other civic associations was sought thru the public meeting process.

**Arlington Dogs:** Is a group of nearly 500 citizen activists furthering the issues of dog ownership in Arlington County. The group has been very involved in the creation of Arlington County's dog park network.

**Douglas Dogs, Glen Dogs, Banneker Dogs, Towers Park Community, Shirlington Dogs, Fair Dogs:** These groups sponsor the Arlington County dog parks located in the Four Mile Run watershed.

## **9.6 Stakeholder Roles**

The State of Virginia's approach to correcting nonpoint source pollution problems continues to be encouragement of voluntary participation thru education and financial incentives; that is to say, outside of the regulatory framework. If, however, voluntary approaches prove to be ineffective, it is likely that implementation will become less voluntary and more regulatory.

The actual stakeholder roles defined for this IP are to implement the corrective actions described in Chapter 6 of this plan. Each commitment outlined in Chapter 6 is preceded by the responsible party for that commitment. There are also timeframes given in which the action will occur.

## **10.0 Watershed Planning Efforts in the Four Mile Run Watershed**

### **10.1 Watershed Plans and Related Plans**

In developing an approach for this implementation plan (IP), the Technical Advisory Committee (TAC) sought to identify any potential overlap between the IP and other restoration efforts in the watershed. By doing so, it was hoped that synergies would develop among those efforts. For this IP programs considered related to bacteria reduction include sanitary sewer rehabilitation, Municipal Separate Storm Sewer (MS4) Permits, and watershed plans. Since the Four Mile Run watershed covers portions of four localities and each locality is a separate political entity asserting its own unique priorities and resource limitations, there are several locality-specific plans related to this IP.

#### **Four Mile Run IP-Related Plans**

- **Water Quality Management Supplement to Alexandria Master Plan**
- **City of Alexandria Master Plan for Dog Exercise Areas and Fenced Dog Parks**
- **Arlington County Stormwater Master Plan**
- **Arlington County Watershed Master Plan**
- **Arlington County Sanitary Sewer Master Plan**
- **City of Falls Church Comprehensive Sanitary Sewer System Improvement Plan**
- **Watershed Management Master Plan for the City of Falls Church (Not yet formally adopted by the City Council)**
- **MS4 Permits for Arlington County, Fairfax County, City of Falls Church, City of Alexandria, and the Virginia Department of Transportation (VDOT)**
- **US Army Corps of Engineers (USACE) in Partnership with Arlington County, the City of Alexandria with funding from the US Environmental Protection Agency (USEPA) Four Mile Run Feasibility Study (To be developed)**
- **Fairfax County Four Mile Run Watershed Plan (To be developed)**

The Water Quality Management Supplement to Alexandria Master Plan (WQMS) (adopted January 13, 2001) is a comprehensive document prepared for compliance with the second phase of Virginia Chesapeake Bay regulations. The aim of the WQMS is to improve the overall water quality of the City's surface waters city-wide. Although bacteria represent only a portion of the pollutants addressed by the WQMS there are many overlaps between the commitments in this IP and the initiatives in the WQMS.

The City of Alexandria Master Plan for Dog Exercise Areas and Fenced Dog Parks, (September 2000) covers many aspects of future dog park siting and the operation and maintenance of those parks. The IP overlaps this master plan in its efforts to control dog waste and the appropriate siting of future dog parks.

The Arlington County Stormwater Master Plan (September 1996) is a master plan covering the Arlington County stormwater infrastructure and permitting. Because many of the measures in this IP are directed toward stormwater infrastructure maintenance and MS4 permit requirements, there is substantial overlap between the master plan and the IP efforts.

The Arlington County Watershed Master Plan (January 2001) is a comprehensive plan addressing watershed issues in all three of the Arlington County watersheds: Four Mile Run, Little Pimmit Run, and Potomac River. The plan covers both surface water quantity and quality issues for the TMDL watershed area and other County areas. Although not all aspects of the watershed plan relate to this IP there are many that are directly related to IP commitments.

The Arlington County Sanitary Sewer Master Plan (December 2003) takes a comprehensive approach to managing the County's sanitary sewer infrastructure. Efforts to properly contain and convey sanitary sewage in the watershed directly relates to IP efforts.

The various MS4 Permits for Arlington County, Fairfax County, City of Falls Church, City of Alexandria, and VDOT (varying permit dates) are issued by the Virginia Department of Environmental Quality (VADEQ) to protect the surface waters to which these MS4s discharge. Each permit is written with permit-specific requirements or follows a notice of intent (NOI) of certain commitments prepared by the permittee. VADEQ intends for the MS4 permit program to work in conjunction with any related TMDL efforts.

The USACE in Partnership with Arlington County, the City of Alexandria with funding from the USEPA Four Mile Run Feasibility Study (To be developed) will be developed by 2008. The study's purpose is to develop a comprehensive plan to restore the 2.3 miles of Four Mile Run confined in a USACE flood control channel built during the 1970s and 1980s. Although focused on the lower portion of the Four Mile Run mainstem, the plan may include upstream efforts aimed at restoring water quality and mitigating water quantity problems.

Fairfax County Four Mile Run Watershed Plan (To be developed) will be developed through a stakeholder process in the next few years. The goal of that project will be to comprehensively evaluate the condition of the Fairfax County portion of the Four Mile Run watershed and to plan for improving the surface water quality and stream channels in that portion of the watershed.

### **10.2 Other Neighboring Impaired Waterbodies**

The tidal segment of Four Mile Run was also listed as impaired due to elevated fecal coliform levels in 1996 and subsequently in 1998 and 2002 (no list was generated in 2000). TMDL development has not yet been scheduled for that segment but it, like the water segment of focus for this IP, is part of the 1999 consent decree requiring the State of Virginia to develop a TMDL for the impaired segment by 2010.

The tidal section of Four Mile Run was also listed on the 2002 Virginia Impaired Waters List for elevated Polychlorinated Biphenyl (PCB) levels in fish tissue. Although not yet scheduled, a TMDL will also be developed for this segment related to PCB contamination.

## **11. Potential Funding Sources**

### **11.1 General Funding Approach**

In general, funding for the actions contained in this Implementation Plan (IP) could potentially come from general sources:

- Locality funds
- Private / nonprofit funds
- Virginia State funds
- Federal funds

When shaping the approach for this IP consensus within the Technical Advisory Committee (TAC) centered on leveraging existing programs and resources to tackle implementation of this TMDL. To that end, the approach developed by this IP is one that aims to build synergies with other programs in the watershed including: local Chesapeake Bay Preservation Ordinance programs, Municipal Separate Storm Sewer System (MS4) permits, Potomac Tributary Strategies, and sanitary sewer rehabilitation programs. To meet these locality-specific programs funding, is allocated to the Operations and/or the Capital Improvement Program Budgets for those specific programs.

### **11.2 Locality Funds**

This IP touches on four separate locality budget areas: sanitary sewer management, storm sewer management, street management, and park management. In general, all but sanitary sewer management is funded from the localities general fund, where sanitary sewer management is primarily funded thru a sanitary sewer utility. The exception to this is Alexandria, which does not have a sanitary sewer utility so that infrastructure management is also funded thru the general fund.

None of the four watershed jurisdictions currently has a stormwater utility for funding stormwater infrastructure projects and thus those projects are funded thru the municipality's general fund. Arlington County has recently undertaken a stormwater utility feasibility study. Arlington and Alexandria both have mechanisms by which monies are collected in specific site development situations that fund regional stormwater management programs thru their Chesapeake Bay Preservation Ordinances.

Total annual costs are presented in Table 7.1 in Chapter 7, Associated Costs and Benefits.

### 11.3 Private Nonprofit Funds

Several nonprofit organizations will participate in the actions committed to in this IP. Much of those labors will be met thru staff and volunteer time. Those efforts include outreach efforts like classroom presentations, buffer restoration, educational material development and distribution, etc. Funding for the activities pursued by the nonprofits can come from their members, a supporting foundation, or grants.

### 11.4 Virginia State Funds

The State of Virginia has a vested interest in the success of this plan. The Virginia Department of Environmental Quality (VADEQ) underwrote the cost of developing the Four Mile Run TMDL and this IP. Currently, VADEQ is pursuing a Watershed Initiative Grant that may include some funding for Four Mile Run implementation projects. There are very few state funding sources available in Virginia for use in implementing the activities proposed by the plan for the Four Mile Run watershed. Listed below is one possible state funding source.

**Virginia Water Facilities Revolving Loan Fund** – This program provide financial assistance in the form of low-interest loans to local governments for needed wastewater treatment improvements at publicly-owned wastewater collection and treatment facilities. <http://www.deq.state.va.us/cap/wwovrview.html>

### 11.5 Federal Funds

**USEPA 319 Funds** – USEPA develops guidelines that describe the process and criteria to be used to award Clean Water Act Section 319 NPS grants to states. States may use up to 20% of the Section 319 incremental funds to develop NPS TMDLs as well as to develop watershed-based plans for Section 303(d) listed waters. The balance of funding can be used for implementing watershed-based plans for waters that have completed TMDLs. Implementation of both agricultural and residential BMPs is eligible. <http://www.epa.gov/owow/nps/319/319stateguide-revised.pdf>.

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